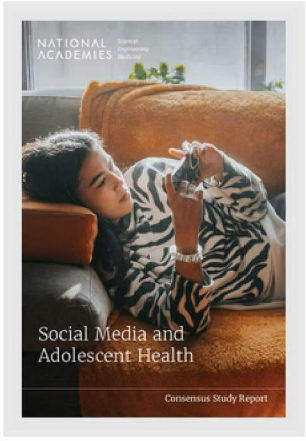
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SUGGESTED CITATION

National Academies of Sciences, Engineering, and Medicine. 2024. *Social Media and Adolescent Health*. Washington, DC: The National Academies Press. https://doi.org/10.17226/27396.

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NATIONAL ACADEMIES Sciences Engineering Medicine

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Washington, DC

Social Media and Adolescent Health

Sandro Galea, Gillian J. Buckley, and Alexis Wojtowicz, *Editors*

Committee on the Impact of Social Media on Adolescent Health

Board on Population Health and Public Health Practice

Health and Medicine Division

Consensus Study Report

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This activity was supported by contracts between the National Academy of Sciences and the Democracy Fund, the Ford Foundation, the John D. and Catherine T. MacArthur Foundation, Luminate Projects Limited, the National Academy of Sciences W.K. Kellogg Foundation Fund, the Open Society Foundations, and the William and Flora Hewlett Foundation. Any opinions, findings, conclusions, or recommendations expressed in this publication do not necessarily reflect the views of any organization or agency that provided support for the project.

International Standard Book Number-13: 978-0-309-71316-0
International Standard Book Number-10: 0-309-71316-1
Digital Object Identifier: https://doi.org/10.17226/27396
Library of Congress Control Number: 2023952318

This publication is available from the National Academies Press, 500 Fifth Street, NW, Keck 360, Washington, DC 20001; (800) 624-6242 or (202) 334-3313; http://www.nap.edu.

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Printed in the United States of America.

Suggested citation: National Academies of Sciences, Engineering, and Medicine. 2024. *Social media and adolescent health*. Washington, DC: The National Academies Press. https://doi.org/10.17226/27396.

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COMMITTEE ON THE IMPACT OF SOCIAL MEDIA ON ADOLESCENT HEALTH

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Reviewers

This Consensus Study Report was reviewed in draft form by individuals chosen for their diverse perspectives and technical expertise. The purpose of this independent review is to provide candid and critical comments that will assist the National Academies of Sciences, Engineering, and Medicine in making each published report as sound as possible and to ensure that it meets the institutional standards for quality, objectivity, evidence, and responsiveness to the study charge. The review comments and draft manuscript remain confidential to protect the integrity of the deliberative process.

We thank the following individuals for their review of this report:

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Although the reviewers listed above provided many constructive comments and suggestions, they were not asked to endorse the conclusions or recommendations of this report nor did they see the final draft before its release. The review of this report was overseen by **TRACY A. LIEU,** Kaiser Permanente Northern California, and **BERNADETTE M. MELNYK,** The Ohio State University. They were responsible for making certain that an independent examination of this report was carried out in accordance with the standards of the National Academies and that all review comments were carefully considered. Responsibility for the final content rests entirely with the authoring committee and the National Academies.

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Acknowledgments

This report is a product of the cooperation and contributions of many people. The committee and staff are grateful for the support of the National Academies of Sciences, Engineering, and Medicine's Health and Medicine Division (HMD) staff who contributed to producing this report. The committee and staff thank Monica Feit, Lori Brenig, Samantha Chao, Annalee Espinosa Gonzales, Leslie Sim, and Taryn Young in the HMD Executive Office; Anne Marie Houppert and Rebecca Morgan in the National Academies Research Center; Amber McLaughlin, Ben Hubbard, Mimi Koumanelis, Sadaf Faraz, and Marguerite Romatelli in the Office of the Chief Communications Officer; Megan Lowry in the Office of News and Public Information; Julie Eubank and Nicole Cohen in the Office of Congressional and Government Affairs; Mandy Enriquez, Dempsey Price, and Ahmir Robinson in the Office of Conference Management; Connie Citro in her role as chair of the Institutional Review Board; and Mattie Cohan in the Office of General Counsel.

The committee thanks all the speakers and moderators who participated in committee meetings, as well as others who provided information, input, and assistance. They include the following:

Sun Joo Grace Ahn, Monica R. Anderson, Mitchell Baker, Hector Balderas, Alvaro Bedoya, Francesca Borgonovi, Marie Bragg, Emily Cherkin, Sarah Coyne, Evelyn Douek, Matthew Gentzkow, Ysabel Gerrard, Jonathan Haidt, Lauren Hale, Amy Hasinoff, Frances Haugen, Jonathan S. Hausmann, Brittan Heller, Mimi Ito, Girard Kelly, Aleksandra Korolova, Sonia Livingstone, Damon McCoy, Katina Michael, Tijana Milosevic, Kathryn C. Montgomery, Megan Moreno, Laurie Moskowitz, Dhiraj

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Murthy, Candice Odgers, Amy Orben, Margarita Panayiotou, Laura Quinn, Jenny Radesky, Tom Romanoff, Gus Rossi, Piotr Sapiezynski, Amanda E. Staiano, Joe Turow, Ari E. Waldman, James Williams, Jean Twenge, and Jonathan Zittrain.

In addition, the committee sincerely thanks the youth who provided valuable input for this report. Thank you to Armand Davidson, Angel A. Deleon, Zach Gottlieb (Talk With Zach), Kenny Jackson, Eva King, Arianna M., Garrick Pane, Henry R., and Margot Teh, who joined public sessions with the committee and staff to provide valuable insight into their own experiences with social media.

Finally, we extend special thanks to the Democracy Fund, the Ford Foundation, the John D. and Catherine T. MacArthur Foundation, Luminate Projects Limited, the National Academy of Sciences W.K. Kellogg Foundation Fund, the Open Society Foundations, and the William and Flora Hewlett Foundation for generously funding this project.

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Preface

> Every age has its particular folly; some scheme, project, or phantasy into which it plunges, spurred on either by the love of gain, the necessity of excitement, or the mere force of imitation.
>
> Charles Mackay, *Memoirs of Extraordinary Popular Delusions and the Madness of Crowds* (1841)

This committee's work emerged from public concern about two phenomena: the growing ubiquity of social media use by children and adolescents, and the increase in poor mental health also among children and adolescents. The co-occurrence of these two phenomena has served, correctly, to catalyze concern that the former is causing the latter and that, as such, there is an urgent need for action to check social media spread and its use to protect child and adolescent mental health. A series of high-profile events, including leaking of internal Facebook documents that suggest social media companies' awareness of some links between social media use and adverse mental health further added fuel to the fire.

The committee recognized that the temptation to draw causal inference and to call for rapid action around social media is strong, and heard, during public session, from a range of academics and activists who feel strongly that causal links between social media and mental health have been unequivocally established and that there is an urgent need for action.

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And yet, in careful deliberation and review of the published literature, the committee arrived at more measured conclusions.

The science suggests that some features of social media function can harm some young people's mental health. These include, but are not limited to, algorithmically driven distortions of reality exacerbating harmful content and disinformation, the distraction away from time that can otherwise be used in more healthy ways, and the creation of opportunities where youth can be abused or exploited. However, there are also several ways in which social media improve the lives of youth, including the creation of opportunities for community among more marginalized youth, and the opportunity for fun and joy for the vast majority of users. This balance lies at the heart of the relation between social media and mental health. While some users, using social media in particular ways, may have their mental health adversely affected, for many others there will be no such harm, and for others still the experience will be helpful. This suggested to the committee a judicious approach to protect youth mental health is warranted rather than some of the more broad-stroke bans that have been proposed by other entities in recent years.

The committee's recommendations include recommendations to develop industry standards that can ensure social media use protects mental health in the long term, the engagement of educators and health care providers in highlighting the benefits, and minimizing the harms of social media use, and specific measures to protect youth from online abuse. The committee also recommends a doubling down on research that can lead to better clarity about the causal links between aspects of social media and mental health, to the end of pointing to more specific actions that can mitigate the harms, and accentuate the positives, of social media.

It is the committee's hope that this work can ground the public conversation around this issue and serve as a platform for better science and targeted action that protects youth's mental health, while preserving a technology that brings joy and connections to so many.

Sandro Galea, *Chair*
Committee on the Impact of Social Media on Adolescent Health

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Acronyms and Abbreviations

ABCD	Adolescent Brain Cognitive Development (Study)
ADHD	attention-deficient/hyperactivity disorder
AI	artificial intelligence
APA	American Psychological Association
API	application program interface
CAEP	Council for the Accreditation of Educator Preparation
CDC	Centers for Disease Control and Prevention
CFAA	Computer Fraud and Abuse Act
COPPA	Children's Online Privacy Protection Act
COVID-19	coronavirus disease of 2019
ESEA	Elementary and Secondary Education Act
ESSA	Every Student Succeeds Act
FTC	Federal Trade Commission
GDPR	General Data Protection Regulation
GIFCT	Global Internet Forum to Counter Terrorism
HIPAA	Health Insurance Portability and Accountability Act

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ICD-11	*International Classification of Diseases*, 11th edition
IEEE	Institute for Electrical and Electronics Engineers
IRB	institutional review board
ISO	International Organization for Standardization
LCME	Liaison Committee on Medical Education
LGBQ	lesbian, gay, bisexual, and questioning
LGBTQ+	lesbian, gay, bisexual, trans, questioning, and more
NIH	National Institutes of Health
NSF	National Science Foundation
NTIA	National Telecommunications and Information Administration
P3P	Platform for Privacy Preferences
SAMHSA	Substance Abuse and Mental Health Services Administration
UNICEF	United Nations Children's Fund

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Summary[1]

Over the last 15 years, smartphone technology has transformed the world at a breakneck pace, making news, information, and entertainment constantly available on a handheld device. This transformation has brought society tremendous benefits, yet excitement over these benefits is increasingly coupled with apprehension about the psychological consequences of constant connectedness, especially during developmentally sensitive periods for children and adolescents. Recent survey data indicate that 95 percent of teens in the United States have a smartphone; almost all of them access the internet daily.

As smartphones have gained popularity, mental health among young people has declined. Teens' use of social media is one of the more widely cited explanations for the observed deterioration in youth mental health. Spurred by public concern of declining mental health among young people, Congress and state legislatures around the country are considering actions to curb adolescents' use of social media and to influence the companies that profit from it, adding urgency to the need for more clarity about precisely how and to what extent social media affects young people.

Disentangling the harms and benefits of social media use was at the heart of the charge to this committee set out by the Democracy Fund, Ford Foundation, the William and Flora Hewlett Foundation, Luminate Projects Limited, the John D. and Catherine MacArthur Foundation, and the Open Society Foundations. These sponsors asked the committee to com-

[1] Please see the main report for citations and lists of works cited.

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ment on the relative risks and benefits of various forms of online media and on the consequences of their use in adolescence. The committee was asked to recommend a strategy to maximize the benefits and minimize the harms associated with social media use and set out a research agenda to help clarify the ways in which social media use influences physical and mental health. The sponsors gave the committee some leeway in its interpretation of the report's target age range. Recognizing that experiences in adolescence are influenced by those earlier in childhood, the committee took a broad view of adolescence and late childhood with a transitional cutoff around age 18.

In defining the scope of this report, the committee relied on a definition of social media adapted from the American Psychological Association: Social media refers to "interactive technologies that facilitate the creation and sharing of information, ideas, interests, and other forms of expression through virtual communities and networks." Social media can therefore include social networking, gaming, virtual worlds, video sharing sites, and blogs. In its understanding of health, the committee was influenced by the World Health Organization's (WHO's) conception of health as "a state of complete physical, mental, and social well-being and not merely the absence of disease." The literature linking health to social media use is understandably weighted toward the exploration of psychological outcomes. The influence of this literature carries into the discussion in this report.

HOW SOCIAL MEDIA WORKS

Social media include a broad range of features that facilitate social interaction online; platforms vary widely in their target audiences, purposes, and design. For this reason, it is important to understand platform features, often called *affordances*,[2] and how they interact with different developmental stages. Some affordances are powered by computational algorithms, a set of instructions that a program follows to solve a problem or perform a task. Algorithms are used for generating recommendations and determining the rank in which content is displayed, for targeting ads, and for content moderation. In a larger sense, algorithms, which are generally proprietary, serve the end goals of keeping users engaged for as long as possible and generating revenue.

There are several ways in which platform algorithms can influence health. While an algorithm may be innocuous, the way it presents content can be harmful, with more sensational and provocative posts given higher

[2] Affordances refers broadly to the possibilities for action arising from the relation between a technology's features and the technology users' goals.

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priority in users' feeds, especially if the user has responded to a similar type of post in the past. This practice has the potential to create distortions and give rise to recursive feedback loops. Recursive feedback can, in turn, exacerbate problems with harmful content and misinformation. Recursive feedback can also promote any number of fringe views from unscientific health treatments to conspiracy theories.

By limiting exposure to diverse perspectives, algorithms can shape users' perceptions of the world around them. Some of this influence comes from persuasive design elements that direct users' attention to return to the site, as by promoting sensational content. Other elements of persuasive design, such as auto-scroll, the gamification of interaction (e.g., the ability to win badges or points based on platform use), push notifications, and public tallies of a post's reach (e.g., likes, retweets) can further manipulate people's intentions to extend time on platforms.

These concerns can be heightened among adolescents. Differing timing in the maturation of the brain and limbic system and the ability of these systems to communicate can leave adolescents with less mature controls for making good judgments and regulating emotions, especially in social situations with peers. Heightened sensitivity to rewards can make the necessary task of disengaging from social media difficult for adolescents, while the desire for independence can make digital spaces especially appealing, allowing teenagers room to make connections and signal their identity without the same parental scrutiny that their in-person interactions might draw.

Encouraging traffic to a platform is in the best interest of the social media companies in part because traffic to the site influences the value of advertising, a major source of revenue for many social media firms. The advertising revenue social media companies earn tends to track the time users' spend on their platforms. The business model where users pay for social media, as for many tech services, with their data rather than cash could be hard to change. Research indicates that willingness to pay cash for social media is low even among employed adults.

Data monetization drives targeted advertising, through which third parties benefit from information about people's behavior and preferences. When platforms collect and sell information in ways that are both circuitous and opaque, there is concern about the potential for exploitation. The Federal Trade Commission's (FTC's) recent guidance on internet advertising and commercial data security is motivated by a desire for more openness regarding companies' data collection policies. The agency also has heightened responsibility to children, codified in the Children's Online Privacy Protection Act (COPPA). The act recognizes that young children lack the capacity to consent to the platforms' terms for online data collection; the act specifically disallows the enticing of personal dis-

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closures for prizes or as part of a game and restricts advertising directed to children. But COPPA's legal protections do not extend to children 13 and older. Recent legislative proposals, including specific protections for adolescents, are being considered at the state and federal levels. Across a range of proposals is a common concern with giving people more control over the ways companies use their data.

Questions of data privacy can quickly become entwined with larger concerns about social media affordances that encourage young people to spend excessive amounts of time on a platform. A growing interest in age-appropriate design and legal restrictions on social media use can create market confusion for social media companies that operate in different jurisdictions. Decisions about how to monitor young people's social media use or about content moderation are necessarily value judgments, based on different values and divergent inferences from a lean body of evidence.

THE POTENTIAL BENEFITS OF SOCIAL MEDIA

Meta-analyses linking social media to various measures of health and well-being generally report small effects and weak associations, drawn from mainly cross-sectional studies. There is ample room for both positive and negative experiences to be obscured in such analyses. It is possible that the small associations reported may be influenced by a balance of good and bad experiences. That the use of social media, like many things in life, may be a constantly shifting calculus of the risky, the beneficial, and the mundane.

The balance between the social, educational, and entertainment value young people find online could be compared to other socially uniting pastimes. It is reasonable to point out that we rarely pathologize teenagers who enjoy watching sports. Yet a societal shift wherein all young people were suddenly watching sports all the time, late at night, to the neglect of other activities, would give us pause. The committee recognizes that social media is associated with harm among some adolescents. If the aggregate experience of social media were harmful to neutral, then restrictive actions would be justified in the interest of protecting the most vulnerable. Yet the reality is more complicated.

Social media has the potential to connect friends and family. It may also be valuable to teens who otherwise feel excluded or lack offline support. Lesbian, gay, bisexual, trans, questioning, and other (LGBTQ+) teenagers may find support online that they do not have in their offline world, as do young people coping with serious illness, bereavement, and mental health problems.

Online communities can also a valuable venue for learning. In social media groups, young people can develop interests that are important to

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them. The fanfiction communities that encourage young people both to write and to give and receive mentorship from other writers are a good example of this. Online networks can also support various hobbies and interests; no matter how niche the interest may be. For some personality types, social media platforms can also be useful creative outlets.

THE RELATION BETWEEN SOCIAL MEDIA AND HEALTH

At the center of any discussion of social media and adolescent health is a growing body of research attempting to measure this association and disentangle the many, sometimes conflicting, often reciprocal mechanisms through which the online experience and physical or mental health can influence each other. Most of this research examines associations between social media use and mental and behavioral outcomes; fewer studies investigate physical outcomes.

There are several reasons why these links between social media and health are complex. First, the direction of the relationship is difficult to determine, as social media may influence a health outcome and health may influence social media use. There is also a lack of uniformity in research approaches. Some factors are conceptualized as an exposure in some studies and an outcome in others. Third, it is difficult to study a relation between an outcome and exposure when the exposure is ubiquitous. The bias introduced by omitted variables makes it difficult to say to what extent a young person's health problems are the cause or the effect of social media use or of another unmeasured cause. Fourth, different levels of analysis can sometimes reveal different dynamics that are difficult to resolve, such as large-scale studies showing health trends at the population level versus psychological-level studies showing small or mixed associations. Furthermore, social media use is not monolithic. The affordances of different social media platforms allow for a broad range of behaviors that can have dramatically different psychological and health implications. It is also important to note that there are a host of proposed mechanisms that may underlie the association between social media and health, not a single dominant mechanism, and these mechanisms are likely not independent of one another and may also be contradictory (e.g., fostering inclusion online but displacing face-to-face interaction with family). Finally considerable heterogeneity emerging in the literature suggests that the relation between social media and health may differ among individuals, making it difficult to draw conclusions that are not highly qualified or particular to certain subgroups.

The committee's review of the literature did not support the conclusion that social media causes changes in adolescent health at the population level. Nevertheless, there are potential harms associated with the

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platforms such as the ability to encourage unhealthy social comparisons, especially for teens who are inclined to view others as somehow better off than themselves. Social comparison may play a role in some teens body image problems and has been proposed as a risk factor for eating disorders.

Social media use can also displace time that could otherwise be given to sleep, exercise, studying, or other hobbies. A serious consequence in its own right, sleep loss is also a risk factor for depression, mood disturbances, injuries, attention problems, and excessive weight gain. Yet the extent to which social media use displaces unambiguously healthy pastimes such as sport and sleep appears to vary across socioeconomic backgrounds. Combined with evidence that young people from the highest income families tend to limit their use of social media, there is reason to suspect that social and economic factors confound many of the risks attributed to the displacing power of social media.

The platforms also have a distracting power that can conflict with an important developmental window for cultivation of attentional control, a skill necessary for academic success and emotional adjustment. Social media use may reduce adolescents' ability to sustain attention and suppress distraction, key components of concentration. At the same time, it is difficult to say that the distraction posed by social media is a function of the media or of the distraction inherent in reading on screens and the related incitements to multitask.

Studies looking at the association between social media use and feelings of sadness over time have largely found small to no effects, but people with clinically meaningful depression may engage with social media differently. Some research has proposed that this relation is circular, with people with more symptoms of depression spending more time using social media and social media use predicting risk of depression. At the same time, the relation between social media use and depression might vary among different demographic or identity groups. Among LGBTQ+ teens, for example, social media use is associated with fewer depressive symptoms but an increased risk of bullying.

Heavy users of online video games can develop a dysfunctional behavior related to games, characterized by a persistent pattern of impaired control over the need to play, to the point where gaming takes precedence over all other life activities. Given that gaming disorder is defined by dysfunction, it is not surprising that many studies find evidence that the disorder predicts depression, anxiety, social phobia, poor school performance, sleep disruption, and poor relationships with parents and peers. Although less well studied, a dysfunctional use of social media appears to be a similar problem. It is currently unclear whether problematic social media use and gaming disorder are distinct disorders or are simply different manifestations of a similar disordered use of technology.

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DESIGN FEATURES

The committee recognizes that perfect controls over what users see is not a realistic or necessarily desirable expectation for social media companies. But there are provisions that can be incorporated into the design of apps, games, and websites that limit the personal information companies collect, the types of content available, and the prompts to extend time on a platform. There are steps that can be taken at the platform level that would help tip the balance of transparency to the users who support the platforms and the government agencies that monitor the fairness of their operations.

Age-appropriate design code aims to make online technology safer for young people, with an emphasis on protecting their privacy. The age-appropriate design movement has put concrete parameters on an otherwise abstract discussion about children's privacy. Its emphasis on both the inputs to, and outputs of, a functional privacy system gives researchers and companies a guideline against which to measure the data collection risks that children encounter online. Yet threats to the mental and physical health of young people are often traced to failures of content moderation, algorithms that promote toxic content, and overuse. Social media platforms would benefit from a similar standard to guide assessment of how their products influence youth well-being.

It is difficult to determine what effect social media has on well-being or the extent to which companies are doing due diligence to protect young people from the more habit-forming affordances of their platforms, as companies retain extremely tight control on their data and algorithms. A general lack of transparency regarding social media operations has bred public distrust of the platforms and the companies that run them. Yet some of the companies' reluctance to share data is valid. Platform algorithms are proprietary, which can make obliging companies to share them seem unfair and uncompetitive. Social media companies also hold a great deal of information about ordinary people that could, in the wrong hands, be used for surveillance or blackmail. For these reasons, the development of technical standards to benchmark platform operations, transparency, and data use requires the coordination of a range of stakeholders.

The International Organization for Standardization (ISO) is an international, nongovernmental organization with a long history of setting and supporting standards. The global reach of social media companies makes such international coordination central to any effort at transparent reporting or benchmarking.

Recommendation 5-1: The International Organization for Standardization should convene an ongoing technical working group

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including industry representatives, civil society, and academic stakeholders to develop standards for social media platform design, transparency, and data use.

The standards for social media operations and platform design would articulate both inputs and outputs of a functional system.[3] This information, like certain audit and systemic risk reports, should be available on request to the FTC. Better transparency and tracking of standardized indicators would eventually allow for comparisons across platforms and, over time, give both the public and the FTC better insight into this market.

Critics of this strategy may maintain that such steps are not necessary as the social media industry already has relevant rules in place. Recent years have seen greater effort at industry self-regulation and third-party regulation of social media. An acknowledgment of the fact that industry stakeholders are often in the best position to set out operational policies underlies the prior recommendation's specification that industry should be part of the ISO technical work group. There is also reason to believe that companies will have an interest in monitoring one another against the standards the ISO group develops. For this reason, the social media companies should formally adopt these standards and reference them in their public documents.

Recommendation 5-2: Social media providers should adopt the standards referenced in the previous recommendation as a matter of policy and as specific provisions in their terms of service.

A public statement that platforms will comply with all the measures included in the standard and a commitment to the standard in its terms of service would be a meaningful step toward an enforceable legal structure on social media. The creation of industry standards for social media would inform the FTC's governance by consent decree, even for social media providers that do not explicitly adopt the standard into their terms of service.

TRAINING AND EDUCATION

Social media has the potential to both harm and benefit young people. Some of the harms can be mitigated and the benefits realized through reliance on product design features, but there will always be a role for individual choice in managing the risks of the online world. The unique vul-

[3] Inputs refer to actions taken by the platform, while outputs are partially driven by the platform but are also shaped by the behaviors of users.

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nerability of young people to toxic content or misinformation is clear, but, in the committee's assessment, broad restrictions to their online access are neither practical nor desirable. It is therefore necessary to create both an online environment that protects young people and social media consumers who are empowered to protect themselves.

Failure to invest in young people's ability to navigate the complex world of online news and media has consequences for the young people themselves and for society. Media literacy education has the potential to create a more informed consumer, but most programs fall short of their promise because of scarce funding, uneven content, or poorly qualified instructors. The lack of a reference standard for a digital media literacy curriculum adds to the problem.

Recommendation 6-1: The U.S. Department of Education should draw national attention to the importance of comprehensive digital media literacy and state boards of education should set standards for the same in grades K through 12.

Teachers are critical players in fostering digital literacy among their students, especially in teaching them how to use technology safely and responsibly, critically evaluate online information, and create and share digital content. If students are to develop digital media literacy, they will need to be educated by teachers who are themselves proficient in the topic and who have been trained in how to convey the subject. Given the rapid pace of change, teachers also will need continuing education to stay abreast of new technological trends.

Recommendation 6-2: The Council for the Accreditation of Educator Preparation should set requirements for digital media literacy education for student teachers and as part of ongoing professional development for veteran teachers. Teacher training interventions should be designed to allow for rigorous evaluation to measure their effectiveness.

Digital media literacy interventions are not usually designed with an eye to rigorous impact evaluation, leaving any estimate of the training's effectiveness subject to confounding. The push for a national standard for digital media literacy education and related teacher training programs provides the opportunity to improve the understanding of what makes some programs successful and some failures. The committee therefore seconds recent calls for more prospective research to identify the essential skills that make up digital media literacy and the most equitable strategy to promote it.

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Young people who are struggling with underlying psychological problems may be using social media and gaming to cope. To an adolescent who sees social media as a vehicle for entertainment, connection, or learning, it would not necessarily be clear that the same pastime that helps them to manage stress is itself a stressor. A recognition of the influence of social media on the mental health of young people prompted a recent Surgeon General's report to recommend routine screening for mental health problems in primary care. A similar concern with compulsive use has led pediatrics organizations in Europe to call for increased awareness and support for members to correctly identify cases of problematic use. But there is a difference between what is recommended and what is practiced. In the same way that students in grades kindergarten through 12 need knowledgeable teachers if they are to achieve mastery of digital media, so do patients need providers who are in a position to counsel them on social media use and spot potential warning signs.

Recommendation 6-3: The Liaison Committee on Medical Education, the Accreditation Commission for Education in Nursing, the Commission on Collegiate Nursing Education, and the Council on Social Work Education should incorporate training on the multiple effects of social media on children's and adolescents' well-being into professional education.

ONLINE HARRASSMENT

Part of the harm associated with social media lies in the harassment some young people experience. These forms of harassment run from the sadly common, as in cyberbullying, to the rare and serious, as in child sexual exploitation. Digital technology can provide an anonymity that emboldens perpetrators, with behavior that would be unacceptable in person flourishing online.

The committee recognizes that social media platforms do not cause harassment or sexual offenses against children, nor are they to blame for the existence of egregious forms of human behavior. At the same time, any company that makes a product central to unconscionable crimes has a role to play in stopping them. In the same way that hotel and airline companies have made prevention of human trafficking an industry-wide corporate social responsibility, so should the technology industry take steps to ensure their users can easily report online abuse and that these reports are followed up.

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Recommendation 7-1: Social media companies should develop systems for reporting, follow-up, and adjudication for cases of online harassment and abuse. These systems should be easy to use, universal, accountable, and transparent.

The committee recognizes that collecting information about which minors experience harassment or abuse rests in uneasy tension with companies' obligations under COPPA. Lack of clarity on how to satisfy these competing duties may have the unintended effect of encouraging companies to turn a blind eye to suspicious interactions online. Social media companies and society would benefit from clear guidance regarding how to manage the trade-offs between child protection and data privacy.

Recommendation 7-2 The Federal Trade Commission should revise its regulations to clarify how to make systems for reporting cases of online harassment and abuse comply with the Children's Online Privacy Protection Act.

When young people are bullied, harassed, or preyed upon by sexual predators and when that abuse is inextricably tied to the reach and anonymity of the internet, society has an obligation to help the victims. The U.S. Substance Abuse and Mental Health Services Administration has the mandate and expertise to provide support and intervention services for children and adolescents who are harmed by their experiences on social media.

Recommendation 7-3: The U.S. Substance Abuse and Mental Health Services Administration should develop support and intervention programs for children and adolescents who experience digital abuse and evaluate the effectiveness of such programs.

A RESEARCH AGENDA

Quantifying the risks and benefits social media pose to young people is difficult for many reasons. Given the challenges in measuring both exposures and outcomes, to say nothing of the variability in psychological responses to stimuli, it is hard to offer an overall summary about the relation between social media and youth mental health beyond observing that the effects, both helpful and harmful, accrue differently to different users.

The standard of evidence needed to establish a causal relation between an outcome and exposure is high. Most of the research on this topic has established only an association between social media use and different mental and physical health outcomes. Evidence of such associations is

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useful and can drive hypothesis formation and further inquiry, but it is not sufficient, on balance, to lead this committee to recommend additional restrictions on young people's access to social media. A stronger evidence base on certain key questions could remove much uncertainty from the work of policy makers.

Recommendation 8-1: The National Institutes of Health, the National Science Foundation, and other research funders should support a research agenda that gives priority to the health consequences of social media use, the epidemiology of problematic use, the mechanisms through which social media use influences health, efforts to remediate harms associated with social media use, the role of parents and other adults in influencing positive use, and algorithmic audits. Across topics, the agencies should emphasize the need for validated tools to measure exposure to social media affordances, data sharing, and the establishment of long-term cohort studies. Special emphasis should be given to study designs that attempt to understand causal directions.

For research to be more useful to both industry and policy makers, it is important to clarify how specific affordances influence health. The committee commends research using randomized designs and experimental platforms to study social networks. Such research is difficult and expensive to conduct and would therefore benefit from being an explicit priority of the major government funders. There are also less onerous ways to answer key questions through capitalizing on natural experiments. Analysis of the staggered rollout of Facebook on college campuses and the simultaneous deterioration in student mental health provided compelling evidence of the platforms' potential harm. As new waves of public policy attempt to limit media use in young people, it will be critical to study the consequences of such restrictions.

At the same time, there are only so many questions that can be answered without the platforms' explicit cooperation. Recommendation 5-1 encourages researchers and platforms to formally collaborate in developing data and operational standards. The committee recognizes, however, that this recommendation might take considerable time to implement. In the meantime, there are researchers and journalists with pressing questions about the advertising, recommendation, and content moderation actions of social media companies. They pursue these questions to the benefit of society and at potential personal liability.

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Recommendation 8-2: Social media companies should make a good faith effort to ensure access to data that would make research on the effects of social media on child and adolescent health possible, including the omission from their terms of service any prohibitions on researchers' use of publicly available data.

A good faith effort to allow researchers to access social media data could be valuable to companies facing a great deal of public distrust and scrutiny; however, there is evidence that companies are moving away from data sharing. Given current efforts to restrict data access, it is reasonable to consider that social media companies may not voluntarily cooperate with Recommendation 8-2. Indeed, the current climate seems to suggest the opposite, that companies are becoming progressively more opposed to data sharing and cooperation with researchers.

Researchers' lack of access to social media data is a problem that has attracted congressional attention in recent years. While the committee does not endorse or oppose any particular legislative proposal on this topic, it commends the legislators' concern with ensuring research access to social media data.

Recommendation 8-3: Congress should pass legislation to ensure researchers can access data to examine the effects of social media on child and adolescent health.

In advancing the legislation recommended, it will be important to articulate technical steps that could improve the anonymization of user data, recognizing nonetheless that complete anonymization of social media data is not always possible or entirely effective. There is no easy or obvious answer to questions of how to balance society's interest in greater transparency of social media operations against individual users' expectations of privacy. It is the committee's hope that by showing commitment to this question, Congress can encourage an open discussion among researchers, industry executives, and privacy experts.

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1

Introduction

There are over 1.3 billion young people between ages 10 and 19 in the world today, approximately 1.8 billion between ages 10 and 24, making up the largest generation of youth to have ever lived (Bustreo et al., 2022; UNICEF, 2022). In much of the world, this generation has grown up with the internet influencing their relationships, the way they learn, and how they experience life milestones. A recent national survey of teens[1] in the United States found that 95 percent have access to a smartphone, and 97 percent use the internet daily (Vogels et al., 2022). This marks a steady increase in internet and device use since the early 2000s and a major cultural shift (Lenhart, 2009). Excitement about the immense potential of digital technologies for education, health, and entertainment is increasingly coupled with concern about the psychological and intellectual consequences of constant connectedness, particularly during developmentally sensitive windows.

Against this backdrop of ambivalence about the role of social media in the lives of young people emerged a series of revelations in fall 2021 from Facebook whistleblower Frances Haugen. Internal documents shared with the *Wall Street Journal*, cited internal research on the platform's potential for harm. While reporting that a majority of users found the networking site Instagram to be either helpful or of no influence on the way they man-

[1] Aged 13 to 17 years.

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age mental health problems, Facebook[2] researchers frankly admitted, "We make body image issues worse for one in three teen girls" (WSJ, 2021a, p. 14). Of similar concern was the company's estimate that 12.5 percent of Facebook users, roughly 360 million people, report that they feel powerless to control their interaction with the platform, checking their accounts constantly, to the detriment of their health, work, and relationships (Wells et al., 2021).

The methods and validity of the company research reported in the Haugen papers cannot be verified, but their publication marked a watershed for Facebook and the social media industry (Duffy, 2021; Horwitz, 2021; Lima, 2021). At the center of this crisis was the perception that Facebook was willing to overlook the risks of their product and publicly misrepresent their internal findings if doing so advanced the company's growth or market standing (Dwoskin et al., 2021; Lima, 2021).

Social comparison is nothing new, and neither are compulsive behaviors. But the scale to which digital technologies facilitate them is. Embarrassment and rejection are worse when they are broadcast to an almost limitless audience and memorialized in an online record. Escape from the psychological cues that encourage toxic behavior becomes logistically impossible when the trigger follows the user everywhere, all the time, in a handheld device.

An interest in the relation between youth mental health and social networking were at the root of Facebook's market research on teen mental health. This research, released with the Frances Haugen papers, found that 82 percent of teenage users had emotional problems in the previous month (WSJ, 2021b). This result is broadly consistent with a body of epidemiological literature describing a "mental health crisis" among young people (CDC, 2022). Over the last decade, the Centers for Disease Prevention and Control's (CDC's) Youth Risk Behavior Survey has found a steadily growing percentage of high school students reporting persistent sadness or hopelessness, with 22 percent considering suicide over the same time (CDC, 2023). As Figures 1-1 and 1-2 indicate, these increases are more pronounced among girls.

In almost every indicator measured by the Youth Risk Behavior Survey, LGBQ[3] teens are worse off than heterosexual teens (see Figure 1-3). Compared with their heterosexual peers, LGBQ students were more likely to misuse prescription opioids, have unstable housing, be bullied (online or at school), and forced to have sex (CDC, 2023). These data suggest that members of sexual and gender minorities face serious risks, which,

[2] Facebook was rebranded as Meta not long after these papers were leaked (Frenkel et al., 2022).

[3] Questions about transgender identity were not part of the survey.

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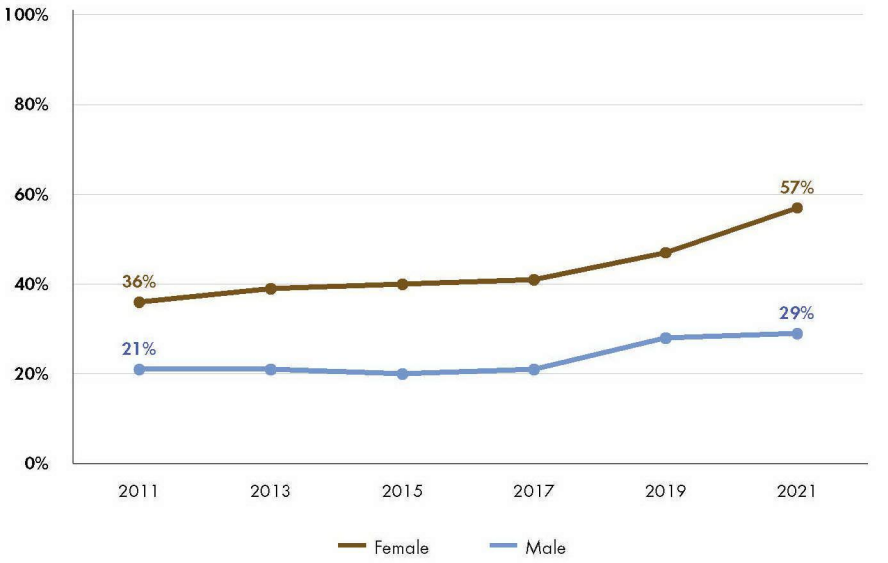


FIGURE 1-1 Percentage of female and male students who experience persistent feelings of sadness or hopelessness, 2011 to 2021.
SOURCE: CDC, 2023.

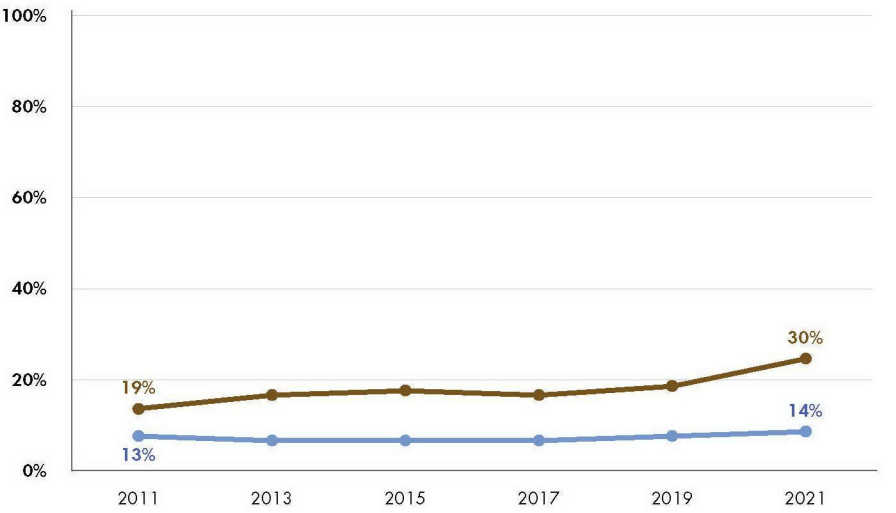


FIGURE 1-2 Percentage of female and male students who seriously considered suicide, 2011 to 2021.
SOURCE: CDC, 2023.

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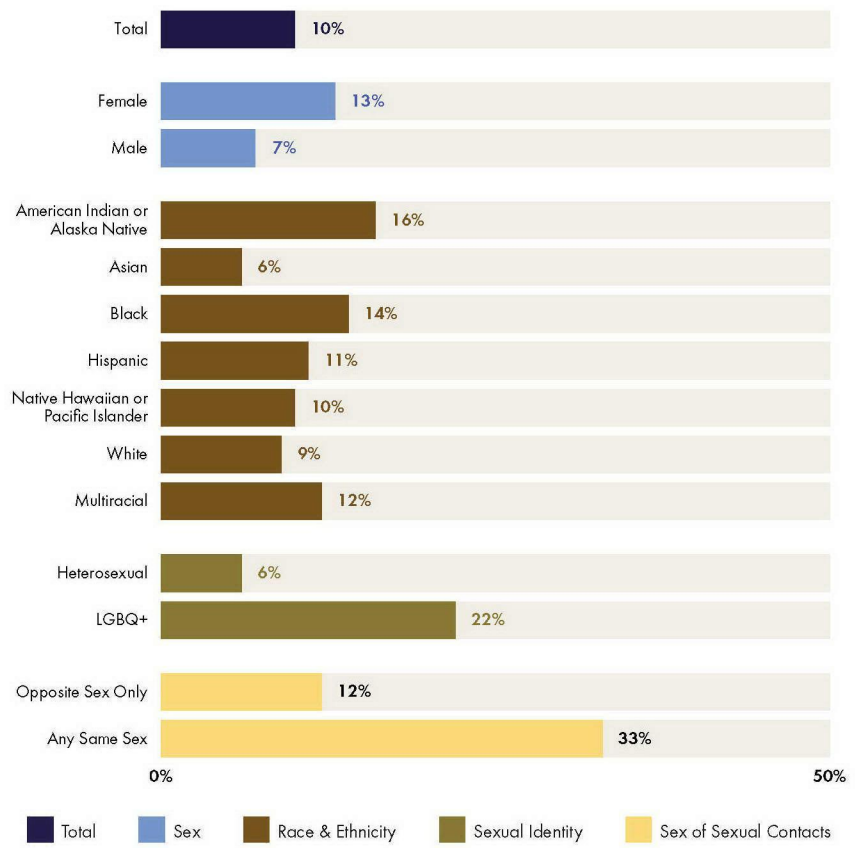


FIGURE 1-3 Percentage of high school students who attempted suicide during the past year by demographic characteristics, 2021.
SOURCE: CDC, 2023.

given that there are roughly 2 million teenagers in the United States who identify as lesbian, gay, bisexual, or transgender, could translate to hundreds of thousands of young people in danger of trauma every year (Conron, 2020). Yet strategies to help these teens, or anyone at elevated risk by virtue of their relative isolation, often hinge on the availability of online support. Social media can provide support and connection for young people who live in communities where sexual and gender diversity are not accepted; it can also serve as a buffer against stigma and loneliness that drive mental health problems (Berger et al., 2022; Jenzen, 2022; Kaniuka et al., 2019). For these reasons, the Trevor Project, a suicide prevention organization for LGBTQ+ youth, recommended supportive

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online communities as a counter to stress, especially the increased stress of the COVID-19 pandemic (Green et al., 2020).

Discerning the relative supportiveness of an online environment remains difficult, however. Much depends on the users' psychosocial makeup, patterns of their online behavior, and their reasons for turning to the online world in the first place (Kuss and Griffiths, 2011; Nesi, 2020). During typical adolescent development, heightened sensitivity to peer evaluation can make the experience of online social exclusion or conflict, a central part of social media use, more intense (Nesi, 2020). Social media can also expose users to content related to disordered eating, self-harm, and suicide, even as increasingly sophisticated algorithms are able to screen for mental health problems from users' profiles (Guntuku et al., 2017; Nesi, 2020). The use of social media to mitigate mental health problems may depend on the extent to which these media have contributed to them in the first place.

Teens' use of social networking is a commonly cited cause for the deterioration in their mental health, but it is by no means the only one (Haidt and Allen, 2020; Turner, 2023; Twenge, 2019). Gun violence, climate change, parental attitudes, social unrest, poverty, inequity, and isolation have all been proposed as explanations, as has some combination of multiple factors (Abrams, 2022; Rosin, 2014; Schiffman, 2022). As Derek Thompson observed in *The Atlantic*,

> these explanations aren't equally valid, and some of them might be purely wrong. But the sheer number of theories reflects the complexity of mental-health challenges and suggests that, perhaps, nobody knows for sure what's going on. (Thompson, 2023)

This confusion extends even to assessments of whether youth mental health is in a state of crisis. Much of the concern about problems in young people comes from an analysis of data from the last decade or two (Morgan et al., 2017; Sumner et al., 2021). Data on suicide, the most extreme consequence of psychological pain, indicate that the apparent spike in problems over the last 15 years may be more an example of long-term cyclicality, following a relative low point in the 1990s and 2000s (see Figure 1-4) (Levitz, 2023; Rinehart and Barkley, 2023). It is also worth noting that suicide mortality has increased in almost all groups over the last 20 years, this is not problem unique to adolescents (Garnett and Curtin, 2023). To be sure, any incidence of suicide, especially among young people, is too much. At the same time, an overemphasis on the recent past could lead an observer to a mistaken emphasis on recent explanations (e.g., teen suicide has risen with use of smartphones and social media, therefore they are related). To better understand this problem, it is nec-

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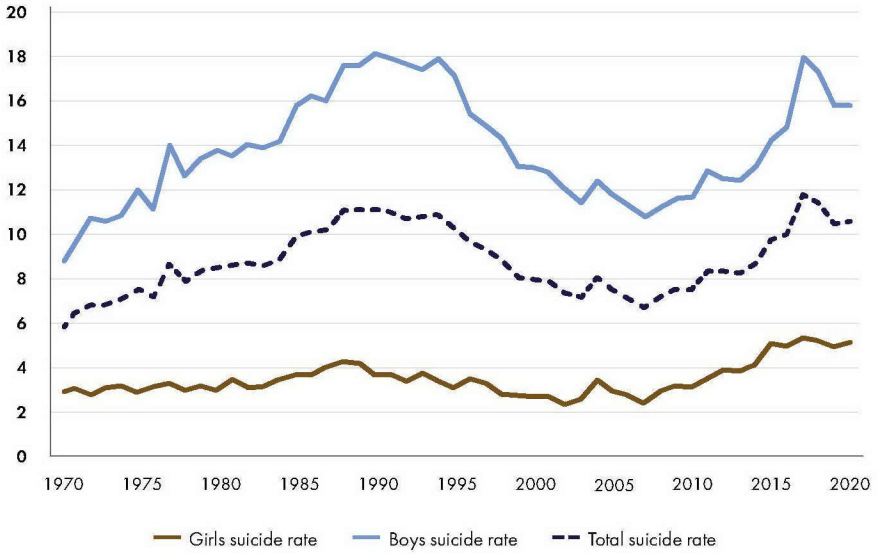


FIGURE 1-4 Suicide rate among teens 15 to 19 per 100,000, from 1970 to 2020.[a] SOURCE: Created with data from the Centers for Disease Control and Prevention WONDER and WISQARS databases.

[a] This figure was replaced after the report was released with a figure that standardizes data points between 1999 and 2020 to those for 15 to 19 year-olds."

essary to look beyond seemingly obvious explanations and identify the young people in need of help.

Nevertheless, a suspicion that social media is at the root of young people's mental health problems has motivated state legislatures around the country to curb adolescent use of social media and take action against the companies that profit from it. In March 2023, the governor of Utah signed a bill limiting the use of social networking and gaming sites by anyone under 18; in California, recent legislation prohibits tech companies from using minors' personal information in ways that could harm them (Metz and Ortutay, 2023; Willon, 2022). With similar legislation proposed in other states and encouraged in President Biden's 2023 State of the Union address, there is a timely and pressing need for more clarity as to the precise harms and benefits social media pose to young people (Singer, 2023).

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THE CHARGE TO THE COMMITTEE

A concern with disentangling the benefits and the harms of social media use is at the root of the charge to this committee set out by the Democracy Fund, the Ford Foundation, the William and Flora Hewlett Foundation, Luminate Projects Limited, the John D. and Catherine T. MacArthur Foundation, and the Open Society Foundations. The statement of task, shown in Box 1-1, was developed through a consultative process including representatives of all the sponsoring organizations. In addition to asking questions about the broad effects of social media on physical and mental health and well-being, the committee was asked to investigate the relative risks and benefits of various forms of online media and the consequences of media use during childhood and adolescence. The committee was also asked to identify a research agenda that might help clarify the causal pathway between social media use and various health indicators. The sponsors asked the National Academies of Sciences, Engineering, and Medicine to convene a consensus committee to answer these questions; committee members had expertise in cognitive science, computational science, economics, education, epidemiology, law, media science, mental health, network science, neuroscience, pediatrics, psychology, social media, and technology. More information about the committee members answering this charge can be found in Appendix A.

The Committee's Approach to Its Charge

This committee had six meetings over 12 days between January and September of 2023 (see agendas for public meetings in Appendix B). In closed sessions, committee members deliberated on the material presented in public sessions and the literature reviewed in this report. Subgroups of the committee had regular calls to develop recommendations and consider the arguments presented. Members of the public submitted various comments and reading material for the committee's review; this material is available on request from the National Academies Public Records Office.

In defining the scope of this report, the committee first struggled in classifying the media in question. Social media platforms vary widely, and a definition that calls out specific platforms or apps risks quickly becoming irrelevant; social networking platforms wax and wane in popularity, especially among young people. For this reason, the committee relies on a definition adapted from the American Psychological Association: Social media refers to "interactive technologies that facilitate the creation and sharing of information, ideas, interests, and other forms of expression through virtual communities and networks" (APA, 2023). This can

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BOX 1-1
Statement of Task

An ad hoc committee of the National Academies of Sciences, Engineering, and Medicine will examine the current research and make conclusions about the impact of social media on the mental and physical health and well-being of adolescents and children. The committee will consider the following questions:

1. In what ways, if any, does social or digital media affect the mental and physical health and well-being of adolescents and children (age 13–18 years), including anxiety, depression, addiction and self-efficacy, social isolation, relationship malformation, relationship with their parents, life satisfaction, and physical activity?
   a. Do these effects differ between different social or digital media use (e.g., social media vs. video streamers)?
   b. Do the effects of social or digital media on adolescents and children differ between different demographics of children (race and ethnicity, gender, socioeconomic status)?

2. In what ways, if any, does the product design of social media (e.g., consumer retention strategies, data profiling, advertising, and others) affect adolescents and children's physical and mental health and well-being?

3. What consequences, if any, do the effects of social or digital media on adolescents and children's mental and physical health and well-being have for education, social development, family dynamics, and projected economic prospects?

4. Do new forms of social media (such as 3D social networking) raise novel questions for the health and well-being of adolescents and children and their families?

The committee should identify what is needed in a research agenda to more fully understand the impact of social media on adolescents, children, and their families, as well as the data that would be required in order to comprehensively evaluate the effects of social media products on the mental and physical health and well-being of adolescents and children.

The committee should also make recommendations for steps that parents, social media companies, and public officials can take to maximize potential benefits and minimize potential harms of social media for adolescents and children.

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include, as the American Academy of Pediatrics and other scholars have highlighted, social networking sites, gaming sites,[4] virtual worlds, video sharing sites, and blogs (Aichner et al., 2021; O'Keeffe et al., 2011). Social networking sites are a subclass of social media characterized by user profiles, the listing of connections, and the ability to view profile information among connections; this subclass has been of particular interest to researchers (Bayer et al., 2020). The term "digital media" is sometimes used as a parent category to capture all media consumed through screens in recognition of the fact that lines between various forms of digital and interactive media are increasingly blurred (Chassiakos et al., 2016).

More important to this report than any particular definition of social media is a concept described in the computing literature as *affordances*, referring to what a user can do with a thing, in this case with a website, app, or video game (Soegaard, n.d.). Affordances include the capacity for public posting, running counts of feedback on posts, and communicating privately with friends or strangers; these topics are discussed more in Chapter 2. A discussion of social media that does not rely heavily on the analysis of affordances risks an overemphasis on specific applications and an underemphasis on the transferable mechanisms at play (Treem and Leonardi, 2012). This shortsightedness can in turn hold back generalizability and obscure the relationship between technology and behavior (Treem and Leonardi, 2012). For this reason, the committee defines *social media* broadly, with an emphasis on affordances, including the affordances that allow for interaction with friends or strangers.

The committee recognizes that in a discussion of social media it can be difficult to separate the platform from the corporation that controls it. Some media that started out as apps or websites are now synonymous with a much larger infrastructure, sometimes born of the stitching together of multiple different media into a hybrid. A profile on a dating site, for example, may pull data from another networking site, posing challenges to researchers who aim to study it. The amalgamation of multiple platforms can also pose concerns for society, as when well-known companies acquire smaller ones, sometimes competitors. The parent company's branding of subsidiaries can in turn affect perception of the similarities or differences among them (Bayer et al., 2020). With this in mind, this report refers to specific platforms only as examples and makes a distinction when necessary between a platform and its parent company.

[4] In this report, video games are included in so much as they have affordances for social media; a larger literature on video games, especially the effects of violent games, is not included. Readers interested in large reviews of gaming can consult the 2019 *APA Task Force Report on Violent Video Games.*

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The Committee's View of Health

The committee's understanding of health is equally important to this report as its understanding of social media. Throughout its deliberations and review of literature, the committee found the research and public discussion linking social media to health was disproportionately, sometimes exclusively, concentrated on mental health outcomes. This is an understandable consequence of the nature of the social media exposure; it is reasonable to wonder, even if constant social comparison or public feedback has psychological consequences, if the same would influence physical health in the same immediate, observable way. Chapter 4 explains how vastly more research has been done linking social media to mental health outcomes than physical ones, with the possible exception of sleep disruptions. The discussion in this report and the literature reviewed reflect the slant in this discussion.

In any case, the committee members were not interested in drawing artificial distinctions between mental and physical health. For readers curious as to why this report refers to health broadly even when citing specifically psychological aspects of well-being, we cite the World Health Organization's (WHO's) definition of health, "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" (WHO, 2023a). The organization's explanation continues, "there is no health without mental health" (WHO, 2023b). Simply put, mental health is health and psychological outcomes are as crucial to population well-being as cardiovascular ones.

At the same time, the committee found it necessary to put logistical guardrails on its conception of a health outcome, especially as reviewed in chapters 3 and 4. Many of the consequences of social media use and the internet in general have a social and political dimension that one could link to mental health. This report discusses the potential for social media to expose young people to fringe political ideas, misogynist or racist views, and other forms of harassment. It also considers the delicate relationship between user privacy and social protection at the center of this problem. This discussion is, for the most part, complementary to the committee's review of the health literature and more related to the committee's charge to suggest a way to maximize benefits and minimize harms associated with social media.

The Inclusion of Lived Experience

In answering its charge, the committee was also sensitive to the importance of understanding the adolescent experience of social media from the people living it. To this end, a call for nominations was posted

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to the study website asking for young people aged 13 to 18 years to share their experience of social media and gaming with the committee. Eleven participants were chosen as a purposive sample that ensured geographic diversity and a range of ages. Participants from across the United States[5] met three times on Zoom to inform the committee's deliberations. Their input served as a sounding board for the recommendations in this report and a check on the validity of the committee's deliberations.

A Comment on Age

In reviewing their charge, the committee members and representatives of the sponsoring organizations discussed the task's reference to both adolescents and children and its emphasis on the 13- to 18-year-old age range. On one hand, this age group may be seen to be at heightened risk, partly on the basis of a legal technicality: The Children's Online Privacy Protection Act (COPPA) restricts the personal information that tech companies can knowingly collect and the services they can provide to children younger than 13.[6] For this reason, technology companies, at least officially, know relatively little about their youngest users (Fowler, 2022; Hunter, 2022; Moyer, 2022). The age restriction reverberates in a relative scarcity of research on social media use in late childhood or early adolescence (Charmaraman et al., 2022). Most importantly, the COPPA age maximum was the result of a political compromise, informed by older rules regulating children's television (Montgomery, 2023). Ages 13 to 18 do not represent a clear developmental stage, nor are these ages necessarily a common grouping for research.

The sponsor representatives clarified that their interest was on young people broadly with a transitional cutoff around age 18, giving the committee some leeway in its determination of the key ages to consider (NASEM, 2023). Recognizing that experiences at age 13 are influenced, even partially predetermined, by experiences earlier in childhood, the committee chose to avoid an overly strict interpretation of the age range cited in its charge. While time and feasibility prevented the committee from analyzing the online well-being of young children or adults in their twenties, this report considers adolescence and late childhood broadly, presenting evidence relating to and strategies intended for children as well as teenagers.

[5] Southern California, Illinois, Kansas, New York, south Texas, Virginia, Wisconsin.
[6] Children's Online Privacy Protection Rule, 16 C.F.R § 312.4 (2013).

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The Organization of This Report

In answering the charge set out in Box 1-1, the committee strove for a thorough and accessible analysis of how social media work and how they influence young users. To this end, Chapter 2 provides an assessment of how social media work, focusing on the common advertising and consumer retention strategies as well as the platform affordances that affect users' experience with particular emphasis on how these affordances interact with adolescence. The next two chapters discuss how social media affect well-being and review recent evidence on the benefits and harms associated with digital media use. Chapter 5 considers how changes to the design of social media might improve transparency and public confidence in the platforms. Chapter 6 sets out training and educational strategies to improve digital literacy among young people; Chapter 7 presents an analysis of the specific problem of digital harassment and abuse. The last chapter highlights bottlenecks that have created gaps in the research linking social media use to well-being and sets out a list of pressing research priorities and actions that might facilitate better research on social media.

REFERENCES

Abrams, Z. 2022. *Stress of mass shootings causing cascade of collective traumas*. https://www.apa.org/monitor/2022/09/news-mass-shootings-collective-traumas (accessed July 18, 2023).

Aichner, T., M. Grunfelder, and O. Maurer. 2021. Twenty-five years of social media: A review of social media applications and definitions from 1994 to 2019. *Cyberpsychology, Behavior, and Social Networking* 24(4):215-222.

APA (American Psychological Association). 2023. *Social media and the internet*. https://www.apa.org/topics/social-media-internet (accessed March 27, 2023).

Bayer, J. B., P. Triệu, and N. B. Ellison. 2020. Social media elements, ecologies, and effects. *Annual Review of Psychology* 71(1):471-497.

Berger, M. N., M. Taba, J. L. Marino, M. S. C. Lim, and S. R. Skinner. 2022. Social media use and health and well-being of lesbian, gay, bisexual, transgender, and queer youth: Systematic review. *Journal of Medical Internet Research* 24(9).

Bustreo, F., S. Germann, and K. Gilmore. 2022. Respecting, protecting, and fulfilling the health and human rights of youth in digital spaces. *The Lancet Child and Adolescent Health* 6(2):75-76.

CDC (Centers for Disease Control and Prevention). 2022. *Adolescent behaviors and experiences survey*. Centers for Disease Control and Prevention. https://www.cdc.gov/healthyyouth/data/abes.htm (accessed March 27, 2023).

CDC. 2023. *Youth risk behavior survey: Data summary and trends report 2011-2021*. Centers for Disease Control and Prevention. https://www.cdc.gov/healthyyouth/data/yrbs/pdf/YRBS_Data-Summary-Trends_Report2023_508.pdf (accessed March 27, 2023).

Charmaraman, L., A. D. Lynch, A. M. Richer, and J. M. Grossman. 2022. Associations of early social media initiation on digital behaviors and the moderating role of limiting use. *Computer Human Behavior* 127.

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Chassiakos, R., J. Radesky, D. Christakis, M. A. Moreno, C. Cross, Council on Communications Media, D. Hill, N. Ameenuddin, J. Hutchinson, A. Levine, R. Boyd, R. Mendelson, and W. S. Swanson. 2016. Children and adolescents and digital media. *Pediatrics* 138(5).

Conron, K. 2020. *LGBT youth population in the United States.* The Williams Institute, UCLA School of Law.

Duffy, C. 2021. The Facebook Papers may be the biggest crisis in the company's history. *CNN*, October 25, 2021.

Dwoskin, E., T. Newmyer, and S. Mahtani. 2021. The case against Mark Zuckerberg: Insiders say Facebook's CEO chose growth over safety. *Washington Post*, October 25.

Fowler, G. 2022. Your kids' apps are spying on them: Apple and Google just look the other way. Here's how we stop them. *The Washington Post.* https://www.washingtonpost.com/technology/2022/06/09/apps-kids-privacy (accessed March 27, 2023).

Frenkel, S., M. Isaac, and R. Mac. 2022. How Facebook is morphing into Meta. *The New York Times.* https://www.nytimes.com/2022/01/31/technology/facebook-meta-change.html (accessed July 6, 2023).

Garnett, M. F., and S. C. Curtin. 2023. *Suicide mortality in the United States, 2001-2021.* Hyattsville, MD: National Center for Health Statistics.

Green, A. E., M. Price-Feeney, S.H. Dorison, and J. Weaver. 2020. *Implications of COVID-19 for LGBTQ youth mental health and suicide prevention.* The Trevor Project. https://www.thetrevorproject.org/blog/implications-of-covid-19-for-lgbtq-youth-mental-health-and-suicide-prevention (accessed March 27, 2023).

Guntuku, S. C., D. B. Yaden, M. L. Kern, L. H. Ungar, and J. C. Eichstaedt. 2017. Detecting depression and mental illness on social media: An integrative review. *Current Opinion in Behavioral Sciences* 18:43-49.

Haidt, J., and N. Allen. 2020. Scrutinizing the effects of digital technology on mental health. *Nature* 578:226-227.

Horwitz, J. 2021. The Facebook whistleblower, Frances Haugen, says she wants to fix the company, not harm it. *Wall Street Journal.* https://www.wsj.com/articles/facebook-whistleblower-frances-haugen-says-she-wants-to-fix-the-company-not-harm-it-11633304122 (accessed March 27, 2023).

Hunter, T. 2022. Instagram rolls out age verification, but not to keep children off the app. *The Washington Post.* https://www.washingtonpost.com/technology/2022/06/23/instagram-age-verification (accessed March 27, 2023).

Jenzen, O. 2022. LGBTQ youth cultures and social media. In *Oxford Research Encyclopedia of Communication.* Oxford University Press. https://doi.org/10.1093/acrefore/9780190228613.013.1363.

Kaniuka, A., K. C. Pugh, M. Jordan, B. Brooks, J. Dodd, A. K. Mann, S. L. Williams, and J. K. Hirsch. 2019. Stigma and suicide risk among the LGBTQ population: Are anxiety and depression to blame and can connectedness to the LGBTQ community help? *Journal of Gay & Lesbian Mental Health* 23:205-220.

Kuss, D. J., and M. D. Griffiths. 2011. Online social networking and addiction—A review of the psychological literature. *International Journal Environmental Research and Public Health* 8(9):3528-3552.

Lenhart, A. 2009. *Teens and social media: An overview.* https://www.pewresearch.org/internet/2009/04/10/teens-and-social-media-an-overview (accessed March 27, 2023).

Levitz, E. 2023. 4 explanations for the teen mental-health crisis. *New York Magazine, The Intelligencer.* https://nymag.com/intelligencer/2023/03/4-explanations-for-the-teen-mental-health-crisis.html (accessed March 27, 2023).

Lima, C. 2021. A whistleblower's power: Key takeaways from the Facebook Papers. *The Washington Post*, October 26.

Metz, S., and B. Ortutay. 2023. Utah social media law means kids need approval from parents. *APNews.* https://apnews.com/article/social-media-utah-kids-84bd1f6481071726327bce25cf3e7522 (accessed June 13, 2023).

Copyright National Academy of Sciences. All rights reserved.

Montgomery, K. 2023. *Promoting safeguards for young people in the digital media & marketing system* (The Children's Online Privacy Protection Act). https://www.nationalacademies.org/event/02-06-2023/assessment-of-the-impact-of-social-media-on-the-health-and-wellbeing-of-adolescents-and-children-meeting-2 (accessed March 27, 2023).

Morgan, C., R. T. Webb, M. J. Carr, E. Kontopantelis, J. Green, C. A. Chew-Graham, N. Kapur, and D. M. Ashcroft. 2017. Incidence, clinical management, and mortality risk following self harm among children and adolescents: Cohort study in primary care. *BMJ* 359:j4351.

Moyer, M. W. 2022. Kids as young as 8 are using social media more than ever, study finds. *The New York Times*. https://www.nytimes.com/2022/03/24/well/family/child-social-media-use.html (accessed March 27, 2023).

NASEM (National Academies of Sciences, Engineering, and Medicine). 2023. *Assessment of the impact of social media on the health and wellbeing of adolescents and children (meeting 1)*. https://www.nationalacademies.org/event/01-05-2023/assessment-of-the-impact-of-social-media-on-the-health-and-wellbeing-of-adolescents-and-children-meeting-1 (accessed March 27, 2023).

Nesi, J. 2020. The impact of social media on youth mental health: Challenges and opportunities. *North Carolina Medical Journal* 81(2):116-121.

O'Keeffe, G. S., K. Clarke-Pearson, and Council on Communications Media. 2011. The impact of social media on children, adolescents, and families. *Pediatrics* 127(4):800-804.

Rinehart, W., and T. Barkley. 2023. *Thoughts on what the CDC YRBS data means for social media, teens, and mental health* (March 14). https://nowandnext.substack.com/p/thoughts-on-cdc-yrbs-data (accessed October 11, 2023).

Rosin, H. 2014. *The overprotected kid*. https://www.theatlantic.com/magazine/archive/2014/04/hey-parents-leave-those-kids-alone/358631 (accessed July 18, 2023).

Schiffman, R. 2022. *Climate anxiety is widespread among youth—Can they overcome it?* https://www.nationalgeographic.com/environment/article/climate-anxiety-is-widespread-among-youth-can-they-overcome-it (accessed July 18, 2023).

Singer, N. 2023. Utah law could curb use of TikTok and Instagram by children and teens. *The New York Times*. https://www.nytimes.com/2023/03/23/technology/utah-social-media-law-tiktok-instagram.html (accessed March 27, 2023).

Soegaard, M. n.d. Affordances. In *The Glossary of Human–Computer Interaction*, edited by M. Soegaard and R. F. Dam. Interaction Design Foundation.

Sumner, S. A., B. Ferguson, B. Bason, J. Dink, E. Yard, M. Hertz, B. Hilkert, K. Holland, M. Mercado-Crespo, S. Tang, and C. M. Jones. 2021. Association of online risk factors with subsequent youth suicide-related behaviors in the US. *JAMA Network Open* 4(9):e2125860-e2125860.

Thompson, D. 2023. The tragic mystery of teenage anxiety. *The Atlantic*. https://www.theatlantic.com/newsletters/archive/2023/02/the-tragic-mystery-of-teenage-anxiety/673076 (accessed March 27, 2023).

Treem, J. W., and P. M. Leonardi. 2012. Social media use in organizations: Exploring the affordances of visibility, editability, persistence, and association. *Annals of the International Communication Association* 36(1):143-189.

Turner, C. 2023. 10 things to know about how social media affects teens' brains. *NPR*. https://www.npr.org/2023/02/16/1157180971/10-things-to-know-about-how-social-media-affects-teens-brains (accessed March 27, 2023).

Twenge, J. 2019. The sad state of happiness in the United States and the role of digital media. In *World happiness report 2019*, edited by J. F. Helliwell, R. Layard and J. D. Sachs. New York: Sustainable Development Solutions Network. Pp. 89–98.

Copyright National Academy of Sciences. All rights reserved.

UNICEF (United Nations Children's Fund). 2022. *Child protection overview*. https://data.unicef.org/topic/adolescents/overview/#:~:text=Investing%20in%20a%20safe%2C%20healthy,cent%20of%20the%20world's%20population (accessed March 27, 2023).

Vogels, E., R. Gelles-Watnick, and N. Massarat. 2022. *Teens, social media and technology 2022*. Pew Research Center. https://www.pewresearch.org/internet/2022/08/10/teens-social-media-and-technology-2022 (accessed March 27, 2023).

Wells, G., D. Seetharaman, and J. Horwitz. 2021. Is Facebook bad for you? It is for about 360 million users, company survey suggests. *Wall Street Journal*. https://www.wsj.com/articles/facebook-bad-for-you-360-million-users-say-yes-company-documents-facebook-files-11636124681 (accessed March 27, 2023).

Willon, P. C., and B. Contreras. 2022. California lawmakers pass new social media protections for minors. *Los Angeles Times*. https://www.latimes.com/politics/story/2022-08-30/california-lawmakers-pass-new-social-media-protections-for-minors (accessed March 27, 2023).

WHO (World Health Organization). 2023a. *Constitution*. https://www.who.int/about/governance/constitution (accessed October 17, 2023).

WHO. 2023b. *Health and well-being*. https://www.who.int/data/gho/data/major-themes/health-and-well-being (accessed October 17, 2023).

WSJ (Wall Street Journal). 2021a. Mental health findings. In *The Facebook Files*. *Wall Street Journal*. https://s.wsj.net/public/resources/documents/mental-health-findings.pdf (accessed March 27, 2023).

WSJ. 2021b. Teen mental health deep dive. *Wall Street Journal*. https://s.wsj.net/public/resources/documents/teen-mental-health-deep-dive.pdf (accessed March 27, 2023).

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2

How Social Media Work

As the previous chapter discussed, social media can include a range of activities and features that facilitate social interaction online. As such, understanding the potential effect of social media on health must move beyond a reductive understanding of social media as a unitary exposure and recognize that there is a broad range of interactions with social media that may result in different consequences for different people at different developmental stages. The creation and consumption of information, including the creation of a personal profile and the ability to comment and react to others' comments and to share and associate online, are important features of social media and ones that can be meaningful to adolescents and differently meaningful at different developmental stages. Social media platforms vary widely in their target audience, design, and purposes, making the broad discussion of social media complicated. For this reason, an understanding of platform affordances and how they interact with different developmental ages and capacities is central to this discussion.

In the interest of narrowing how we think of the range of social media functions to better understand the relation between social media and health, affordances refer broadly to the possibilities of action arising from the relation between a person's goals and a technology's features; in fact, affordances can enable or constrain certain behaviors or actions (Evans et al., 2017). Through affordances, technology influences but does not determine the possible actions available to a user. Online communication technologies have a range of affordances that shape how people

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interact and how they construct their identities and relationships (Treem and Leonardi, 2012). Persistence, for example, is an affordance that refers to the durability of online content. Some social media platforms allow users to create and share content that can be stored and accessed at any time, meaning that information shared on social media can have lasting repercussions.

An affordance approach also recognizes that while the goals and motivations of adolescents may not change over the years, the features of social media technology do, as do the economic and regulatory environments in which social media companies operate. For example, sensitivity to peers' opinions, self-expression, and identity development are well-established needs during adolescence that are unlikely to change 10 or 20 years from now (Steinberg and Morris, 2001). The features of social media technology that adolescents may use for self-expression and identity development are, in contrast, likely to be very different from current iterations in 10 or 20 years. In the same way, the algorithms that operate social media technology can be expected to be in almost constant flux, as will the economic and legal conditions within which social media platforms operate.

This chapter discusses how social media function with particular attention to affordances, aiming to lay the ground for an understanding of how these affordances interact with development to influence adolescents. This chapter discusses the features, services, and functions that a person encounters in the technology's interface (e.g., a like button, a sharing function, a messaging service), the ways the technologies operate and the algorithms that drive them; the way these operations interact with adolescents' developmental stages and needs, and the business models and legal constraints that influence how social media platforms operate. These four aspects of social media functioning are tightly entwined, but it is useful to consider them separately in describing the overall operation.

SOCIAL MEDIA AFFORDANCES

The discussion of social media affordances sometimes highlights *persistence*, referring to the automatic archive of online statements; *replicability* or the ability of information to be copied and shared; *scalability*, meaning the potential for wide visibility of information in online public platforms, and *searchability* meaning the ability of such information to be searched for and located (boyd, 2010). When considering how adolescents use social media, however, there are other relevant features to consider.

Social media platforms have features that influence how users communicate, share information, and interact online as well as the information they see. Most adolescents who use social make use of affordances

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for *creation and consumption* of content. Many platforms enable youth to create and share text, images, videos, or other creations such as games or code. Common ways to share content include posting to a profile on Instagram or Facebook, broadcasting to a group on Twitter, and uploading a fanfiction story to a website, just to cite a few examples. Some spaces allow users to view media without the need to add content; in others, such as BeReal, creating content is mandatory. Some models such as YouTube and TikTok do not even require users to have an account on the platform. The *individual or collaborative nature* of the content created is a related affordance. Some platforms are designed for one user to create content and share it, while other platforms, including the games Minecraft and Roblox, for example, are geared to collaborative creation. Still other platforms have aspects of both individual and collective production.

Platforms enable messaging in varying time frames, described as *synchronous or asynchronous communication*. Synchronous communication refers to real-time back-and-forth interaction, as in chat rooms or massively multiplayer online role playing games. Asynchronous communication, a feature of the vast majority of platforms, enables users to post and respond to posts at any time, either shortly after the initial message or later as in message threads or comments. Some platforms (e.g., Discord) offer both synchronous and asynchronous communication. Communication can also have an aspect of *anonymity*. On platforms such as Reddit, users need not display their names or any identifying information. On other platforms (e.g., Facebook), messages are linked to accounts with the user's account name and photo displayed. Still other platforms (e.g., Instagram or World of Warcraft) do not necessarily display a name but are easily identifiable through searches or platform recordkeeping. Platforms can also have some identity-displaying requirements but allow the use of supplemental apps that are completely anonymous. The gaming, blockchain, and financial technology platform YOLO is an example of the latter hybrid-anonymous communication.

On a related note, *public or private communication* is an important feature of social media. Some platforms are designed for private messages, either one-on-one or in groups (e.g., WhatsApp or Marco Polo). Other platforms may have the option to send direct messages or support private messages through a supplemental app as with Facebook messenger. Public communication, on the other hand, can involve discussion forums, as on Quora or Reddit, public feedback threads as on the fanfiction app Wattpad, and public comments.

The ability to display connections to other users or causes is a feature of many types of social media described as *affiliation*. Affiliation is commonly indicated through tags added to content (e.g., @, #). Some platforms, such as Twitter, also allow the forwarding or reposting of other

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users' content on one's own account. Through affiliation and reposting users can indicate their like or dislike of other users' content, something that is also made visible through like tallies and comments.

The extent to which these comment tallies or other records of the social media experience remain accessible, known as *recordability* of content, is variable. Some user-created content disappears after being viewed, as on Snapchat, or after a short time, as in an Instagram story. Some platforms allow users to modify or delete posted content. Other platforms do not allow any editing of posted content. Nevertheless, because of screen capture, sharing, and reposting, most content is at least theoretically recordable.

All social media platforms enable some way to tailor a profile to a user's personal requirements. *Individualization* can include aspects of the users' display such as the design of the appearance of the profile (e.g., Instagram) or play space (e.g., Minecraft) or types of curated content (e.g., Pinterest). Some platforms have questions that create the profile structure (e.g., Tinder or Yubo). On some apps, the user personalizes a username and a description of self, or avatar, sometimes including the appearance of the avatar, as on the videogame League of Legends.

Recommendations are social media affordances that can connect users with interesting content or with people who may share similar interests. Recommendations can be presented in a way to encourage extending the time spent on the platform. For example, most platforms have a default user setting to enable notifications, meaning users are notified every time they have a new message or new content in their feeds. Such settings encourage the user to return to platforms they were not otherwise using and to open messages, review who has engaged with their content, and spend more time on the platform. Some platforms embed recommendations in user feeds. Others have recommended content play automatically. Recommended content can appear endlessly. Some platforms present new material using an infinite scroll. Social media companies can also recommend advertisements or add-on purchases in a banner on the top of the screen or embedded in feeds; they may enable automatically played videos. All these features (recommending content, autoplay, infinite scroll, banners, and push notifications) are part of persuasive design, tools to capture users' attention and time to the financial benefit of the companies.

PLATFORM OPERATIONS

Many of the affordances described in the previous section are powered by computational algorithms (others, such as the ability to leave comments on a video or chat with a fellow gamer are the result of platform design decisions). An algorithm is a set of instructions or a series of

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steps that a computer or program follows in order to solve a problem or perform a specific task. On social media platforms, algorithms are evaluated based on their efficiency, accuracy, and complexity. The *efficiency* of an algorithm refers to how quickly it can perform the desired task considering the resources used. *Accuracy*, in contrast, refers to how well an algorithm can achieve the desired outcome. Both accuracy and efficiency are evaluated relative to a particular platform. An algorithm's *complexity*, referring to how difficult the algorithm is to understand and implement, is another important feature. Most algorithms employed by today's platforms are incredibly complex, with a simple video recommendation depending a million lines of code (Computerphile, 2014; Murthy, 2021).

Algorithms rely on information platforms to collect information about their users' actions and behaviors. Algorithms can reveal patterns in the copious amounts of data that internet use generates, even the passively collected "data exhaust" of no obvious value to the platform (George et al., 2014). Information about when and how people search the internet, what they shop for, and who they interact with can be valuable to platforms when taken on aggregate and combined with other information (George et al., 2014).

Given concern about potential negative consequences, researchers have started to evaluate algorithms' bias and transparency. Definitions of these concepts evolve over time and vary across disciplines (Jacobs and Wallach, 2021; Mulligan et al., 2019). Bias can refer to many different concepts. In this report, the term is primarily focused on algorithmic fairness or lack thereof. Even with that narrowed scope, there are various interpretations that consider the effects of algorithmic decisions on disparities of outcomes across groups (e.g., similar exposure to health-promoting content across races) or limit the use of group characteristics in decision making (e.g., platform decision to serve a piece of content being independent from race). Recent scholarship also highlights the importance of accounting for justice (Arneson, 2018; Jacobs and Wallach, 2021). Accountability becomes relevant when someone harmed by algorithmic decision making seeks redress. Finally, transparency, while still a contested concept, generally refers to the factors underlying algorithmic decisions being open to the relevant stakeholders (Mulligan et al., 2019).

The algorithms' technical sophistication points to the explicit purposes that the creators of social media tools have in mind; this purpose varies across platforms. Today, algorithms are being used to manage, curate, and moderate content that people see online. This section describes how these algorithms work and power the affordances and features described in the previous sections.

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Platform Algorithms

Social media platforms use a variety of algorithms to manage content that users see. These algorithms are often proprietary and use a variety of machine learning and artificial intelligence (AI) techniques to determine which content to show to users and to develop a platform's unique niche. Their goal is to maximize engagement and, for many platforms, keep users on them for as long as possible. Platforms' efforts to curate the content users see are advanced by four main types of tools: algorithms for making recommendations, algorithms for ranking, algorithms for targeting advertising, and algorithms that moderate what content a user sees in their feed.

Recommendation Algorithms

Social media platforms collect a vast amount of data on their users, including their browsing history, search queries, interests, and social connections. They use these data to create user profiles and to make personalized recommendations. Companies can also infer characteristics of a user based on information about that person's social connections or people to whom they are otherwise similar (Davison et al., 2010; Mislove et al., 2010). A collaborative filtering algorithm looks at the user's behavior, such as which posts were liked or shared, and then recommends similar content.

Broadly speaking, recommendation algorithms are geared to help users discover new content on and off the platform including people to follow, things to buy, etc. Platforms also harness the information in a user's images, posts, and videos with algorithms analyzing the material to determine its meaning and then make recommendations based on the user's interests and preferences. On top of that, many platforms provide summaries of what is currently being discussed, which serve as measures of the pulse of the crowd. This material is provided by algorithms that detect trending topics. These algorithms look at spikes in particular emergent topics present in users' posts and recommend content related to those topics. Most recommendation algorithms also account for engagement with a post, as indicated by its number of likes, shares, and comments. Posts with high engagement are more likely to be recommended. Finally, these algorithms also consider timeliness, such as how recent the post was and how long it has been since the user last logged in. Recent posts and posts from accounts with which the user engages frequently are more likely to be recommended to others.

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Ranking Algorithms

Content ranking and sorting algorithms are used to determine the order in which content is displayed to users. The idea is to provide users with a personalized and engaging experience by showing them the most relevant and high-quality content first. These algorithms aim to balance the interests of the user with the interests of the platform while also promoting engagement and user satisfaction. A common strategy considers measures of how relevant the content is to the user's interests and behavior. For example, if a user frequently engages with posts about cats—or, more relevant to this discussion, about eating disorders—the algorithm may prioritize posts about those topics in their feed. Measures of engagement can be subtle; even the amount of time a user lingers over content can influence ranking algorithms.

Ranking algorithms may prioritize content based on relevance; relevance can in turn be inferred from user activities. Social connections influence estimates of relevance. For example, algorithms generally give more weight to content from friends and family members. Measures of engagement with a post (e.g., the number of likes and shares) can also influence its rank with posts with high engagement being more likely to be ranked higher and displayed to more users. Ranking algorithms also consider the recency of the items to be sorted, giving more weight to newer posts, as users are more likely to engage with fresh content. Quality of the content is also considered in deriving ranking positions, with the posts' originality, credibility, and tone playing a role. Some platforms (e.g., Facebook) have also experimented with showing users a diverse range of content, by providing them an option for an all-encompassing reverse chronological ordering view of content (called feeds on Facebook). The idea behind such affordances has been to support opportunities to diversify from topics that align with and are reinforced by user preferences, avoiding overreliance on a single topic or source (Mahapatra, 2020; TikTok, 2021).

Recommendation and ranking algorithms may work hand in hand to determine how content is displayed in a user's feed. Platforms may first identify what types or pieces of content are the most suitable for a particular user's feed at a point in time, and then use some objective measures of relevance or engagement to rank them. At times, ranked content could be interwoven with advertised content if the advertisements are consistent with the user's interests and past activities. The latter is again triggered by a set of different algorithms called ad-targeting algorithms.

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Ad-Targeting Algorithms

In addition to targeting particular content, social media algorithms also use information about users to target advertising. Most social media platforms are free to use, although some, such as Roblox, LinkedIn, Hinge, and Twitter, offer premium versions for a subscription fee. In general, social media companies rely on advertising revenue and therefore have highly sophisticated ad-targeting algorithms. These algorithms can use contextual or behavioral cues to create targeted, personalized advertising campaigns, determining which users should see which ads. The goal of these algorithms is to show ads to users who are most likely to be interested in them to increase the effectiveness of their advertisers' investment.

Social media platforms have rich information about their users: browsing history, search queries, interests, and social connections as well as basic demographic information such as age, gender, and occupation. Ad targeting algorithms use all this information to create personalized profiles behind the scenes, often opaque to the end user. Contextual information on where the ad is displayed is also considered to ensure the relevance of posted advertisements.

Ad-targeting can also incorporate an element of collaborative filtering. Some algorithms target users who are demographically or behaviorally similar to existing customers or followers (an approach known as lookalike targeting). Some platforms also allow advertisers to upload their customer lists or create custom audiences based on specific criteria, such as people who have visited their website or interacted with their social media pages.

Content Moderation Algorithms

Most social media platforms have content moderation policies that aim to protect their users from harmful or offensive content. Determining what constitutes harmful content depends on the company's policies, outlined in its terms of service. Typical examples include hate speech, nudity, violence, and spam. While content moderation is a feature of all media, and has always been, content moderation for social media is substantially more complex given the rapid and high volume of information available to social media users. As such, approaches to moderation have grown and evolved rapidly with the companies that implement them. Today's approaches may bear little resemblance even to previous policies of the same company. Online bulletin boards, for example, were once carefully managed by dedicated administrators who were an integral part of the community, a model still central to platforms such as Reddit. Nevertheless, the volume of content moderation required on large platforms relies

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increasingly on contract workers or firms to remove disturbing and illegal content from the site (Roberts, 2016).

Discerning what content is offensive or vulgar is necessarily a judgment call. Impressions of a vulgar level of nudity, for example, are highly dependent on local cultural norms, posing challenges for multinational companies. This dilemma led TikTok, for example, to issue separate content moderation guidance for more and less socially conservative countries, although journalistic research has found that the platform's decisions often far overreach accepted norms, particularly in the censoring of depictions of homosexuality (Hern, 2019). The same researchers found the platform to be strangely permissive in other decisions, taking "the unusual approach of erring on the side of risk when it came to sexualized content featuring children" (Hern, 2019).

TikTok's inconsistent approach to content moderation is one of many incidents that have drawn public attention to content moderation. The 2016 U.S. presidential election, in which social media played an influential part, was another (Caplan et al., 2018; Edelman, 2020; McSherry, 2020). The importance of effective moderation policies is now a prominent part of companies internal and external policy debates. Platforms may selectively reduce the prominence of content from users who, while not explicitly violating the platforms' terms, are sufficiently offensive or misleading as to border on a violation (Gillespie, 2022).

Academic researchers are increasingly aware of the shortcomings that exist in the way platforms are managed (Gorwa, 2019). Platforms generally use a combination of artificial intelligence and human staff to enforce content moderation policies. Many platforms encourage users to report offensive or harmful content in an effort to improve the efficiency of their moderation efforts. Some violations can be detected with automated methods; for example, the presence of certain keywords for example can indicate likely hate speech, and automated tools can analyze the content of images, videos, or text. The analysis of metadata, information such as where, how, and by whom a post was created, can also inform an algorithm's assessment of whether content violates a platform's terms of service. Moderation algorithms often use a variety of techniques in combination, including machine learning, natural language processing, and computer vision, but specific moderation strategies vary. Box 2-1 lists examples of how some well-known social media platforms moderate content.

While each platform has its own proprietary and often unique moderation strategy, there have been some collective efforts to standardize the process. The Global Internet Forum to Counter Terrorism (GIFCT) is one prominent example of such standardization. The forum started as a coalition of technology companies working together to deprive terrorists of the

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BOX 2-1
Overview of Prominent Social Media Platforms' Posted Content Moderation Policies

Facebook uses technology and human reviewers to assess content that may violate its community standards. Artificial intelligence (AI) and machine learning tools are used to scan posts for images and phrases to identify violating content before it appears on any news feed, while human reviewers are assigned to evaluate content that has been reported by users. Human reviewers with subject matter and language expertise are also assigned to evaluate content that may require more context or nuance, which may not be distinguishable by AI.

Instagram, owned by the same parent company as Facebook, also uses machine learning algorithms to identify and remove content that violates its community guidelines. If necessary, the AI sends content to human moderators to examine the posts more closely, as Facebook does. The algorithm scans for specific keywords and phrases that are associated with prohibited content, such as nudity or hate speech. The algorithm also considers the context of the post, such as the caption and hashtags used in an attempt to identify actual violations of guidelines.

TikTok also uses AI to automatically review all videos, including images, titles, descriptions, and audio. The AI will automatically remove material that clearly violates community guidelines. Human moderators review material that has been flagged by AI as well as content reported by users.

Twitter uses a combination of automated and human moderation to identify content that violates its rules, although the threshold for violation may be higher than on other platforms, as the platform has a policy of not screening and removing content on the grounds that it is offensive alone. Twitter may be moving to a process where major decisions such as account closures are approved by a council of human moderators.

YouTube uses machine learning and teams of human moderators who review flagged content and remove videos that violate its community guidelines. It also relies on its users and "Trusted Flaggers" to report potentially problematic content. YouTube also uses another automated system, called Content ID, to detect and remove copyrighted material.

SOURCE: Espinoza et al., 2023; Guardian Staff and Agencies, 2022; Instagram, 2023a; Meta, 2023a; TikTok, 2023a; Twitter, 2023; YouTube, 2023a, 2023b.

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amplifying value of social media. Industry commitment to collaboration was at the root of its involvement in the GIFCT (Huszti-Orban, 2018).

GIFCT working groups have explored strategies for optimal content moderation, advocating the use of artificial intelligence and algorithms that use machine learning to identify and remove terrorist content before it is widely viewed (GIFCT, 2021b). Sharing of perceptual hashes, "representation[s] of original content that cannot be reverse-engineered to recreate the content," is one strategy GIFCT promotes (GIFCT, 2023). Through hash sharing, member companies can quickly inform colleagues at other companies in the forum of potential terrorist content without sharing user data. GIFCT also gives some attention to support for smaller companies for whom the cost of compliance with content moderation, especially policies that rely on human moderators, might be prohibitive (GIFCT, 2021a).

Response to GIFCT's work, from member companies and press, has been generally positive (Criddle, 2023; Hadavas, 2020; Microsoft, 2017). After public concern that Facebook had been used to incite violence against the Rohingya minority population in Myanmar, the company improved its detection algorithm for hate speech in the local language (Stecklow, 2018; Stevenson, 2018). Unsurprisingly, training the algorithm to understand objectionable terms has led to a dramatic increase in the removal of terrorist content on major platforms (Gorwa et al., 2020). Facebook reports that 99 percent of content from ISIS and Al Qaeda is detected before anyone flags it; YouTube reports removing 98 percent of violent extremist content (GIFCT, 2019). Yet meaningful interpretation of such claims is difficult. The percentage of content found to be in violation of policy and removed can only be a subset of all the violating content that exists. Regardless of how close to perfect a moderation system is, its success depends largely on the accurate identification of the most harmful content, with room for error only in the margins. Such qualitative evaluations of not just the content removed but its relative likelihood to cause harm depends on both objective measurement of harm and more complete data on content moderation and takedowns.

Distortions Associated with Algorithms

At the same time, no amount of computational sophistication can produce algorithms that cater perfectly to end users' needs, demands, and goals. As a 2022 White House briefing noted:

> Although tech platforms can help keep us connected, create a vibrant marketplace of ideas, and open up new opportunities for bringing products and services to market, they can also divide us and wreak serious real-world harms. (White House, 2022)

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Of particular concern to this report are the potential harms to young people. This section discusses some of the challenges that have emerged from the persistent and increasing reliance of social media platforms on algorithmic computation.

The Black Box Nature of Platform Algorithms

Part of opening a social media account is an invitation to authorize the platform to track data. For this, users have to accept these terms to make an account. But terms of service are widely, if not universally, ignored, prompting a recent article to describe the idea that users' endorse them as "the biggest lie on the internet" (Obar and Oeldorf-Hirsch, 2020).

Research indicates that while 79 percent of adults express concern about how companies use their personal data, only about 60 percent of adults report reading privacy policies even some of the time (Auxier et al., 2019). Endorsing terms of service, even if only officially, can absolve companies of responsibility for misuse of personal data. Terms of service sometimes stipulate account security measures, and users who do not take required measures may be more vulnerable to hacking or data breaches. What is more, platforms can terminate accounts over violations of terms of service (Instagram, 2023c; Meta, 2022; TikTok, 2023b). Given the complexity of most terms of service and the real challenges of information overload, there is concern that users today simply cannot make meaningful use of notice-and-consent terms, but it is difficult to say what a better system would look like (Turow et al., 2023).

Despite being central to the end user experience, the nature of social media platform algorithms makes them opaque to users. The information used in algorithmic input, how such information is processed, and how the user's experience is generated are rarely clear. There is also a problem of the inherent complexity of the process, a complexity that drives much uncertainty.

The use of black box algorithms by social media platforms to define and influence the user experience has been criticized for its biases and lack of transparency (Waddell, 2021). Technology companies, for their part, have been notoriously reluctant to share what they consider trade secret information with the public (Foss-Solbrekk, 2021; Waddell, 2021). Content moderation decisions, already subject to somewhat subjective interpretation of rules, are even less open when made by an algorithm (Gorwa et al., 2020). When certain viewpoints appear to be penalized or given special treatment, backlash will follow, as the process that underlies these important social and political decisions is somewhat opaque.

In her public testimony, Facebook whistleblower Frances Haugen described the company's interest in growth at the expense of safety argu-

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ing that the company made subjective, secretive decisions about what content its users should see because its harmful algorithms were in fact profitable (Haugen, 2021). Facebook denied this allegation, citing a $13 billion investment and 40,000 safety staff (Ryan and White, 2021). While neither Haugen's allegations nor the usefulness of the company's investment in safety can be objectively verified, the industry's reticence to authorize independent analysis of their algorithms contributes to a perception of malfeasance (Darcy, 2021; Mostert and Urbelis, 2021; Thune, 2021).

The proprietary and black box nature of platform algorithms can cause subtle harms to users. Even highly educated users are not fully aware of how social media algorithms work and how they affect their social connections. For example, if a user's close friend or family member's content is not showing up in their feed, they may assume that the person is intentionally ignoring them, when, in reality, the social media algorithm is responsible for the lack of visibility. Research indicates that many users do not realize how social media platforms are designed to show them content that is most likely to engage them and keep them on the platform, rather than providing a comprehensive view of the content their friends and family members are posting (Eslami et al., 2015). Feeds also tend to mix network content with advertisements, further confusing people's understanding of why something is in their feed.

Algorithmic audits by external parties have been suggested as a way to measure the extent of these harms, but such audits are difficult to implement partly because platform algorithms are constantly changing in ways that affect the curation and distribution of content. Some of these changes are merely annoying, as when a post disappears from a user's feed. Others are discriminatory: Facebook has allowed its advertisers to exclude whole racial, ethnic, and age groups from seeing ads (Angwin and Parris, 2016; Angwin et al., 2017). In some cases, the algorithmic influence on how ads are shown to users can conflict with the advertisers' goals (Ali et al., 2021; Sapiezynski, 2023).There may be bias in how ads are pushed to users even when the advertiser explicitly requested certain audiences (e.g., disproportionate views by male users when advertisers wanted an equal split of male and female viewers) (Ali et al., 2019).

It may not be possible or advisable to fully reverse engineer algorithmic systems powering today's social media sites, but there is reason to believe that some of an algorithm's harmful consequences could be identified through the use of so-called glass box analyses that identify the data and features driving the users' experience (Dobbrick et al., 2022). Algorithmic audits have turned out to be helpful in recent years to identify gender and racial biases in online systems and to understand misinformation online. Glass-box approaches, wherein platform designers create fea-

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Social Media and Adolescent Health

tures and scaffolds for third-party researchers and practitioners to study the intricacies of the underlying platform algorithms without having to know all possible proprietary details, can supplement these efforts.

While some scholars have advocated for glass-box analysis of social media platforms' algorithms, others have recognized that this would have several implications. First, a public-interest infrastructure to facilitate scrutiny of platforms and offer appropriate guidelines on how to redress problems would be needed. Such infrastructure would likely need to involve academia, government agencies, civil society groups, and user collectives, and be capable of conducting thorough examinations and addressing problems using means such as competitive pressures, the media, or legal action.

The Effect of Algorithmic Practices

Platform algorithms arguably play an important role in regulating what users see, seeking to keep them safe online. Algorithms do well at identifying certain types of clear and egregious violations. For example, child sexual abuse material, a universally reviled and illegal category of content, is relatively straightforward for companies to articulate and for automated moderation to detect (U.S. Congress, 2019). Other objectionable content, however, has more ambiguous boundaries, and algorithms have difficulty making precise determinations in the face of ambiguity (Duarte et al., 2017; Fishman, 2023). Self-harm content and hate speech, for instance, can be identified only through contextual interpretation. Developing tools that can accurately detect and remove this content is a significant challenge (Neumann, 2013).

Further, content moderation practices themselves have been met with skepticism among some scholars and internet activists. Chandrasekharan and colleagues found that Reddit's ban of certain racist and demeaning threads caused the people spreading them to either quit the platform or move on to other topics, vastly reducing their influence (Chandrasekharan et al., 2017). Similarly, investigations found that misinformation on election fraud and hate speech fell sharply after the January 2021 deplatforming of former president Donald Trump (Dwoskin and Timberg, 2021). But it is not always clear if such drops are the result of the most radical users simply taking their business to more obscure and poorly moderated forums. While such migration makes the work of content moderators on mainstream platforms easier, it poses a separate problem for society in that it removes the moderating influence of mainstream discourse from the lives of the people already on the margins, thereby contributing to their increased radicalization (Lanteri, 2022). The same pattern has

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been documented among users leaving Twitter for explicitly right-wing-friendly platforms such as Gab and Parler; Telegram serves a similar role for Islamic State militants (Ribeiro et al., 2021; Warrick, 2016). Playing out over many online platforms, such migration has led to the public questioning whether commitment to removing offensive content would "come at the expense of [creating] a more toxic and radical community" (Ribeiro et al., 2021).

There is ample reason to suspect that harmful information may be more likely to flourish on online platforms with fewer moderation measures in place. Obscure platforms can foster echo chambers as they attract users who share similar perspectives. Users who seek out these platforms through recommendations may be more receptive to the messages circulated on them. Research on online groups devoted to eating disorders indicates that such users will adapt their behavior to allow their objectionable content to escape detection, using strategies such as intentional misspelling and coding their language to avoid notice (Chancellor et al., 2017). In such circles, the content moderation algorithm can inadvertently perpetuate disordered norms and beliefs about diet. Ultimately, many of the key challenges to protecting young people's well-being online come back to trade-offs in dealing with subtle and complex content on topics such as self-harm.

The limited efficacy of platform algorithms and their potential to create distortions can give rise to recursive feedback loops for users. Although the algorithms' goal may be relatively innocuous, the manner in which the content is presented can be a source of harm (Kirdemir et al., 2021; Lee et al., 2022; Logrieco et al., 2021). An emphasis on maximizing user engagement, discussed later in this chapter, may be at the root of the problem, as algorithms sort content based on users' history, favoring the material to which users have responded in the past. The most sensational and provocative posts are often given the highest priority for this reason, exposing users to a narrow range of content that reinforces their existing beliefs and interests, encouraging recursive feedback loops.

Recursive feedback can, in turn, exacerbate problems with harmful content and misinformation. If a user shows interest in conspiracy theories, for example, then the algorithm may recommend more of the same content, creating the impression that such theories are more prominent than they actually are. This misperception lends a veneer of credibility to misinformation. Vaccine hesitancy is a prime example of the fallout of recursive feedback, but many quack health treatments have been promoted through the same path (Brugnoli et al., 2019; Dow et al., 2021; Robins-Early, 2022; Swire-Thompson and Lazer, 2020).

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The Implementation of Persuasive Algorithmic Design

As noted above, social media platforms are often designed to keep users engaged and coming back for more. While often beneficial, some of the design elements can shape users' perceptions of the world around them by limiting their exposure to diverse perspectives.

One of the key ways that social media platforms use design to influence user behavior is through notifications. Notifications are designed to grab attention and encourage users to take specific actions, such as opening an app or liking or commenting on a post. However, notifications can affect user behavior by prioritizing certain types of content or interactions over others (Altuwairiqi et al., 2019). For example, social media platforms may prioritize notifications for posts with high engagement, such as likes or comments, which can direct users' attention toward those posts and away from others that are equally or more important. At the same time, inadequate notification features may create apprehension or anxiety over missing an opportunity (i.e., fear of missing out) (Alutaybi et al., 2019).

Another design element that can shape behavior is infinite scrolling (Cara, 2019). Infinite scrolling allows users to move through their feeds without having to click a "next page" button, a feature that encourages users to spend more time on the platform. Infinite scroll also tends to prioritize the most popular content rather than providing a comprehensive view of network posts. Infinite scroll has the potential to keep people on a platform; it can also have the effect of overwhelming people who may miss out on important content that is buried deeper in their feed (Bhargava, 2023; Karagoel and Nathan-Roberts, 2021).

The algorithms that tailor the content users see in their feeds to their interests and preferences are also an obvious source of distortions. While personalization can create a sense of relevance and engagement, it can also create filter bubbles, thereby reinforcing echo chambers. Filter bubbles occur when users only see content that aligns with their preexisting beliefs and preferences, limiting their exposure to diverse perspectives and leading to a distorted sense of reality (Arguedas et al., 2022; Rhodes, 2022). Additionally, personalization can lead to privacy concerns, as social media platforms may collect and use personal data to create targeted content (Eg et al., 2023).

Gamification is another persuasive design element used in social media platforms. The ability to win badges or points or to be on leaderboards encourages more use of the platform (Bitrián et al., 2021). It can also encourage users to value certain types of interactions or behaviors over others. For example, social media platforms may reward users for engaging with popular or controversial content even if it is misleading or harmful (Alizadeh et al., 2023).

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Persuasive design can also manipulate social influence (Stibe and Oinas-Kukkonen, 2014; Wiafe et al., 2020). Social proof, for example, refers to the influence of others on a person's attitudes or behaviors (Das et al., 2014). Design features that display the number of likes, shares, or followers that a user has can create a sense of pressure or conformity around certain types of content or interactions (Sanak-Kosmowska, 2021). A high count of likes or re-posts can create a social pressure to continue the re-sharing of content (Hartmann et al., 2021; Richler, 2023).

Most people's lack awareness of the extent to which their personal data drive operational algorithms may be the result of a long-held emphasis in computing on seamless design, that is, a system where the operations of a technology are invisible to the user (Inman and Ribes, 2019). An emerging emphasis on the opposite, platform design that makes the complexity and ambiguity of the technology clearer, is gaining traction as a way to make users aware of their influence on a platform's operations (Inman and Ribes, 2019). This so-called "seamful" design aims to convey the logic influencing the mix of human and algorithmic involvement in the content shown to users.

ADOLESCENTS AND SOCIAL MEDIA

Teenagers are often early adapters to social media platforms; spikes and drops in platform popularity among young people are crucially important to social media companies (Frenkel et al., 2021). They are also active users of the technology: A recent nationally representative survey found that 95 percent of teenagers have a smart phone, a 22 percentage point increase over the last 8 years (Vogels et al., 2022). The use of smartphones tends to start early in adolescence, over 40 percent of children aged 8 to 12 have a smartphone; 18 percent of children in this age group report using social media every day (Rideout et al., 2021).

The relative popularity of different social media platforms among teenagers can shift rapidly. The most popular platform today, the video sharing cite YouTube, is used by 95 percent of teens every day (Vogels et al., 2022). More than a third of teenagers say they use a social media platform "almost constantly" with YouTube again being most often named (see Figure 2-1) (Vogels et al., 2022).

Pew researchers found Black and Hispanic teens may use online media more than their White peers; more than half of Black and Hispanic teens and 37 percent of White teens report being online "almost constantly" (Vogels et al., 2022). In the same way, girls appear to use modestly more online media than boys, and teens over age 15 more often engaged in constant use than younger teens (see Figure 2-2). On the whole, 55 per-

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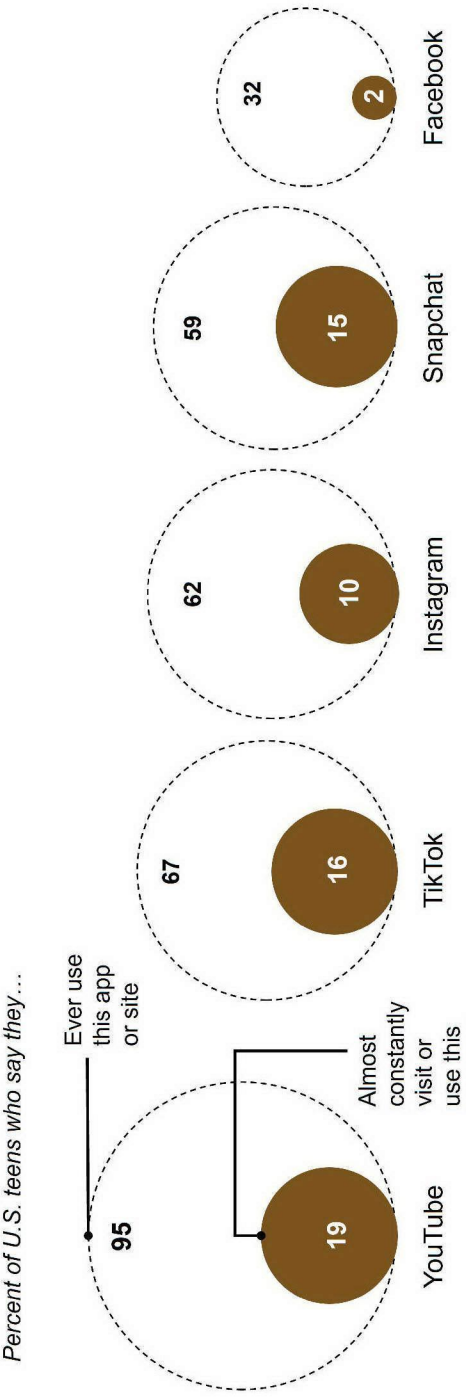


FIGURE 2-1 Percentage of U.S. teens who say they "ever use this app or site" or "almost constantly use this app or site."
SOURCE: Vogels et al., 2022.
NOTE: Teens refer to those ages 13 to 17. Those who did not give an answer or gave other responses are not shown.

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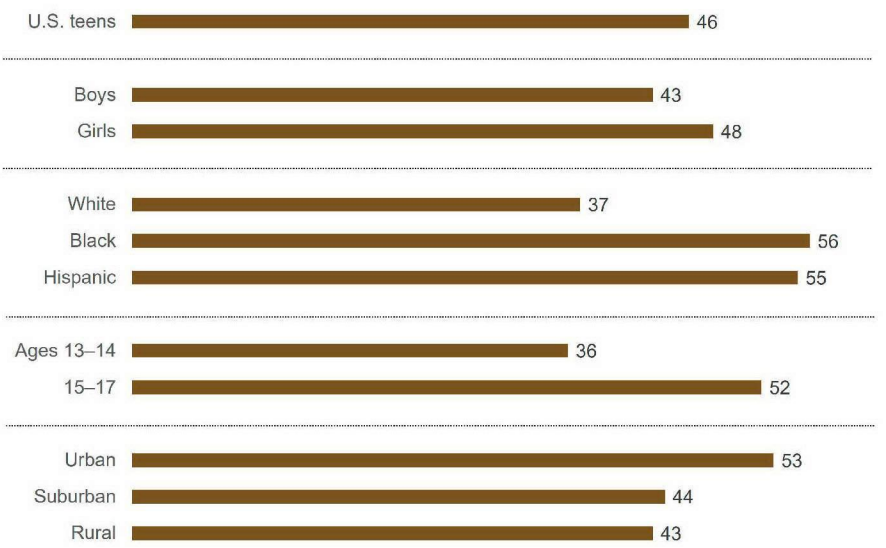


FIGURE 2-2 Percentage of U.S. teens who say they use the internet almost constantly either on a computer or a cellphone.
SOURCE: Vogels et al., 2022.
NOTE: Teens refer to those ages 13 to 17. White and Black teens include those who report being only one race and are not Hispanic. Hispanic teens are of any race. Those who did not give an answer or gave other responses are not shown.

cent of teens said the time they spend on social media is about right, only 8 percent thought they were on social media too little; the rest thought their time spent was too much (Vogels et al., 2022).

The Adolescent Experience Interacts with Platform Affordances

Adolescence is a time of tremendous cognitive, social, emotional and physical change. These changes involve both opportunity for maturation and vulnerability to environmental stressors (NASEM, 2019). There is a mismatch in the timing of maturation in different brain systems and the ability of these systems to communicate (Dahl, 2004; Giedd et al., 2015). Early in adolescence, the start of puberty initiates dramatic changes in the brain's limbic system that regulates emotions, moods, feelings of reward, and social needs. In contrast, the brain's prefrontal cortex, which is critical for carrying out functions such as decision making and regulating emo-

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tions, takes longer to develop and fully mature. This developmental mismatch can leave adolescents with less mature controls for making good judgments and regulating emotions and impulses, especially when emotions are high, and peers are around. Thus, the underlying maturational processes that operate during this stage of development are the very ones that can render adolescents more vulnerable, relative to younger children or adults, to social media affordances.

The brain undergoes profound development from adolescence into early adulthood (Guyer et al., 2023). Three key features of adolescent brain development are especially relevant to a discussion of social media affordances. One is a heightened sensitivity to rewards as well as dynamic changes in the function of the dopaminergic system (Silverman et al., 2015; Spear, 2011; Wahlstrom et al., 2010). The second is protracted maturation of brain networks that support cognitive control (Giedd et al., 2015). The third is neural sensitivity to specific types of social information (Nelson et al., 2016).

Beyond physical changes, in the second decade of life, youth refine their identity, assert their autonomy, build intimate relationships with peers and romantic partners, and begin to take on adult roles and responsibilities. These maturational processes specific to adolescence can also interact with social media in ways that are both similar to, and different from, younger children and adults.

Platforms are designed to keep users engaged, a feature sometimes described as stickiness. Stickiness is typically realized through the persuasive design features described earlier in this chapter. For adolescents, ongoing brain development and a heightened sensitivity to rewards coupled with still developing cognitive control make it difficult to disengage despite their best intentions and even knowledge about the consequences. When faced with content that is increasingly interesting and emotionally exciting, as pushed content may be, the task of getting offline is more difficult; the adolescent brain is particularly susceptible to highly emotional or arousing contexts (Guyer et al., 2016). A strong desire for social connectedness may lead adolescents to have relaxed privacy settings or a willingness to connect with strangers and a strong need to check accounts for feedback from peers, such as likes and comments, given the reinforcing potential for a social reward that engages dopamine-producing brain regions (Nelson et al., 2016; Sherman et al., 2018). For the same reason, notifications about new messages or comments on platforms are challenging for youth to ignore when doing homework or trying to sleep (Kidron et al., 2018).

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Neurobiological Maturation

As children approach adolescence, their brains reach adult size, but they continue neurobiological maturation during the teen years into the mid to late twenties. Much of this maturation comes from the refinement and coordination of the brain's prefrontal cortex that leads to improved capacity for logic, planning, memory, and abstract thinking (van der Molen, 1994). In tandem, executive function—the higher order skills and cognitive processes that help youth regulate their time, attention, emotions, and impulses—continue to develop in adolescence but do not fully mature until the mid-twenties (Friedman and Miyake, 2017; Zelazo and Carlson, 2012). In general, cognitive skills and impulse control improve tremendously during this second decade, but the process is uneven and largely shaped by both pubertal changes and personal experience. For this reason, the problem-solving skills of a prepubescent 13-year-old is likely to be different than a 13-year-old who started puberty at age 9. Both age and timing of developmental milestones, such as puberty, can influence the experience of social media.

Changes in the prefrontal cortex during adolescence into young adulthood involve reduced gray matter volume caused by the pruning of unused connections. Pruning improves the transmission of neural signals, and myelination increases white matter volume to improve transmission of neural signals and strengthen connections between brain regions (Giedd et al., 2015; Mills et al., 2016). Constant engagement in social media in early adolescence may alter neural sensitivity to rewards and punishments (Maza et al., 2023).

Reflecting a developmental mismatch between drives and controls, brain systems for processing socioemotional incentives and exerting cognitive control both grow rapidly in adolescence but at different rates. Sensitivity to rewards increases from childhood through adolescence, peaking in the late teens and then declining (Braams et al., 2015; Silverman et al., 2015). Regulation of impulsive behavior, a function of cognitive control, develops more slowly. For this reason, adolescence is characterized by both increased enjoyment of risk-taking and a disinclination to limit it, making teens more likely to take greater risks, online and offline, than adults or children (Albert et al., 2013; Shulman et al., 2016; Steinberg, 2010).

Studies using functional magnetic resonance imaging (fMRI) have linked the use of social networking sites to brain adaptations in samples of adolescents and young adults (Wadsley and Ihssen, 2023). The brain's so-called reward circuit is involved in social media use, and especially in excessive or problematic use, as it is in other behavioral addictions, though it is hard to say if these changes are a cause or an effect of social

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media use (Wadsley and Ihssen, 2023). Recent fMRI studies have linked the use of social media in early adolescence with changes in the neural underpinnings for sensitivity to social feedback. Similar research suggests that multiple neural networks can be reconfigured in response to personalized video feeds in young adults (Su et al., 2021). While none of these studies can establish that social media use *causes* changes in the brain, the emerging literature suggests a potential interaction of social media stimuli and neurological development.

Social and Emotional Development

Increased neural maturity supports young people's ability to think not only about their mental state but that of others as well (Hall et al., 2021). An increased ability to consider other perspectives drives empathetic and prosocial behaviors as well as increased social comparison (Hollarek and Lee, 2022). Adolescents may give undue weight to other people's opinions, real or imagined, delivered explicitly or implicitly (Elkind and Bowen, 1979; Guyer et al., 2014; Pfeifer et al., 2009; Venticinque et al., 2021). This internalized, relational thinking can interact with social media affordances such as affiliation, content creation, and recordability, and might increase teenagers' vulnerability to violate platforms' terms of service or circumvent moderation policies (e.g., to maintain a clandestine identity).

Along with a better understanding of one's own and others' mental states, the developing adolescent is increasingly better at recognizing their own emotions and regulating emotional intensity (Silvers, 2022). While stabilizing with age, emotional intensity is influenced by hormonal changes and puberty (Guyer et al., 2016). The considerable variability in hormonal cycling can influence young people's moods and emotions, including their emotional response to stimuli such as social media (Buchanan et al., 1992). There are also important cultural differences in how emotions are expressed and the range of emotion considered acceptable to display (Kiel and Kalomiris, 2015). Emotional regulation plays a role in the expression of emotion online and the propensity to have negative emotional reactions; it is also central to basic coping and self-regulation (Blumberg et al., 2016; Gioia et al., 2021; Giordano et al., 2023; Greenwood and Long, 2009; Marino et al., 2020).

Developmental Needs of Adolescence

Milestones of adolescence, such as learning to drive, getting a job, helping to mind younger children, and having romantic relationships

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are markers of increasing freedom and responsibility. A desire for independence is intertwined with physical, mental, and sexual maturation of teens. It also makes digital spaces especially appealing, as young people can interact with others without the same parental oversight as their in-person interactions might draw. On social media, adolescents can select content, connections, and activities allowing platforms' curation algorithms to further tailor such content for them.

Development of identity is an important part of adolescence. Teens spend time exploring their thoughts, beliefs, and feelings, and thinking about how they signal these beliefs to others (Meeus et al., 1999). Social media features provide a myriad of ways to display oneself publicly and receive feedback on those displays, including a variety of configurations of social connections. Even using the same platform, youth might maintain multiple accounts with different connections and different presentations of self. Social media can also offer a window on different identities, potentially valuable for young people who do not have in-person role models of identity, such as members of sexual and gender minorities.

The importance of peers for teens also relates to their identity development. Young people choose friends with shared interests, experiences, or traits and may become more like their peers over time (Brechwald and Prinstein, 2011). Teens typically spend more waking hours with their peers, both online and offline, than with their parents and often give more attention to markers of their peer affiliations (e.g., clothing style, walking close together). The selection and socialization aspects of peer relationships can be seen in both face-to-face and digital interactions (Brechwald and Prinstein, 2011; McPherson et al., 2001).

Sexual maturation is a significant milestone of adolescence, and this can involve opportunities for emotional and physical intimacy with others (Suleiman et al., 2017). Many aspects of romantic relations are similar to friendship, with feelings of closeness, support, and biochemical rewards (Furman and Shomaker, 2008; Yau and Reich, 2018). Adolescents seek information about sex and sexuality from various sources, including media (DeLamater and Friedrich, 2002). With the advent of social media, youth can now find sexual content, information about sexuality, and romantic and sexual partners online.

THE SOCIAL MEDIA BUSINESS MODEL

The affordances that various platforms offer influence users' experiences with social media. Choices as to how to deploy different affordances are influenced in turn by the platforms' business models, which in the case of social media are typically classified as organic, earned, or paid.

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Organic media, sometimes described as owned media, emphasize the importance of customers engaging with the brand. Users do not pay for organic media; the company bears the cost of the staff and salaries needed to support them. Similarly, earned media refers to the free publicity a brand or company may receive from uncompensated customers who are motivated to create word-of-mouth promotion or buzz, sometimes captured and amplified on social media. Paid media, by far the most prevalent form, refers to traditional advertising where businesses pay the platform to position advertisements (Lovett and Staelin, 2016). Meta for example, the parent company of Facebook, Instagram, and WhatsApp, makes an estimated 98 percent of its revenue from advertising (Allyn, 2022). The value of advertising is determined by traffic to the website and users' responsiveness to the ads, typically quantified by measures of engagement (e.g., number of clicks, time spent on the site).

Sometimes paid advertising is obvious, as when a video streaming service shows commercials. Other examples are less clear. It is not always easy to distinguish paid content from that which users' produce. Sponsored content refers to material developed by social media users or influencers under contract with a company, such as unboxing videos or product testimonials, for example (Radesky et al., 2020). Sponsored content can be difficult to identify. While children older than age seven gradually develop an understanding of the persuasive intent of advertising, including commercials, sponsored content and influencer marketing (e.g., toy reviews, toy play videos) are much harder for them to resist (Radesky et al., 2020). What is more, social media influencers are often entertaining, blurring the line between commercial and noncommercial content (Balaban et al., 2022). Among adolescents, understanding the persuasive intent of sponsored content does not necessarily trigger skepticism, especially among teens younger than 14 (van Reijmersdal and van Dam, 2020). Even after age 16, when intellectual sophistication regarding advertising is similar to adult levels, adolescents are still highly susceptible to influencers' sponsored content (Balaban et al., 2022).

Although paid advertising drives much of the business of social media, there are other revenue sources. Some platforms have subscription or a hybrid-subscription models, wherein the basic service is provided for no cost but additional features can be accessed for a fee (Kumar, 2014). Some apps and platforms also earn income though user purchases, such as in-game purchases in video games. Especially when games are free to download, game features and updates that encourage players to buy content can represent important parts of a company's business model (Hamari et al., 2017).

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Data Monetization

Underlying most advertising models online is the use of information about consumers (e.g., their preferences, behavior, and characteristics) for commercial purposes. Some companies buy and sell data about their customers, but the more common practice is to use the information generated by internet traffic in product development and management (Ofulue and Benyoucef, 2022). An iterative process of collecting information about customers, sometimes called business intelligence, is not a new practice, but the extent to which the internet facilitates it raises ethical questions about the balance of power between buyer and seller.

If social media users were obliged to pay directly to use platforms, the correlation between the firm's revenue and consumer's valuation of the product would be stronger than when revenue depends on advertising. There is evidence of a gulf between social media users' willingness to pay and a counter indicator of valuation called willingness to accept (referring to willingness to accept payment to stop using the platform) (Sunstein, 2020). A nationally representative survey found willingness to pay for Instagram to be a median of $5 a month, but the same participants would require, at the median, $100 a month to stop using the platform (Sunstein, 2020). The same pattern was observed across social media platforms (Facebook, Snapchat, Reddit, Twitter, WhatsApp, YouTube). Such gaps reflect that people value social media but are unwilling to transfer cash for it. Similar studies have shown that only 5 percent of app users make any in-app purchases, partly because users consider the apps to be properly free of charge and that in app sales are a form of unfair monetization (Salehudin and Alpert, 2022).

Data monetization allows consumers to pay for the apps and platforms they enjoy without transferring cash. The advertising revenue social media companies earn tends to track the time users' spend on their platform (Grover, 2022). Some research indicates that this business model would be difficult to change: even adult consumers have expressed reluctance to pay for social media (Holt and Morgeson, 2023). For adolescents, who could be expected to be more sensitive to fees, it is safe to assume willingness to pay would be even less.

Data monetization drives targeted advertising, a practice that can be both efficient and intrusive. Better information about customers allows advertisers to spend more efficiently, companies to develop better products, and consumers to be exposed to more relevant messages. Television advertising, for example, targets commercials based on relatively crude assumptions about the overlap between market and audience demographics. The promise of social media advertising is that it obviates this imprecision and better delivers to advertisers their desired customer base.

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The compromise for the users of social media platforms is that companies collect information in ways that remain opaque to most people, partly because the terms of service described earlier in this chapter are universally ignored or not understood. When third parties benefit from information about people's behavior and preferences—information collected and sold in circuitous or highly technical ways—there can be concerns about the ethics of the monetization practice (Fred, 2017).

Legal Constraints on Data and Privacy

Protection of users' privacy online is the subject of growing public interest (Klosowski, n.d.; Rahnama and Pentland, 2022; World Bank, 2019). Social media companies in particular have access to wellsprings of personal data about their users, information that they could use to discriminate against customers or manipulate them in sophisticated ways (Acemoglu, 2021). The use of data to target advertising or to sell to data brokers raises questions as to how much information about one's health, personal relationships, or work people would want to share and to what ends, to say nothing of related concerns with how safe such data may be from hackers. Because companies that amass these data do so to their financial advantage there are concerns that the largest companies have an unfair advantage over their smaller competitors based only on their access to data (Berner, 2021; Bose, 2019).

The Federal Trade Commission and COPPA

Authority over unfair and deceptive practices in commerce are the purview of the Federal Trade Commission (FTC, 2021). The agency has a heightened consumer protection responsibility to children, codified by the Children's Online Privacy Protection Act (COPPA), which seriously limits the amount of information online service providers can collect about children younger than 13 years old.[1]

A concern with the erosion of consumer privacy and companies' obligations to be open about their data collection practices motivated the FTC to provide a series of guidance documents on internet advertising and marketing (FTC, 2000, 2008, 2013). The agency has also issued an advance notice of proposed rulemaking on commercial surveillance and data security (FTC, 2022b).

A more recent process has turned attention to stealth marketing to children, misleading advertising through influencers, and microtargeting of consumers (FTC, 2022a). The agency has recently taken advantage of its

[1] Children's Online Privacy Protection Act, 15 U.S.C. § 6501-6505 (2021): 2182-2183.

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authority to require companies to provide written response to questions about their practices and management, with inquiries on deceptive marketing and data collection on social media (FTC, 2020, 2021, 2023). When the agency determines that companies have acted unlawfully, it can issue fines, as it did in 2019 when it required Google and its subsidiary YouTube to pay $170 million for data collection in violation of COPPA (FTC, 2019).

COPPA recognizes that young children lack the capacity to consent to terms of service that allow for online data collection. This problem led to statutory provisions that prohibit the tracking and collection of personal information from children younger than 13 years without a parent's explicit consent; under COPPA, parents can review and prevent further use of information that may already have been collected.[2] The act specifically disallows the enticing of personal disclosures for prizes or as part of a game and sharply restricts advertising directed to children.

But COPPA's legal protections do not extend to minors aged 13 and older. Proposed legislation aims to change this by extending COPPA protections through age 16.[3] Other legislative proposals aim to extend protections to all minors and would require platforms to report on "foreseeable risks of harm" their products pose.[4] State legislatures have also shown an increased interest in this topic. As Figure 2-3 shows, as of mid-2023 state legislatures across the country have passed comprehensive privacy laws, several of these included specific privacy protections for children (Blackwell, 2023).

Navigating Disparate Legal Provisions

The myriad of pending state and federal privacy laws share a common concern with giving people more control over the ways companies use their data (GDPR, 2023; Rahnama and Pentland, 2022). Questions about privacy can quickly become intertwined with larger concerns about social media affordances that encourage children and adolescents to spend more time on the platform—to companies' financial benefit and the possible detriment of the young person (Yu et al., 2018).

An interest in age-appropriate design, a topic discussed more in Chapter 5, has developed in response to the growing apprehension that companies' operations harm children and adolescents. For this reason, the California Age-Appropriate Design Code Act requires companies that provide online services for, or advertisements targeted to, anyone under

[2] *Children's Online Privacy Protection Rule*, 15 U.S.C. § 6502(b)(1)(B); 16 C.F.R § 312.6(a) (2013).

[3] *Children and Teens' Online Privacy Protection Act*, S. 1628, 117th Cong., 2nd sess. (2022).

[4] *Kid's Online Safety Act*, S. 3663, 117th Cong., 2nd sess. (2022).

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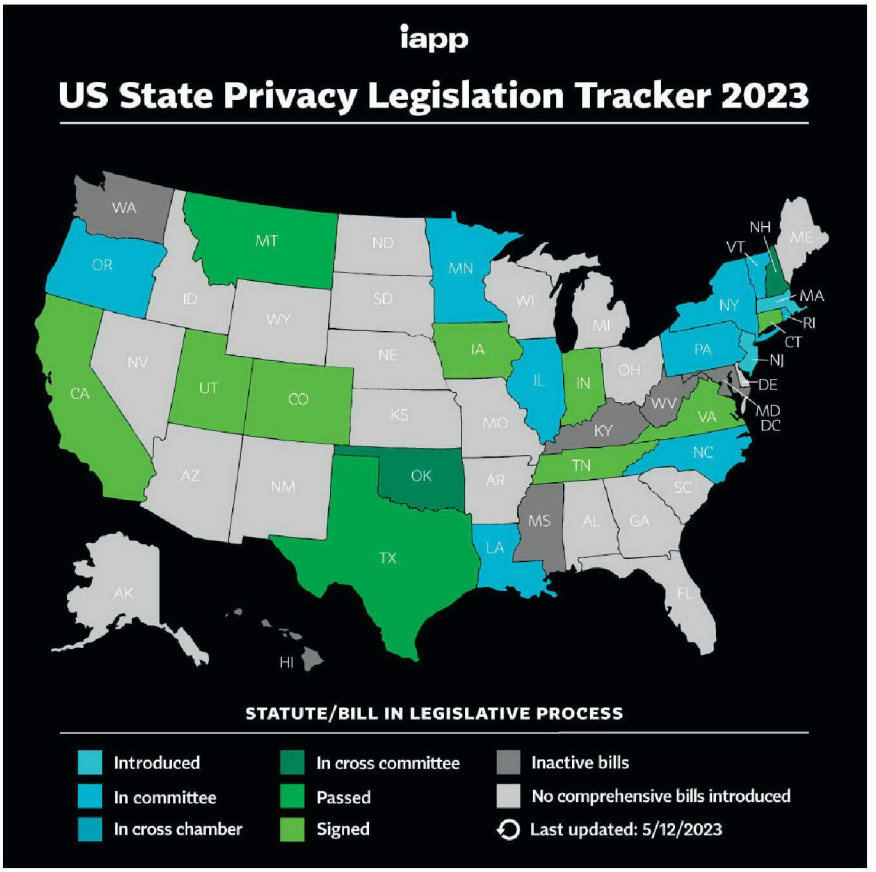


FIGURE 2-3 States privacy legislation as of mid-2023.
SOURCE: IAPP, 2023. This "US State Privacy Legislation Tracker," produced by the International Association of Privacy Professionals (IAPP) originally appeared in the IAPP Resource Center. It is reprinted with permission. It is updated regularly and this version is from May 12, 2023. Any modifications made for accessibility are not those of the IAPP.

age 18 to a more conservative standard of operations.[5] Age-appropriate design, discussed more in Chapter 5, generally shifts the onus of managing personal data from the young user to the tech company (Yu et al., 2018).

But for social media companies, which operate in different states and countries, complying with disparate laws presents logistical challenges. What is more, differences in regulations among states or countries are

[5] *California Age-Appropriate Design Code Act*, California Civil Code §§1798.99.28–1798.99.40.

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a reflection of widely varying social norms (Pfefferkorn, 2023). A recent Utah law that limits minors from using social media between 10:30 PM and 6:30 AM is seen by some as suitably protective of young people's physical and mental health and by others as an intrusive step to isolate them (The Associated Press, 2023; Wen, 2023). Content moderation decisions regarding what is indecent, incendiary, or uncivil, aside from being famously difficult to discern, are also necessarily value judgments that will strike some people as overly restrictive, biased, or unfair (Fagan, 2020). Recent court decisions have recognized constitutional limits on the government's ability to interfere with social media companies' editorial choices.[6]

The unique power of technology companies in general, and social media companies in particular, to influence people's experience of news, entertainment, and their social relationships is at the heart of some questioning the influence of the companies' products on their users, especially young users. Social media affordances and the way the platforms operate can have a unique influence on adolescents, an influence described in more detail in the next chapter.

REFERENCES

Acemoglu, D. 2021. *Harms of AI*. Department of Economics, Massachusetts Institute of Technology. https://economics.mit.edu/sites/default/files/publications/Harms%20of%20AI.pdf (accessed September 21, 2023).

Albert, D., J. Chein, and L. Steinberg. 2013. The teenage brain: Peer influences on adolescent decision making. *Current Directions in Psychological Science* 22:114-120.

Ali, M., P. Sapiezynski, M. Bogen, A. Korolova, A. Mislove, and A. Rieke. 2019. Discrimination through optimization: How Facebook's ad delivery can lead to biased outcomes. *Proceedings of the ACM Human–Computer Interaction.* 3(CSCW):Article 199.

Ali, M., P. Sapiezynski, A. Korolova, A. Mislove, and A. Rieke. 2021. *Ad delivery algorithms: The hidden arbiters of political messaging*. Paper presented at Proceedings of the 14th ACM International Conference on Web Search and Data Mining, Virtual Event, Israel.

Alizadeh, M., E. Hoes, and F. Gilardi. 2023. Tokenization of social media engagements increases the sharing of false (and other) news but penalization moderates it. *Scientific Reports* 13(1):13703.

Allyn, B. 2022. Meta announces another drop in revenue. https://www.npr.org/2022/10/27/1132042031/meta-announces-another-drop-in-revenue (accessed September 21, 2023).

Altuwairiqi, M., E. Arden-Close, E. Bolat, L. Renshaw-Vuillier, and R. Ali. 2019. *When people are problematically attached to social media: How would the design matter?* Paper read at IEEE International Conference on Systems, Man and Cybernetics, Bari, Italy..

[6] Murthy v. Missouri, No. 23-411 (U.S. Oct. 20, 2023) (mem), *Moody v. NetChoice, LLC*, No. 22-277 (U.S. Sept. 29, 2023) (mem.), *NetChoice, LLC v. Paxton*, No. 22-555 (U.S Sept. 29, 2023) (mem.)

Copyright National Academy of Sciences. All rights reserved.

Alutaybi, A., E. Arden-Close, J. McAlaney, A. Stefanidis, K. Phalp, and R. Ali. 2019. *How can social networks design trigger fear of missing out?* Paper presented at IEEE International Conference on Systems, Man and Cybernetics, Bari, Italy.

Angwin, J., and T. Parris. 2016. Facebook lets advertisers exclude users by race. *Propublica*. https://www.propublica.org/article/facebook-lets-advertisers-exclude-users-by-race (accessed September 21, 2023).

Angwin, J., A. Tobin, and M. Varner. 2017. Facebook (still) letting housing advertisers exclude users by race. *Propublica*. https://www.propublica.org/article/facebook-advertising-discrimination-housing-race-sex-national-origin (accessed September 21, 2023).

Arguedas, A., C. T. Robertson, R. Fletcher, and R. K. Neilsen. 2022. *Echo chambers, filter bubbles, and polarisation: A literature review.* Reuters Institute for the Study of Journalism. Reuters Institute. https://reutersinstitute.politics.ox.ac.uk/echo-chambers-filter-bubbles-and-polarisation-literature-review (accessed September 21, 2023).

Arneson, R. 2018. Four conceptions of equal opportunity. *The Economic Journal* 128(612): F152-F173.

Auxier, B., L. Rainie, M. Anderson, A. Perrin, M. Kumar, and E. Turner. 2019. Americans and privacy: Concerned, confused and feeling lack of control over their personal information. https://www.pewresearch.org/internet/2019/11/15/americans-and-privacy-concerned-confused-and-feeling-lack-of-control-over-their-personal-information (accessed September 21, 2023).

Balaban, D. C., M. Mucundorfeanu, and L. I. Mureșan. 2022. Adolescents' understanding of the model of sponsored content of social media influencer Instagram stories. *2022* 10(1):12.

Berner, M. 2021. Research backed consumer services could solve our two biggest problems with big tech. *Forbes*. https://www.forbes.com/sites/forbestechcouncil/2021/09/13/research-backed-consumer-services-could-solve-our-two-biggest-problems-with-big-tech/?sh=6c99e499323e (accessed December 26, 2023).

Bhargava, H. 2023. *Infinite scroll: Addiction by design in information platforms*. Paper read at Theory in Economics of Information Systems, March 31-April 2, San Francisco.

Bitrián, P., I. Buil, and S. Catalán. 2021. Enhancing user engagement: The role of gamification in mobile apps. *Journal of Business Research* 132:170-185.

Blumberg, F. C., J. L. Rice, and A. Dickmeis. 2016. Social media as a venue for emotion regulation among adolescents. In *Emotions, technology, and social media*, edited by S. Y. Tettegah. San Diego, CA: Elsevier Academic Press. Pp. 105-116.

Bose, N. 2019. House antitrust probe report likely by 'first part' of 2020. *Reuters*. https://www.reuters.com/article/us-tech-antitrust-idUSKBN1WX1WA (accessed December 26, 2023).

boyd, d. 2010. Social network sites as networked publics: Affordances, dynamics, and implications. In *A networked self: Identity, community, and culture on social network sites*. Z. Papacharissi (ed.). New York: Routledge. Pp. 39-58

Braams, B. R., A. C. K. van Duijvenoorde, J. S. Peper, and E. A. Crone. 2015. Longitudinal changes in adolescent risk-taking: A comprehensive study of neural responses to rewards, pubertal development, and risk-taking behavior. *Journal of Neuroscience* 35(18):7226-7238.

Brechwald, W. A., and M. J. Prinstein. 2011. Beyond homophily: A decade of advances in understanding peer influence processes. *Journal of Adolescent Research* 21(1):166-179.

Brugnoli, E., M. Cinelli, W. Quattrociocchi, and A. Scala. 2019. Recursive patterns in online echochambers. *Scientific Reports* 9(1):20118.

Buchanan, C. M., J. S. Eccles, and J. B. Becker. 1992. Are adolescents the victims of raging hormones: Evidence for activational effects of hormones on moods and behavior at adolescence. *Psychology Bulletin* 111(1):62-107.

Caplan, R., L. Hanson, and J. Donovan. 2018. *Dead reckoning: Navigating content moderation after "fake news"*. Data & Society Research Institute.

Copyright National Academy of Sciences. All rights reserved.

Social Media and Adolescent Health

Cara, C. 2019. Dark patterns in the media: A systematic review. *Network Intelligence Studies* 7(14).

Chancellor, S., Y. Kalantidis, J. A. Pater, M. D. Choudhury, and D. A. Shamma. 2017. *Multimodal classification of moderated online pro-eating disorder content*. Paper presented at Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems, Denver, Colorado, USA.

Chandrasekharan, E., U. Pavalanathan, A. Srinivasan, A. Glynn, J. Eisenstein, and E. Gilbert. 2017. You can't stay here: The efficacy of Reddit's 2015 ban examined through hate speech. *Proceedings of the ACM on Human-Computer Interaction* 1(CSCW):1-22.

Computerphile. 2014. YouTube's secret algorithm. https://www.youtube.com/watch?v=BsCeNCVb-d8 (accessed September 15, 2023).

Criddle, C. 2023. Google develops free terrorism moderation tool for smaller websites. *Financial Times*. https://www.ft.com/content/c2da6eb1-ba81-40c5-a411-dfc94ea280db (accessed January 12, 2023).

Dahl, R. E. 2004. Adolescent brain development: A period of vulnerabilities and opportunities. Keynote address. *Annals of the New York Academy of Sciences*. 1021:1-22.

Darcy, O. 2021. Social media algorithms to face scrutiny as lawmakers look to curb misinformation. *CNN Business*. https://www.cnn.com/2021/04/27/media/social-media-algorithms-reliable-sources/index.html (accessed September 21, 2023).

Das, S., A. D. I. Kramer, L. A. Dabbish, and J. I. Hong. 2014. *Increasing security sensitivity with social proof: A large-scale experimental confirmation*. Paper presented at Proceedings of the 2014 ACM SIGSAC Conference on Computer and Communications Security, Scottsdale, Arizona, USA.

Davison, B., T. Suel, N. Craswell, and B. Liu. 2010. *Proceedings of the Third International Conference of Web search and Web Data Mining, WSDM 2010*. New York, NY.

DeLamater, J., and W. N. Friedrich. 2002. Human sexual development. *Journal of Sex Research* 39:10-14.

Dobbrick, T., J. Jakob, C.-H. Chan, and H. Wessler. 2022. Enhancing theory-informed dictionary approaches with "glass-box" machine learning: The case of integrative complexity in social media comments. *Communication Methods and Measures* 16(4):303-320.

Dow, B. J., A. L. Johnson, C. S. Wang, J. Whitson, and T. Menon. 2021. The COVID-19 pandemic and the search for structure: Social media and conspiracy theories. *Social and Personality Psychology Compass* 15(9):e12636.

Duarte, N., E. Llanso, and A. Loup. 2017. *Mixed messages?: The limits of automated social media content analysis*. Center for Democracy & Technology. https://perma.cc/NC9B-HYKX (accessed September 21, 2023).

Dwoskin, E., and C. Timberg. 2021. Misinformation dropped dramatically the week after Twitter banned Trump and some allies. *The Washington Post*. https://www.washingtonpost.com/technology/2021/01/16/misinformation-trump-twitter (accessed September 21, 2023).

Edelman, G. 2020. Better than nothing: A look at content moderation in 2020. https://www.wired.com/story/content-moderation-2020-better-than-nothing (accessed September 21, 2023).

Eg, R., Ö. Demirkol Tønnesen, and M. K. Tennfjord. 2023. A scoping review of personalized user experiences on social media: The interplay between algorithms and human factors. *Computers in Human Behavior Reports* 9:100253.

Elkind, D., and R. Bowen. 1979. Imaginary audience behavior in children and adolescents. *Developmental Psychology* 15:38-44.

Eslami, M., A. Rickman, K. Vaccaro, A. Aleyasen, A. Vuong, K. Karahalios, K. Hamilton, and C. Sandvig. 2015. *"I always assumed that I wasn't really that close to [her]": Reasoning about invisible algorithms in news feeds*. Paper presented at Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems, Seoul, Republic of Korea.

Copyright National Academy of Sciences. All rights reserved.

Espinoza, J., C. Criddle, and H. Murphy. 2023. EU tells Elon Musk to hire more staff to moderate Twitter. *Ars Technica*. https://arstechnica.com/tech-policy/2023/03/eu-tells-elon-musk-to-hire-more-staff-to-moderate-twitter/#:~:text=Twitter%20currently%20uses%20a%20mix,which%20owns%20Facebook%20and%20Instagram (accessed September 21, 2023).

Evans, S. K., K. E. Pearce, J. Vitak, and J. W. Treem. 2017. Explicating affordances: A conceptual framework for understanding affordances in communication research. *Journal of Computer-Mediated Communication* 22(1):35-52.

Fagan, F. 2020. Optimal social media content moderation and platform immunities. *European Journal of Law and Economics* 50(3):437-449.

Fishman, B. 2023. *Dual-use regulation: Managing hate and terrorism online before and after Section 230 reform*. https://www.brookings.edu/research/dual-use-regulation-managing-hate-and-terrorism-online-before-and-after-section-230-reform (accessed September 21, 2023).

Foss-Solbrekk, K. 2021. Three routes to protecting AI systems and their algorithms under IP law: The good, the bad and the ugly. *Journal of Intellectual Property Law & Practice* 16(3):247-258.

Fred, J. 2017. *Data monetization – how an organization can generate revenue with data?* Tempere University of Technology. https://trepo.tuni.fi/bitstream/handle/123456789/24694/fred.pdf?%20sequence=4&isAllowed=y (accessed September 21, 2023).

Frenkel, S., R. Mac, and M. Isaac. 2021. Instagram struggles with fears of losing its 'pipeline': Young users. *The New York Times*. https://www.nytimes.com/2021/10/16/technology/instagram-teens.html (accessed December 27, 2023).

Friedman, N., and A. Miyake. 2017. Unity and diversity of executive functions: Individual differences as a window on cognitive structure. *Cortex* 86:186-204..

FTC (Federal Trade Commission). 2000. *Advertising and marketing on the internet: Rules of the road*. Bureau of Consumer Protection. https://www.ftc.gov/system/files/ftc_gov/pdf/bus28-rulesroad-2023_508.pdf (accessed December 27, 2023).

FTC. 2008. FTC approved new rule provision under the CAN-SPAM Act. https://www.ftc.gov/system/files/ftc_gov/pdf/bus28-rulesroad-2023_508.pdf (accessed December 27, 2023).

FTC. 2013. *.com disclosures: How to make effective disclosures in digital advertising*. https://www.ftc.gov/system/files/documents/plain-language/bus41-dot-com-disclosures-information-about-online-advertising.pdf (accessed December 27, 2023).

FTC. 2019. Google and YouTube will pay record $170 million for alleged violations of children's privacy law. https://www.ftc.gov/news-events/news/press-releases/2019/09/google-youtube-will-pay-record-170-million-alleged-violations-childrens-privacy-law (accessed September 21, 2023).

FTC. 2020. FTC issues orders to nine social media and video streaming services seeking data about how they collect, use, and present information. https://www.ftc.gov/news-events/news/press-releases/2020/12/ftc-issues-orders-nine-social-media-video-streaming-services-seeking-data-about-how-they-collect-use (accessed September 21, 2023).

FTC. 2021. A brief overview of the Federal Trade Commission's investigative, law enforcement, and rulemaking authority. https://www.ftc.gov/about-ftc/mission/enforcement-authority#top (accessed September 21, 2023).

FTC. 2022a. FTC proposes to strengthen advertising guidelines against fake and manipulated reviews. https://www.ftc.gov/news-events/news/press-releases/2023/06/federal-trade-commission-announces-proposed-rule-banning-fake-reviews-testimonials#:~:text=The%20Federal%20Trade%20Commission%20proposed%20a%20new%20rule,a%20product%20or%20service%20and%20undercut%20honest%20businesses (accessed December 27, 2023).

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Social Media and Adolescent Health

FTC. 2022b. Trade regulation rule on commercial surveillance and data security. *Federal Register* 87(August 22):51273-51299.

FTC. 2023. FTC issues orders to social media and video streaming platforms regarding efforts to address surge in advertising for fraudulent products and scams. https://www.ftc.gov/news-events/news/press-releases/2023/03/ftc-issues-orders-social-media-video-streaming-platforms-regarding-efforts-address-surge-advertising (accessed September 21, 2023).

Furman, W., and L. B. Shomaker. 2008. Patterns of interaction in adolescent romantic relationships: Distinct features and links to other close relationships. *Journal of Adolescence* 31(6):771-788.

GDPR (General Data Protection Regulation). 2023. *What is GDPR, the EU's new data protection law?* https://gdpr.eu/what-is-gdpr (accessed September 21, 2023).

George, G., M. Haas, and A. Pentland. 2014. Big data and management. *Academy of Management Journal* 57:321-326.

Giedd, J. N., A. Raznahan, A. Alexander-Bloch, E. Schmitt, N. Gogtay, and J. L. Rapoport. 2015. Child psychiatry branch of the National Institute of Mental Health longitudinal structural magnetic resonance imaging study of human brain development. *Neuropsychopharmacology* 40(1):43-49.

GIFCT (Global Internet Forum to Counter Terrorism). 2019. *About our mission*. https://perma.cc/44V5-554U (accessed September 21, 2023).

GIFCT. 2021a. *GIFCT Technical Approaches Working Group: Executive summary.* https://gifct.org/wp-content/uploads/2021/07/GIFCT-TAWG21-ExecSummary.pdf (accessed December 26, 2023).

GIFCT. 2021b. *Technical approaches working group: Gap analysis and recommendations for deploying technical solutions to tackle the terrorist use of the internet.* https://gifct.org/wp-content/uploads/2021/07/GIFCT-TAWG-2021.pdf (accessed December 26, 2023).

GIFCT. 2023. GIFCT's hash-sharing database. https://gifct.org/hsdb (accessed September 21, 2023).

Gillespie, T. 2022. Do not recommend? Reduction as a form of content moderation. *Social Media + Society* 8(3):20563051221117552.

Gioia, F., V. Rega, and V. Boursier. 2021. Problematic internet use and emotional dysregulation among young people: A literature review. *Clinical Neuropsychiatry: Journal of Treatment Evaluation* 18(1):41-54.

Giordano, A. L., M. K. Schmit, and J. McCall. 2023. Exploring adolescent social media and internet gaming addiction: The role of emotion regulation. *Journal of Addictions & Offender Counseling* 44(1):69-80.

Gorwa, R. 2019. The platform governance triangle: Conceptualising the informal regulation of online content. *Internet Policy Review* 8(2).

Gorwa, R., R. Binns, and C. Katzenbach. 2020. Algorithmic content moderation: Technical and political challenges in the automation of platform governance. *Big Data & Society* 7(1):2053951719897945.

Greenwood, D., and C. Long. 2009. Mood specific media use and emotion regulation: Patterns and individual differences. *Personality and Individual Differences* 46:616-621.

Grover, S. 2022. *Which ad revenue metrics should publishers track?* September 2. https://www.adpushup.com/blog/which-ad-revenue-metrics-should-publishers-track/#:~:text=One%20of%20the%20supreme%20ad,which%20content%20to%20improve%20on;%20https://doi.org/10.2202/1446-9022.1154 (accessed October 10, 2023).

Guardian Staff and Agencies. 2022. Elon Musk declares Twitter 'moderation council'—as some push the platform's limits. *The Guardian*. https://www.theguardian.com/technology/2022/oct/28/elon-musk-twitter-moderation-council-free-speech (accessed December 24, 2023).

Copyright National Academy of Sciences. All rights reserved.

Guyer, A. E., J. D. Caouette, C. C. Lee, and S. K. Ruiz. 2014. Will they like me? Adolescents' emotional responses to peer evaluation. *International Journal of Behavioral Development* 38(2):155-163.

Guyer, A. E., J. S. Silk, and E. E. Nelson. 2016. The neurobiology of the emotional adolescent: From the inside out. *Neuroscience & Biobehavioral Reviews* 70:74-85.

Guyer, A. E., S. J. Beard, and J. S. Venticinque. 2023. Brain development during adolescence and early adulthood. In *APA handbook of adolescent and young adult development*, APA Handbooks in Psychology®. Washington, DC, US: American Psychological Association. Pp. 21-37.

Hadavas, C. 2020. The future of free speech online may depend on this database. *Slate*. https://slate.com/technology/2020/08/gifct-content-moderation-free-speech-online.html (accessed December 24, 2023).

Hall, H. K., P. M. R. Millear, M. J. Summers, and B. Isbel. 2021. Longitudinal research on perspective taking in adolescence: A systematic review. *Adolescent Research Review* 6(2):125-150.

Hamari, J., K. Alha, S. Järvelä, J. M. Kivikangas, J. Koivisto, and J. Paavilainen. 2017. Why do players buy in-game content? An empirical study on concrete purchase motivations. *Computers in Human Behavior* 68:538-546.

Hartmann, P., P. Fernández, V. Apaolaza, M. Eisend, and C. D'Souza. 2021. Explaining viral CSR message propagation in social media: The role of normative influences. *Journal of Business Ethics* 173(2):365-385.

Haugen, F. 2021. Written testimony of Frances Haugen before the United States House of Representatives Committee on Energy and Commerce Subcommittee on Communications and Technology. https://docs.house.gov/meetings/IF/IF16/20211201/114268/HHRG-117-IF16-Wstate-HaugenF-20211201-U1.pdf (accessed September 21, 2023).

Hern, A. 2019. TikTok's local moderation guidelines ban pro-LGBT content. https://www.theguardian.com/technology/2019/sep/26/tiktoks-local-moderation-guidelines-ban-pro-lgbt-content (accessed September 21, 2023)

Hollarek, M., and N. Lee. 2022. Current understanding of developmental changes in adolescent perspective taking. *Current Opinion in Psychology* 45:101308.

Holt, G. T. M., and V. Morgeson. 2023. Research: How people feel about paying for social media. *Harvard Business Review*. https://hbr.org/2023/04/research-how-people-feel-about-paying-for-social-media (accessed October 3, 2023).

Husch Blackwell. 2023. A comprehensive resource for tracking U.S. state children's data privacy legislation. https://www.huschblackwell.com/2023-state-childrens-privacy-law-tracker (accessed September 21, 2023).

Huszti-Orban, K. 2018. *Internet intermediaries and counter-terrorism: Between self-regulation and outsourcing law enforcement*. NATO CCD COE Publications. https://ccdcoe.org/uploads/2018/10/Art-12-Internet-Intermediaries-and-Counter-Terrorism.-Between-Self-Regulation-and-Outsourcing-Law-Enforcement.pdf (accessed September 21, 2023).

IAPP (International Association of Privacy Professionals). 2023. *Statute/bill in legislative process*. Portsmouth, NH: IAPP.

Inman, S., and D. Ribes. 2019. *"Beautiful seams": Strategic revelations and concealments*. Paper presented at the 2019 CHI Conference on Human Factors in Computing Systems, Glasgow, Scotland, UK.

Instagram. 2023a. *Community guidelines*. https://help.instagram.com/477434105621119?helpref=faq_content (accessed September 21, 2023).

Instagram. 2023b. *How instagram uses artificial intelligence to moderate content*. https://help.instagram.com/423837189385631 (accessed September 21, 2023).

Instagram. 2023c. *Terms of use*. https://help.instagram.com/581066165581870/?helpref=uf_share (accessed September 21, 2023).

Copyright National Academy of Sciences. All rights reserved.

Social Media and Adolescent Health

Jacobs, A. Z., and H. Wallach. 2021. *Measurement and fairness*. Paper presented at Proceedings of the 2021 ACM Conference on Fairness, Accountability, and Transparency, Virtual Event, Canada.

Karagoel, I., and D. Nathan-Roberts. 2021. Dark patterns: Social media, gaming, and e-commerce. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting* 65:752-756.

Kidron, B., A. Evans, J. Afia, J. Adler, H. Bowden-Jones, L. Hackett, A. Juj, A. Przybylski, R. Angharad, and Y. Scot. 2018. Disrupted childhood: The cost of persuasive design. https://5rightsfoundation.com/static/5Rights-Disrupted-Childhood.pdf (accessed September 15, 2023).

Kiel, E., and A. Kalomiris. 2015. Current themes in understanding children's emotion regulation as developing from within the parent-child relationship. *Current Opinion in Psychology* 3:11-16.

Kirdemir, B., J. Kready, E. Mead, M. N. Hussain, and N. Agarwal. 2021. Examining video recommendation bias on YouTube. https://dl.acm.org/doi/abs/10.1007/978-3-030-80387-2_7 (accessed September 15, 2023).

Klosowski, T. n.d. How to protect your digital privacy. The Privacy Project. *The New York Times*. https://www.nytimes.com/guides/privacy-project/how-to-protect-your-digital-privacy (accessed September 21, 2023).

Kumar, V. 2014. Making "freemium" work. *Harvard Business Review* (May). https://hbr.org/2014/05/making-freemium-work (accessed September 21, 2023).

Lanteri, C. 2022. *Improving social media content moderation: An examination of the flow of online conspiracy theories across varying platform models and policies*. University of North Carolina. https://cdr.lib.unc.edu/concern/honors_theses/6h4413239 (accessed September 21, 2023).

Lee, A. Y., H. Mieczkowski, N. B. Ellison, and J. T. Hancock. 2022. The algorithmic crystal: Conceptualizing the self through algorithmic personalization on TikTok. *Proceedings of the ACM Human–Computer Interaction*. 6(CSCW2):Article 543.

Logrieco, G., M. R. Marchili, M. Roversi, and A. Villani. 2021. The paradox of TikTok anti-pro-anorexia videos: How social media can promote non-suicidal self-injury and anorexia. *International Journal of Environmental Research and Public Health* 18(3):1041.

Lovett, M. J., and R. Staelin. 2016. The role of paid, earned, and owned media in building entertainment brands: Reminding, informing, and enhancing enjoyment. *Marketing Science* 35(1):142-157.

Mahapatra, A. 2020. *On the value of diversified recommendations*. Meta. https://about.instagram.com/blog/engineering/on-the-value-of-diversified-recommendations (accessed September 21, 2023).

Marino, C., G. Gini, F. Angelini, A. Vieno, and M. M. Spada. 2020. Social norms and e-motions in problematic social media use among adolescents. *Addictive Behaviors Reports* 11.

Maza, M. T., K. A. Fox, S. J. Kwon, J. E. Flannery, K. A. Lindquist, M. J. Prinstein, and E. H. Telzer. 2023. Association of habitual checking behaviors on social media with longitudinal functional brain development. *JAMA Pediatrics* 177(2):160-167.

McPherson, M., L. Smith-Lovin, and J. M. Cook. 2001. Birds of a feather: Homophily in social networks. *Annual Review of Sociology* 27:415-444.

McSherry, C. 2020. Content moderation and the U.S. election: What to ask, what to demand. Electronic Frontier Foundation. https://www.eff.org/deeplinks/2020/10/content-moderation-and-us-election-what-ask-what-demand (accessed September 21, 2023).

Meeus, W., J. Iedema, M. Helsen, and W. Vollebergh. 1999. Patterns of adolescent identity development: Review of literature and longitudinal analysis. *Developmental Review* 19:419-461.

Meta. 2022. *Terms of service*. https://m.facebook.com/legal/terms (accessed September 21, 2023).

Copyright National Academy of Sciences. All rights reserved.

Meta. 2023a. *Detecting violations*. https://transparency.fb.com/enforcement/detecting-violations (accessed September 29, 2023).

Meta. 2023b. *How meta enforces its policies*. Meta. https://transparency.fb.com/enforcement (accessed September 21, 2023).

Microsoft. 2017. Facebook, Microsoft, Twitter and YouTube provide update on Global Internet Forum to Counter Terrorism. https://blogs.microsoft.com/on-the-issues/2017/12/04/facebook-microsoft-twitter-and-youtube-provide-update-on-global-internet-forum-to-counter-terrorism (accessed September 21, 2023).

Mills, K. L., A.-L. Goddings, M. M. Herting, R. Meuwese, S.-J. Blakemore, E. A. Crone, R. E. Dahl, B. Güroğlu, A. Raznahan, E. R. Sowell, and C. K. Tamnes. 2016. Structural brain development between childhood and adulthood: Convergence across four longitudinal samples. *NeuroImage* 141:273-281.

Mislove, A., B. Viswanath, K. P. Gummadi, and P. Druschel. 2010. *You are who you know: Inferring user profiles in online social networks*. Paper presented at the Third International Conference on Web Search and Data Mining. WSDM, February 4-6.

Mostert, F., and A. Urbelis. 2021. Social media platforms must abandon algorithmic secrecy. *Financial Times*. https://www.ft.com/content/39d69f80-5266-4e22-965f-efbc19d2e776 (accessed September 21, 2023).

Mulligan, D. K., J. A. Kroll, N. Kohli, and R. Y. Wong. 2019. This thing called fairness: Disciplinary confusion realizing a value in technology. *Proceedings of the ACM Human-Computing Interaction* 3(CSCW):Article 119.

Murthy, D. 2021. Evaluating platform accountability: Terrorist content on YouTube. *American Behavioral Scientist* 65(6):800-824.

NASEM (National Academies of Sciences, Engineering, and Medicine). 2019. *The promise of adolescence: Realizing opportunity for all youth*. Washington, DC: The National Academies Press. https://doi.org/10.17226/25388.

Nelson, E. E., J. M. Jarcho, and A. E. Guyer. 2016. Social re-orientation and brain development: An expanded and updated view. *Developmental Cognitive Neuroscience* 17:118-127.

Neumann, P. R. 2013. Options and strategies for countering online radicalization in the United States. *Studies in Conflict & Terrorism* 36(6):431-459.

Obar, J. A., and A. Oeldorf-Hirsch. 2020. The biggest lie on the internet: Ignoring the privacy policies and terms of service policies of social networking services. *Information, Communication & Society* 23(1):128-147.

Ofulue, J., and M. Benyoucef. 2022. Data monetization: Insights from a technology-enabled literature review and research agenda. *Management Review Quarterly*. https://doi.org/10.1007/s11301-022-00309-1.

Pfefferkorn, R. 2023. Prepared remarks on U.S. legal considerations for children's online safety policy. https://cyberlaw.stanford.edu/blog/2023/03/prepared-remarks-us-legal-considerations-childrens-online-safety-policy (accessed September 21, 2023).

Pfeifer, J. H., C. L. Masten, L. A. Borofsky, M. Dapretto, A. J. Fuligni, and M. D. Lieberman. 2009. Neural correlates of direct and reflected self-appraisals in adolescents and adults: When social perspective-taking informs self-perception. *Child Development* 80(4):1016-1038.

Radesky, J., Y. R. Chassiakos, N. Ameenuddin, D. Navsaria, Council on Communication and Media. 2020. Digital advertising to children. *Pediatrics* 146(1).

Rahnama, H., and A. Pentland. 2022. The new rules of data privacy. *Harvard Business Review*, https://hbr.org/2022/02/the-new-rules-of-data-privacy (accessed September 21, 2023).

Rhodes, S. C. 2022. Filter bubbles, echo chambers, and fake news: How social media conditions individuals to be less critical of political misinformation. *Political Communication* 39(1):1-22.

Copyright National Academy of Sciences. All rights reserved.

Ribeiro, M. H., S. Jhaver, S. Zannettou, J. Blackburn, G. Stringhini, E. D. Cristofaro, and R. West. 2021. Do platform migrations compromise content moderation? Evidence from r/The_Donald and r/Incels. *Proceedings of the ACM Human–Computer Interaction.* 5(CSCW2):Article 316.

Richler, J. 2023. Social pressure to share fake news. *Nature Reviews Psychology* 2(5):265.

Rideout, V., A. Peebles, S. Mann, and M. B. Robb. 2021. *The common sense census: Media use by tweens and teens.* San Francisco, CA: Common Sense.

Roberts, S. T. 2016. Commercial content moderation: Digital laborers' dirty work. In *The Intersectional Internet: Race, Sex, Class, and Culture Online*, edited by S. U. Noble and B. Tynes: Peter Lang Publishing.

Robins-Early, N. 2022. There's a reason thousands of people take quack cures for Covid. *The Guardian.* https://www.theguardian.com/commentisfree/2022/feb/17/quacks-cashed-in-world-quick-fix-covid-ivermectin-social-media-conspiracy-theories (accessed December 24, 2023).

Ryan, J., and A. White. 2021. Whistle-blower decries Facebook's 'free pass' for bad behavior. *Bloomberg.* https://www.bloomberg.com/news/articles/2021-10-05/facebook-insider-shows-morally-bankrupt-company-senators-say#xj4y7vzkg (accessed September 21, 2023).

Salehudin, I., and F. Alpert. 2022. To pay or not to pay: Understanding mobile game app users' unwillingness to pay for in-app purchases. *Journal of Research in Interactive Marketing* 16:633-647.

Sanak-Kosmowska, K. 2021. *Evaluating social media marketing: Social proof and online buyer behaviour.* London: Routledge. https://doi.org/10.4324/9781003128052.

Sapiezynski, P. 2023. Individual and societal effects of ad delivery algorithms. Paper presented at Assessment of the Impact of Social Media on the Health and Wellbeing of Children and Adolescents Meeting 2, Washington DC. February 6. https://www.nationalacademies.org/event/02-06-2023/assessment-of-the-impact-of-social-media-on-the-health-and-wellbeing-of-adolescents-and-children-meeting-2 (accessed January 12, 2024).

Sherman, L. E., L. M. Hernandez, P. M. Greenfield, and M. Dapretto. 2018. What the brain 'likes': Neural correlates of providing feedback on social media. *Social Cognitive and Affective Neuroscience*: 13(7):699-707.

Shulman, E. P., A. R. Smith, K. Silva, G. Icenogle, N. Duell, J. Chein, and L. Steinberg. 2016. The dual systems model: Review, reappraisal, and reaffirmation. *Developmental Cognitive Neuroscience* 17:103-117.

Silverman, M. H., K. Jedd, and M. Luciana. 2015. Neural networks involved in adolescent reward processing: An activation likelihood estimation meta-analysis of functional neuroimaging studies. *NeuroImage* 122:427-439.

Silvers, J. A. 2022. Adolescence as a pivotal period for emotion regulation development. *Current Opinion in Psychology* 44:258-263.

Spear, L. P. 2011. Rewards, aversions and affect in adolescence: Emerging convergences across laboratory animal and human data. *Developmental Cognitive Neuroscience* 1(4):390-403.

Stecklow, S. 2018. Why Facebook is losing the war on hate speech in Myanmar. In *Inside Facebook's Myanmar Operation: Hatebook*, edited by P. Hirschberg. Reuters. https://www.reuters.com/investigates/special-report/myanmar-facebook-hate (accessed September 21, 2023).

Steinberg, L. 2010. Biosocial theories of crime: A social neuroscience perspective on adolescent risk-taking, edited by K. M. Beaver and A. Walsh. London: Routledge.

Steinberg, L., and A. S. Morris. 2001. Adolescent development. *Annual Review of Psychology* 52:82-110.

Copyright National Academy of Sciences. All rights reserved.

Stevenson, A. 2018. Facebook admits it was used to incite violence in Myanmar. *The New York Times*. https://www.nytimes.com/2018/11/06/technology/myanmar-facebook.html (accessed September 21, 2023).

Stibe, A., and H. Oinas-Kukkonen. 2014. Using social influence for motivating customers to generate and share feedback. *Lecture Notes in Computer Science* 8462:224-235. https://doi.org/10.1007/978-3-319-07127-5_19.

Su, C., H. Zhou, C. Wang, F. Geng, and Y. Hu. 2021. Individualized video recommendation modulates functional connectivity between large scale networks. *Human Brain Mapping* 42(16):5288-5299.

Suleiman, A. B., A. Galván, K. P. Harden, and R. E. Dahl. 2017. Becoming a sexual being: The 'elephant in the room' of adolescent brain development. *Developmental Cognitive Neuroscience* 25:209-220.

Sunstein, C. R. 2020. Valuing Facebook. *Behavioural Public Policy* 4(3):370-381.

Swire-Thompson, B., and D. Lazer. 2020. Public health and online misinformation: Challenges and recommendations. *Annual Review of Public Health* 41(1):433-451.

The Associated Press. 2023. Utah's new social media law means children will need approval from parents. https://www.npr.org/2023/03/24/1165764450/utahs-new-social-media-law-means-children-will-need-approval-from-parents (accessed September 21, 2023).

Thune, J. 2021. It's time Congress pulled back the curtain on social media algorithms. *CNN*. https://www.cnn.com/2021/11/11/opinions/congress-algorithms-filter-bubble-transparency-act-thune/index.html (accessed September 21, 2023).

TikTok. 2021. An update on our work to safeguard and diversify recommendations. https://newsroom.tiktok.com/en-us/an-update-on-our-work-to-safeguard-and-diversify-recommendations (accessed September 21, 2023).

TikTok. 2023a. *Our approach to content moderation*. https://www.tiktok.com/transparency/en-us/content-moderation/ (accessed September 21, 2023).

TikTok. 2023b. *Terms of service*. https://www.tiktok.com/legal/page/us/terms-of-service/en (accessed December 27, 2023).

Treem, J. W., and P. M. Leonardi. 2012. Social media use in organizations: Exploring the affordances of visibility, editability, persistence, and association. *Annals of the International Communication Association* 36(1):143-189.

Turow, J., Y. Lelkes, N. A. Draper, and A. E. Waldman. 2023. Americans can't consent to companies' use of their data: They admit they don't understand it, say they're helpless to control it, and believe they're harmed when firms use their data—making what companies do illegitimate. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4391134 (accessed September 21, 2023).

Twitter. 2023. *About offensive content*. https://help.twitter.com/en/safety-and-security/offensive-tweets-and-content (accessed September 21, 2023).

U.S. Congress, House of Representatives, and Committee on Homeland Security. 2019. Examining social media companies' efforts to counter online terror content and misinformation. 116th Cong., 1st Sess. June 26.

van der Molen, P. C. M. 1994. Cognitive psychophysiology: A window to cognitive development and brain maturation. In *Human Behavior and the Developing Brain*. New York, NY, US: The Guilford Press. Pp. 456-490.

van Reijmersdal, E. A., and S. van Dam. 2020. How age and disclosures of sponsored influencer videos affect adolescents' knowledge of persuasion and persuasion. *Journal of Youth and Adolescence* 49(7):1531-1544.

Venticinque, J. S., R. Chahal, S. J. Beard, R. A. Schriber, P. D. Hastings, and A. E. Guyer. 2021. Neural responses to implicit forms of peer influence in young adults. *Social Neuroscience* 16(3):327-340.

Copyright National Academy of Sciences. All rights reserved.

Social Media and Adolescent Health

Vogels, E., R. Gelles-Watnick, and N. Massarat. 2022. *Teens, social media and technology 2022.* Pew Research Center. https://www.pewresearch.org/internet/2022/08/10/teens-social-media-and-technology-2022 (accessed December 26, 2023).

Waddell, K. 2021. Tech companies too secretive about algorithms that curate feeds, study says. *Consumer Reports.* https://www.consumerreports.org/consumer-protection/tech-companies-too-secretive-about-algorithms-that-curate-feeds-a8134259964 (accessed September 21, 2023).

Wadsley, M., and N. Ihssen. 2023. A systematic review of structural and functional MRI studies investigating social networking site use. *Brain Sciences* 13(5):787.

Wahlstrom, D., P. Collins, T. White, and M. Luciana. 2010. Developmental changes in dopamine neurotransmission in adolescence: Behavioral implications and issues in assessment. *Brain and Cognition* 72(1):146-159.

Warrick, J. 2016. The 'app of choice' for Jihadists ISIS seizes on internet tool to promote terror. *The Washington Post*. https://www.washingtonpost.com/world/national-security/the-app-of-choice-for-jihadists-isis-seizes-on-internet-tool-to-promote-terror/2016/12/23/a8c348c0-c861-11e6-85b5-76616a33048d_story.html (accessed September 21, 2023).

Wen, L. S. 2023. Utah is limiting kids' social media access. Other states should follow. *The Washington Post*, April 11. https://www.washingtonpost.com/opinions/2023/04/11/utah-social-media-law-other-states (accessed February 24, 2024).

White House. 2022. Readout of White House listening session on tech platform accountability. https://www.whitehouse.gov/briefing-room/statements-releases/2022/09/08/readout-of-white-house-listening-session-on-tech-platform-accountability (accessed December 24, 2023).

Wiafe, I., F. N. Koranteng, E. Owusu, A. O. Ekpezu, and S. A. Gyamfi. 2020. Persuasive social features that promote knowledge sharing among tertiary students on social networking sites: An empirical study. *Journal of Computer Assisted Learning* 36(5):636-645.

World Bank. 2019. *Practitioner's guide: Data protection and privacy laws.* https://id4d.worldbank.org/guide/data-protection-and-privacy-laws (accessed October 3, 2023).

Yau, J. C., and S. M. Reich. 2018. Are the qualities of adolescents' offline friendships present in digital interactions? *Adolescent Research Review* 3(3):339-355.

YouTube. 2023a. *How content ID works.* https://support.google.com/youtube/answer/2797370?hl=en (accessed September 21, 2023).

YouTube. 2023b. *How does YouTube manage harmful content?* https://www.youtube.com/howyoutubeworks/our-commitments/managing-harmful-content (accessed September 21, 2023).

Yu, J., M. Stoilova, and S. Livingstone. 2018. Regulating children's data and privacy online: The implications of the evidence for age-appropriate design. https://blogs.lse.ac.uk/medialse/2018/11/01/regulating-childrens-data-and-privacy-online-the-implications-of-the-evidence-for-age-appropriate-design (accessed September 21, 2023).

Zelazo, P. D., and S. M. Carlson. 2012. Hot and cool executive function in childhood and adolescence: Development and plasticity. *Child Development Perspectives* 6(4):354-360.

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3

Potential Benefits of Social Media

One of the tasks of this report is to summarize the effect of social media on adolescents and children, including its influence on their education, social development, and family dynamics. Full understanding of these effects involves consideration not only of the harms of social media (the topic of much of the existing research presented in the next chapter), but to explore its potential benefits.

The perception that social media is a threat may be partially attributed to researchers' interest in exploring harms. When faced with evidence of a deterioration in young people's mental health the logical reaction is to first consider the potentially harmful role of new technology. There is also a question of publication bias. The tendency for statistically significant or flashy results to be published and null results to be filed away is a problem across disciplines, although it may be particularly acute in social science (Franco et al., 2014; Peplow, 2014). When published literature carries a bias, any subsequent meta-analysis or review will carry that bias forward into overstated conclusions (Meier and Reinecke, 2020; Olsson and Sundell, 2023). For this reason, tests for publication bias are increasingly common in meta-analyses (Peters et al., 2006; van Enst et al., 2014).

Of the 25 recent meta-analyses and reviews presented in Appendix C, 12 discuss the problem of publication bias in the field, and 11 of those 12 publications attempt to measure publication bias with statistical tools. Meta-analyses linking social media use to depression and overuse, as well as those on social capital, social connectedness, and social comparison cite evidence of publication bias in their results (Cunningham et al., 2021; Liu

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et al., 2016; McComb et al., 2023; McCrae et al., 2017; Shannon et al., 2022). But other meta-analyses on topics such as sleep deprivation, depression and anxiety, and internet gaming disorder found no such evidence (Alimoradi et al., 2019; Liu et al., 2022; Lozano-Blasquo et al., 2022; Meier and Reinecke, 2020; Shannon et al., 2022; Stevens et al., 2021; Yin et al., 2019; Yoon et al., 2019).

What is more, the meta-analyses presented in Appendix C report small effects and weak associations, drawn mainly from cross-sectional studies establishing associations between social media use and adolescent well-being. Only one of the meta-analyses reviewed in Appendix C, for example, drew on exclusively experimental data (McComb et al., 2023). There is ample room for positive and negative experiences within or between users to be obscured in analyses. It is possible that the small associations reported may be influenced by a balance of good and bad experiences. That the use of social media, like many things in life, may be a constantly shifting calculus of the risky, the beneficial, and the mundane.

The balance between the social value and entertainment young people find online can be compared to other socially uniting, entertaining pastimes. It is reasonable to point out that we seldom pathologize young people who enjoy watching sports. Yet a societal shift wherein all young people were suddenly watching sports all the time, late night, to the neglect of other activities, would give us pause. The committee recognizes that social media is associated with harm for some young people, though whether or not it is the cause of such harm is harder to say. If the aggregate experience of social media were harmful to neutral, then different restrictive actions would be justified in the interest of protecting the most vulnerable. Yet the reality is more complicated. This chapter discusses the beneficial potential of social media with some emphasis on the processes through which benefits may accrue.

WHY ADOLESCENTS USE SOCIAL MEDIA

As the previous chapter indicated, social media sites include a variety of affordances, many of which are powered by algorithms that operate behind the scenes. These very design elements of social media platforms intersect with the adolescent developmental experience in ways that influence their social media use. Academic researchers and public discussion have directed considerable attention to understanding these intersections, contributing to a narrative that social media harms people by undermining relationships, cultivating superficiality, increasing anxiety and depression, and inhibiting the ability to concentrate and sustain attention.

One nationally representative, longitudinal study that followed children ages 10 to 13 over 8 years, found that time spent on social media was

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not associated with depression or anxiety (Coyne et al., 2020). Subgroup analyses led the researchers to conclude that "far more adolescents have positive or neutral experience on [social media] than negative," allowing that the most benefit may accrue to young people with chaotic home lives and those who feel marginalized, groups often at increased risk for mental health problems (Coyne, 2023, p. 18). Such results suggest that social media may benefit some groups of young people.

Adolescent self-reports paint a similar picture. Figure 3-1 shows results of a recent Pew Research survey showing that over 90 percent of a nationally representative sample of teens aged 13 to 17 years find social media to have a positive or neutral effect on them (Anderson et al., 2022), though more than one-third felt the amount of time they spent using social media was too much (Vogels et al., 2022). A modest majority (54 percent) thought it would be very hard or somewhat hard to give up social media (Anderson et al., 2022).

Teenagers, like adults, use social media to accomplish goals and satisfy needs. Recognizing social media as a tool helps understand the real or perceived benefits and the reasons why adolescents use the platform (Lee et al., 2023). When asked about the benefits of using social media, adolescents list connections and socializing, accessing information and learning, along with entertainment and fun, as some of the reasons for using social media (see Figure 3-1).

Social connection is important in early life as it has implications for the development of secure relationships and even good physical health later in life (Caspi et al., 2006; Danese et al., 2009; Holt-Lunstad, 2022; Yang et al., 2016). Social media platforms offer a means of social connection. By using these platforms, adolescents can easily connect with friends, classmates, and acquaintances, allowing them to maintain relationships, expand their social networks, and stay connected even when physically apart. It is not clear the extent to which social media use fosters real social connection, however. A meta-analysis of cross-sectional data found weak but positive associations between social media use and loneliness (Zhang et al., 2022). This association may differ across ages. A survey exploring the relationship between social media use and loneliness in four countries found that, during the COVID-19 pandemic, frequent social media use was associated with greater levels of loneliness among young adults,[1] though this correlation could be related to a circular relationship with social media use and other isolating mental health problems (Bonsaksen et al., 2021). Further, social interactions are not always positive and doing so online is no exception (Brooks and Dunkel Schetter, 2011; Holt-Lunstad and Uchino, 2019).

[1] Aged 18 to 39.

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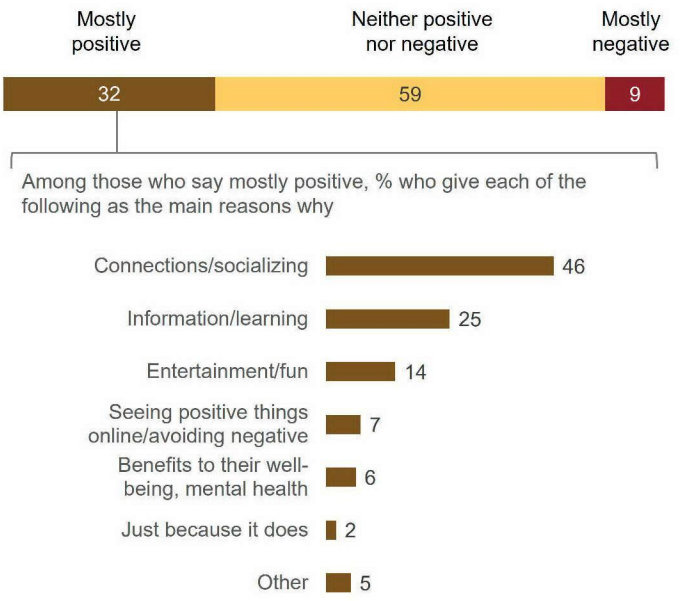


FIGURE 3-1 Percentage of U.S. teens (age 13 to 17 years) who say social media has had a (mostly positive, neutral, or mostly negative) effect on them personally. SOURCE: Anderson et al., 2022.

Social media can also provide a space for self-expression. Teens can express their identities, share their thoughts, and showcase their creativity through posts, photos, videos, and stories. This enables them to shape their online personas and receive validation and feedback from others—feedback that can be kind or hurtful. Additionally, social media can be used as a means to fulfill a need for belonging. Adolescents often seek acceptance and validation from their peers, and social media platforms offer communities where they can find like-minded individuals who share similar interests, values, or experiences. Furthermore, social media is a source of entertainment for adolescents that can be used to share funny videos, memes, music tailored to their interests, and more. Adolescents can find news, educational content, and discussions on various topics of interest on social media, thereby staying up to date on current events and global issues.

Understanding why youth use social media can help us understand how to tap into mechanisms to maximize their potential benefits. These reasons include learning, entertainment, relaxation, connection, stress relief, and a normal adolescent tendency to seek out varied and novel experiences (Anderson et al., 2022; Hancock et al., 2022). Social media can provide a window to cultural experiences and information and, most

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obviously, a venue to socialize. Social media can foster positive emotions, as would happen for a young person using the platforms to connect with grandparents who live far away; it can also be used to avoid negative feelings, as might happen when someone watches a funny video or an online music lesson to take their mind off a bad day at school (Cauberghe et al., 2021). At the center of these experiences are the use of coping strategies, some healthier than others. Although avoidance and escape are not always undesirable, the healthier strategies (e.g., seeking social support) may account for some people having a more positive experience on the platforms than others.

Social Capital and Social Connectedness

One of the most obvious potential benefits of social media is its power to connect friends and family. Adolescents report communication with family and friends as the most common and important functions of using social media (Allen et al., 2014). Indeed, adolescents who take a positive view of social media attribute this firstly to the social connectedness and interactions the platforms allow (Anderson et al., 2022). Qualitative research among young adults suggested that online interactions offer a controllable and accessible way to maintain relationships, especially valuable for maintaining ties to friends and family who live far away (Scott et al., 2022). Some researchers have suggested that the social media affordances for direct, active exchanges with other users, so-called active use, allow for more positive effects on well-being than what is described as passive use, meaning scrolling or consuming the information without contributing, though such patterns may depend on the viewer's mindset (Beyens et al., 2020). (That is, passive scrolling through a friend's photos could also bring someone happiness, depending on the person and their attitude toward what they are viewing.) More recent work has questioned the validity of the active use–passive use dichotomy, however (Valkenburg et al., 2021). Use of social media in real life is invariably a mix of active and passive features that are difficult to disentangle experimentally or conceptually (Valkenburg et al., 2021).

Adolescents use social media to maintain friendships and explore their identity, both central developmental tasks for their age (Uhls et al., 2017). It is not clear if online and offline friendships are necessarily equivalent. But friendship in general is important to building a sense of social connectedness, a feeling of connection with other people that encompasses feeling cared for and belonging (Bowins, 2021). Friendship is valuable in its own right, it also promotes life satisfaction and reduces anxiety (Zhou and Cheng, 2022). In experimental settings, messaging with

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a friend has been shown to be a valuable means of stress reduction for adolescents (Yau et al., 2021).

The use of social media for connectedness may benefit family relationships as well. Survey research among Italian parents who use social media to communicate with teenage children suggests that platforms can be used for wider and more open communication among family members (Procentese et al., 2019). Of course, much of this effect depends on baseline functioning in the family unit. Longitudinal research has identified parental warmth as a protective influence that prevents teens from experiencing mental health difficulties and being involved in cyberbullying (Stockdale et al., 2018). Among children in foster care, for example, for whom the loss and separation from their natal families may be especially painful, some experts have proposed social media may help maintain positive relationships and emotional health (Castles, 2015). For this reason, guidance from the Administration for Children and Families encourages foster parents to help children use social media to maintain a sense of normalcy and important relationships, while at the same time discussing privacy and discretion with the young people to ensure their experience is productive (Child Welfare Information Gateway, 2022).

Maintaining social connections is associated with better well-being (Jordan, 2023). Social media may contribute by building social capital, the tangible and intangible resources available to people through their social networks. Research among undergraduates has found that high levels of interaction on Facebook are associated with higher levels of bridging relationships between people who are not close friends, who can share new perspectives and information (Ellison et al., 2014). A cross-sectional study among undergraduates found that people who use social media to connect with a diverse friend group also tend to have higher social self-efficacy (a perceived capability to navigate social situations and make friends), though it is not clear if social media builds this self-efficacy or if more confident people simply have a larger online friend group (Kim et al., 2020). More recent pooled analyses have found that social networking can benefit its users through strengthening weak ties or transitioning an acquaintance into a friend (Ahmad et al., 2023; Liu et al., 2016).

Instrumental Support

The social connections that young people build online can translate into instrumental support, a type of assistance that helps people meet tangible needs (Schultz et al., 2022). By providing a means to network, for example, social media can help teens build social capital that can be leveraged to find jobs and other opportunities, something that can be useful to young people as they seek out internships and other work and to find a

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place in their wider community (Garg and Pahuja, 2020; Steinfield et al., 2008). Employers may use social media to vet job candidates, for example (Grensing-Pophal, 2023).

Some research suggests the use of social media to signal academic or creative interests, ask for advice, and network can be useful skills for teenagers (Ching et al., 2018). Social media has been used in programs to link high-school seniors from underrepresented ethnic groups to academic and career mentors (Schwartz et al., 2016). A recent review found instrumental support to be relatively common among adolescents on social media (Odgers and Jensen, 2020). When facing challenges ranging from teen motherhood to becoming a first-generation college student, research finds informational support and helping behaviors (i.e., sharing advice and information) to be common in online social interactions (Odgers and Jensen, 2020; Sherman and Greenfield, 2013; Wohn et al., 2013).

Combating Isolation

Social media can be valuable to adolescents who otherwise may feel excluded or lack offline support, including patients with rare diseases or disabilities, and those who struggle with obesity or mental illness, or come from marginalized groups such as LGBTQ+ young people (Chassiakos et al., 2016). By offering a means to connect with people in the same position, social media can reduce stigma and be a venue for sharing coping strategies.

Social media can allow neurodiverse teens, for example, a way to connect socially with others that is manageable for them, thereby reducing feelings of loneliness (Sallafranque-St-Louis and Normand, 2017). Qualitative research among adolescents with autism spectrum disorder indicates that the removal of body language cues that can be difficult for people with autism to interpret make social media an enjoyable venue for them (Jedrzejewska and Dewey, 2022).

While the use of internet technology to ease loneliness has had mixed success more broadly (Bonsaksen et al., 2021; Gheorghe and Stănculescu, 2021), it can help ease loneliness in certain circumstances. In social media, LGBTQ+ adolescents living in rural areas sometimes find support that they may not have in their offline world (Escobar-Viera et al., 2022). LGBTQ+ youth also report benefits from connecting with other queer youth online and establishing support systems (Berger et al., 2022; Han et al., 2019; Selkie et al., 2020). A similar pattern may be at work among young people in foster care, for whom social media and gaming are a welcome tool to make and maintain relationships in the face of frequent disrupting changes to their living space (Gustavsson and MacEachron, 2015; Sage and Jackson, 2022).

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Social media can help adolescents cope with grief and bereavement offering the opportunity to connect with people who have experienced a similar loss (Sofka, 2017). The same is true for young people navigating isolating illnesses. Social media groups for various health conditions including cancer, diabetes, and rare diseases provide a way for patients to come together and support each other (Chou and Moskowitz, 2016; Daniels et al., 2021; Househ et al., 2014; Malik et al., 2019). For people suffering from serious mental illness, the support of peers online is especially valuable, especially peers who can relate to the challenges of coping with mental health problems (Naslund et al., 2016).

Much of the concern about the harms of social media revolve around its capacity for displacement, including the displacement of in-person socializing (Twenge, 2020). Yet survey data suggest that this may vary by socioeconomic status. Teens from lower-income groups are less likely to interact with friends in their homes or outside of school and tend to put strong value on the friendships they make online, through gaming for example, even though these friends are not necessarily people whom they know offline (Lenhart et al., 2015).

Moreover, socializing in person is not always possible. Physical isolation is a source of loneliness that social media can counter. During the peak physical distancing requirements of the COVID-19 pandemic, social media became the only venue many young people had to connect with their friends (Kurz and Jahng, 2022). Even as pandemic-era distancing requirements ease, infrequent in-person time with friends is a fact of life for many adolescents. Driving and car ownership are relatively more expensive to young people today than they were in past generations, and most of the United States is poorly served by public transit, limiting young people's mobility and ability to socialize in person with people who are not close neighbors (Kurz and Jahng, 2022).

At its most extreme end, isolation and related mental health problems can manifest in suicidal thoughts and self-harm. Some evidence indicates that supportive online communities can decrease risk of suicidal ideation and improve well-being (De Choudhury and Kıcıman, 2017). As social networking allows users an easy way to communicate with a large pool of people, the sites can provide someone in distress with valuable emotional support, especially to people who use the sites actively and frequently (De Choudhury and Kıcıman, 2017; Liu et al., 2016). Intervention studies have found that artificial intelligence can analyze social media data to predict some online behaviors that may indicate suicidical ideation (Lekkas et al., 2021).

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Learning

Qualitative research indicates that adolescents value social media for its ability to expose them to the world and support their education (Shankleman et al., 2021). A 15-country cross-sectional survey of more than 100,000 15-year-olds found that, in western countries, social media use predicts a greater ability for reading and navigating information online (Chen et al., 2021). Social media can facilitate processes that have always been part of schooling such as studying together and sharing homework strategies (Hadjipanayis et al., 2019). Other processes are relatively new and more unique to teens.

The concept of a media ecology, referring to both the technology that facilitates media access and its influence on human culture, ideas, and politics, is important to understanding why learning on social media is important for adolescents (Milberry, 2012). The separation of formal and informal learning is not always clear in the new media ecology. Survey research among middle school students has found social media forums to be useful in collaboration on science and engineering projects, which may be part of an iterative, collaborative learning process (Won et al., 2015). A mixed methods study[2] of 12 to 14 year olds in Spain found that the informal learning characteristic of social media empowers young people and increases self-motivation for learning (Gil Quintana and Osuna-Acedo, 2020).

An intense engagement with new media in the service of acquiring more expertise about a niche interest, sometimes described as geeking out, is an important dimension of learning for young people (Ito et al., 2010). The types of learning often characterized as geeking out tend toward parallel exploration of a topic with friends and mediated by technology, with knowledge-building becoming difficult to separate from broader youth culture (Ito et al., 2010).

Writing Skills

Adolescents tend to use social media for both classroom exercises and supplemental assignments (Galvin and Greenhow, 2020). A recent narrative review found that use of social media for academic writing has been associated with less writing anxiety and a great sense of agency for the students to write about topics important to them (Galvin and Greenhow, 2020).

This sense of agency may be most evident in fanfiction, the long-form writing genre wherein amateur writers imagine different story lines for

[2] Using participatory workshops, interviews, self-report in a diary, and observation.

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characters known from other art forms. There are millions of registered users on the online hub fanfiction.net; they upload thousands of stories every day (Evans et al., 2017). Online fanfiction communities can be important for informal learning, a place for young people to build literacy skills and support the same skills in others, all while building supportive social connections (Shang et al., 2021). The more engaging topics can help draw in young people who may feel restricted by academic composition classes (Galvin and Greenhow, 2020). In the United States, speakers of other languages may also use fanfiction as a way to hone their English skills and socialize at the same time (Black, 2008).

Fanfiction can help cultivate writing skills and has also fostered the emergence of a type of coaching called distributed mentoring (see Box 3-1) (Evans et al., 2016; Froelich et al., 2021). Participants in fanfiction communities engage as both writers and coaches, learning about writing and about how to give and receive mentorship (Aragon and Davis, 2019; Evans et al., 2016). Qualitative research among fanfiction writers suggests that the experience of the fanfiction community, particularly the mentorship, gave them both the skills and the confidence needed for success in higher education (Aragon and Davis, 2019; Evans et al., 2016).

Online networks for shared hobbies, interests, or identities can also be important for young people. Affinity networks can provide coaching

BOX 3-1
Seven Characteristics of Distributed Mentoring in Fanfiction Communities

Aggregation: Authors receive mentorship from multiple other individuals.

Accretion: Information shared by multiple individuals accretes over time, as authors build a cumulative repository of knowledge.

Acceleration: The active discussion of specific, nuanced elements accelerates the learning process.

Abundance: This attribute refers to the sheer quantity of comments and reviews received in openly networked environments like fanfiction forums.

Availability: Stories and reviews persist indefinitely, allowing reviewers and authors to have long-term relationships, with easy reference to past material.

Asynchronicity: Authors and reviewers can communicate back and forth with each other despite being on different schedules or even in different time zones.

Affect: The great number of positive reviews generates encouragement and inspiration for authors, offsetting the far smaller number of negative reviews.

SOURCE: Evans et al., 2016. Reprinted with permission.

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and support for a range of interests including reading, music, crafts and creative arts, and games (Ito et al., 2019). No matter how niche the interest may be, the scope of the internet almost guarantees that people can connect, across distance and other barriers, with other people to support their skills and help them grow.

Self-Expression and Independence

Forming a coherent sense of self and identity are core tasks of adolescent development. In the second decade of life, adolescents define themselves and change their relationship with their parents and other adults. Social media can aid the task, affording young people a place to explore their identity and shape their sense of self (Spies Shapiro and Margolin, 2014).

Parents may attempt to monitor their children on social media. A 2016 Pew Research survey found that 60 percent of parents check their children's social media profiles and about the same percentage check their browsing history (Anderson, 2016). A more recent Pew survey found that only 28 percent friend or follow their child on social media (Auxier et al., 2020). But young people can still seek out privacy and a separate space to experiment with identity online. The Instagram affordances such as photo filters and asynchronicity, for example, tend to encourage the presentation of a carefully curated, public persona (Kanchinadam et al., 2018). Teens may supplement this account with a secondary account for close friends, that presents far less performative content (Kanchinadam et al., 2018). Even within the same platform, teens can experiment with different identities and different levels of privacy.

Teens often report using social media to share information about oneself, one's environment, and one's social life and connections, with part of this experience involving feedback on this presentation from others (Márquez et al., 2022; Yau and Reich, 2019). A relatively long-standing body of research indicates that this self-presentation and exploring of identity is an important part of adolescence that social media can support (Moreno and Uhls, 2019; Subrahmanyam and Šmahel, 2011; Valkenburg et al., 2005). Qualitative research finds that many young people, especially cisgender girls, are meticulous in selecting which platform or account to post to, editing pictures, monitoring comments and likes, and removing posts when not viewed favorably by peers (Bell, 2019; Yau and Reich, 2019). A similarly developmentally appropriate interest in self-presentation is part of avatar personalization and one that gay, lesbian, and transgender teens may put more emphasis on (Morgan et al., 2020).

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Encouraging Creativity

Social media can be a venue to exhibit different forms of expression, such as in fanfiction and affinity groups discussed earlier. Qualitative research also reveals that teens use different platforms for different ends, with some platforms being used only for watching videos and others only for communicating with close friends (Anderson et al., 2022). Some platforms are also important creative outlets. A 2022 survey found that seven out of ten teenagers see social media as a place where they can express their creative side (Anderson et al., 2022). For Black and Hispanic teens, this appears to be an even more valued feature of social media, with 75 and 73 percent of Black and Hispanic teens respectively citing the value of social media as a creative forum (Anderson et al., 2022).

Teens' use of social media can support their creativity, especially when the platform has affordances for ownership, association, and visibility (Vilarinho-Pereira et al., 2021). As with many of the benefits and risks of social media, the value of a creative outlet may be more pronounced for different personality types. Teens who are more extraverted, open to experience, and lower in neuroticism reported more creative activity online (Pérez-Fuentes et al., 2019). Research among adults suggests that using social media for authentic self-expression, rather than for presenting a curated persona, predicts greater life satisfaction and well-being; the same may be true for adolescents (Bailey et al., 2020).

A 2016 study including teenagers in 8 countries found that creative expression on social media runs from casual to expert forms, with the highly skilled forms sometimes being marketable and a source of income (see Table 3-1). During the COVID-19 pandemic, social media helped some teens grow their creativity, expanding their circle of like-minded friends and providing interested young people with an outlet for personal growth (Zaeske et al., 2022).

Empowerment and Civic Engagement

Social media is a vehicle to harness the political and social power of young people and has facilitated some powerful social movements over the last two decades (Baskin-Sommers et al., 2021; Daiute, 2018). Social media provides a quick, convenient way to learn about and discuss current events. The social connectedness and community building discussed earlier in this chapter also have ramifications for offline civic activity. The Swedish environmental activist Greta Thunberg, for example, has used social media to exponentially expand her reach, informing adolescents around the world about a school strike for climate change, which eventually grew into a global environmental movement (Kurz and Jahng, 2022). For Greta Thunberg and other young people at the center of social move-

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TABLE 3-1 Types of Creative Production on Social Media

	Casual	Aspirational	Expert
Type of Production	Photos and videos	Writing, photos, videos, graphic design, and drawing	Writing, photos, videos, graphic design, and drawing
Planning	Spontaneous and simple	Moderately planned	Highly planned
Consideration and use of narrative and aesthetic values	Not important. Basic techniques and concepts are applied	Very important. Eagerness to learn and apply new techniques and concepts	Very important. Media encyclopedic knowledge and use of various techniques and concepts
Motivation	Entertainment and relationship with peers	Skill improvement and peer recognition	Skill improvement and originality

SOURCE: Guerrero-Pico et al., 2019.

ments, social media is likely an enhancing factor for their activist work and not the explanation for it (Fullam, 2017).

The same capacity for mass dissemination of information that makes the internet useful for education also influences young people's point of view. A 2018 Pew survey found that roughly two-thirds of teens aged 13 to 18 used social media to learn about different points of view or show their support for causes (Anderson and Jiang, 2018). At the same time, only a minority of youth (<10 percent) in both the Pew 2018 and 2022 samples reported using social media to post about politics (Anderson and Jiang, 2018; Anderson et al., 2022).

In qualitative studies, youth report being more aware of social and political events due to social media (Common Sense Media, 2019). Research among 11- to 15-year-old participants in the Adolescent Brain Cognitive Development (ABCD) Study found that 30 percent of respondents used social media to engage with the Black Lives Matter movement (Baskin-Sommers et al., 2021).

Some researchers have proposed that the increased access to news and information through social media leads to conversations offline and to feelings of civic involvement (Lenzi et al., 2015). This effect is not limited to the United States. UNICEF data suggest that between 43 and 64 percent of children and teens in 11 countries look for news online, and that young people who engage in political discussions online are more likely to participate in the political process offline (Cho et al., 2020). Like

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the Pew reports, UNICEF data offer no evidence that young people participate in superficial or ostentatious political posting (so-called clicktivism or hashtag activism) (Cho et al., 2020). On the contrary, Pew investigators found that only 7 percent of sample teens used hashtags related to political or social issues, 10 percent used social media to encourage their friends to take part in political or social causes (Anderson et al., 2022).

Civic involvement and social cohesion can be meaningful ends related to social media use, valuable both to adolescents and to society. That said, increased political involvement is not always positive. Social media has been cited as a source of political polarization, rife with partisanship and incivility, though such climates vary among different platforms (Ferguson, 2021; Oden and Porter, 2023). It is difficult to say if a heightened hostility to opposing political views is a function of social media use or if social media is simply reflecting a broader cultural change. Some scholars have proposed that platforms built around offline friendship may have a mix of affordances that increase polarization, while groups built around shared interests may work counter to it (Literat and Kligler-Vilenchik, 2021). Political polarization and the normalization of fringe viewpoints, like many of the topics reviewed in this chapter, can be amorphous and hard to measure. Similar problems abound in measuring the direct health effects of social media use, as the next chapter will discuss.

REFERENCES

Ahmad, Z., S. H. Soroya, and K. Mahmood. 2023. Bridging social capital through the use of social networking sites: A systematic literature review. *Journal of Human Behavior in the Social Environment* 33(4):473-489.

Alimoradi, Z., C.-Y. Lin, A. Broström, P. H. Bülow, Z. Bajalan, M. D. Griffiths, M. M. Ohayon, and A. H. Pakpour. 2019. Internet addiction and sleep problems: A systematic review and meta-analysis. *Sleep Medicine Reviews* 47:51-61.

Allen, K., T. Ryan, D. Gray, D. McInerney, and L. Waters. 2014. Social media use and social connectedness in adolescents: The positives and the potential pitfalls. *The Australian Educational and Developmental Psychologist* 31(1):18-31.

Anderson, M. 2016. *Parents, teens, and digital monitoring.* Pew Research Center. https://www.pewresearch.org/internet/2016/01/07/parents-teens-and-digital-monitoring (accessed December 28, 2023).

Anderson, M., and J. Jiang. 2018. *Teens' social media habits and experiences.* Pew Reserch Center. https://www.pewresearch.org/internet/2018/11/28/teens-social-media-habits-and-experiences (accessed December 28, 2023).

Anderson, M., E. A. Vogels, A. Perrin, and L. Rainie. 2022. *Connection, creativity, and drama: Teen life on social media in 2022.* Pew Research Center. https://www.pewresearch.org/internet/2022/11/16/connection-creativity-and-drama-teen-life-on-social-media-in-2022 (accessed December 28, 2023).

Aragon, C., and K. Davis. 2019. *Writers in the secret garden: Fanfiction, youth, and new forms of mentoring.* Cambridge, MA: MIT Press.

Auxier, B., M. Anderson, A. Perrin, and E. Turner. 2020. *Parenting children in the age of screens.* Pew Research Center. https://www.pewresearch.org/internet/2020/07/28/parenting-children-in-the-age-of-screens (accessed December 28, 2023).

Copyright National Academy of Sciences. All rights reserved.

Bailey, E. R., S. C. Matz, W. Youyou, and S. S. Iyengar. 2020. Authentic self-expression on social media is associated with greater subjective well-being. *Nature Communications* 11(1):4889.

Baskin-Sommers, A., C. Simmons, M. Conley, S.-A. Chang, S. Estrada, M. Collins, W. Pelham, E. Beckford, H. Mitchell-Adams, N. Berrian, S. F. Tapert, D. G. Gee, and B. J. Casey. 2021. Adolescent civic engagement: Lessons from Black Lives Matter. *Proceedings of the National Academy of Sciences* 118(41):e2109860118.

Bell, B. T. 2019. "You take fifty photos, delete forty nine and use one": A qualitative study of adolescent image-sharing practices on social media. *International Journal of Child-Computer Interaction* 20:64-71.

Berger, M. N., M. Taba, J. L. Marino, M. S. C. Lim, and S. R. Skinner. 2022. Social media use and health and well-being of lesbian, gay, bisexual, transgender, and queer youth: Systematic review. *Journal of Medical Internet Research* 24(9).

Beyens, I., J. L. Pouwels, I. I. van Driel, L. Keijsers, and P. M. Valkenburg. 2020. The effect of social media on well-being differs from adolescent to adolescent. *Scientific Reports* 10(1).

Black, R. W. 2008. *Adolescents and online fan fiction*. New York: Peter Lang.

Bonsaksen, T., M. Ruffolo, J. Leung, D. Price, H. Thygesen, M. Schoultz, and A. Ø. Geirdal. 2021. Loneliness and its association with social media use during the COVID-19 outbreak. *Social Media + Society* 7(3):20563051211033821.

Bowins, B. 2021. Chapter 4 - social connectedness. In *States and processes for mental health*, edited by B. Bowins. Academic Press. Pp. 41-48.

Brooks, K. P., and C. Dunkel Schetter. 2011. Social negativity and health: Conceptual and measurement issues. *Social and Personality Psychology Compass* 5(11):904-918.

Caspi, A., H. Harrington, T. E. Moffitt, B. J. Milne, and R. Poulton. 2006. Socially isolated children 20 years later: Risk of cardiovascular disease. *Archives of Pediatric and Adolescent Medicine* 160(8):805-811.

Castles, T. 2015. *Making safe connections: Foster teens and social media.* http://foster-care-newsletter.com/foster-teens-and-social-media (accessed September 21, 2023).

Cauberghe, V., I. Van Wesenbeeck, S. De Jans, L. Hudders, and K. Ponnet. 2021. How adolescents use social media to cope with feelings of loneliness and anxiety during COVID-19 lockdown. *Cyberpsychology, Behavior and Social Networking* 24(4):250-257.

Chassiakos, R., J. Radesky, D. Christakis, M. A. Moreno, C. Cross, Council on Communications Media, D. Hill, N. Ameenuddin, J. Hutchinson, A. Levine, R. Boyd, R. Mendelson, and W. S. Swanson. 2016. Children and adolescents and digital media. *Pediatrics* 138(5).

Chen, J., C.-H. Lin, and G. Chen. 2021. A cross-cultural perspective on the relationships among social media use, self-regulated learning and adolescents' digital reading literacy. *Computers & Education* 175(C):15.

Child Welfare Information Gateway. 2022. *Social media: Tips for foster parents and caregivers.* https://www.childwelfare.gov/pubPDFs/smtips_parent.pdf (accessed October 13, 2023).

Ching, D., R. Santo, K. Peppler, and C. Hoadley. 2018. *"He saw I had a loving for it": Youth interest signaling as a means of generating social support in technology pathways.* HIVE Research Lab. https://brokering.hiveresearchlab.org/reports/report-he-saw-i-had-a-loving-for-it-youth-interest-signaling-as-a-means-of-generating-social-support-in-technology-pathways (accessed December 28, 2023).

Cho, A., J. Byrne, and Z. Pelter. 2020. *Digital civic engagement by young people.* UNICEF Office of Global Insight and Policy. https://www.unicef.org/globalinsight/reports/digital-civic-engagement-young-people#:~:text=Digital%20civic%20engagement%20by%20youth%20can%20include%20digital,belonging%20to%20a%20campus%20or%20community%20group%20online (accessed December 28, 2023).

Chou, W.-y. S., and M. Moskowitz. 2016. Social media use in adolescent and young adult (AYA) cancer survivors. *Current Opinion in Psychology* 9:88-91.

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Common Sense Media. 2019. *Teen news engagement: Key findings and toplines*. https://www.commonsensemedia.org/sites/default/files/research/report/2019_cs-sm_summary-toplines_release.pdf (accessed October 12, 2023).

Coyne, S. 2023. Who is most at risk and who is most likely to benefit from using social media long-term?: A differential susceptibility approach. Paper presented at Assessment of the Impact of Social Media on the Health and Wellbeing of Children and Adolescents Meeting 1, Washington, DC, January 9. https://www.nationalacademies.org/event/01-05-2023/assessment-of-the-impact-of-social-media-on-the-health-and-wellbeing-of-adolescents-and-children-meeting-1 (accessed January 12, 2023).

Cunningham, S., C. C. Hudson, and K. Harkness. 2021. Social media and depression symptoms: A meta-analysis. *Research on Child and Adolescent Psychopathology* 49(2):241-253.

Daiute, C. 2018. Adolescent civic engagement in contemporary political and technological realities. *Oxford Scholarship Online*. https://doi.org/10.1093/oso/9780190847128.003.0005.

Danese, A., T. E. Moffitt, H. Harrington, B. J. Milne, G. Polanczyk, C. M. Pariante, R. Poulton, and A. Caspi. 2009. Adverse childhood experiences and adult risk factors for age-related disease: Depression, inflammation, and clustering of metabolic risk markers. *Archives of Pediatric and Adolescent Medicine* 163(12):1135-1143.

Daniels, S. R., C.-C. Yang, S. J. Toohey, and V. W. Willard. 2021. Perspectives on social media from adolescents and young adults with cancer. *Journal of Pediatric Oncology Nursing* 38(4):225-232.

De Choudhury, M., and E. Kıcıman. 2017. The language of social support in social media and its effect on suicidal ideation risk. *Proceedings of the International AAAI Conference on Web and Social Media* 2017:32-41.

Ellison, N. B., J. Vitak, R. Gray, and C. Lampe. 2014. Cultivating social resources on social network sites: Facebook relationship maintenance behaviors and their role in social capital processes. *Journal of Computer-Mediated Communication* 19(4):855-870.

Escobar-Viera, C. G., S. Choukas-Bradley, J. Sidani, A. J. Maheux, S. R. Roberts, and B. L. Rollman. 2022. Examining social media experiences and attitudes toward technology-based interventions for reducing social isolation among LGBTQ youth living in rural United States: An online qualitative study. *Frontiers in Digital Health* 4(900695).

Evans, S., K. Davis, A. Evans, J. A. Campbell, D. P. Randall, K. Yin, and C. Aragon. 2017. *More than peer production: Fanfiction communities as sites of distributed mentoring*. Paper presented at the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing, Portland, Oregon.

Evans, S., D. Randall, J. Campbell, K. Davis, C. Aragon, and A. Evans. 2016. How fan fiction mentors can change lives. *School Library Journal*. https://www.slj.com/story/how-fanfiction-mentors-can-change-lives (accessed December 28, 2023).

Ferguson, C. J. 2021. Does the internet make the world worse? Depression, aggression and polarization in the social media age. *Bulletin of Science, Technology & Society* 41(4):116-135.

Franco, A., N. Malhotra, and G. Simonovits. 2014. Publication bias in the social sciences: Unlocking the file drawer. *Science* 345(6203):1502-1505.

Froelich, N., A. Liu, R. Shang, Z. Xiao, T. Neils, J. Frens, and C. Aragon. 2021. *Reciprocity in reviewing on fanfiction.net*. Poster presented at 23rd HCI International Conference, HCII 2021, virtual event.

Fullam, J. 2017. Becoming a youth activist in the internet age: A case study on social media activism and identity development. *International Journal of Qualitative Studies in Education* 30(4):406-422.

Galvin, S., and C. Greenhow. 2020. Writing on social media: A review of research in the high school classroom. *TechTrends* 64(1):57-69.

Garg, P., and D. S. Pahuja. 2020. Social media: Concept, role, categories, trends, social media and AI, impact on youth, careers, recommendations. Chapter 8 in *Managing Social Media Practices in the Digital Economy*. Pp. 172-192.

Copyright National Academy of Sciences. All rights reserved.

Gheorghe, P., and E. Stănculescu. 2021. *Loneliness and social media usage: A meta-analysis*. Paper presented at the 32nd International Congress of Psychology, Prague, Czech Republic.

Gil Quintana, J., and S. Osuna-Acedo. 2020. Transmedia practices and collaborative strategies in informal learning of adolescents. *Social Sciences* 9(6):92.

Grensing-Pophal, L. 2023. *Should you consider social media when evaluating job candidates?* https://www.shrm.org/resourcesandtools/hr-topics/people-managers/pages/social-media-when-hiring.aspx (accessed October 26, 2023).

Guerrero-Pico, M., M.-J. Masanet, and C. A. Scolari. 2019. Toward a typology of young produsers: Teenagers' transmedia skills, media production, and narrative and aesthetic appreciation. *New Media & Society* 21(2):336-353.

Gustavsson, N., and A. MacEachron. 2015. Positive youth development and foster care youth: A digital perspective. *Journal of Human Behavior in the Social Environment* 25:407-415.

Hadjipanayis, A., E. Efstathiou, P. Altorjai, T. Stiris, A. Valiulis, B. Koletzko, and H. Fonseca. 2019. Social media and children: What is the paediatrician's role? *European Journal of Pediatrics* 178(10):1605-1612.

Han, X., W. Han, J. Qu, B. Li, and Q. Zhu. 2019. What happens online stays online?—Social media dependency, online support behavior and offline effects for LGBT. *Computers in Human Behavior* 93:91-98.

Hancock, J. T., S. X. Liu, M. Luo, and H. Mieczkowski. 2022. Social media and psychological well-being. In *Psychology of Technology: Social Science Research in the Age of Big Data*, edited by S. C. Matz. American Psychological Association. Pp. 195-238.

Holt-Lunstad, J. 2022. Social connection as a public health issue: The evidence and a systemic framework for prioritizing the "social" in social determinants of health. *Annual Review of Public Health* 43(1):193-213.

Holt-Lunstad, J., and B. N. Uchino. 2019. Social ambivalence and disease (SAD): A theoretical model aimed at understanding the health implications of ambivalent relationships. *Perspectives on Psychological Science* 14(6):941-966.

Househ, M., E. Borycki, and A. Kushniruk. 2014. Empowering patients through social media: The benefits and challenges. *Health Informatics Journal* 20(1):50-58.

Ito, M., S. Baumer, M. Bittanti, D. Boyd, R. Cody, B. Herr-Stephenson, H. A. Horst, P. G. Lange, D. Mahendran, K. Z. Martinez, C. Pascoe, D. Parkel, L. Robinson, C. Sims, and L. Tripp. 2010. Hanging out, messing around, and geeking out: Kids living and learning with new media. *Writing and Pedagogy* 3(2).

Ito, M., C. Martin, M. Rafalow, K. S. Tekinbaş, A. Wortman, and R. C. Pfister. 2019. Online affinity networks as contexts for connected learning. In *The Cambridge Handbook of Motivation and Learning*, Cambridge Handbooks in Psychology, edited by K. A. Renninger and S. E. Hidi. Cambridge: Cambridge University Press. Pp. 291-311.

Jedrzejewska, A., and J. Dewey. 2022. Camouflaging in autistic and non-autistic adolescents in the modern context of social media. *Journal of Autism and Developmental Disorders* 52(2):630-646.

Jordan, M. 2023. The power of connection: Self-care strategies of social wellbeing. *Journal of Interprofessional Education & Practice* 31:100586.

Kanchinadam, T., S. Sallick, Q. Robinson, J. Whitby, S. Kim, A. Hasse, S. Cortesi, and A. Lombana-Bermudez. 2018. *How youth are reinventing Instagram and why having multiple accounts is trending*. https://medium.com/berkman-klein-center/how-youth-are-reinventing-instagram-and-why-having-multiple-accounts-is-trending-ac6eb0a288db (accessed September 21, 2023).

Kim, Y., B. Kim, H.-S. Hwang, and D. Lee. 2020. Social media and life satisfaction among college students: A moderated mediation model of SNS communication network heterogeneity and social self-efficacy on satisfaction with campus life. *The Social Science Journal* 57(1):85-100.

Copyright National Academy of Sciences. All rights reserved.

Kurz, D. B., and S. Jahng. 2022. *Texas' teens face a social media ban: A new start or a recipe for destructive isolation?* Research Association for Interdisciplinary Studies. RAIS Conference Proceedings 2022-2023. https://ideas.repec.org/p/smo/raiswp/0230.html (accessed December 28, 2023).

Lee, A. Y., N. B. Ellison, and J. T. Hancock. 2023. To use or be used? The role of agency in social media use and well-being. *Frontiers in Computer Science* 5(1123323).

Lekkas, D., R. J. Klein, and N. C. Jacobson. 2021. Predicting acute suicidal ideation on Instagram using ensemble machine learning models. *Internet Interventions* 25:100424.

Lenhart, A., A. Smith, M. Anderson, M. Duggan, and A. Perrin. 2015. *Teens, technology, and friendship*. Pew Research Center. https://www.pewresearch.org/internet/2015/08/06/teens-technology-and-friendships (accessed December 26, 2023).

Lenzi, M., A. Vieno, G. Altoe, L. Scacchi, D. D. Perkins, R. Zukauskiene, and M. Santinello. 2015. Can Facebook informational use foster adolescent civic engagement? *American Journal of Community Psychology* 55(3-4):444-454.

Literat, I., and N. Kligler-Vilenchik. 2021. How popular culture prompts youth collective political expression and cross-cutting political talk on social media: A cross-platform analysis. *Social Media + Society* 7(2):20563051211008821.

Liu, D., S. E. Ainsworth, and R. F. Baumeister. 2016. A meta-analysis of social networking online and social capital. *Review of General Psychology* 20(4):369-391.

Liu, M., K. E. Kamper-DeMarco, J. Zhang, J. Xiao, D. Dong, and P. Xue. 2022. Time spent on social media and risk of depression in adolescents: A dose-response meta-analysis. *International Journal of Environmental Research and Public Health* 19(9):5164.

Lozano-Blasquo, R., M. P. Latorre-Martinez, and A. Cortés-Pascual. 2022. Screen addicts: A meta-analysis of internet addiction in adolescence. *Children and Youth Services Review* 135.

Malik, F. S., N. Panlasigui, J. Gritton, H. Gill, J. P. Yi-Frazier, and M. A. Moreno. 2019. Adolescent perspectives on the use of social media to support type 1 diabetes management: Focus group study. *Journal of Medical Internet Research* 21(6):e12149.

Márquez, I., D. Lanzeni, and M.-J. Masanet. 2022. Teenagers as curators: Digitally mediated curation of the self on Instagram. *Journal of Youth Studies* 26(7):907-924. https://doi.org/10.1080/13676261.2022.2053670.

McComb, C. A., E. J. Vanman, and S. J. Tobin. 2023. A meta-analysis of the effects of social media exposure to upward comparison targets on self-evaluations and emotions. *Media Psychology* 26(5):612-635.

McCrae, N., S. Gettings, and E. Purssell. 2017. Social media and depressive symptoms in childhood and adolescence: A systematic review. *Adolescent Research Review* 2(4):315-330.

Meier, A., and L. Reinecke. 2020. Computer-mediated communication, social media, and mental health: A conceptual and empirical meta-review. *Communication Research* 48(8):1182-1209.

Milberry, K. 2012. Media ecology. *Oxford Bibliographies*. https://www.oxfordbibliographies.com/display/document/obo-9780199756841/obo-9780199756841-0054.xml (accessed September 21, 2023).

Moreno, M. A., and Y. T. Uhls. 2019. Applying an affordances approach and a developmental lens to approach adolescent social media use. *Digital Health* 5(January–December).

Morgan, H., A. O'Donovan, R. Almeida, A. Lin, and Y. Perry. 2020. The role of the avatar in gaming for trans and gender diverse young people. *International Journal Environmental Research and Public Health* 17(22).

Naslund, J. A., K. A. Aschbrenner, L. A. Marsch, and S. J. Bartels. 2016. The future of mental health care: Peer-to-peer support and social media. *Epidemiology and Psychiatric Sciences* 25(2):113-122.

Oden, A., and L. Porter. 2023. The kids are online: Teen social media use, civic engagement, and affective polarization. *Social Media + Society* 9(3):20563051231186364.

Copyright National Academy of Sciences. All rights reserved.

Odgers, C. L., and M. R. Jensen. 2020. Annual research review: Adolescent mental health in the digital age: Facts, fears, and future directions. *Journal of Child Psychology and Psychiatry* 61(3):336-348.

Olsson, T. M., and K. Sundell. 2023. Publication bias, time-lag bias, and place-of-publication bias in social intervention research: An exploratory study of 527 Swedish articles published between 1990–2019. *PLOS ONE* 18(2):e0281110.

Peplow, M. 2014. Social sciences suffer from severe publication bias. *Nature*. https://doi.org/10.1038/nature.2014.15787.

Pérez-Fuentes, M. D. C., M. D. M. Molero Jurado, J. J. Gázquez Linares, N. F. Oropesa Ruiz, M. D. M. Simón Márquez, and M. Saracostti. 2019. Self-expressive creativity in the adolescent digital domain: Personality, self-esteem, and emotions. *International Journal Environmental Research and Public Health* 16(22).

Peters, J. L., A. J. Sutton, D. R. Jones, K. R. Abrams, and L. Rushton. 2006. Comparison of two methods to detect publication bias in meta-analysis. *JAMA* 295(6):676-680.

Procentese, F., F. Gatti, and I. D. Napoli. 2019. Families and social media use: The role of parents' perceptions about social media impact on family systems in the relationship between family collective efficacy and open communication. *International Journal of Environmental Research and Public Health* 16(24).

Sage, M., and S. Jackson. 2022. A systematic review of internet communication technology use by youth in foster care. *Child and Adolescent Social Work Journal* 39(4):375-390.

Sallafranque-St-Louis, F., and C. L. Normand. 2017. From solitude to solicitation: How people with intellectual disability or autism spectrum disorder use the internet. *Cyberpsychology: Journal of Psychosocial Research on Cyberspace* 11(1):Article 7.

Schultz, B. E., C. F. Corbett, and R. G. Hughes. 2022. Instrumental support: A conceptual analysis. *Nursing Forum* 57(4):665-670.

Schwartz, S. E. O., S. S. Kanchewa, J. E. Rhodes, E. Cutler, and J. L. Cunningham. 2016. "I didn't know you could just ask:" Empowering underrepresented college-bound students to recruit academic and career mentors. *Children and Youth Services Review* 64:51-59.

Scott, R. A., J. Stuart, and B. L. Barber. 2022. Connecting with close friends online: A qualitative analysis of young adults' perceptions of online and offline social interactions with friends. *Computers in Human Behavior Reports* 7:100217.

Selkie, E., V. Adkins, E. Masters, A. Bajpai, and D. Shumer. 2020. Transgender adolescents' uses of social media for social support. *Journal of Adolescent Health* 66(3):275-280.

Shang, R., Z. Xiao, J. Frens, and C. Aragon. 2021. *Giving and receiving: Reciprocal review exchange in online fanfiction communities*. Paper presented at the 2021 Conference on Computer Supported Cooperative Work and Social Computing, Virtual Event.

Shankleman, M., L. Hammond, and F. W. Jones. 2021. Adolescent social media use and well-being: A systematic review and thematic meta-synthesis. *Adolescent Research Review* 6(4):471-492.

Shannon, H., K. Bush, P. J. Villeneuve, K. G. Hellemans, and S. Guimond. 2022. Problematic social media use in adolescents and young adults: Systematic review and meta-analysis. *JMIR Mental Health* 9(4):e33450.

Sherman, L. E., and P. M. Greenfield. 2013. Forging friendship, soliciting support: A mixed-method examination of message boards for pregnant teens and teen mothers. *Computers in Human Behavior* 29(1):75-85.

Sofka, C. 2017. Grief, adolescents, and social media. In *Understanding Child and Adolescent Grief*, edited by C. Arnold. Routledge/Taylor & Francis Group. Pp. 163-178.

Spies Shapiro, L. A., and G. Margolin. 2014. Growing up wired: Social networking sites and adolescent psychosocial development. *Clinical Child and Family Psychology Review* 17(1):1-18.

Steinfield, C., N. Ellison, and C. Lampe. 2008. Social capital, self-esteem, and use of online social network sites: A longitudinal analysis. *Journal of Applied Developmental Psychology* 29.

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Stevens, M. W. R., D. Dorstyn, P. H. Delfabbro, and D. L. King. 2021. Global prevalence of gaming disorder: A systematic review and meta-analysis. *Australian and New Zealand Journal of Psychiatry* 55(6):553-568.

Stockdale, L. A., S. M. Coyne, and L. M. Padilla-Walker. 2018. Parent and child technoference and socioemotional behavioral outcomes: A nationally representative study of 10- to 20-year-old adolescents. *Computers in Human Behavior* 88:219-226.

Subrahmanyam, K., and D. Šmahel. 2011. Adolescents' digital worlds: An introduction. In *Digital Youth: The Role of Media in Development.* New York, NY: Springer New York. Pp. 1-25.

Twenge, J. M. 2020. Increases in depression, self-harm, and suicide among U.S. adolescents after 2012 and links to technology use: Possible mechanisms. *Psychiatric Research and Clinical Practice* 2(1):19-25.

Uhls, Y. T., N. B. Ellison, and K. Subrahmanyam. 2017. Benefits and costs of social media in adolescence. *Pediatrics* 140(Supplement_2):S67-S70.

Valkenburg, P. M., A. P. Schouten, and J. Peter. 2005. Adolescents' identity experiments on the internet. *New Media & Society* 7(3):383-402.

Valkenburg, P. M., I. I. van Driel, and I. Beyens. 2021. The associations of active and passive social media use with well-being: A critical scoping review. *New Media & Society* 24(2):530-549.

van Enst, W. A., E. Ochodo, R. J. P. M. Scholten, L. Hooft, and M. M. Leeflang. 2014. Investigation of publication bias in meta-analyses of diagnostic test accuracy: A meta-epidemiological study. *BMC Medical Research Methodology* 14(1):70.

Vilarinho-Pereira, D. R., A. A. Koehler, and D. de Souza Fleith. 2021. Understanding the use of social media to foster student creativity: A systematic literature review. *Creativity. Theories – Research – Applications* 8(1):124-147.

Vogels, E., R. Gelles-Watnick, and N. Massarat. 2022. *Teens, social media and technology 2022.* Pew Research Center. https://www.pewresearch.org/internet/2022/08/10/teens-social-media-and-technology-2022 (accessed December 28, 2023).

Wohn, D. Y., N. B. Ellison, M. L. Khan, R. Fewins-Bliss, and R. Gray. 2013. The role of social media in shaping first-generation high school students' college aspirations: A social capital lens. *Computers & Education* 63:424-436.

Won, S. G. L., M. A. Evans, C. Carey, and C. G. Schnittka. 2015. Youth appropriation of social media for collaborative and facilitated design-based learning. *Computers in Human Behavior* 50:385-391.

Yang, Y. C., C. Boen, K. Gerken, T. Li, K. Schorpp, and K. M. Harris. 2016. Social relationships and physiological determinants of longevity across the human life span. *Proceedings of the National Academy of Sciences* 113(3):578-583.

Yau, J. C., and S. M. Reich. 2019. "It's just a lot of work": Adolescents' self-presentation norms and practices on Facebook and Instagram. *Journal of Research on Adolescence* 29(1):196-209.

Yau, J. C., S. M. Reich, and T.-Y. Lee. 2021. Coping with stress through texting: An experimental study. *Journal of Adolescent Health* 68(3):565-571.

Yin, X.-Q., D. A. de Vries, D. A. Gentile, and J.-L. Wang. 2019. Cultural background and measurement of usage moderate the association between social networking sites (SNSs) usage and mental health: A meta-analysis. *Social Science Computer Review* 37(5):631-648.

Yoon, S., M. Kleinman, J. Mertz, and M. Brannick. 2019. Is social network site usage related to depression? A meta-analysis of Facebook-depression relations. *Journal of Affective Disorders* 248:65-72.

Zaeske, L. M., T. P. Harris, A. Williams, H. Long, B. A. Kerr, and M. Birdnow. 2022. Adolescent technology-use and creative activities during COVID-19: A qualitative study. *Thinking Skills and Creativity* 46:101190.

Zhang, L., C. Li, T. Zhou, Q. Li, and C. Gu. 2022. Social networking site use and loneliness: A meta-analysis. *The Journal of Psychology* 156(7):492-511.

Zhou, Z., and Q. Cheng. 2022. Relationship between online social support and adolescents' mental health: A systematic review and meta-analysis. *Journal of Adolescence* 94(3):281-292.

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4

The Relation between Social Media and Health

At the center of any discussion of social media and adolescent health is a growing body of research attempting to measure the associations and disentangle the many, sometimes conflicting, often reciprocal, mechanisms through which the online experience and physical or mental health can influence each other. This chapter reviews recent evidence linking social media to various outcomes, most of them threats to health and well-being.

There are several reasons why these links between social media and health are complex. First of all, the direction of the relation is difficult to determine, as social media may influence a health outcome, and that health outcome may in turn influence subsequent social media use. There is also a lack of uniformity in research approaches. Some factors are conceptualized as a dependent variable in some studies and as an independent variable in others.[1] Third, it is difficult to study a relation between an outcome and exposure when the exposure is ubiquitous. The bias introduced by omitted variables makes it difficult to say to what extent a young person's health problems are the cause or the effect of social media use or of another, unmeasured cause. Fourth, different levels of analysis

[1] A characteristic such as self-esteem, for example, could be influenced by social media use; a pathway some research has explored (Vogel et al., 2014). Other studies have considered how a tendency to social comparison, related to self-esteem, influences the way a person uses social media and feels about this use (Vogel et al., 2015). Still other studies aim to establish only that the use of social media and self-esteem are related (Saiphoo et al., 2020; Woods and Scott, 2016).

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can sometimes reveal different dynamics that are difficult to resolve, such as large-scale studies showing health trends at the population level but psychological-level studies showing small or mixed effects. Another reason for the complexity in the relationship between social media use and health, as made clear in Chapters 2 and 3, is that social media use is not monolithic. The affordances of different social media platforms allow for a broad range of behaviors that can have dramatically different psychological and health implications. For example, using social media to connect with distant family members might be good for health, while using social media to stalk a former partner is more likely bad. Both behaviors take place on social media, and might even take the same amount of time, but the experience is different. Also, it is important to note that there are a host of proposed mechanisms that may underlie the association between social media and health, rather than a single dominant mechanism, and these mechanisms are likely not independent of one another and may also be contradictory (e.g., fostering inclusion online but displacing face-to-face interaction with family). Finally, considerable heterogeneity emerging in the literature, suggesting that the relationship between social media and health likely differs substantially among individuals, makes it difficult to make conclusions that are not highly qualified or particular to certain subgroups.

THE COMMITTEE'S APPROACH TO THE EVIDENCE REVIEW

In considering the evidence linking social media to adolescent health,[2] the committee looked at indicators of both physical health (e.g., sleep, exercise, diet) and mental or behavioral health (e.g., depression and anxiety), as well as outcomes involving salient psychological experiences (e.g., social comparison). The literature presented in this chapter is weighted toward the potential harms of social media use for adolescents' mental health, a reflection of the scientific literature. This chapter also reflects that more research has been done on mental and behavioral outcomes than on physical ones, with the exception of sleep disruptions. The committee also recognizes that physical and mental health influence each other. Sleep loss, for example, can be a cause or an effect of depression, or both; the two are often related. Moreover, the position of this committee as expressed in Chapter 1 is that mental health is health because health is more than simply the absence of disease.

There is a long-standing historical literature that social connect has physical health effects on biomarkers of disease, chronic disease, and

[2] The committee acknowledges that some pathways that have not been explicitly studied in children may still influence their health and this chapter cites some studies on older participants, usually undergraduates.

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disease-related mortality (HHS, 2023a; Holt-Lunstad, 2018, 2022; Yang et al., 2016). The long-term risk or protective value of social media to influence the same is far less well studied, a serious limitation of the research.

Inferring Causation

Most research on the relation between social media and health is cross-sectional, and the preponderance of cross-sectional research has in turn informed a number of systematic reviews and meta-analyses (see Appendix C). It is difficult to establish a cause and effect relationship on the basis of such evidence. One meta-analysis of over 200 papers published between 2006 and 2018 found small associations between social media use and anxiety and depression; it also found small associations between social media use and social connectedness, a positive outcome (Hancock et al., 2022b). A 2020 meta-analysis of fewer studies found no strong association between social networking and various measures of well-being (Appel et al., 2020); other researchers found a weak association between use of social networking and depressive symptoms (Cunningham et al., 2021). A 2016 meta-analysis found small to moderate associations between social networking use and measures of social capital (Liu et al., 2016). Other meta-analyses have suggested that the small associations may be influenced by the choice of mental health indicators (Meier and Reinecke, 2020; Yin et al., 2019).

One criterion to establish a causal relationship between an outcome and exposure is that the exposure happens before the outcome. Given the ubiquity of social media in the lives of adolescents over the last few decades, few studies are able to do this; fewer still have followed participants over a long period of time. Longitudinal designs can provide valuable insight into patterns in outcomes over time. While longitudinal research cannot in itself establish a causal relationship, such studies can help control for several types of bias introduced by individual characteristics (Vander Wyst et al., 2019). Longitudinal studies that can control for baseline variation, as with the randomized allocation of different exposures, provide even stronger evidence for causality (Toh and Hernán, 2008), but are extremely rare in the study of social media.

The committee recognizes that studies showing that a social media exposure preceded changes in mental health or well-being are not necessarily evidence that social media caused the changes. Especially in mental health epidemiology: the true onset of psychological problems can be difficult to ascertain even in clinical settings. Consider the example of a teenager learning of their parents' divorce and immediately turning to social media for solace or distraction. The psychological fallout of processing the divorce may take many months longer to manifest, confounding the causal inference.

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A final challenge is that mental health outcomes have complicated roots and are difficult to measure. There is wide variability in the methods and rigor seen in publications about social media and mental health, making it difficult to synthesize their findings (Ivie et al., 2020; Keles et al., 2020). This leaves the observer with a good amount of literature to inform theories and pique hypotheses as to how social media might be effecting young people, but with far less certitude that can, with confidence, lead to dispositive conclusions.

The committee's review of the literature presented in this chapter and Appendix C did not support the conclusion that social media causes changes in adolescent health at the population level. This chapter summarizes the evidence the committee considered on the association between young people's social media use and various measures of behavioral, mental, and physical health. It is not a systematic review; rather, this chapter presents the committee's analysis of key trends and findings in the field. In the interest of timeliness and as a reflection of the rapid pace of technological change, the analysis is weighted to relatively recent publications, primarily including literature published in the last five years (January 2018 through May 2023), along with some references published before 2018, particularly those identified in systematic reviews. Additionally, the committee conducted hand searches for landmark publications with no limits on publication date. A table of key systematic reviews and meta-analyses can be found in Appendix C.

The timing of the papers reviewed overlaps significantly with the COVID-19 pandemic. Regardless of whether researchers were explicitly studying the influence of school closures and lockdowns on social media use, the importance of this context for the questions of interest is notable. During the pandemic, adolescents used social media more frequently, both for continued communication with friends and family and for schoolwork (Bozzola et al., 2022). Social media was also one of few sources of entertainment during lockdown (Anderson et al., 2022).

HEALTH EFFECTS

Concerns about the possible health effects of media on children and adolescents have existed as long as the media have (Bandura et al., 1963; NIMH, 1982; U.S. Surgeon General, 1972). Research on the effects of social media is more recent, and as yet mostly limited to studies establishing an association between the media exposure and an outcome. Social media include a variety of affordances that are used in different ways by different people, who vary in age, developmental capacity, and susceptibilities. Further, most research is designed to assess whether social media use and various outcomes are related, not whether the media use causes the outcome in question.

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It is important to note that a great deal of this research uses between-group comparisons, such as the comparison between young people who use different platforms or have different amounts of use. Far fewer studies have looked at within-person changes related to using or not using social media. There may also be important variability in how young people of different demographic characteristics use social media that could influence their well-being. A large UK study found that the power of social media to influence well-being depended on developmental stage, with girls between ages 11 and 13 and boys between ages 14 and 15 to be in particularly sensitive window (Orben et al., 2022). Too often research groups adolescents broadly or uses convenient age cutoffs rather than grounding analyses in developmental stages or accounting for the influential timing of puberty.

Because of the profound extent of their physical, neurobiological, social, emotional, and cognitive development, adolescents may be uniquely vulnerable to health effects related to social media use (Crone and Konijn, 2018; HHS, 2023b). This chapter highlights some key evidence of this pattern and notes, when possible, the developmental features that may be behind adolescents' unique susceptibility. The analysis will include factors thought to influence health outcomes (e.g. social comparison, displacement) as well as specific health outcomes (e.g. anxiety, problematic use).

Social Comparison

Comparing oneself to others is a normal part of adolescents' identity development and can elicit both good and bad feelings. Research has found that youth using social media frequently engage in comparisons of themselves to others online, and some research suggests that social comparisons might mediate the relationship between social media use and negative affect (Fardouly and Vartanian, 2016; Nesi and Prinstein, 2015). A 2017 experiment in which high schoolers browsed Instagram found that those who engaged in higher levels of negative social comparison had significantly worse post-browsing feelings compared with peers with less negative social comparison; they were also the most helped by an intervention to reduce negative social comparisons (Weinstein, 2017).

Cross-sectional and survey research among undergraduates has found that comparisons of popularity, happiness, and likeability are part of social media use (Lee, 2014; Wang et al., 2017; Wirtz et al., 2021). Adolescents may be relatively more affected by social comparisons, however (Weinstein, 2017, 2018). Some evidence suggests that young users compare themselves to others and use that information to further explore their own identity (Noon, 2020). It is possible that lateral and downward social

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comparisons can be supportive of teens' well-being. For example, adolescents' comparisons to youth who are similar to them may contribute to benign envy (rather than malicious envy) and serve to inspire youth (Noon and Meier, 2019). Relatedly, passive social media use and upward comparisons have been found to be positively associated with materialism among adolescents[3] (Hu and Liu, 2020). A considerable amount of social media and social comparison research has focused on body image and attractiveness (discussed later in this chapter), rather than constructs such as happiness and popularity.

Social comparisons seem to be more common among younger adolescents than older teens and adults, although experimental research has not focused as closely on this age range. A systematic review of mostly cross-sectional research on problematic social media use (loosely defined as use that causes dysfunction in daily life and offline activities) among adolescents and psychiatric disorders highlighted a series of studies that found negative social comparisons around body image to be related to depressive symptoms, especially among girls. In this study, this was not found to be related to time on social media, but rather to social comparisons (Cataldo et al., 2020). These comparisons may be worse when the subject of the comparison is a celebrity or an acquaintance, and less so for close friends and family (Scully et al., 2023).

The problems related to social comparison are thought to be worse for teens who engage in so-called upward comparisons, viewing other people better off in some way—happier, more popular, or more attractive than themselves (de Vries et al., 2018). Longitudinal research looking at the effect of social media within a person (i.e., the same person over time) found no overall association between social media use and life satisfaction (Boer et al., 2021). A Dutch study assessing social media use and self-esteem 6 times a day over 3 weeks found no within-person relationship between social media and self-esteem, giving more support to the idea that one's susceptibility to the helpful or harmful influence of social media varies widely among individuals (Valkenburg et al., 2021). Individual styles of using social media may account for some of the difference. A repeat-measure, cross-sectional study of younger adolescents (aged 10 to 14 years) found that social media use characterized by viewing and responding to other people's posts rather than sharing about oneself was associated with a lower self-esteem regarding appearance in girls (Steinsbekk et al., 2021).

Some research suggests that certain youth might be more at risk for making negative social comparisons and for feeling badly as a result. In

[3] Passive social media use refers to monitoring other people and scrolling through their information without directly engaging. Active social media use, in contrast, refers to messaging friends and broadcasting information about oneself (Valkenburg et al., 2021).

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a study of 8th and 9th graders, researchers found that young people who were rated as low in popularity by their peers were more likely to engage in social comparison and report more depressive symptoms afterward (Nesi and Prinstein, 2015). The user's inclination to social comparison online is related in turn to self-esteem—with girls being more susceptible to negative comparisons (Cingel et al., 2022). Survey research among young (mostly undergraduate) Black women suggests that social media comparison to an idealized archetype (in this case "the Strong Black Woman") is associated with lower self-esteem, though the direction of the association is not possible to determine (Stanton et al., 2017). (That is, it may be that women who are struggling in other ways endorse ideals of Black womanhood as a coping strategy, or the exposure to this ideal raises feelings of inadequacy in otherwise healthy women.) A systematic review of studies involving youth under 19 years of age suggested that low self-esteem and social comparison may account for the relationship between problematic social media use and depression (Cataldo et al., 2020).

Family dynamics may also play a role in youth's social comparisons on social media and subsequent feelings of sadness. Parents' monitoring of social media, their communication with their children, and baseline family conflict could be background factors that influence young people's mental state and attitude toward social media. A study of children between 10 and 12 years old found that more parental control was related to less social media use and less frequent social comparisons when browsing, which in turn predicted better mental health (Fardouly et al., 2018).

Body Image, Body Satisfaction, and Disordered Eating

There is long-standing concern that exposure to unrealistic images of female beauty in the media, not only social media, can drive feelings of body dissatisfaction, especially in girls and women (Botta, 1999; Stice and Shaw, 1994). The prevalence of the thin-ideal images on social media has been cited as a cause of both clinical eating disorders and problems such as depression and anxiety (Fitzsimmons-Craft et al., 2020). Nevertheless, it is difficult to disentangle the causal factors in this relationship.

To start, the psychological factors that influence the development of eating disorders including anxiety, depression, and obsessive-compulsive behaviors, can also manifest in disordered behaviors such as overuse of social media (Barakat et al., 2023; Yurtdaş-Depboylu et al., 2022). It is also true that someone suffering from disordered or ruminative thinking about food and diet may use social media to seek out information about thinness and dietary restriction. The potential for algorithmic feedback to promote disordered eating to people who are already at high risk raises heightened

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concern. Research among teens in treatment for eating disorders found that the patients who spent the most time on TikTok do so despite a concern that social media is harmful to their health and self-esteem (Pruccoli et al., 2022). The same platform that helps some patients find recovery support was, for others, a source of body shaming and rumination (Pruccoli et al., 2022).

Social comparison may play a role in teens' body image and body satisfaction. At the same time, clinical eating disorders are exceedingly rare,[4] so the population-level effects of social media to encourage them is not easily quantified. Research among young women finds little effect of viewing fitness and thinness influencers on perceptions of one's own body image (Cohen and Blaszczynski, 2015; Fardouly et al., 2015; Haferkamp and Kramer, 2011; Tiggemann and Zaccardo, 2015). Yet the photo-sharing emphasis of some social media platforms, coupled with some users' high investment in self-image, has been proposed as a risk for eating disorders (Saul et al., 2022).

A cross-sectional study of middle schoolers, for example, found that youth who had more body dissatisfaction engaged with social media more and reported more online social anxiety, depressive symptoms, and difficulty with offline relationships (Charmaraman et al., 2021). In focus groups, girls of the same age have acknowledged using social media for comparison, although the harms were greatly mitigated by factors such as baseline media literacy, supportive relationships with parents, and a nurturing school environment (Burnette et al., 2017). Similar research on the correlation between social media use and body dissatisfaction among teens found the association was weaker for those who reported positive relationships with their mothers, suggesting that some home and environmental factors might be protective (de Vries et al., 2019).

The type of behavior young people engage in on social media may contribute to disordered eating. Soliciting other users' ratings of one's appearance is, unsurprisingly, associated with shame and the constant monitoring of appearance, especially among girls (Salomon and Brown, 2018).

The risk of social media to aggravate body image problems may also be a function of advertising. Advertisements for cosmetics and beauty products are some of the most commonly shown to teenagers (Slater et al., 2012). At the same time, labeling of altered or enhanced advertising images, mandatory in some countries, does not appear to reduce the com-

[4] The National Institute of Mental Health estimates the population lifetime prevalence of anorexia nervosa as 0.6 percent (0.9 percent in females, 0.3 percent in males); the point prevalence of bulimia nervosa was 0.3 percent (0.5 percent in females, 0.1 percent in males) (NIMH, 2023).

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parisons or negative feelings associated with viewing them (Tiggemann, 2022).

There is little research explicitly examining the effect of social media use and body image and related issues among male, transgender, or nonbinary teens. Most studies in the field look at the association between social media use and body image among cisgender female users (Rodgers and Rousseau, 2022).

Displacement

One of the main ways social media use affects health is by taking up time that would otherwise have been spent differently. The displacement of time otherwise given to sleep, exercise, or hobbies can have consequences for health (Twenge et al., 2018). If time spent on social media replaces time spent sleeping or leads to withdrawal from friends and hobbies the displacement seems to predict depression and anxiety (Hökby et al., 2016). For example, a recent systematic review found social media use to be associated with consumption of fast food, sugary drinks, and a diet of unhealthy snacks, possibly because of displacement of regular meals or encouragement of mindless eating (Sina et al., 2022). Social media can also displace less healthy activities. For adolescents in emotionally volatile homes, interacting on social media may provide a welcome respite from listening to family members argue; engaging in a gamified fitness challenge could displace sedentary screen time. Nevertheless, most literature on displacement looks at its relatively straightforward effects on sleep or physical activity.

Considerable observational and cross-sectional research links the use of screen media to less sleep, later bedtimes, poor quality sleep, and daytimes sleepiness in young people (Carter et al., 2016; Hale et al., 2019). A systematic review of only high and moderate quality studies (8 longitudinal and 35 cross-sectional designs) found consistent associations between digital media use and delayed sleep, daytime sleepiness, sleep duration and quality, and sleep deficiency among young people aged 16 to 25 (Brautsch et al., 2023). The same review found that computer, internet, and social media use were associated with shorter duration and poorer quality sleep, though the same association was not evident for television, game console, or tablet use (Brautsch et al., 2023). A high level of mental stimulation time lost to social media (compared with more passive activities) may account for the reduced quality of sleep (Alonzo et al., 2021). The consequences of sleep loss are revisited later in this chapter.

Increasing use of digital technology, including social media, is also associated with a sedentary lifestyle, which can pose health risks for anyone, but especially for children (Oh et al., 2022). A nationally repre-

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sentative, cross-sectional study of over 40,000 students in 8th, 10th, and 12th grades in the United States found that regular social media use was associated with extremes of health behaviors (Shimoga et al., 2019). That is, among physically active teens frequent social media use was associated with high levels of physical activity, while frequent social media use was associated with sedentary behavior among the least active teens (Shimoga et al., 2019). Similarly, poor sleepers who used social media frequently had a greater disruption to their sleep than adequate sleepers who use social media to the same extent (Shimoga et al., 2019). It may be that young people merely extend their existing personality and behaviors into their social media use, with users of moderate intensity having better well-being than their peers who use social media heavily or not at all.

Chapter 8 of this report explains why raw screen time is not generally a useful research variable, although studies of displacement may be an exception to that rule. Entertainment screen time displaces time spent in sleep and exercise and is a risk factor for clinically problematic use (Gentile et al., 2017b; Lua et al., 2023). Having screen media in children's bedrooms, for example, is associated with increased time spent on media, which in turn statistically predicted poorer school performance, greater risk for obesity, and a greater risk for gaming disorder (Gentile et al., 2017b).

Yet the extent to which social media use displaces unambiguously healthy pastimes such as sport and sleep appears to vary across socioeconomic background. The amount of sleep adolescents get each night has been in decline since the 1990s, with teens from minority racial and ethnic groups and of lower socioeconomic status the most likely to be in sleep deficit (Keyes et al., 2015). Teens and young adults from lower-income households and from some minoritized ethnic groups have been shown to experience a higher burden of sleep disruption related to social media use than their White or more affluent peers (Levenson et al., 2017). The same trends are even more pronounced in relation to measures of overweight: a problem that has been increasing in the United States since at least the 1980s and is disproportionately found among children of lower-income and less educated parents (Ogden et al., 2010, 2018). Combined with evidence that young people from the highest income families tend to limit their use of social media, there is reason to suspect that social and economic factors confound many of risks attributed to social media use (Micheli, 2016).

Attention and Learning

Humans learn from whatever they pay attention to, and adolescents are no different. Learning occurs through several mechanisms (Gentile and Gentile, 2021). Not only can the content consumed via social media

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be learned, but so can ways of processing information. Because social media can be consumed in small amounts of time and are often used while multitasking (i.e., looking at social media feeds while also doing something else, such as homework, having a conversation, or watching TV), this could have an effect on attention, which in turn, can influence learning and school performance.

The distracting power of social media may work through the attentional vigilance elicited by social media notifications, likes, or messages, especially among adolescents who may be more sensitive to these features. Adolescence is an important developmental window for the cultivation of attentional control, a skill necessary for academic success and socioemotional adjustment (Rueda et al., 2010; Siebers et al., 2022). Social media prompts users to continual connectivity, which can make it more difficult to stay on task and concentrate (Dontre, 2021). Partly for this reason, social media use is thought to reduce adolescents' ability to sustain attention and suppress distraction, key components of concentration. Some evidence supports this theory. A study using repeated measures multiple times a day over 21 days found that social media use was associated with distraction among 7th and 8th graders despite the participants' reports of feeling little distraction on average (Siebers et al., 2022). A recent network analysis in the UK found time spent on social media predicted concentration problems in adolescent girls (though time spent on social media was not an influential predictor of other mental health problems) (Panayiotou et al., 2023).

At the same time, it is difficult to say that the distraction posed by social media is a function of the media. Reading on screens is fundamentally distracting, as it is difficult to separate the act of reading from other notices and incitements to multitask (Liu, 2022). Switching between tasks poses serious cognitive demands (Dontre, 2021), which are likely magnified for adolescents. Research among undergraduates, presumably at least somewhat motivated students, found that in 3 hours of studying students encounter an average of 35 distractions that divert their attention for a total of 25 minutes (Calderwood et al., 2014). That said, an experiment banning laptops from undergraduate classrooms found no benefit, even a possible detriment to learning (as students in the no-laptop group simply did not come to class) (Elliott-Dorans, 2018). A 2018 meta-analysis found mobile phone use in the classroom to modestly interfere with student learning and academic performance, although this small effect was driven more by undergraduates than K through 12 students (Kates et al., 2018).

One meta-analysis found associations between media multitasking and problems with attention regulation (e.g., increased mind wandering and distractibility), behavior regulation (e.g., emotion regulation and self-monitoring), inhibition or impulsiveness (e.g., higher level of impul-

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siveness and lower level of inhibition), and memory (Wiradhany and Koerts, 2021). Effect sizes were small ($z = 0.16$ to 0.22) but significant for each of the four aspects measured. Another meta-analysis found a small but statistically significant associations between media multitasking and problems with cognitive control, ability to sustain attention, and working memory (Parry and le Roux, 2021).

There is also evidence that screen media use in general is associated with attention problems, such as attention-deficit/hyperactivity disorder (ADHD). Longitudinal studies have found the amount of media use can predict ADHD symptoms, although it is likely a reciprocal relationship (Gentile et al., 2012; Swing et al., 2010). Similarly small associations have been recorded between media use and ADHD-related behaviors such as inability to focus, hyperactivity, and impulsivity (Beyens et al., 2018; Nikkelen et al., 2014).

Family and Media Use

Family practices, especially parents' decisions regarding media use, likely influence the extent to which social media affects teenagers' mental health and well-being. Parental rules, communication, and the monitoring of media have been conceptualized in a variety of ways. Many parents use messaging apps and social media to connect with their children throughout the day, and research using intensive daily monitoring of teens' phones found that Black and Hispanic teens had more digital contact with their parents than White teens, and daughters had more frequent contact than sons (Jensen et al., 2021). Using social media to stay connected to children may improve parent–child communication and afford parents' greater involvement in their children's lives (Dworkin et al., 2018; Rudi and Dworkin, 2018). Yet given the mainly cross-sectional study designs in this field, it is difficult to disentangle whether parents' rules are an influence on their children's social media use or a reaction to their children's experiences online.

A recent meta-analysis on the role of parents to reduce the harm of social media found that parents' co-using and actively guiding their children's media was associated with a small but helpful effect to reduce the risk of problematic use and inappropriate behavior online, although more for children than older adolescents (Chen and Shi, 2019). Parents' imposition of restrictions on media use was associated with less time spent online, though mostly for younger children (Chen and Shi, 2019). A similar meta-analysis found the same coviewing and active guidance parenting strategies to be related to less aggression in response to viewing violent media and improved concentration and less problematic use of TikTok (Collier et al., 2016; Qin et al., 2023). A large survey of Spanish

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teens found that parents' restrictions on online media use were associated with lower digital literacy and poorer understanding of online risks in their children (Rodríguez-de-Dios et al., 2018).

In guiding their children's and teens' media use, parents need to consider their children's increasing maturity and give progressively more independence with age. It is likely that restrictions on media use are useful for young children, while increased communication and awareness are more suitable and helpful for teenagers (Gabrielli and Tanski, 2020; Young and Tully, 2022). More restrictive rules around social media, when communicated in a way that recognizes and supports the adolescent's increasing independence, has been shown to be effective in decreasing the aggression associated with violent media viewing (Fikkers et al., 2017). Survey data has found associations between parents' restrictive and controlling use of technology, such as confiscating an adolescent's phone for punishment, with young people taking more risks online, as in interacting with strangers, while a more open and communicative style about rules and expectations online was associated with fewer risks (Young and Tully, 2022).

There is some indication that family structures and the quality of parent–child relationships influence how teens use social media and the risks and benefits of that use. On average, adolescents from single parent households use more digital technology and also may experience more problematic media use than their peers in two-parent households (Bloemen and De Coninck, 2020; Ko et al., 2015; Mei et al., 2016). Adolescents who are among the highest users of social media tend to come from families characterized by greater conflict and lower perceived support (Vannucci and McCauley Ohannessian, 2019). Some researchers have suggested that problems with parent–child attachment may be a pathway to compulsive social media use in later life (D'Arienzo et al., 2019). Open communication between parents and teens appears to be key to optimal social media use (Padilla-Walker et al., 2011; Reid Chassiakos et al., 2016).

Feelings of Sadness, Anxiety, Depression, and Stress

Feelings of sadness, anxiety, depression, and stress are some of the most frequently studied outcomes related to social media use. Studies across adolescent samples in the United States and other countries do not find a consistent pattern (e.g., Bezinovic et al., 2015; Hoare et al., 2017; Kircaburun, 2016; Kreski et al., 2021; Wartberg et al., 2020; Zhang et al., 2019). The larger sample sizes and increased statistical power associated with meta-analysis generally find small and inconsistent effects. This might be due to variability in measures of social media use, that is, the lumping together of different platforms or different types of use, or of

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using relatively crude proxies such as screen time. Variability in the uses of social media is another explanation, with demographic, neurological, and developmental differences all possibly influencing the results. In one meta-analysis, the most often replicated finding was that the small portion of youth who engage in very high, problematic levels of media use tend to also experience more depressive symptoms (Shannon et al., 2022).

Studies looking at the association between social media use and feelings of sadness over time have largely found small to no effects. An 8-year longitudinal study of a nationally representative sample found no association between time using media and self-reported feelings of sadness (Coyne et al., 2020). A shorter-term study using more precise time measurement, asking youth throughout their day about their mood and every evening about their smartphone activities, found no association between device use and mental health (Jensen et al., 2019).

Any study that asks participants to recall their mood or their behavior is vulnerable to bias, especially if the behaviors recalled are relatively mundane and forgettable. A technique called ecological momentary assessment aims to reduce such bias by sampling participants at random times and supporting these brief assessments with electronic records or psychological sensors (Shiffman et al., 2008). A study using this technique found that girls aged 11 to 13 years experienced more lingering emotional pain from negative interactions with friends on social media than from the negative interactions offline (Hamilton et al., 2021). In general, ecological momentary assessment studies have found limited to weak evidence of the association between mental health and media use (Houghton et al., 2018; Jensen et al., 2019; Sewall et al., 2021).

A 2020 meta-analysis including studies on 11- to 18-year-olds found a small association between social media use and symptoms of depression, but the authors cautioned against overinterpreting this result given the heterogeneity in the studies reviewed and overall small effect size (Ivie et al., 2020). A similar review, this one including both adults and adolescents, found an association between depression and time spent on social media, frequency of checking social media, and engaging in upward social comparisons, though the effects ranged from small to medium and varied widely among studies (Yoon et al., 2019).

Another recent meta-analysis of cross-sectional and longitudinal studies of social media (mainly Facebook) and well-being found a very small but positive relation between social media and depression, with a modestly stronger, though not statistically significant, relationship seen in college-age samples than in younger adolescents (Hancock et al., 2022a). A similarly small relationship has been observed between social media use over time and rates of depression (Orben and Przybylski, 2019).[5]

[5] This section was modified after release of the report to more accurately reflect the paper cited and to remove an incorrectly cited reference.

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Several meta-analyses and systematic reviews have used raw screen time as an exposure variable (Li et al., 2022; Liu et al., 2022; Santos et al., 2023; Tang et al., 2021). Such results are difficult to interpret as screen time as an umbrella category can encompass widely varying exposures. For example, a recent meta-analysis pooled estimates of time on social media and depression from cross-sectional and longitudinal studies and found a linear relationship between risk of depression and time spent on social media, with risk of depression increasing an estimated 13 percent with every additional hour of exposure, with the pattern being more pronounced in girls than boys (Liu et al., 2022). At the same time, the authors cautioned against using observational studies to support any causal claims, as the studies included were vulnerable to bias, with depressed participants being more likely to report higher social media use (Liu et al., 2022).

A longitudinal study of younger adolescents (aged 11 to 14 years) found that not just time but the number and variety of platforms used were predictive of later feelings of sadness, with high social media use associated with worse mental health, especially when using more platforms (Vannucci and McCauley Ohannessian, 2019). A 2021 meta-analysis found time and intensity of social media use to be associated with depressive symptoms for adults and for youth but measurement aspects, such as whether participants were recruited through social networking sites or other spaces, influenced effect estimates with the estimate of the effect being stronger in studies that recruited through the platforms (Cunningham et al., 2021).

Clinical Samples

Young people with clinically meaningful depression are an important population to consider in understanding the risks of social media. Elias and Gorey's scoping review of social media use among patients with clinical or bipolar depression found their perceptions of social media use to be twice as related to positive and protective effects than negative ones (Elias and Gorey, 2022). Others have found baseline levels of depression to predict media use more than media use predicting depression (Heffer et al., 2019). A small body of research suggests that depressed users may engage with social media differently than the general population; machine learning tools can identify depressed mood in social media posts (Ghosh and Anwar, 2021; Zogan et al., 2022). A narrative review of self-harm and social media found that self-injurious and suicidal young people use social media to seek out support from others like themselves but are also likely to seek out and be exposed to self-harm content, which they may then come to see as normal (Memon et al., 2018).

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Patterns of Use

Some research suggests that the relationship between social media use and feelings of sadness might be circular. In a sample of Chinese undergraduates, passive social media use predicted depressive symptoms and depressive symptoms predicted passive social media use (Wang et al., 2018). Similar patterns seem to apply to adolescents. Passive browsing on Instagram has been shown to be related to depressive symptoms in 11- to 19-year-olds (Frison and Eggermont, 2016). Adolescents with higher depressive symptoms tend to spend more time on screens, and social media use among adolescents may predict depression risk over time (Houghton et al., 2018; Raudsepp and Kais, 2019).

Other researchers have proposed that the type of social media use is the principal feature that determines its relative harmfulness (Valkenburg et al., 2021). A review of longitudinal studies found that passive social media use is associated with low life satisfaction and feelings of sadness, though the relationship between active use and life satisfaction is less clear (Course-Choi and Hammond, 2021). In a sample of youth with mild to severe depressive symptoms, Nereim and colleagues (2022) used ecological momentary assessment to determine that, on average, active social media use was related to better mood and passive use to worse mood, but these patterns of results varied by race and ethnicity (differences discussed in the next section). Similarly, a review of the quality of social media use and depressive symptoms among teens and adults found that negative quality social media use (referring to use that is likely to undermine one's psychological well-being such as use characterized by bullying or envy) was related to depressive feelings, and these findings did not differ between adults and teenagers (Vahedi and Zannella, 2021).

Differences Among Youth

The connection between social media use and adolescent depressive symptoms might vary among different demographic or identity groups. A systematic review of mostly qualitative and cross-sectional research on this connection among LGBTQ+ teens found that social media use was associated with fewer depressive symptoms but more risk of discrimination (Berger et al., 2022). Although systematic reviews of racial and ethnic differences in the association between social media and adolescent health have not yet been published, research suggests differences exist. For example, using within-person comparisons among young people with mild to severe depressive symptoms, Black, non-Hispanic participants reported more negative mood during active social media use and White, non-Hispanic youth reported less positive mood during passive social

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media use (Nereim et al., 2022). Like LGBTQ+ adolescents, adolescents of color are also more at risk for exposure to discrimination and bias online which can result in increased depressive symptoms and even post-traumatic stress disorder symptoms (Tynes et al., 2019). In general, there are both benefits and harms involved with social media use for sexual and gender minorities and for teenagers of color.

Some studies have shown that the association between social media use and measures of depression and anxiety is similar for male and female adolescents; others have seen the association only among girls (Keles et al., 2020). Other investigators have suggested that passive social media use may predict more problems in female teens and active use in male teens (Frison and Eggermont, 2017). Socioeconomic status is less studied, although family income is related to both mental health and adolescents' access to and use of social media (Odgers and Robb, 2020). Young people from the lowest income brackets are more likely to have online experiences spill into their in-person world, as with online arguments becoming conflicts at school (Odgers, 2018). There are socioeconomic dimensions to whether a young person has a device or reliable internet access with which to use social media in the first place (Odgers and Robb, 2020). There is also some evidence that the relationship between social media use and some outcomes varies by household income. Among 10- to 14-year-old participants in the Adolescent Brain Cognitive Development (ABCD) Study, higher household income was associated with more problematic video game use for Black adolescents, but not White ones (Nagata et al., 2022).

Consequences of Exposure to Pornography

While not a feature of social media use per se, social media can be an avenue of exposure to online pornography. A Common Sense Media survey of more than 1,300 13- to 17-year-olds found that almost three-quarters of teens had seen pornography online, with social media being the point of access for about 18 percent of respondents (Robb and Mann, 2023). Accidental exposure to pornography, through clicking on an ad or link, accounted for 40 percent of reported exposure, with the average age of first exposure being 12 years (Robb and Mann, 2023). About half of teens surveyed reported viewing pornography with violent themes such as rape, choking, and infliction of pain (Robb and Mann, 2023).

Survey data indicate distress, shock, and disgust are common reactions to unwanted pornography viewing among children and teens (Flood, 2009). It is not easy to say what the longer-term effects of this exposure may be. Sexualized exposure to women may increase acceptance of gender stereotypes (Ward, 2003). Pornography can also influence ado-

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lescents' reference points for normal sexual behavior, normalizing aggressive behavior in dating and sexual experiences (Flood, 2009; Rodenhizer and Edwards, 2019; Wright, 2014). Repeated exposure to inappropriate sexual content in childhood is associated with risky sexual behavior in later life; there is some evidence that repeated exposure to pornography in adolescence is associated with a skewed understanding of healthy sexual relationships (Bozzola et al., 2022; Maurer and Taylor, 2020).

Sleep

There are three main ways in which digital media use can disrupt sleep quality and duration (LeBourgeois et al., 2017). First, media use can displace sleep by delaying bedtimes, disrupting sleep through notifications, and reducing sleep duration by waking earlier to check phones (Hale et al., 2019; LeBourgeois et al., 2017). Second, devices can disrupt circadian rhythms through their light emissions which can heighten arousal, decrease sleepiness at night, and reduce melatonin production (Chang et al., 2015; LeBourgeois et al., 2017). Third, media use can be psychologically stimulating in which interactions with others, fear of missing out, and viewed content can affect mood in ways that make sleep difficult (Cain and Gradisar, 2010; LeBourgeois et al., 2017).

A review of video game use and sleep found gaming predicted delayed bedtimes and reduced attention the following day (Peracchia and Curcio, 2018). Use of smartphones and other media devices at night has been shown to delay sleep among adolescents and young adults (Chang et al., 2015; Figueiro and Overington, 2015; Orzech et al., 2016). In focus groups, teenagers reported a need to check and respond to messages to be a large contributor to insufficient sleep, delayed bedtime, and daytime tiredness (Scott et al., 2019). Research among undergraduates that relied on logging software to record use of phones and computers found that sleep can also influence social media use, with sleep-deprived participants showing worse mood, more social media use, and problems with concentration (Mark et al., 2016).

Sleep is important for everyone's physical and mental health, especially so for adolescents given their rapid physical and cognitive growth (NHLBI, 2022). Adolescents need between 8 and 10 hours of sleep for every waking day to support the changes brought about by puberty, growth of long bones, and neurological development (Paruthi et al., 2016). A serious consequence in its own right, sleep loss is also a risk factor for depression, mood disturbances, injuries, attention problems, and excessive weight gain (Lowry et al., 2012; Owens and Weiss, 2017; Paruthi et al., 2016). A nationally-representative, cross-sectional study found that only slightly more than a third of parents of teenagers aged 12 to 17 had

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rules about smartphone use at bedtime, but adolescents whose parents had such rules had far less experience of daytime sleepiness (Hamilton and Lee, 2021).

Daytime sleepiness is far from the only consequence of sleep loss in teens. In an experimental setting, when adolescent participants were allocated to have 10 hours a night in bed for sleep or a sleep schedule restricted to 6.5 hours a night (representing only roughly 30 minutes shorter than U.S. teens' sleep on average [Nationwide Children's, 2023], teens with restricted sleep were seen to have more problems with emotional regulation, feelings of anxiety, hostility, and fatigue (Baum et al., 2014). Analysis of the Centers for Disease Prevention and Control's Youth Risk Behavior Surveys analysis suggests that relative to young people who sleep 8 hours a night, those who sleep 4 or fewer hours a night have 5.9 times higher odds of having a serious suicide attempt (95 percent confidence interval 2.8 to 12.6); those who slept more than 10 hours a night had 4.8 times increased odds of having a serious suicide attempt (95 percent confidence interval 1.3 to 17.1) (Fitzgerald et al., 2011).

Given the importance of sleep for emotional regulation and concentration in adolescents, its relation to mental health problems is powerful on its own. The evidence linking social media to sleep loss is therefore concerning and may be the most plausible mechanism through which social media could be harmful.

Internet Gaming Disorder

There is a considerable body of research suggesting that some heavy users of online video games develop dysfunctional symptoms. There is good consensus that internet gaming disorder, the "persistent and recurrent use of the internet to engage in games, often with other players, leading to clinically significant impairment or distress" is a problem deserving of further study; it was added to the fifth edition of *Diagnostic and Statistical Manual of Mental Disorders* (APA, 2013, p. 795). The body of research accumulating since 2013 led to gaming disorder (also commonly known as "video game addiction" or "gaming addiction") being included in the *International Classification of Diseases*, 11th revision (ICD-11) as a disorder caused by addictive behavior (WHO, 2019). The *ICD-11* description emphasizes that the disorder must be a persistent pattern over which the gamer has impaired control to the point that gaming takes precedence over other interests and daily activities. The gaming behavior must escalate despite causing problems for the gamer such as interpersonal conflict, poor grades, and deteriorating health. The behavior must also be apparent over an extended time, not accounted for by any other mental disorder nor related to use of any substance or medicine, and the source of distress

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or impairment in some aspects of life functioning (WHO, 2019). In short, both definitions emphasize the power of technology to disrupt healthy functioning, not how much time is spent with the technology, though it would be unusual if dysfunctional use were not also lengthy.

Estimates of the prevalence of internet gaming disorder vary depending on sample characteristics and measurement techniques, and range from about 1 percent to 10 percent of users (Gentile et al., 2017a). Meta analyses of internet gaming disorder estimate a prevalence among adolescents from 4.6 percent to 8.8 percent with male adolescents being affected the most (Fam, 2018; Gao et al., 2022; Stevens et al., 2021). Internet gaming disorder effects adolescent males five times more often than adolescent females (Fam, 2018).

Given that gaming disorder is defined by dysfunction, it is not surprising that many studies find evidence that it statistically predicts depression, anxiety, social phobia, poor school performance, sleep disruption, and poor relationships with parents and peers (Ahmed et al., 2022; Gentile et al., 2009; Gentile et al., 2011; Mannikko et al., 2020; Ostinelli et al., 2021; Teng et al., 2020). Acknowledging that most young people who play video games do not become addicted to them, it is important nevertheless to recognize that a nontrivial percentage do. Without treatment, the consequences on health and social functioning for these young people can be serious.

Problematic Social Media Use

Social media use can also be considered problematic when it causes dysfunction in daily life activities such as in-person activities, schooling, and sleep (Caplan, 2010; Casale and Banchi, 2020). While problematic social media use is not yet classified as a disorder, it is associated with other mental health problems. A meta-analysis of international studies found that problematic social media use, mainly use of Facebook, was associated with worse mental health, especially depression, although this analysis was heavily weighted to adult samples (Huang, 2022). What is more, problematic social media use, like internet gaming disorder, is often associated with disruptions in sleep, mood, and functioning that could have independent effects on mental health (Bányai et al., 2017; Paakkari et al., 2021; Pontes, 2017).

There is no consistent estimate of the extent to which problematic social media use predicts other mental problems. Multiple studies have found problematic level of social media use to be associated with poor mental health, loneliness, and suicidality (Bányai et al., 2017; Marino et al., 2018; O'Day and Heimberg, 2021; Sedgwick et al., 2019). Other studies have shown that problematic social media use earlier in adolescence

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(ages 10 to 16) predicted depression and lower life satisfaction a year later (Boer et al., 2022).

It is currently unclear whether problematic social media use and gaming disorder are distinct disorders or are simply different manifestations of a similar disordered use of technology. A 2-year longitudinal study of risk factors for gaming disorder and a more general internet use disorder, found more similarities than differences in risk factors (Kim et al., 2022). Cross-sectional research has found similar overlap in risk factors for internet gaming disorder, problematic social media use, and the more general problematic internet use (Moreno et al., 2022).

At the time of this report, only gaming disorder has been officially recognized as a mental health disorder by the World Health Organization. There is some suggestion that males are more likely to become addicted to gaming whereas females are more likely to become addicted to social media (Leonhardt and Overå, 2021). One meta-analysis of 140,000 people in over 20 countries demonstrated this basic finding, but also noted that the gender-correlated difference appears larger when focusing on social media specifically rather than more general internet addiction (Su et al., 2020). Nonetheless, the body of research demonstrating that a subset of social media users and gamers experience substantial dysfunction is growing rapidly (King et al., 2013).

Virtual Reality

While not a form of social media per se, virtual reality can be a feature of various video games and social media platforms. Still a relatively new feature of social media, the literature on the effects of virtual reality on health is scant. These affordances are accessed through virtual reality headsets, can create a psychologically and physiologically immersive experience mimicking the real world in ways that children cannot necessarily identify as symbolic or not real, though few studies have explored the effects of virtual reality in participants younger than 18 (Bailey and Bailenson, 2017).

Virtual reality headsets can put considerable strain on the eyes (Hirzle et al., 2022). Headache, nausea, and upset stomach are also common side effects of using virtual reality (Zhang, 2020). For this reason, some guidance has suggested restricting the length of time that children can use virtual reality to 10 or 30 minutes and to be especially mindful of restrictions in children with a history of eye problems (Bailenson, 2023; Yamada-Rice et al., 2017).

On the other hand, virtual reality technology has promise as a teaching tool, especially for immersing students in experiences that would otherwise be dangerous, impossible, or counterproductive (Bailenson,

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2023). Skills for which the practice involves risk of injury, including rough sports such as football, may be well suited to virtual training models, as are simulations of behaviors that could not be done in real life because their consequences are too severe (e.g., the conservation lessons learned from a simulated experience of cutting down a tree) or too expensive (e.g., snorkeling on a coral reef) (Bailenson, 2023). The technology can be useful to imitate experiences of living in a different body, which may cultivate empathy, as in the immersive 1,000 Cut Journey experience meant to help people understand the cumulative toll of racism (Cogburn et al., 2018).

Virtual reality programs offer promising options to support adolescent health, particularly for the provision of clinical mental health services and stress management programs (Björling et al., 2022; Hugh-Jones et al., 2023). A systematic review of virtual reality in hospitals found that the technology had a distracting power, which could be a useful tool to reduce pain and anxiety in young people (Ridout et al., 2021). At the same time, the newness of the technology and its known physical risks prevent any widespread endorsement of virtual reality other than for clearly targeted uses of short duration.

Engaging and Practicing Health-Promoting Behavior

Social media could potentially influence health by providing young people with trustworthy sources of health information. At the same time, a recent systematic review found that adolescents' consumption of health information on social media may be as much about building community and connectedness as building health knowledge (Freeman et al., 2023). As with teens' attitudes toward political comments on social media, adolescents use considerable discretion in identifying suitable health topics to share about on social media, their decisions being heavily influenced by social norms in their peer group (Freeman et al., 2023). Possibly because of distrust of the platforms or from compartmentalizing, many teens appear disinclined to follow health-related social media pages or post about health to their profiles (Leary et al., 2019). That said, the internet more broadly is a useful tool to learn about health. A survey of teenage boys found that almost half use social media sites to find out about mental health topics that they would never ask another person about (Best et al., 2014).

The reach and scale of social media platforms means they can be harnessed for health education and behavior change and may be useful to reach vulnerable young people and promote health equity (Hunter et al., 2019; Welch et al., 2016).

There is modest evidence that social media can be used to improve diet and nutrition as well as knowledge of how to prevent HIV and other

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sexually transmissible infections among teens (Hsu et al., 2018; Wadham et al., 2019). Some interventions are targeted at important subpopulations, such as pregnant teenagers, for whom social media has been used with some success to improve nutrition knowledge and diet (Vander Wyst et al., 2019).

Social media can also be a powerful tool for targeted health promotion, including messages about mental health and suicide prevention (Latha et al., 2020). Digital tools can be used to help bring mental health help to people who might not otherwise access it (Bucci et al., 2019). The same monitoring has been successful for teens with asthma (Panzera et al., 2013). Qualitative research has found that by serving as a vehicle to promote lived experience, social media can inspire more intentional seeking of health information among LGBTQ+ teens (Hsu et al., 2018).

There is also a world of socially connected apps that can be used for health promotion, including menstrual cycle, diet, and exercise tracking apps. These apps might make a game of exercise among friends, for example, and could be appealing to teens (Ludwig and Galluzzi, 2018). A 2016 study found that 29 percent of teens who had a smartphone had downloaded some health-related apps (Wartella et al., 2016). These could be useful for health promotion, as when paired with appropriate counselling (Singh et al., 2014). However, menstrual cycle tracking apps, for example, could be misleading to young users given their predictions of fertile and infertile windows (Fowler et al., 2020). As with any app that collects sensitive health information, data privacy, a topic discussed more in the next chapter, is a heightened concern.

GUIDELINES AND RECOMMENDATIONS FROM OTHER AUTHORITATIVE BODIES

As this chapter has made clear, the scientific literature on the health effects of social media use is mixed and inconclusive. At the same time, there is consistent demand for syntheses of this literature, which several authoritative bodies have provided. Table 4-1 summarizes recent guidance on adolescents and social media use from the American Academy of Pediatrics, American Psychological Association, and the U.S. Surgeon General. In general, these groups have given professional practice guidelines and advice on "roles, patient populations, or practice settings based on current research and professional consensus," (APA, 2021, p. 4). These should not be mistaken for clinical practice guidelines that are developed for clinicians and depend on a fairly high standard of evidence (IOM, 2011).

Table 4-1 reflects broad consensus on several points related to young people's use of social media. All three documents, like this report, empha-

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TABLE 4-1 Authoritative Bodies' Guidance on Social and Digital Media Use and Adolescents

Publication	Target Audience*	Guidance or Recommendations
Media Use in School-Aged Children and Adolescents[a]	Pediatricians	• Work with families and schools to promote understanding of the benefits and risks of media • Promote adherence to guidelines for adequate physical activity and sleep via a family media use plan • Advocate for and promote information and training in media literacy • Be aware of tools to screen for sexting, cyberbullying, problematic internet use, and internet gaming disorder
	Families	• Develop, consistently follow, and routinely revisit a family media use plan: o Address what type of, and how much, media are used and what media behaviors are appropriate for each child or teenager and for parents; place consistent limits on hours per day of media use as well as types of media used o Promote that children and adolescents get the recommended amount of daily physical activity (1 hour) and adequate sleep (8–12 hours, depending on age) o Recommend that children not sleep with devices in their bedrooms, including TVs, computers, and smartphones; avoid exposure to devices or screens for 1 hour before bedtime o Discourage entertainment media while doing homework o Designate media-free times together (e.g., family dinner) and media-free locations (e.g., bedrooms) in homes; promote activities that are likely to facilitate development and health, including positive parenting activities, such as reading, teaching, talking, and playing together o Communicate guidelines to other caregivers, such as babysitters or grandparents, so that media rules are followed consistently • Engage in selecting and coviewing media with your child, through which your child can use media to learn and be creative, and share these experiences with your family and your community

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		• Have ongoing communication with children about online citizenship and safety, including treating others with respect online and offline, avoiding cyberbullying and sexting, being wary of online solicitation, and avoiding communications that can compromise personal privacy ad safety. • Actively develop a network of trusted adults (e.g., aunts, uncles, coaches) who can engage with children through social media and to whom children can turn when they encounter challenges
	Researchers, governmental organizations, and industry	• Continue research into the risks and benefits of media: o Prioritize longitudinal and robust study designs, including new methodologies for understanding media exposure and use o Prioritize interventions including reducing harmful media use and preventing and addressing harmful media experiences • Inform educators and legislators about research findings so they can develop updated guidelines for safe and productive media use
Health Advisory on Social Media Use in Adolescence[b]	Not always specified, but implied to be: parents, social media companies, adolescents, clinicians, teachers, policy makers, and research funders	• Youth using social media should be encouraged to use functions that create opportunities for social support, online companionship, and emotional intimacy that can promote healthy socialization • Social media use, functionality, and permissions/consenting should be tailored to youths' developmental capabilities; designs created for adults may not be appropriate for children • In early adolescence (i.e., typically 10–14 years), adult monitoring (i.e., ongoing review, discussion, and coaching around social media content) is advised for most youths' social media use; autonomy may increase gradually as kids age and if they gain digital literacy skills; however, monitoring should be balanced with youths' appropriate needs for privacy • To reduce the risks of psychological harm, adolescents' exposure to content on social media that depicts illegal or psychologically maladaptive behavior, including content that instructs or encourages youth to engage in health-risk behaviors, such as self-harm (e.g., cutting, suicide), harm to others, or those that encourage eating disordered behavior (e.g., restrictive eating, purging, excessive exercise) should be minimized, reported, and removed; moreover, technology should not drive users to this content

(*continued*)

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TABLE 4-1 Continued

Publication	Target Audience*	Guidance or Recommendations
		• To minimize psychological harm, adolescents' exposure to "cyberhate" including online discrimination, prejudice, hate, or cyberbullying, especially directed toward a marginalized group (e.g., racial, ethnic, gender, sexual, religious, ability status) or toward an individual because of their identity or allyship with a marginalized group, should be minimized • Adolescents should be routinely screened for signs of "problematic social media use" that can impair their ability to engage in daily roles and routines and that may present a risk for more serious psychological harms over time • The use of social media should be limited so as to not interfere with adolescents' sleep and physical activity • Adolescents should limit use of social media for social comparison, particularly around beauty-related or appearance-related content • Adolescents' social media use should be preceded by training in social media literacy to ensure that users have developed psychologically informed competencies and skills that will maximize the chances for balanced, safe, and meaningful use of social media. • Substantial resources should be provided for continued scientific examination of the positive and negative effects of social media on adolescent development
Surgeon General's Advisory on Social Media and Youth Mental Health[c]	Policy makers	• Strengthen protections to ensure greater safety for children interacting with all social media platforms, in collaboration with governments, academic organizations, public health experts, and technology companies: o Develop age-appropriate safety standards for technology platforms o Require a higher standard of data privacy for children o Pursue policies that further limit access in ways that minimize the risk of harm for all children, including strengthening and enforcing age minimums • Ensure technology companies share data relevant to the health effect of their platforms with independent researchers and the public in a manner that is timely, sufficiently detailed, and protects privacy • Support the development, implementation, and evaluation of digital and media literacy curricula in schools and within academic standards • Support increased funding for future research

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Technology industry	• Engage with international partners working to protect children and adolescents against online harm to their health and safety • Conduct and facilitate transparent and independent assessments of the impact of social media products and services on children and adolescents; assume responsibility for the impact of products on different subgroups and ages of children and adolescents, regardless of the intent behind them: Be transparent and share assessment findings and underlying data with independent researchers and the public in a manner that protects privacy Assess the potential risks of online interactions, and take active steps to prevent potential misuse. Establish scientific advisory committees to inform approaches and policies • Prioritize user health and safety in the design and development of social media products and services: Ensure default settings for children are set to highest safety and privacy standards Adhere to, and enforce, age minimums • Design, develop, and evaluate platforms, products, and tools that foster safe and healthy online environments for youth • Share data relevant to the health impact of platforms and strategies employed to ensure safety and well-being with independent researchers and the public in a manner that is timely and protects privacy • Create effective and timely systems and processes to adjudicate requests and complaints from young people, families, educators, and others to address online abuse, harmful content and interactions, and other threats to children's health and safety

(*continued*)

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TABLE 4-1 Continued

Publication	Target Audience*	Guidance or Recommendations
	Parents	• Create a family media plan • Create tech-free zones, and encourage children to foster in-person friendships. Since electronics can be a potential distraction after bedtime and can interfere with sleep, consider restricting the use of phones, tablets, and computers for at least 1 hour before bedtime and through the night. Consider keeping family mealtimes and in-person gatherings device-free to build social bonds and engage in a two-way conversation. Help your child develop social skills and nurture his or her in-person relationships by encouraging unstructured and offline connections with others and making unplugged interactions a daily priority. • Model responsible social media behavior. As children often learn behaviors and habits from what they see around them, try to model the behavior you want to see. • Teach kids about technology and empower them to be responsible online participants at the appropriate age. Discuss with children the benefits and risks of social media as well as the importance of respecting privacy and protecting personal information in age-appropriate ways. • Report cyberbullying and online abuse and exploitation. Talk to your child about their reporting options, and provide support, without judgment, if he or she tells or shows you that they (a) are being harassed through email, text message, online games, or social media or (b) have been contacted by an adult seeking private images or asking them to perform intimate or sexual acts. You or your child can report cyberbullying to the school and/or the online platform, or your local law enforcement. • Work with other parents to help establish shared norms and practices and to support programs and policies around healthy social media use.
	Children and Adolescents	• Reach out for help. If you or someone you know is being negatively affected by social media reach out to a trusted friend or adult for help. • Create boundaries to help balance online and offline activities. • Develop protective strategies and healthy practices such as tracking the amount of time you spend online, blocking unwanted contacts and content, learning about and using available privacy and safety settings, learning and utilizing digital media literacy skills to help tell the difference between fact and opinion, and ensuring you are connecting with peers in-person.

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- Be cautious about what you share. Personal information about you has value. Be selective with what you post and share online and with whom, as it is often public and can be stored permanently.
- Protect yourself and others. Harassment that happens in email, text messaging, direct messaging, online games, or on social media is harmful and can be cyberbullying:
  - Don't keep online harassment or abuse a secret.
  - Don't take part in online harassment or abuse.

Researchers

- Establish the impact of social media on youth mental health as a research priority and develop a shared research agenda. Research should include but not be limited to:
  - Rigorous evaluation of social media's impact on youth mental health and well-being, including longitudinal and experimental studies.
  - Role of age, developmental stage, cohort processes, and the in-person environment in influencing the onset and progression of poor mental health outcomes among social media users.
  - Benefits and risks associated with specific social media designs, features, and content.
  - Long-term effects on adults of social media use during childhood and adolescence.
- Develop and establish standardized definitions and measures for social media and mental health outcomes that are regularly evaluated and can be applied across basic research, population surveillance, intervention evaluation, and other contexts.
- Evaluate best practices for healthy social media use in collaboration with experts including health care providers, parents, and youth.
- Enhance research coordination and collaboration.

NOTE: Unless otherwise noted, audiences are specifically identified in guidance documents.
SOURCES: [a] AAP et al., 2016a; [b] APA, 2023; [c] HHS, 2023b.

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Social Media and Adolescent Health

size the importance of digital media literacy to empower young people to protect their personal information, be responsible in their social media participation, and be vigilant about the harms of cyberbullying and abuse. There is also a common consideration for balance, making time for sleep, in-person interaction, and physical activity. As in this report, all the guidance documents emphasize the pressing need for research, including both independent evaluation of social media products and longitudinal and experimental designs to better understand social media's influence on development. The documents also share a concern with helping parents who may feel deeply ambivalent about their children's use of social media.

The committee sympathizes with some parents' desire for authoritative prescriptions on teenagers' social media use but is also mindful of overreaching the data. Social media is a relatively new tool, and it is already clear that this tool can be used for good or ill, the relative balance of good and bad depends on the user. There is also a wide diversity of experience and maturity among adolescents; this diversity introduces considerable room for judgment and context to the discussion. While experts can say with confidence that respect for the child's privacy and autonomy should increase with age, there is no clear age cutoff for use of any particular social media affordance. Tolerance for ambiguity and sensitivity to individual needs are defining features of parenting adolescents. Parenting their use of social media is no exception.

Such ambiguity is perhaps most clear in a comparison of the American Academy of Pediatrics recommendations on media use for children under 5 years and to its recommendations for school-aged children and adolescents. In its guidance for preschoolers and toddlers, the academy gives hard limits, expressed in hours per day, on the amount of time young children should use screen media; it is equally clear about an age below which screen media is not appropriate (AAP et al., 2016b). Such guidance is scientifically credible, building off decades of research on children's television, a body of work that is largely transferable to other media as young children do not generally interact with social affordances online. The academy's companion publication for children aged 5 to 18, issued in the same year, is far less proscriptive. Its recommendations, summarized in Table 4-1, encourage a use of social media that is planned and intentional, open communication between parents and children, and the fostering of a network of trusted adults outside of the household to whom a child could turn when facing challenges online.

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Parents struggling to put guardrails on their teenage children's social media use would do well to remember that social media can bring young people joy and foster a sense of community. This community may be especially valuable to members of minority identity groups or to anyone with niche or unusual interests that can be fostered online. At the same time, social media can be a venue for harassing behavior and exposure to fringe ideas, though evidence suggests that support from parents can mitigate these problems (Hébert et al., 2016; Samara et al., 2021). The committee concurs with the American Academy of Pediatrics and American Psychological Association's emphasis on ongoing discussion between parents and children as to how they use social media, looking for opportunities to talk about risks such as oversharing, harassment, or forming skewed perceptions. The threat of social media to displace other activities, especially sleep, also warrants vigilance from parents. Parents can also cultivate awareness of their children's baseline emotional and behavioral state so as to be attuned to any changes in it. Heightened intensity of emotions, disengagement from friends, schoolwork, or hobbies could all be related to risky or problematic use of social media (as they are to other health and interpersonal problems) (Aboujaoude, 2010; Kuss and Lopez-Fernandez, 2016).

In short, managing social media in adolescence, like many of the challenges of growing up, is eased by supportive and loving families. At the same time, the line between supportive parents and responsible, productive use of social media is not particularly clear or direct. Overstating this relationship or venturing hard and fast rules regarding teenagers' use of social media, rules that the data cannot support, is not something this committee can do. For this reason, the following chapters discuss steps that could create a more transparent industry and a better-informed consumer of social media. Box 4-1 summarizes some of this report's main messages for parents.

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BOX 4-1
Notes for Parents

The balance of benefits and harms young people experience on social media is likely to vary widely and may give some parents cause for concern. While the data do not support a clear proscription on social media use among adolescents this report offers some guidance for parents weighing the pros and cons of social media for their teenage children.

- There is a wide diversity of maturity and circumstances among adolescents; this diversity introduces considerable room for judgment into parents' estimations of whether or how often their teenage children should use social media.
- Respect for young people's privacy and autonomy should gradually increase with age, but there is no clear age cutoff for the use of any particular social media affordance.
- An ongoing, open discussion between parents and children regarding social media use is crucial, especially when the conversation turns to the risks of oversharing, harassment, or the forming of skewed perceptions.
- Parents do well to stay attuned to their children's baseline emotional and behavioral states and monitor any changes in them. Heightened intensity of emotions and changes in behavior can be warning signs of interpersonal problems including problematic social media use and gaming addiction.
- An objective quality benchmark could be invaluable to parents who are struggling to discern various platforms' commitments to young people's privacy and safety online. Efforts to promulgate industry standards will, in the long term, be useful to parents as will investments in educating young people in digital media literacy.

REFERENCES

AAP (American Academy of Pediatrics) Council on Communications and Media, D. Hill, N. Ameenuddin, Y. R. Chassiakos, C. Cross, J. Radesky, J. Hutchinson, A. Levine, R. Boyd, R. Mendelson, M. Moreno, W. S. Swanson, and MBE. 2016a. Media use in school-aged children and adolescents. *Pediatrics* 138(5):e20162592.

AAP Council on Communications and Media, J. Radesky, D. Christakis, D. Hill, N. Ameenuddin, Y. L. Reid Chassiakos, C. Cross, J. Hutchinson, A. Levine, R. Boyd, R. Mendelson, M. A. Moreno, and W. S. Swanson. 2016b. Media and young minds. *Pediatrics* 138(5).

Aboujaoude, E. 2010. Problematic internet use: An overview. *World Psychiatry* 9(2):85-90.

Ahmed, G. K., A. A. Abdalla, A. M. Mohamed, L. A. Mohamed, and H. A. Shamaa. 2022. Relationship between time spent playing internet gaming apps and behavioral problems, sleep problems, alexithymia, and emotion dysregulations in children: A multicentre study. *Child and Adolescent Psychiatry and Mental Health* 16(1).

Alonzo, R., J. Hussain, S. Stranges, and K. K. Anderson. 2021. Interplay between social media use, sleep quality, and mental health in youth: A systematic review. *Sleep Medicine Reviews* 56.

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Anderson, M., E. A. Vogels, A. Perrin, and L. Rainie. 2022. *Connection, creativity and drama: Teen life on social media in 2022*. https://www.pewresearch.org/internet/wp-content/uploads/sites/9/2022/11/PI_2022.11.16_Teens-Social-Media-Connection_FINAL.pdf (accessed July 5, 2023).

APA (American Psychiatric Association). 2013. Conditions for further study. In *Diagnostic and Statistical Manual of Mental Disorders*. 5th ed. Arlington, VA: American Psychiatric Association.

APA. 2021. *APA guidelines on evidence-based psychological practice in health care*. https://www.apa.org/about/policy/psychological-practice-health-care.pdf (accessed June 29, 2023).

APA. 2023. *Health advisory on social media use in adolescence*. https://www.apa.org/topics/social-media-internet/health-advisory-adolescent-social-media-use.pdf (accessed July 11, 2023).

Appel, M., C. Marker, and T. Gnambs. 2020. Are social media ruining our lives? A review of meta-analytic evidence. *Review of General Psychology* 24(1):60-74.

Bailenson, J. 2023. VR (3D social networks) and wellbeing. Paper read at Assessment of the Impact of Social Media on the Health and Well-being of Children and Adolescents Meeting 4, Washington, DC.

Bailey, J. O., and J. Bailenson. 2017. Immersive virtual reality and the developing child. In *Cognitive Development in Digital Contexts*, edited by P. Brooke and F. C. Blumberg. San Diego, CA: Elsevier. Pp. 181-200.

Bandura, A., D. Ross, and S. A. Ross. 1963. Imitation of film-mediated aggressive models. *The Journal of Abnormal and Social Psychology* 66(1):3-11.

Bányai, F., A. Zsila, O. Király, A. Maraz, Z. Elekes, M. D. Griffiths, C. S. Andreassen, and Z. Demetrovics. 2017. Problematic social media use: Results from a large-scale nationally representative adolescent sample. *PLOS ONE* 12(1).

Barakat, S., S. A. McLean, E. Bryant, A. Le, P. Marks, P. Aouad, S. Barakat, R. Boakes, L. Brennan, E. Bryant, S. Byrne, B. Caldwell, S. Calvert, B. Carroll, D. Castle, I. Caterson, B. Chelius, L. Chiem, S. Clarke, J. Conti, L. Crouch, G. Dammery, N. Dzajkovski, J. Fardouly, C. Felicia, J. Feneley, A.-M. Firriolo, N. Foroughi, M. Fuller-Tyszkiewicz, A. Fursland, V. Gonzalez-Arce, B. Gouldthorp, K. Griffin, S. Griffiths, A. Hambleton, A. Hannigan, M. Hart, S. Hart, P. Hay, I. Hickie, F. Kay-Lambkin, R. King, M. Kohn, E. Koreshe, I. Krug, A. Le, J. Linardon, R. Long, A. Long, S. Madden, S. Maguire, D. Maloney, P. Marks, S. McLean, T. Meddick, J. Miskovic-Wheatley, D. Mitchison, R. O'Kearney, S. H. Ong, R. Paterson, S. Paxton, M. Pehlivan, G. Pepin, A. Phillipou, J. Piccone, R. Pinkus, B. Raykos, P. Rhodes, E. Rieger, S. Rodan, K. Rockett, J. Russell, H. Russell, F. Salter, S. Sawyer, B. Shelton, U. Singh, S. Smith, E. Smith, K. Spielman, S. Squire, J. Thomson, M. Tiggemann, S. Touyz, R. Utpala, L. Vartanian, A. Wallis, W. Ward, S. Wells, E. Wertheim, S. Wilksch, M. Williams, S. Touyz, S. Maguire, and National Eating Disorder Research Consortium. 2023. Risk factors for eating disorders: Findings from a rapid review. *Journal of Eating Disorders* 11(1):8.

Baum, K. T., A. Desai, J. Field, L. E. Miller, J. Rausch, and D. W. Beebe. 2014. Sleep restriction worsens mood and emotion regulation in adolescents. *Journal of Child Psychology and Psychiatry* 55(2):180-190.

Berger, M. N., M. Taba, J. L. Marino, M. S. C. Lim, and S. R. Skinner. 2022. Social media use and health and well-being of lesbian, gay, bisexual, transgender, and queer youth: Systematic review. *Journal of Medical Internet Research* 24(9).

Best, P., R. Manktelow, and B. J. Taylor. 2014. Social work and social media: Online help-seeking and the mental well-being of adolescent males. *The British Journal of Social Work* 46(1):257-276.

Beyens, I., P. M. Valkenburg, and J. T. Piotrowski. 2018. Screen media use and ADHD-related behaviors: Four decades of research. *Proceedings of the National Academy of Sciences USA* 115(40):9875-9881.

Copyright National Academy of Sciences. All rights reserved.

Bezinovic, P., D. Rovis, N. Roncevic, and L. Bilajac. 2015. Patterns of internet use and mental health of high school students in Istria County Croatia: Cross-sectional study. *Croatian Medical Journal* 56(3):297-305.

Björling, E. A., J. Sonney, S. Rodriguez, N. Carr, H. Zade, and S. H. Moon. 2022. Exploring the effect of a nature-based virtual reality environment on stress in adolescents. *Frontiers in Virtual Reality* 3.

Bloemen, N., and D. De Coninck. 2020. Social media and fear of missing out in adolescents: The role of family characteristics. *Social Media and Society* 6(4).

Boer, M., G. W. J. M. Stevens, C. Finkenauer, M. E. de Looze, and R. J. J. M. van den Eijnden. 2021. Social media use intensity, social media use problems, and mental health among adolescents: Investigating directionality and mediating processes. *Computers in Human Behavior* 116.

Boer, M., R. J. J. M. van den Eijnden, C. Finkenauer, M. Boniel-Nissim, C. Marino, J. Inchley, A. Cosma, L. Paakkari, and G. W. J. M. Stevens. 2022. Cross-national validation of the social media disorder scale: Findings from adolescents from 44 countries. *Addiction* 117(3):784-795.

Botta, R. A. 1999. Television images and adolescent girls' body image disturbance. *Journal of Communication* 49(2):22-41.

Bozzola, E., G. Spina, R. Agostiniani, S. Barni, R. Russo, E. Scarpato, A. Di Mauro, A. V. Di Stefano, C. Caruso, G. Corsello, and A. Staiano. 2022. The use of social media in children and adolescents: Scoping review on the potential risks. *International Journal of Environmental Research and Public Health* 19(16).

Brautsch, L. A., L. Lund, M. M. Andersen, P. J. Jennum, A. P. Folker, and S. Andersen. 2023. Digital media use and sleep in late adolescence and young adulthood: A systematic review. *Sleep Medicine Reviews* 68.

Bucci, S., M. Schwannauer, and N. Berry. 2019. The digital revolution and its impact on mental health care. *Psychology and Psychotherapy* 92(2):277-297.

Burnette, C. B., M. A. Kwitowski, and S. E. Mazzeo. 2017. "I don't need people to tell me I'm pretty on social media:" A qualitative study of social media and body image in early adolescent girls. *Body Image* 23:114-125.

Cain, N., and M. Gradisar. 2010. Electronic media use and sleep in school-aged children and adolescents: A review. *Sleep Medicine* 11(8):735-742.

Calderwood, C., P. L. Ackerman, and E. M. Conklin. 2014. What else do college students "do" while studying? An investigation of multitasking. *Computers & Education* 75:19-29.

Caplan, S. E. 2010. Theory and measurement of generalized problematic internet use: A two-step approach. *Computers in Human Behavior* 26(5):1089-1097.

Carter, B., P. Rees, L. Hale, D. Bhattacharjee, and M. S. Paradkar. 2016. Association between portable screen-based media device access or use and sleep outcomes: A systematic review and meta-analysis. *JAMA Pediatrics* 170(12):1202-1208.

Casale, S., and V. Banchi. 2020. Narcissism and problematic social media use: A systematic literature review. *Addictive Behaviors Reports* 11:100252.

Cataldo, I., B. Lepri, M. J. Y. Neoh, and G. Esposito. 2020. Social media usage and development of psychiatric disorders in childhood and adolescence: A review. *Frontiers in Psychiatry* 11:508595.

Chang, A. M., D. Aeschbach, J. F. Duffy, and C. A. Czeisler. 2015. Evening use of light-emitting ereaders negatively affects sleep, circadian timing, and next-morning alertness. *Proceedings of the National Academy of Sciences USA* 112(4):1232-1237.

Charmaraman, L., A. M. Richer, C. Liu, A. D. Lynch, and M. A. Moreno. 2021. Early adolescent social media-related body dissatisfaction: Associations with depressive symptoms, social anxiety, peers, and celebrities. *Journal of Developmental and Behavioral Pediatrics* 42(5):401-407.

Copyright National Academy of Sciences. All rights reserved.

Social Media and Adolescent Health

Chen, L., and J. Shi. 2019. Reducing harm from media: A meta-analysis of parental mediation. *Journalism & Mass Communication Quarterly* 96(1):173-193.

Cingel, D. P., A. R. Lauricella, L. B. Taylor, H. R. Stevens, S. M. Coyne, and E. Wartella. 2022. U.S. adolescents' attitudes toward school, social connection, media use, and mental health during the COVID-19 pandemic: Differences as a function of gender identity and school context. *PLOS ONE* 17(10):e0276737.

Cogburn, C. D., J. Bailenson, E. Ogle, T. Asher, and T. Nichols. 2018. *1000 Cut Journey*. Paper presented at ACM SIGGRAPH 2018 Virtual, Augmented, and Mixed Reality, Vancouver, British Columbia, Canada.

Cohen, R., and A. Blaszczynski. 2015. Comparative effects of Facebook and conventional media on body image dissatisfaction. *Journal of Eating Disorders* 3:23.

Collier, K. M., S. M. Coyne, E. E. Rasmussen, A. J. Hawkins, L. M. Padilla-Walker, S. E. Erickson, and M. K. Memmott-Elison. 2016. Does parental mediation of media influence child outcomes? A meta-analysis on media time, aggression, substance use, and sexual behavior. *Developmental Psychology* 52(5):798-812.

Course-Choi, J., and L. Hammond. 2021. Social media use and adolescent well-being: A narrative review of longitudinal studies. *Cyberpsychology, Behavior and Social Networking* 24(4):223-236.

Coyne, S. M., A. A. Rogers, J. D. Zurcher, L. Stockdale, and M. Booth. 2020. Does time spent using social media impact mental health?: An eight year longitudinal study. *Computers in Human Behavior* 104.

Crone, E. A., and E. A. Konijn. 2018. Media use and brain development during adolescence. *Nature Communications* 9(1).

Cunningham, S., C. C. Hudson, and K. Harkness. 2021. Social media and depression symptoms: A meta-analysis. *Research on Child and Adolescent Psychopathology* 49(2):241-253.

D'Arienzo, M. C., V. Boursier, and M. D. Griffiths. 2019. Addiction to social media and attachment styles: A systematic literature review. *International Journal of Mental Health and Addiction* 17(4):1094-1118.

de Vries, D. A., A. M. Möller, M. S. Wieringa, A. W. Eigenraam, and K. Hamelink. 2018. Social comparison as the thief of joy: Emotional consequences of viewing strangers' Instagram posts. *Media Psychology* 21(2):222-245.

de Vries, D. A., H. G. M. Vossen, and P. van der Kolk-van der Boom. 2019. Social media and body dissatisfaction: Investigating the attenuating role of positive parent-adolescent relationships. *Journal of Youth and Adolescence* 48(3):527-536.

Dontre, A. J. 2021. The influence of technology on academic distraction: A review. *Human Behavior and Emerging Technologies* 3(3):379-390.

Dworkin, J., J. H. Rudi, and H. Hessel. 2018. The state of family research and social media. *Journal of Family Theory & Review* 10(4):796-813.

Elias, C. L., and K. M. Gorey. 2022. Online social networking among clinically depressed young people: Scoping review of potentially supportive or harmful behaviors. *Journal of Technology in Human Services* 40(1):79-96.

Elliott-Dorans, L. R. 2018. To ban or not to ban? The effect of permissive versus restrictive laptop policies on student outcomes and teaching evaluations. *Computers & Education* 126:183-200.

Fam, J. Y. 2018. Prevalence of internet gaming disorder in adolescents: A meta-analysis across three decades. *Scandinavian Journal of Psychology* 59(5):524-531.

Fardouly, J., and L. R. Vartanian. 2016. Social media and body image concerns: Current research and future directions. *Current Opinion in Psychology* 9:1-5.

Fardouly, J., P. C. Diedrichs, L. R. Vartanian, and E. Halliwell. 2015. Social comparisons on social media: The impact of Facebook on young women's body image concerns and mood. *Body Image* 13:38-45.

Copyright National Academy of Sciences. All rights reserved.

Fardouly, J., N. R. Magson, C. J. Johnco, E. L. Oar, and R. M. Rapee. 2018. Parental control of the time preadolescents spend on social media: Links with preadolescents' social media appearance comparisons and mental health. *Journal of Youth and Adolescence* 47(7):1456-1468.

Figueiro, M., and D. Overington. 2015. Self-luminous devices and melatonin suppression in adolescents. *Lighting Research and Technology* 48.

Fikkers, K. M., J. T. Piotrowski, and P. M. Valkenburg. 2017. A matter of style? Exploring the effects of parental mediation styles on early adolescents' media violence exposure and aggression. *Computers in Human Behavior* 70:407-415.

Fitzgerald, C. T., E. Messias, and D. J. Buysse. 2011. Teen sleep and suicidality: Results from the Youth Risk Behavior Surveys of 2007 and 2009. *Journal of Clinical Sleep Medicine* 07(04):351-356.

Fitzsimmons-Craft, E. E., M. J. Krauss, S. J. Costello, G. M. Floyd, D. E. Wilfley, and P. A. Cavazos-Rehg. 2020. Adolescents and young adults engaged with pro-eating disorder social media: Eating disorder and comorbid psychopathology, health care utilization, treatment barriers, and opinions on harnessing technology for treatment. *Eating and Weight Disorders* 25(6):1681-1692.

Flood, M. 2009. The harms of pornography exposure among children and young people. *Child Abuse Review* 18(6):384-400.

Fowler, L. R., C. Gillard, and S. Morain. 2020. Teenage use of smartphone applications for menstrual cycle tracking. *Pediatrics* 145(5).

Freeman, J. L., P. H. Y. Caldwell, and K. M. Scott. 2023. How adolescents trust health information on social media: A systematic review. *Academic Pediatrics* 23(4):703-719.

Frison, E., and S. Eggermont. 2016. Exploring the relationships between different types of Facebook use, perceived online social support, and adolescents' depressed mood. *Social Science Computer Review* 34(2):153-171.

Frison, E., and S. Eggermont. 2017. Browsing, posting, and liking on Instagram: The reciprocal relationships between different types of Instagram use and adolescents' depressed mood. *Cyberpsychology, Behavior, and Social Networking* 20(10):603-609.

Gabrielli, J., and S. E. Tanski. 2020. The A, B, Cs of youth technology access: Promoting effective media parenting. *Clinical Pediatrics* 59(4-5):496-499.

Gao, Y. X., J. Y. Wang, and G. H. Dong. 2022. The prevalence and possible risk factors of internet gaming disorder among adolescents and young adults: Systematic reviews and meta-analyses. *Journal of Psychiatric Research* 154:35-43.

Gentile, D. A., and J. R. Gentile. 2021. *Learning from video games (and everything else): The general learning model*. Cambridge University Press. https://www.cambridge.org/core/elements/learning-from-video-games-and-everything-else/0884E98F572DA4565772BEEAD3097D29 (accessed September 16, 2023).

Gentile, D. A., C. A. Anderson, S. Yukawa, N. Ihori, M. Saleem, L. K. Ming, A. Shibuya, A. K. Liau, A. Khoo, B. J. Bushman, L. Rowell Huesmann, and A. Sakamoto. 2009. The effects of prosocial video games on prosocial behaviors: International evidence from correlational, longitudinal, and experimental studies. *Personality & Social Psychology Bulletin* 35(6):752-763.

Gentile, D. A., H. Choo, A. Liau, T. Sim, D. Li, D. Fung, and A. Khoo. 2011. Pathological video game use among youths: A two-year longitudinal study. *Pediatrics* 127(2):e319-e329.

Gentile, D., E. Swing, C. Lim, and A. Khoo. 2012. Video game playing, attention problems, and impulsiveness: Evidence of bidirectional causality. *Psychology of Popular Media Culture* 1:62-70.

Gentile, D. A., K. Bailey, D. Bavelier, J. F. Brockmyer, H. Cash, S. M. Coyne, A. Doan, D. S. Grant, C. S. Green, M. Griffiths, T. Markle, N. M. Petry, S. Prot, C. D. Rae, F. Rehbein, M. Rich, D. Sullivan, E. Woolley, and K. Young. 2017a. Internet gaming disorder in children and adolescents. *Pediatrics* 140(Supplement_2):S81-S85.

Copyright National Academy of Sciences. All rights reserved.

Gentile, D. A., O. N. Berch, H. Choo, A. Khoo, and D. A. Walsh. 2017b. Bedroom media: One risk factor for development. *Developmental Psychology* 53(12):2340-2355.

Ghosh, S., and T. Anwar. 2021. Depression intensity estimation via social media: A deep learning approach. *IEEE Transactions on Computational Social Systems* 8(6):1464-1474.

Haferkamp, N., and N. C. Kramer. 2011. Social comparison 2.0: Examining the effects of online profiles on social-networking sites. *Cyberpsychology, Behavior and Social Networking* 14(5):309-314.

Hale, L., X. Li, L. E. Hartstein, and M. K. LeBourgeois. 2019. Media use and sleep in teenagers: What do we know? *Current Sleep Medicine Reports* 5(3):128-134.

Hamilton, J. L., and W. Lee. 2021. Associations between social media, bedtime technology use rules, and daytime sleepiness among adolescents: Cross-sectional findings from a nationally representative sample. *JMIR Mental Health* 8(9):e26273.

Hamilton, J. L., Q. B. Do, S. Choukas-Bradley, C. D. Ladouceur, and J. S. Silk. 2021. Where it hurts the most: Peer interactions on social media and in person are differentially associated with emotional reactivity and sustained affect among adolescent girls. *Research on Child and Adolescent Psychopathology* 49(2):155-167.

Hancock, J., S. X. Liu, M. Luo, and H. Mieczkowski. 2022a. Psychological well-being and social media use: A meta-analysis of associations between social media use and depression, anxiety, loneliness, eudaimonic, hedonic and social well-being. *Social Science Research Network (SSRN)* March 9.

Hancock, J. T., S. X. Liu, M. Luo, and H. Mieczkowski. 2022b. Social media and psychological well-being. In *Psychology of technology: Social science research in the age of big data*, edited by S. C. Matz. American Psychological Association. Pp. 195-238.

Hébert, M., J. M. Cénat, M. Blais, F. Lavoie, and M. Guerrier. 2016. Child sexual abuse, bullying, cyberbullying, and mental health problems among high schools students: A moderated mediated model. *Depression and Anxiety* 33(7):623-629.

Heffer, T., M. Good, O. Daly, E. MacDonell, and T. Willoughby. 2019. The longitudinal association between social-media use and depressive symptoms among adolescents and young adults: An empirical reply to Twenge et al. (2018). *Clinical Psychological Science* 7(3):462-470.

HHS (U.S. Department of Health and Human Services). 2023a. *Our epidemic of loneliness and isolation: The U.S. Surgeon general's advisory on the healing effects of social connection and community.* Office of the Surgeon General. Washington, DC: U.S. Department of Health and Human Services.

HHS. 2023b. *Social media and youth mental health: The U.S. Surgeon general's advisory.* Office of the Surgeon General. https://www.hhs.gov/surgeongeneral/priorities/youth-mental-health/social-media/index.html (accessed December 30, 2023).

Hirzle, T., F. Fischbach, J. Karlbauer, P. Jansen, J. Gugenheimer, E. Rukzio, and A. Bulling. 2022. Understanding, addressing, and analysing digital eye strain in virtual reality head-mounted displays. *ACM Transactions on Computer-Human Interactions* 29(4):Article 33.

Hoare, E., K. Milton, C. Foster, and S. Allender. 2017. Depression, psychological distress and internet use among community-based Australian adolescents: A cross-sectional study. *BMC Public Health* 17(1):365.

Hökby, S., G. Hadlaczky, J. Westerlund, D. Wasserman, J. Balazs, A. Germanavicius, N. Machín, G. Meszaros, M. Sarchiapone, A. Värnik, P. Varnik, M. Westerlund, and V. Carli. 2016. Are mental health effects of internet use attributable to the web-based content or perceived consequences of usage? A longitudinal study of European adolescents. *JMIR Mental Health* 3(3):e31.

Holt-Lunstad, J. 2018. Why social relationships are important for physical health: A systems approach to understanding and modifying risk and protection. *Annual Review of Psychology* 69(1):437-458.

Copyright National Academy of Sciences. All rights reserved.

Holt-Lunstad, J. 2022. Social connection as a public health issue: The evidence and a systemic framework for prioritizing the "social" in social determinants of health. *Annual Review of Public Health* 43(1):193-213.

Houghton, S., D. Lawrence, S. C. Hunter, M. Rosenberg, C. Zadow, L. Wood, and T. Shilton. 2018. Reciprocal relationships between trajectories of depressive symptoms and screen media use during adolescence. *Journal of Youth and Adolescence* 47(11):2453-2467.

Hsu, M. S. H., A. Rouf, and M. Allman-Farinelli. 2018. Effectiveness and behavioral mechanisms of social media interventions for positive nutrition behaviors in adolescents: A systematic review. *Journal of Adolescent Health* 63(5):531-545.

Hu, Y.-T., and Q.-Q. Liu. 2020. Passive social network site use and adolescent materialism: Upward social comparison as a mediator. *Social Behavior and Personality: An International Journal* 48(1).

Huang, C. 2022. A meta-analysis of the problematic social media use and mental health. *International Journal of Social Psychiatry* 68(1):12-33.

Hugh-Jones, S., M. Ulor, T. Nugent, S. Walshe, and M. Kirk. 2023. The potential of virtual reality to support adolescent mental well-being in schools: A UK co-design and proof-of-concept study. *Mental Health & Prevention* 30:200265.

Hunter, R. F., K. de la Haye, J. M. Murray, J. Badham, T. W. Valente, M. Clarke, and F. Kee. 2019. Social network interventions for health behaviours and outcomes: A systematic review and meta-analysis. *PLoS Medicine* 16(9):e1002890.

IOM (Institute of Medicine). 2011. *Clinical practice guidelines we can trust*. Washington, DC: National Academies Press.

Ivie, E. J., A. Pettitt, L. J. Moses, and N. B. Allen. 2020. A meta-analysis of the association between adolescent social media use and depressive symptoms. *Journal of Affective Disorders* 275:165-174.

Jensen, M., M. George, M. Russell, and C. Odgers. 2019. Young adolescents' digital technology use and mental health symptoms: Little evidence of longitudinal or daily linkages. *Clinical Psychological Science* 7(6):1416-1433.

Jensen, M., M. J. George, M. A. Russell, M. A. Lippold, and C. L. Odgers. 2021. Daily parent-adolescent digital exchanges. *Research on Child and Adolescent Psychopathology* 49(9):1125-1138.

Kates, A. W., H. Wu, and C. L. S. Coryn. 2018. The effects of mobile phone use on academic performance: A meta-analysis. *Computers & Education* 127:107-112.

Keles, B., N. McCrae, and A. Grealish. 2020. A systematic review: The influence of social media on depression, anxiety and psychological distress in adolescents. *International Journal of Adolescence and Youth* 25(1):79-93.

Keyes, K. M., J. Maslowsky, A. Hamilton, and J. Schulenberg. 2015. The great sleep recession: Changes in sleep duration among US adolescents, 1991–2012. *Pediatrics* 135(3):460-468.

Kim, H. S., G. Son, E. B. Roh, W. Y. Ahn, J. Kim, S. H. Shin, J. Chey, and K. H. Choi. 2022. Prevalence of gaming disorder: A meta-analysis. *Addictive Behaviors* 126:107183.

King, D. L., P. H. Delfabbro, T. Zwaans, and D. Kaptsis. 2013. Clinical features and axis I comorbidity of Australian adolescent pathological internet and video game users. *Australian & New Zealand Journal of Psychiatry* 47(11):1058-1067.

Kircaburun, K. 2016. Self-esteem, daily internet use and social media addiction as predictors of depression among Turkish adolescents. *Journal of Education and Practice* 7(24):64-72.

Ko, C. H., P. W. Wang, T. L. Liu, C. F. Yen, C. S. Chen, and J. Y. Yen. 2015. Bidirectional associations between family factors and internet addiction among adolescents in a prospective investigation. *Psychiatry and Clinical Neurosciences* 69(4):192-200.

Kreski, N., J. Platt, C. Rutherford, M. Olfson, C. Odgers, J. Schulenberg, and K. M. Keyes. 2021. Social media use and depressive symptoms among United States adolescents. *Journal of Adolescent Health* 68(3):572-579.

Kuss, D. J., and O. Lopez-Fernandez. 2016. Internet addiction and problematic internet use: A systematic review of clinical research. *World Journal of Psychiatry* 6(1):143-176.

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Social Media and Adolescent Health

Latha, K., K. S. Meena, M. R. Pravitha, M. Dasgupta, and S. K. Chaturvedi. 2020. Effective use of social media platforms for promotion of mental health awareness. *Journal of Education and Health Promotion* 9:124.

Leary, M. P., E. N. Clegg, M. E. Santella, P. J. Murray, J. S. Downs, and M. D. Olfert. 2019. Consumption of health-related content on social media among adolescent girls: Mixed-methods pilot study. *JMIR Formative Research* 3(1):e11404.

LeBourgeois, M. K., L. Hale, A. M. Chang, L. D. Akacem, H. E. Montgomery-Downs, and O. M. Buxton. 2017. Digital media and sleep in childhood and adolescence. *Pediatrics* 140:S92-S96.

Lee, S. Y. 2014. How do people compare themselves with others on social network sites?: The case of Facebook. *Computers in Human Behavior* 32:253-260.

Leonhardt, M., and S. Overå. 2021. Are there differences in video gaming and use of social media among boys and girls?—A mixed methods approach. *International Journal of Environmental Research and Public Health* 18(11).

Levenson, J. C., A. Shensa, J. E. Sidani, J. B. Colditz, and B. A. Primack. 2017. Social media use before bed and sleep disturbance among young adults in the United States: A nationally representative study. *Sleep* 40(9).

Li, L., Q. Zhang, L. Zhu, G. Zeng, H. Huang, J. Zhuge, X. Kuang, S. Yang, D. Yang, Z. Chen, Y. Gan, Z. Lu, and C. Wu. 2022. Screen time and depression risk: A meta-analysis of cohort studies. *Frontiers in Psychiatry* 13:1058572.

Liu, M., K. E. Kamper-DeMarco, J. Zhang, J. Xiao, D. Dong, and P. Xue. 2022. Time spent on social media and risk of depression in adolescents: A dose-response meta-analysis. *International Journal of Environmental Research and Public Health* 19(9).

Liu, D., S. E. Ainsworth, and R. F. Baumeister. 2016. A meta-analysis of social networking online and social capital. *Review of General Psychology* 20(4):369–391.

Liu, Z. 2022. Reading in the age of digital distraction. *Journal of Documentation* 78(6):1201-1212.

Lowry, R., D. K. Eaton, K. Foti, L. McKnight-Eily, G. Perry, and D. A. Galuska. 2012. Association of sleep duration with obesity among US high school students. *Journal of Obesity* 2012:476914.

Lua, V. Y. Q., T. B. K. Chua, and M. Y. H. Chia. 2023. A narrative review of screen time and wellbeing among adolescents before and during the COVID-19 pandemic: Implications for the future. *Sports (Basel)* 11(2).

Ludwig, J., and C. Galluzzi. 2018. Mobile diet and exercise apps for adolescent weight loss. *American Nurse Today* 13(8):41-42.

Mannikko, N., H. Ruotsalainen, J. Miettunen, H. M. Pontes, and M. Kaariainen. 2020. Problematic gaming behaviour and health-related outcomes: A systematic review and meta-analysis. *Journal of Health Psychology* 25(1):67-81.

Marino, C., G. Gini, A. Vieno, and M. M. Spada. 2018. The associations between problematic Facebook use, psychological distress and well-being among adolescents and young adults: A systematic review and meta-analysis. *Journal of Affective Disorders* 226:274-281.

Mark, G., Y. Wang, M. Niiya, and S. Reich. 2016. Sleep debt in student life: Online attention focus, Facebook, and mood. Paper presented at Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems, San Jose, California.

Maurer, B. T., and L. C. Taylor. 2020. The effect of digital media on children in their formative years. *JAAPA: official journal of the American Academy of Physician Assistants* 33(5):46-51.

Mei, S., Y. H. Yau, J. Chai, J. Guo, and M. N. Potenza. 2016. Problematic internet use, well-being, self-esteem and self-control: Data from a high-school survey in China. *Addictive Behaviors* 61:74-79.

Meier, A., and L. Reinecke. 2020. Computer-mediated communication, social media, and mental health: A conceptual and empirical meta-review. *Communication Research* 48(8):1182-1209.

Memon, A. M., S. G. Sharma, S. S. Mohite, and S. Jain. 2018. The role of online social networking on deliberate self-harm and suicidality in adolescents: A systematized review of literature. *Indian Journal of Psychiatry* 60(4):384-392.

Copyright National Academy of Sciences. All rights reserved.

Micheli, M. 2016. Social networking sites and low-income teenagers: Between opportunity and inequality. *Information, Communication & Society* 19(5):565-581.

Moreno, M., K. Riddle, M. C. Jenkins, A. P. Singh, Q. Zhao, and J. Eickhoff. 2022. Measuring problematic internet use, internet gaming disorder, and social media addiction in young adults: Cross-sectional survey study. *JMIR Public Health and Surveillance* 8(1):e27719.

Nagata, J. M., G. Singh, O. M. Sajjad, K. T. Ganson, A. Testa, D. B. Jackson, S. Assari, S. B. Murray, K. Bibbins-Domingo, and F. C. Baker. 2022. Social epidemiology of early adolescent problematic screen use in the United States. *Pediatric Research* 92(5):1443-1449.

Nationwide Children's. 2023. *Sleep in adolescents*. https://www.nationwidechildrens.org/specialties/sleep-disorder-center/sleep-in-adolescents#:~:text=Adolescents%20are%20notorious%20for%20not,9%20%C2%BC%20hours%20of%20sleep (accessed October 18, 2023).

Nereim, C., D. Bickham, and M. Rich. 2022. Exploring use patterns and racial and ethnic differences in real time affective states during social media use among a clinical sample of adolescents with depression: Prospective cohort study. *JMIR Formative Research* 6(5).

Nesi, J., and M. J. Prinstein. 2015. Using social media for social comparison and feedback-seeking: Gender and popularity moderate associations with depressive symptoms. *Journal of Abnormal Child Psychology* 43(8):1427-1438.

NHLBI (National Heart, Lung, and Blood Institute). 2022. *Why is sleep important?* https://www.nhlbi.nih.gov/health/sleep/why-sleep-important (accessed July 5, 2023).

Nikkelen, S. W., P. M. Valkenburg, M. Huizinga, and B. J. Bushman. 2014. Media use and ADHD-related behaviors in children and adolescents: A meta-analysis. *Developmental Psychology* 50(9):2228-2241.

NIMH (National Institute of Mental Health). 1982. *Television and behavior: Ten years of scientific progresss and implications for the eighties*. Government Printing Office.

NIMH. 2023. *Eating disorders*. https://www.nimh.nih.gov/health/statistics/eating-disorders (accessed October 18, 2023).

Noon, E. J. 2020. Compare and despair or compare and explore? Instagram social comparisons of ability and opinion predict adolescent identity development. *Cyberpsychology: Journal of Psychosocial Research on Cyberspace* 142(2).

Noon, E. J., and A. Meier. 2019. Inspired by friends: Adolescents' network homophily moderates the relationship between social comparison, envy, and inspiration on Instagram. *Cyberpsychology, Behavior and Social Networking* 22(12):787-793.

O'Day, E. B., and R. G. Heimberg. 2021. Social media use, social anxiety, and loneliness: A systematic review. *Computers in Human Behavior Reports* 3:100070.

Odgers, C. 2018. Smartphones are bad for some teens, not all. *Nature* 554(7693):432-434.

Odgers, C., and M. B. Robb. 2020. *Tweens, teens, tech, and mental health: Coming of age in an increasingly digital, uncertain, and unequal world*. https://www.commonsensemedia.org/sites/default/files/research/report/tweens-teens-tech-and-mental-health-full-report-final-for-web1.pdf (accessed June 1, 2023).

Ogden, C. L., M. M. Lamb, M. D. Carroll, and K. M. Flegal. 2010. Obesity and socioeconomic status in children and adolescents: United States, 2005-2008. *NCHS Data Brief* 51:1-8.

Ogden, C. L., M. D. Carroll, T. H. Fahouri, C. M. Hales, C. D. Fryar, X. Li, and D. S. Freedman. 2018. Prevalence of obesity among youths by household income and education level of head of household—United States 2011-2014. *MMWR Morbidity and Mortality Weekly Report* 67(6):186-189.

Oh, C., B. Carducci, T. Vaivada, and Z. A. Bhutta. 2022. Interventions to promote physical activity and healthy digital media use in children and adolescents: A systematic review. *Pediatrics* 149.

Orben, A., and A. K. Przybylski. 2019. The association between adolescent well-being and digital technology use. *Nature Human Behavior* 3(2):173-182.

Orben, A., A. K. Przybylski, S. J. Blakemore, and R. A. Kievit. 2022. Windows of developmental sensitivity to social media. *Nature Communications* 13(1):1649.

Copyright National Academy of Sciences. All rights reserved.

Social Media and Adolescent Health

Orzech, K. M., M. A. Grandner, B. M. Roane, and M. A. Carskadon. 2016. Digital media use in the 2 h before bedtime is associated with sleep variables in university students. *Computers in Human Behavior* 55(A):43-50.

Ostinelli, E. G., C. Zangani, B. Giordano, D. Maestri, O. Gambini, A. D'Agostino, T. A. Furukawa, and M. Purgato. 2021. Depressive symptoms and depression in individuals with internet gaming disorder: A systematic review and meta-analysis. *Journal of Affective Disorders* 284:136-142.

Owens, J. A., and M. R. Weiss. 2017. Insufficient sleep in adolescents: Causes and consequences. *Minerva Pediatrica* 69(4):326-336.

Paakkari, L., J. Tynjälä, H. Lahti, K. Ojala, and N. Lyyra. 2021. Problematic social media use and health among adolescents. *International Journal of Environmental Research and Public Health* 18(4):1-11.

Padilla-Walker, L. M., K. J. Christensen, and R. D. Day. 2011. Proactive parenting practices during early adolescence: A cluster approach. *Journal of Adolescence* 34(2):203-214.

Panayiotou, M., L. Black, P. Carmichael-Murphy, P. Qualter, and N. Humphrey. 2023. Time spent on social media among the least influential factors in adolescent mental health: Preliminary results from a panel network analysis. *Nature Mental Health* 1(5):316-326.

Panzera, A. D., T. K. Schneider, M. P. Martinasek, J. H. Lindenberger, M. Couluris, C. A. Bryant, and R. J. McDermott. 2013. Adolescent asthma self-management: Patient and parent-caregiver perspectives on using social media to improve care. *Journal of School Health* 83(12):921-930.

Parry, D. A., and D. B. le Roux. 2021. "Cognitive control in media multitaskers" ten years on: A meta-analysis. *Cyberpsychology: Journal of Psychosocial Research on Cyberspace* 15(2):Article 7.

Paruthi, S., L. J. Brooks, C. D'Ambrosio, W. A. Hall, S. Kotagal, R. M. Lloyd, B. A. Malow, K. Maski, C. Nichols, S. F. Quan, C. L. Rosen, M. M. Troester, and M. S. Wise. 2016. Consensus statement of the American Academy of Sleep Medicine on the recommended amount of sleep for healthy children: Methodology and discussion. *Journal of Clinical Sleep Medicine* 12(11):1549-1561.

Peracchia, S., and G. Curcio. 2018. Exposure to video games: Effects on sleep and on post-sleep cognitive abilities. A sistematic review of experimental evidences. *Sleep Science (Sao Paulo, Brazil)* 11(4):302-314.

Pontes, H. M. 2017. Investigating the differential effects of social networking site addiction and internet gaming disorder on psychological health. *Journal of Behavioral Addictions* 6(4):601-610.

Pruccoli, J., M. De Rosa, L. Chiasso, A. Perrone, and A. Parmeggiani. 2022. The use of TikTok among children and adolescents with eating disorders: Experience in a third-level public Italian center during the SARS-COV-2 pandemic. *Italian Journal of Pediatrics* 48(1).

Qin, Y., A. Musetti, and B. Omar. 2023. Flow experience is a key factor in the likelihood of adolescents' problematic TikTok use: The moderating role of active parental mediation. *International Journal of Environmental Research and Public Health* 20(3).

Raudsepp, L., and K. Kais. 2019. Longitudinal associations between problematic social media use and depressive symptoms in adolescent girls. *Preventive Medicine Reports* 15.

Reid Chassiakos, Y. L., J. Radesky, D. Christakis, M. A. Moreno, and C. Cross. 2016. Children and adolescents and digital media. *Pediatrics* 138(5).

Ridout, B., J. Kelson, A. Campbell, and K. Steinbeck. 2021. Effectiveness of virtual reality interventions for adolescent patients in hospital settings: Systematic review. *Journal of Medical Internet Research* 23(6):e24967.

Robb, M. B., and S. Mann. 2023. *Teens and pornography.* Common Sense Media. https://www.commonsensemedia.org/sites/default/files/research/report/2022-teens-and-pornography-final-web.pdf (accessed June 30, 2023).

Rodenhizer, K. A. E., and K. M. Edwards. 2019. The impacts of sexual media exposure on adolescent and emerging adults' dating and sexual violence attitudes and behaviors: A critical review of the literature. *Trauma Violence Abuse* 20(4):439-452.

Copyright National Academy of Sciences. All rights reserved.

Rodgers, R. F., and A. Rousseau. 2022. Social media and body image: Modulating effects of social identities and user characteristics. *Body Image* 41:284-291.

Rodríguez-de-Dios, I., J. M. F. van Oosten, and J.-J. Igartua. 2018. A study of the relationship between parental mediation and adolescents' digital skills, online risks and online opportunities. *Computers in Human Behavior* 82:186-198.

Rudi, J., and J. Dworkin. 2018. Is technology-mediated parental monitoring related to adolescent substance use? *Substance Use & Misuse* 53(8):1331-1341.

Rueda, M. R., P. Checa, and M. K. Rothbart. 2010. Contributions of attentional control to socioemotional and academic development. *Early Education and Development* 21(5):744-764.

Saiphoo, A. N., L. Dahoah Halevi, and Z. Vahedi. 2020. Social networking site use and self-esteem: A meta-analytic review. *Personality and Individual Differences* 153:109639.

Salomon, I., and C. S. Brown. 2018. The selfie generation: Examining the relationship between social media use and early adolescent body image. *The Journal of Early Adolescence* 39(4):539-560.

Samara, M., A. A. Massarwi, A. El-Asam, S. Hammuda, P. K. Smith, and H. Morsi. 2021. The mediating role of bullying and victimisation on the relationship between problematic internet use and substance abuse among adolescents in the UK: The parent–child relationship as a moderator. *Frontiers in Psychiatry* 12.

Santos, R. M. S., C. G. Mendes, G. Y. Sen Bressani, S. de Alcantara Ventura, Y. J. de Almeida Nogueira, D. M. de Miranda, and M. A. Romano-Silva. 2023. The associations between screen time and mental health in adolescents: A systematic review. *BMC Psychology* 11(1):127.

Saul, J., R. F. Rodgers, and M. Saul. 2022. Adolescent eating disorder risk and the social online world: An update. *Child and Adolescent Psychiatric Clinics of North America* 31(1):167-177.

Scott, H., S. M. Biello, and H. C. Woods. 2019. Identifying drivers for bedtime social media use despite sleep costs: The adolescent perspective. *Sleep Health* 5(6):539-545.

Scully, M., L. Swords, and E. Nixon. 2023. Social comparisons on social media: Online appearance-related activity and body dissatisfaction in adolescent girls. *Irish Journal of Psychological Medicine* 40(1):31-42.

Sedgwick, R., S. Epstein, R. Dutta, and D. Ougrin. 2019. Social media, internet use and suicide attempts in adolescents. *Current Opinion in Psychiatry* 32(6):534-541.

Sewall, C. J. R., T. R. Goldstein, and D. Rosen. 2021. Objectively measured digital technology use during the COVID-19 pandemic: Impact on depression, anxiety, and suicidal ideation among young adults. *Journal of Affective Disorders* 288:145-147.

Shannon, H., K. Bush, P. J. Villeneuve, K. G. Hellemans, and S. Guimond. 2022. Problematic social media use in adolescents and young adults: Systematic review and meta-analysis. *JMIR Ment Health* 9(4):e33450.

Shiffman, S., A. A. Stone, and M. R. Hufford. 2008. Ecological momentary assessment. *Annual Review of Clinical Psychology* 4(1):1-32.

Shimoga, S. V., E. Erlyana, and V. Rebello. 2019. Associations of social media use with physical activity and sleep adequacy among adolescents: Cross-sectional survey. *Journal of Medical Internet Research* 21(6).

Siebers, T., I. Beyens, J. L. Pouwels, and P. M. Valkenburg. 2022. Social media and distraction: An experience sampling study among adolescents. *Media Psychology* 25(3):343-366.

Sina, E., D. Boakye, L. Christianson, W. Ahrens, and A. Hebestreit. 2022. Social media and children's and adolescents' diets: A systematic review of the underlying social and physiological mechanisms. *Advances in Nutrition* 13(3):913-937.

Singh, A., S. Wilkinson, and S. Braganza. 2014. Smartphones and pediatric apps to mobilize the medical home. *The Journal of Pediatrics* 165(3):606-610.

Slater, A., M. Tiggemann, K. Hawkins, and D. Werchon. 2012. Just one click: A content analysis of advertisements on teen web sites. *Journal of Adolescent Health* 50(4):339-345.

Copyright National Academy of Sciences. All rights reserved.

Stanton, A. G., M. C. Jerald, L. M. Ward, and L. R. Avery. 2017. Social media contributions to strong Black woman ideal endorsement and Black women's mental health. *Psychology of Women Quarterly* 41(4):465-478.

Steinsbekk, S., L. Wichstrøm, F. Stenseng, J. Nesi, B. W. Hygen, and V. Skalická. 2021. The impact of social media use on appearance self-esteem from childhood to adolescence—A 3-wave community study. *Computers in Human Behavior* 114:106528.

Stevens, M. W. R., D. Dorstyn, P. H. Delfabbro, and D. L. King. 2021. Global prevalence of gaming disorder: A systematic review and meta-analysis. *Australian and New Zealand Journal of Psychiatry* 55(6):553-568.

Stice, E., and H. E. Shaw. 1994. Adverse effects of the media portrayed thin-ideal on women and linkages to bulimic symptomatology. *Journal of Social and Clinical Psychology* 13(3):288-308.

Su, W., X. Han, H. Yu, Y. Wu, and M. N. Potenza. 2020. Do men become addicted to internet gaming and women to social media? A meta-analysis examining gender-related differences in specific internet addiction. *Computers in Human Behavior* 113:106480.

Swing, E. L., D. A. Gentile, C. A. Anderson, and D. A. Walsh. 2010. Television and video game exposure and the development of attention problems. *Pediatrics* 126(2):214-221.

Tang, S., A. Werner-Seidler, M. Torok, A. J. Mackinnon, and H. Christensen. 2021. The relationship between screen time and mental health in young people: A systematic review of longitudinal studies. *Clinical Psychology Review* 86:102021.

Teng, Z., M. D. Griffiths, Q. Nie, G. Xiang, and C. Guo. 2020. Parent-adolescent attachment and peer attachment associated with internet gaming disorder: A longitudinal study of first-year undergraduate students. *Journal of Behavioral Addictions* 9(1):116-128.

Tiggemann, M. 2022. Digital modification and body image on social media: Disclaimer labels, captions, hashtags, and comments. *Body Image* 41:172-180.

Tiggemann, M., and M. Zaccardo. 2015. "Exercise to be fit, not skinny": The effect of fitspiration imagery on women's body image. *Body Image* 15:61-67.

Toh, S., and M. A. Hernán. 2008. Causal inference from longitudinal studies with baseline randomization. *International Journal of Biostatistics* 4(1):Article 22.

Twenge, J. M., T. E. Joiner, G. Martin, and M. L. Rogers. 2018. Amount of time online is problematic if it displaces face-to-face social interaction and sleep. *Clinical Psychological Science* 6(4):456-457.

Tynes, B. M., H. A. Willis, A. M. Stewart, and M. W. Hamilton. 2019. Race-related traumatic events online and mental health among adolescents of color. *Journal of Adolescent Health* 65(3):371-377.

U.S. Surgeon General. 1972. *Television and growing up: The impact of televised violence.* U.S. Government Printing Office.

Vahedi, Z., and L. Zannella. 2021. The association between self-reported depressive symptoms and the use of social networking sites (SNS): A meta-analysis. *Current Psychology* 40(5):2174-2189.

Valkenburg, P. M., I. I. van Driel, and I. Beyens. 2021. The associations of active and passive social media use with well-being: A critical scoping review. *New Media & Society* 24(2):530-549.

Vander Wyst, K. B., M. E. Vercelli, K. O. O'Brien, E. M. Cooper, E. K. Pressman, and C. M. Whisner. 2019. A social media intervention to improve nutrition knowledge and behaviors of low income, pregnant adolescents and adult women. *PLOS ONE* 14(10).

Vannucci, A., and C. McCauley Ohannessian. 2019. Social media use subgroups differentially predict psychosocial well-being during early adolescence. *Journal of Youth and Adolescence* 48(8):1469-1493.

Vogel, E. A., J. P. Rose, L. R. Roberts, and K. Eckles. 2014. Social comparison, social media, and self-esteem. *Psychology of Popular Media Culture* 3(4):206-222.

Copyright National Academy of Sciences. All rights reserved.

Vogel, E. A., J. P. Rose, B. M. Okdie, K. Eckles, and B. Franz. 2015. Who compares and despairs? The effect of social comparison orientation on social media use and its outcomes. *Personality and Individual Differences* 86:249-256.

Wadham, E., C. Green, J. Debattista, S. Somerset, and A. Sav. 2019. New digital media interventions for sexual health promotion among young people: A systematic review. *Sex Health* 16(2):101-123.

Wang, J.-L., J. Gaskin, D. H. Rost, and D. A. Gentile. 2018. The reciprocal relationship between passive social networking site (SNS) usage and users' subjective well-being. *Social Science Computer Review* 36(5):511-522.

Wang, J. L., H. Z. Wang, J. Gaskin, and S. Hawk. 2017. The mediating roles of upward social comparison and self-esteem and the moderating role of social comparison orientation in the association between social networking site usage and subjective well-being. *Frontiers in Psychology* 8:771.

Ward, L. M. 2003. Understanding the role of entertainment media in the sexual socialization of American youth: A review of empirical research. *Developmental Review* 23(3):347-388.

Wartberg, L., L. Kriston, and R. Thomasius. 2020. Internet gaming disorder and problematic social media use in a representative sample of German adolescents: Prevalence estimates, comorbid depressive symptoms and related psychosocial aspects. *Computers in Human Behavior* 103:31-36.

Wartella, E., V. Rideout, H. Montague, L. Beaudoin-Ryan, and A. Lauricella. 2016. Teens, health and technology: A national survey. *Media and Communication* 4(3)13-23.

Weinstein, E. 2017. Adolescents' differential responses to social media browsing: Exploring causes and consequences for intervention. *Computers in Human Behavior* 76:396-405.

Weinstein, E. 2018. The social media see-saw: Positive and negative influences on adolescents' affective well-being. *New Media & Society* 20(10):3597-3623.

Welch, V., J. Petkovic, J. Pardo Pardo, T. Rader, and P. Tugwell. 2016. Interactive social media interventions to promote health equity: An overview of reviews. *Health Promotion and Chronic Disease in Canada: Research, Policy and Practice* 36(4):63-75.

WHO (World Health Organization). 2019. *6c51 gaming disorder. In International Statistical Classification of Diseases and Related Health Problems (11th ed.).* https://icd.who.int/browse11/l-m/en#/http%3A%2F%2Fid.who.int%2Ficd%2Fentity%2F1448597234 (accessed July 2, 2023).

Wiradhany, W., and J. Koerts. 2021. Everyday functioning-related cognitive correlates of media multitasking: A mini meta-analysis. *Media Psychology* 24(2):276-303.

Wirtz, D., A. Tucker, C. Briggs, and A. M. Schoemann. 2021. How and why social media affect subjective well-being: Multi-site use and social comparison as predictors of change across time. *Journal of Happiness Studies* 22(4):1673-1691.

Woods, H. C., and H. Scott. 2016. #sleepyteens: Social media use in adolescence is associated with poor sleep quality, anxiety, depression and low self-esteem. *Journal of Adolescence* 51:41-49.

Wright, P. J. 2014. Pornography and the sexual socialization of children: Current knowledge and a theoretical future. *Journal of Children and Media* 8(3):305-312.

Yamada-Rice, D., F. Mushtaq, A. Woodgate, D. Bosmans, A. Douthwaite, I. Douthwaite, W. Harris, R. Holt, D. Kleeman, J. Marsh, E. Milovidov, M. Mon Williams, B. Parry, A. Riddler, P. Robinson, D. Rodrigues, S. Thompson, and S. Whitley. 2017. *Children and virtual reality: Emerging possibilities and challenges.* https://researchonline.rca.ac.uk/id/eprint/3553 (accessed September 16, 2023).

Yang, Y. C., C. Boen, K. Gerken, T. Li, K. Schorpp, and K. M. Harris. 2016. Social relationships and physiological determinants of longevity across the human life span. *Proceedings of the National Academy of Sciences USA* 113(3):578-583.

Copyright National Academy of Sciences. All rights reserved.

Social Media and Adolescent Health

Yin, X.-Q., D. A. de Vries, D. A. Gentile, and J.-L. Wang. 2019. Cultural background and measurement of usage moderate the association between social networking sites (SNSs) usage and mental health: A meta-analysis. *Social Science Computer Review* 37(5):631-648.

Yoon, S., M. Kleinman, J. Mertz, and M. Brannick. 2019. Is social network site usage related to depression? A meta-analysis of Facebook-depression relations. *Journal of Affective Disorders* 248:65-72.

Young, R., and M. Tully. 2022. Autonomy vs. control: Associations among parental mediation, perceived parenting styles, and U. S. adolescents' risky online experiences. *Cyberpsychology: Journal of Psychosocial Research on Cyberspace* 16(2):Article 5.

Yurtdaş-Depboylu, G., G. Kaner, and S. Özçakal. 2022. The association between social media addiction and orthorexia nervosa, eating attitudes, and body image among adolescents. *Eating and Weight Disorders* 27(8):3725-3735.

Zhang, C. 2020. Investigation on motion sickness in virtual reality environment from the perspective of user experience. Paper read at 2020 IEEE 3rd International Conference on Information Systems and Computer Aided Education (ICISCAE), September 27–29, Dalian, China.

Zhang, J., H. Hu, D. Hennessy, S. Zhao, and Y. Zhang. 2019. Digital media and depressive symptoms among Chinese adolescents: A cross-sectional study. *Heliyon* 5(5):e01554.

Zogan, H., I. Razzak, X. Wang, S. Jameel, and G. Xu. 2022. Explainable depression detection with multi-aspect features using a hybrid deep learning model on social media. *World Wide Web* 25(1):281-304.

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5

Design Features

As Chapter 2 explained, social media algorithms influence a user's experience of social media in ways that are both complicated and highly variable. Young people's experiences with social media can also be influenced by exposure to violent or otherwise toxic content, by harassment, or through introduction to bad actors, such as adults interested in grooming to sexual predation or incitement to political radicalization. The committee recognizes that perfect controls over what users see is not a realistic or necessarily desirable expectation for social media companies. But there are provisions that can be incorporated into the design of apps, games, and websites that limit the personal information companies collect, the types of content available, and the prompts to extend time on a platform.

There will always be a place for a knowledgeable consumer to make informed decisions about risks faced online. In the same way health literacy can allow patients to have more knowledgeable, better prepared conversations with their health providers, media literacy, a topic discussed in detail in the next chapter, can allow for a more informed understanding about decisions made online. At the same time, the complexity and pace of the online environment far exceed what adolescents—or any layperson—could be reasonably expected to understand. This chapter recommends steps at the level of platform design that would help tip the balance of transparency to the users who support the platforms and the government agencies that monitor the fairness of their operations.

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AGE-APPROPRIATE DESIGN CODE

The central mission of age-appropriate design is to make technology safer for young people through "a set of processes for digital services when end users are children [that] aids in the tailoring of the services that are provided" (IEEE, 2021, p.11). Age-appropriate design can extend to the way vendors collect and use information about minors and how schools promote educational technology to students. It includes enhanced privacy protections, whether in products specifically designed for minors (e.g., children's programming on YouTube) or products they are likely to access (e.g., search engines). The rights and developmental needs of children are central to the determination of the age appropriateness of a product or platform.

Creating or modifying a product to meet child-friendly design standards starts with a full review of how the products' features may influence children and a plan for how to mitigate those risks and test new changes. The next steps, undertaken simultaneously, involve auditing the features, identifying risks, and mitigating them. Steps to minimize targeted advertising to children, for example, begin with an overview of corporate policies on data privacy and the shareholders' views on the matter (IEEE, 2021).

A growing interest in designing digital technology for children led the Institute for Electrical and Electronics Engineers (IEEE), an international association for electronic and electrical engineering, and the 5Rights Foundation to release a standard for age-appropriate design in 2021 (Shahriari and Shahriari, 2017). This design puts the burden of establishing users' age on the producer of the technology. Knowledge of users' age in turn allows companies to present terms of use that reflect adolescents' progressively growing capacity for understanding and independent decision making (IEEE, 2021).

Age-appropriate design emphasizes the protection of young people's online privacy. The code requires platforms to collect only the necessary information and use it in the way that the child (or, in some cases, the responsible adult) had agreed to and not for commerce. It also discourages the persuasive design features (i.e., features intended to extend the time spent on a platform such as push notifications and tones when new content is posted) that extend use, especially at night, and promotes a high standard for content moderation. The standard also stipulates that it is the technology developer's responsibility to reduce the automated recommendation of violent, offensive, or harmful content and misinformation (IEEE, 2021).

For product developers and vendors, age-appropriate design may seem to impose burdensome restrictions, especially if they work in dif-

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ferent jurisdictions with varying levels of relevant legal or regulatory controls. In such a situation, the IEEE guidance encourages full review of all applicable laws and regulations and, when in doubt as to the standard required, to proceed with the service that more conservatively reflects the best interests of the child (IEEE, 2021). For example, if a user declines to enter a birthdate or if age cannot be verified, the technology developer should not offer nudges to stay longer on the platform or push notifications at night.

The California Age-Appropriate Design Code Act,[1] like similar legislation in the UK, is primarily concerned with young people's data privacy (Information Comissioner's Office, 2023). The IEEE standard goes slightly further, including guidance on limiting features that encourage extended use of platforms. But even the IEEE standard offers fewer specifics on content moderation. Its guidance encourages companies to make investments in moderation proportionate to risk, that terms of content moderation should be clear, and that parents and children should have a means for redress (IEEE, 2021).

Age-appropriate design guidance can be technically vague and hard to enforce, and assessment of compliance has been described as subjective (Farthing et al., 2021; Franqueria et al., 2022; Goldman, 2022). Whether other states follow the age-appropriate design code lead set by California remains to be seen, and even if they do, critics of age-appropriate design have seen it as infantilizing of children, especially older adolescents, as the emphasis on acting in the best interest of the child presupposes that the child is incapable of discerning what their best interests may be (Collinson and Persson, 2022). What is more, some of the most serious risks to the mental and physical health of young people come from overuse and algorithms that present unhealthy content. These are not necessarily problems that age-appropriate design code aims to solve.

The age-appropriate design movement put concrete parameters on what had been an abstract discussion about children's privacy. Its emphasis on both the inputs to and outputs of a functional privacy system gives researchers and companies a guideline against which to measure the data collection risks that children encounter online. Yet threats to the mental and physical health of young people are often traced to failures of content moderation, algorithms that promote toxic content, and overuse. Social media platforms would benefit from a similar standard to guide assessment of how their algorithms influence well-being.

[1] California Civil Code §§ 1798.99.28–1798.99.40.

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GREATER TRANSPARENCY AND ACCOUNTABILITY

Social media is an important source of entertainment and connection for many people, especially adolescents. Given the importance these platforms have in people's lives there is a growing momentum for more openness and oversight of their operation. Much of the public outrage elicited by Frances Haugen's revelations stemmed from the perception of secrecy, the idea that harms known to executives inside the company were kept from the public (Allyn, 2021). Allowing researchers and civil society watchdogs access to social media data and review of their algorithms would allow for a better understanding of how social media platforms influence young people for better or worse.

It is difficult to determine what effect social media has on well-being or the extent to which companies are doing due diligence to protect young people from the more habit-forming affordances of their platforms, as companies retain extremely tight control on their data and algorithms (Krass, 2022). Publicly available data can support some research. The University of Michigan's Iffy Quotient, for example, aims to monitor the extent to which Facebook and Twitter amplify disinformation (Center for Social Media Responsibility, 2022). But even this is vulnerable. In 2021 Facebook sued researchers attempting to study political advertising—using publicly available information—because the data scraping tools they used violated the platforms' terms of service, a topic discussed more in Chapter 8 (Knight First Amendment Institute, 2021; Panditharatne, 2022). The tools Facebook authorizes for researchers, including a searchable advertisement library called Ad Library API and a network data analysis tool called CrowdTangle, provide "tightly circumscribed and spotty information" (Panditharatne, 2022). Civil society groups requesting access to social media data have reported an arbitrary lottery-like process, highly dependent on personal relationships and subject to favoritism (Bradshaw and Barrett, 2022).

In the same way, there can be a seemingly arbitrary approach to the enforcement of content moderation guidelines. Participation in social media has become an important part of modern life. When a platform's decisions seem unfair, aggrieved users may take the position that they are a victim of corporate overreach, being denied access to a public venue, in a manner similar to being disallowed entry to a movie theater or store (MacCarthy, 2021). While such concerns are reasonable, there is also deep public ambivalence regarding outside interference, especially from the government, in determining which public statements should be amplified and which ones should be silenced. In the balancing of trade-offs, a system for content moderation has emerged that relies on oversight boards,

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groups of experts that are neither fully independent of the platform nor fully open about their process (Douek, 2019).

A general lack of transparency regarding social media operations has bred public distrust of the platforms and the companies that run them. Figure 5-1 shows results of a 2021 survey conducted by researchers at George Mason University and *The Washington Post* indicating widespread mistrust of the platforms. Transparency is a remedy for distrust, as it provides some assurance that the platform is conforming to public values and expectations (MacCarthy, 2021).

Some of the companies' reluctance to share information is well founded. Platform algorithms are proprietary, which can make obliging companies to share seem unfair and uncompetitive. Social media platforms also hold a great deal of information about ordinary people that could, in the wrong hands, be used for surveillance or blackmail (Bradshaw and Barrett, 2022). Therefore, questions of data access and sharing can be especially fraught. Not all researchers can trust that their work will be free from government interference, nor can civil society organizations always assume that their independence will be respected.

The need for more accountability and openness in social media has attracted the attention of Congress. Dozens of pieces of legislation in the

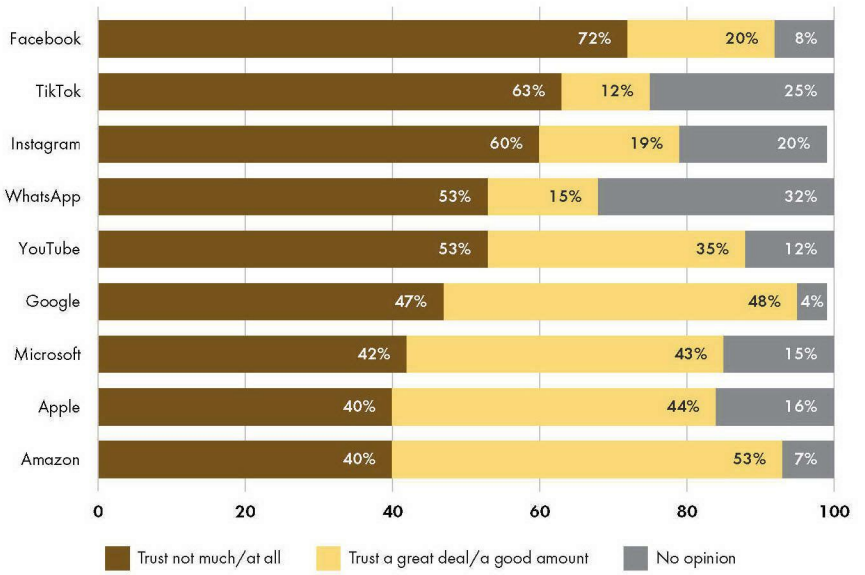


FIGURE 5-1 Response to the question, "How much do you trust each of the following companies or services to responsibly handle your personal information and data on your internet activity?"
SOURCE: Kelly and Guskin, 2021.

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last two sessions alone have taken aim at advertising transparency, data privacy, protections for minors, oversight of mobile apps, targeted marketing, and other aspects of platform operations.[2] There is clearly momentum and political will for a system for better oversight. In response to this momentum, the social media companies, including Meta and Alphabet, have come to accept data privacy legislation (Kang, 2018). A prompt coordinated effort to develop technical standards for platform operations, transparency, and data use would be a meaningful step toward a better, global system for platform accountability.

Recommendation 5-1: The International Organization for Standardization should convene an ongoing technical working group including industry representatives, civil society, and academic stakeholders to develop standards for social media platform design, transparency, and data use.

Social media is a widely diverse set of tools, used differently, by different people. The extent to which particular platforms are committed to maximizing the beneficial uses and curtailing the harmful ones is not clear to anyone. The development of uniform standards is an essential precursor to any transparent reporting, benchmarking of progress, or regulation. Without such standards outside auditors cannot judge the effectiveness of content moderation or the role of a platform's advertising or recommendation algorithms in promoting harmful content. Harmonized standards are also the basis of comprehensible public disclosures, such as those governing terms and conditions of using an online service, or measures taken to counter harassment or hate speech. A standard format for data at the application program interface also greatly eases the study of confidential algorithms (MacCarthy, 2022).

The International Organization for Standardization (known as ISO) is an international, nongovernmental organization with a long history in successfully setting and maintaining international standards. Its members include the national standard-setting bodies of 168 countries and use a process described as "voluntary, consensus-based and market relevant" (ISO, n.d.). Given the worldwide reach of social media platforms and the companies' need to operate across borders and cultures, such international support and buy-in are crucial. ISO also has long experience and well-defined processes for updating standards to ensure their continued

[2] A Congress.gov search for legislation in the 117th and 118th Congresses for legislation about online advertising, social networks, social media, online privacy, or online data indicated more than 40 pieces of immediately relevant legislation, with many hundreds more tangentially relevant.

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relevance, something that will be necessary given the pace of change in this field (ISO, 2021). ISO has considerable experience in similarly thorny and technical topics. The ISO/IEC 27000 family of standards, for example, provides a model for information security management and data protection (ISO, 2022). The committee envisions a similarly inclusive process guiding the development of platform standards for social media.

The recommended standard setting process would be iterative and dynamic, given the rapid pace of change in social media technology and in society's perception of threats. The ISO process is also designed to include the full range of stakeholders needed to comment on the management of technical processes, including "people such as manufacturers, sellers, buyers, customers, trade associations, users or regulators" (ISO, 2023).

The Types of Standards Needed

The standards for social media operations and platform design would, like the IEEE standard for age-appropriate design, articulate both inputs and outputs of a functional system. Inputs refer to actions taken by the platform, while outputs are partially driven by the platform but are also shaped by the behaviors of users. Inputs can include processes for content moderation or data use, content of privacy agreements, and mandatory disclosures to users, all reflective of decisions largely within the platform's control. Outputs could include platform health measures, such as the amount of toxicity on a platform, for example. A platform's content moderation and take-down policies will influence measures of toxicity, but the platform cannot fully control something driven by the behavior of its users. The distinction is key, as adherence to input standards requires little if any margin for reaction time on the part of the platform.

At the platform level, measures should move beyond simple aggregates and provide informative percentile summaries. The reported percentiles would aim to capture the harm experienced by those most vulnerable, such as the amount of cyberbullying experienced by the most bullied decile of adolescents. Since the association between social media use and health outcomes varies across groups, standards should allow quantification at the group or community level. Finally, aligned with algorithmic transparency standards, on request, platforms should provide summaries at the user level.

To better illustrate how this recommendation would work, Table 5-1 gives examples of key measures for which the ISO working group would develop standards together with examples of input and output measures that could be tracked. As discussed in Chapter 2, platform algorithms cover ranking, ad-targeting, and content moderation. As such, Table 5-1

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gives examples of standards for each algorithmic type. As noted earlier, standards should be measured comprehensively, so Table 5-1 gives examples of concrete platform-, community-, and user-level outcomes. When applicable, past work with significant overlap is also presented, although the many empty cells in this column illustrate the importance of building these standards and encouraging their adoption.

One important measure that companies should report is their efforts to remediate youth mental health problems. This information, like certain audit and systemic risk reports, should be available on request to the Federal Trade Commission (FTC). Better clarity on and tracking of the standardized indicators would eventually allow for comparisons across platforms and over time, giving both the public and the FTC better clarity on the risks these platforms pose.

It is important to note that the examples provided in Table 5-1 are proposed for illustrative purposes, not as a definitive list of needs. Part of the value of a reoccurring convening via ISO is that the standards could develop in line with a growing body of scientific consensus on the ways social media influences adolescents. Consider for example, the influence of image sharing platforms on body image discussed in Chapter 4. Given the strength of this association, the recommended standards may do well to include measures related to the amount of such content seen on a given platform.

ADOPTING THE STANDARDS

Critics of the previous recommendation may maintain that such steps are not necessary as the social media industry already has relevant rules in place. Self-regulation has long been relied on in the media: television, movies, videogames, and music all make use of industry standards for content rating (Napoli, 2018). Recent years have seen greater effort at industry self- and third-party regulation of social media, exemplified by Facebook's Oversight Board (Klonick, 2020). This oversight board could help protect users from unfair treatment (Maroni, 2019). At the same time, there will always be a suspicion that the real goal of such a board, or any effort at self-regulation, is to bolster the platform's market position or authority (Maroni, 2019). Social media platforms' success depends on engaging as many users as possible, something controversy and emotion can do (Brown, 2021). Asking companies to moderate the more sensational voices on their platform could be asking them to act against their business interests (Brown, 2021).

Skepticism of self-regulation aside, enacting a regulatory framework across jurisdictions on global companies is not always a legally or logistically viable option (Henderson et al., 2016). An acknowledgement of the

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TABLE 5-1 Operationalizing Standards for Social Media Operations, Transparency, and Data Use

	Aim	Input Examples	Output Examples	Transferable Work
Content-based health measures	To analyze the nature of the content with implications for users' health and well-being	The amount and type of resources dedicated to ensuring harmful content is identified and demoted	Reports on the amount of cyberbullying experienced by the 25%, 10%, 5%, and 1% most bullied users tracked over time (platform-level measure) Reports on the amount of cyberbullying found in a specific subcommunity, e.g., Facebook group (community-level measure) Reports on the amount of cyberbullying attacks experienced by a user, reported to that user on request (user-level measure) Reports on material taken down, proportion of moderation decisions appealed	

(*continued*)

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TABLE 5-1 Continued

	Aim	Input Examples	Output Examples	Transferable Work
			Reports on the amount of cyberbullying attacks experienced by a user, reported to that user on request (user-level measure)	
		The public content moderation policy, the number of content moderators	Reports on material taken down, proportion of moderation decisions appealed	
		The amount of resources dedicated to ensuring advertising algorithms do not expose adolescents to harmful content	Reports on the amount of harmful content served to adolescents through ads	
Network-based health measures	To track the extent to which social connection on the platform is positive and the extent to which it is negative	The amount and type of resources dedicated to discerning network quality	Reports on the fraction of user connections that promote social connectedness	
Privacy and security	To better align privacy and security settings with user preferences	Privacy setting portability To allow users to state privacy preferences once and deploy them across apps and platforms	Reports on privacy and security that measure how users' understanding of the privacy and security policy evolve over time	The UK open banking initiative, wherein nine major banks developed an industry standard for customers to transfer their financial data[a]

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		Privacy policies written in standard machine-readable format that can be read automatically by a web browser reducing burden on user	Reports on the number of users that benefit from the use of machine-readable privacy policies (users that port their privacy settings to use elsewhere)	The Platform for Privacy Preferences (P3P) tool, intended to enable users to limit their exposure to websites with privacy policies that do not match their preferences[b]
Data use	To clarify what types of data algorithms can use	Predictive models to identify young people in mental health crisis	Proxy indicators such as proportion of young people in suspected mental health crisis seeing ads about support services	
		A public database of advertising targeting criteria	Advertising algorithms audited and audit reports shared with FTC	
Operational transparency	To improve understanding of how the platforms work	Reports on the actions taken to make the platform's operations more transparent	Recommendation algorithms audited and audit reports shared with FTC	

NOTE: [a] Brown, 2022; [b] Cranor, 2003.

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fact that industry stakeholders are often in the best position to set out operational policies underlies the prior recommendation's specification that industry should be part of the ISO technical work group. There is also reason to believe that companies will have an interest in monitoring one another against the standards the ISO group develops. For this reason, the social media companies should formally adopt these standards and reference them in their public documents.

The companies would do well to adopt such standards to forestall more sweeping regulatory action (Cusumano et al., 2021). The UK's proposed Online Safety Bill, for example, put significant demands on platforms, even specifying the type of content moderation technology they must use (Church and Pehlivan, 2023). Such restrictions can be impractical and detract from the time and resources platforms can designate for product improvement or even to developing better tools for content moderation.

Recommendation 5-2: Social media providers should adopt the standards referenced in the previous recommendation as a matter of policy and as specific provisions in their terms of service.

A public statement that platforms will comply with all the measures included in the standard and a commitment to the standard in its terms of service would be a meaningful step toward an enforceable legal structure on social media. Section 5 of the Federal Trade Commission Act gives the FTC the authority to penalize firms that engage in unfair or deceptive business practices, although this provision includes an exception enacted in 1980 prohibiting the FTC from using its unfairness authority to promulgate rules governing children's advertising.[3] Using this authority, the agency has brought enforcement actions against companies that have failed to honor commitments made in their privacy policies and other similar documents (FTC, 2023).

Failure to honor basic cybersecurity standards may also represent an unfair business practice (FTC, 2021). Unlike deception, which is judged against a firm's affirmative statement, unfairness can be seen as a more general failure to meet society's expectations, including standards of industry practice (Pertschuk et al., 1980). Though applied more sparingly, unfairness can be the basis for enforcement actions even against egregious conduct by companies that have not actively incorporated those standards into their terms of use (FTC, 2003).

The FTC's ability to characterize business practices as unfair depends on the agency giving firms sufficient notice of what is necessary to meet

[3] 15 U.S. Code § 57a.

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their legal obligations.[4] The agency's proposed new rule on commercial surveillance and data security has identified the "extent [to which] commercial surveillance practices or lax data security measures harm children, including teenagers" as an area of particular concern.[5] An industry standard on data security and advertising could facilitate the agency's oversight of these practices.

The creation of a standard would also support the FTC's use of consent decrees as a regulatory tool. The agency will negotiate consent decrees with companies that fail to meet expected standards, as it has done for data protection (Daily Business Review, 2015). Once a company agrees to a consent decree, the terms of the decree determine its obligations to remediate, regardless of whether or not those terms are strictly within the FTC's authority (Rosch, 2011).

The creation of industry standards for social media would inform the FTC's governance by consent decree, even for social media providers that do not explicitly adopt the standard into its terms of service. Nevertheless, it is the committee's hope that the standards development process described in Recommendation 5-1 would trigger a virtuous cycle of compliance. International standards can be a marker of good business practice and even a badge of pride, a dynamic that would be analogous to companies seeking green building certification in the absence of any legal obligation to do so. The normative pressure of industry standards could serve as a signal to the public of a company's sincere and meaningful steps to mitigate the harms associated with its product.

USING THE STANDARDS

A similar process is underway in artificial intelligence (AI) and machine learning. Ethical AI tool kits are designed to enable more open communication among technology developers, researchers, policy makers, and civil society (Wong et al., 2023). Tools such as Model Cards, which provide short explanations of how and against which machine learning tools are benchmarked, are a step toward transparency in AI (Mitchell et al., 2019). Similarly, public documentation on the provenance of the datasets used to calibrate machine learning models is gaining traction as a way to mitigate the harms a biased model can cause (Gebru et al., 2021).

As part of the ethical AI movement, IEEE has set out standards and guidelines to ensure that the AI systems prioritize human well-being in design (Shahriari and Shahriari, 2017). The standards developed from the

[4] *Federal Trade Commission vs. Wyndham Worldwide Corp.*, 799 F.3d 236 (3d Cir. 2015).

[5] Federal Trade Commission, "16 CFR Chapter I: Trade Regulation Rule on Commercial Surveillance and Data Security," *Federal Register* 87, No. 202 (October 20, 2022) 63738.

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implementation of Recommendation 5-1 could draw on these principles, evaluating the platform's transparency about its policies and practices and its accountability for data breaches or violations of user privacy. The standards could evaluate whether the platform has age-verification processes, data encryption, and robust privacy policies in place, along with efforts to educate parents and other stakeholders on cyberbullying and reporting and blocking mechanisms. The standards could shine a light on the extent to which platforms are performing due diligence to enforce their age minimums. In 2021, Common Sense Media found that 38 percent of children between ages 8 and 12 have used social media, for example (Rideout et al., 2021). Standards could also clarify whether a social media platform's content is suitable for children and teens based on age-appropriate criteria and whether the design of the platforms' features and affordances for young people are developmentally informed or evidence based.

Practically speaking, such standards could form the basis of a rating system or a checklist assessment of items that enumerate responsible design. Such a checklist could be used to create a library of ranked social media platforms or apps wherein included apps have some level of endorsement for children or teens. The library could even provide clear language information to parents and guardians about the specific purposes and affordances of each app—something particularly valuable given the dynamic and changing landscape of new social media platforms.

The committee recognizes that greater transparency and accountability in the design of social media do not necessarily prevent young people from accessing inappropriate content or taking risks online. Many young people are tech-savvy and can find ways to bypass age restrictions or privacy settings. Nevertheless, an objective quality benchmark could be invaluable to parents trying to determine which platforms could provide the most positive experience for their children. Complying with certain standards would be an important indicator to anyone in a position to authorize a platform or app for personal or institutional use, as in a school system. Some form of benchmarking apps could help school districts better interpret the market for educational technology.

Social media operations are remarkably poorly understood, especially for products so influential and widely used. Accessible and comparable standards would be an aid to consumers who want a valid indicator of various platforms' commitment to data privacy, content moderation, and other important aspects of the user experience. This important first step toward product benchmarking could introduce greater transparency and ultimately more fair competition into an opaque market.

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REFERENCES

Allyn, B. 2021. *Here are 4 key points from the Facebook whistleblower's testimony on Capitol Hill.* https://www.npr.org/2021/10/05/1043377310/facebook-whistleblower-frances-haugen-congress (accessed September 18, 2023).

Bradshaw, S., and B. Barrett. 2022. *Civil society organizations' data, access, and tooling needs for social media research.* https://informationenvironment.org/wp-content/uploads/2022/09/RP5-Civil-Society-Organizations-Data-Access-and-Tooling-Needs-for-Social-Media-Research.pdf (accessed September 18, 2023).

Brown, I. 2022. The UK's Midata and Open Banking Programmes: A case study in data portability and interoperability requirements. *Technology and Regulation* 2022:113-123.

Brown, N. 2021. Regulatory Goldilocks: Finding the just and right fit for content moderation on social platforms moderation on social platforms. *Texas A&M Law Review* 8(3). https://scholarship.law.tamu.edu/cgi/viewcontent.cgi?article=1219&context=lawreview (accessed September 18, 2023).

Center for Social Media Responsibility. 2022. *Iffy Quotient.* University of Michigan, School of Information. https://csmr.umich.edu/projects/iffy-quotient (accessed February 23, 2024).

Church, P., and C. N. Pehlivan. 2023. The Digital Services Act (DSA): A new era for online harms and intermediary liability. *Global Privacy Law Review* 4(1):53-59.

Collinson, J., and J. Persson. 2022. What does the 'best interests of the child' mean for protecting children's digital rights? A narrative literature review in the context of the ICO's age appropriate design code. *Communications Law* 27(3):132-148.

Cranor, L. F. 2003. P3P: Making privacy policies more useful. *IEE Security & Privacy* (Nov/Dec):50-55. https://users.ece.cmu.edu/~adrian/630-f05/readings/cranor-p2p.pdf (accessed September 18, 2023).

Cusumano, M. A., A. Gawer, and D. B. Yoffie. 2021. Social media companies should self-regulate. Now. *Harvard Business Review.* https://hbr.org/2021/01/social-media-companies-should-self-regulate-now (accessed December 31, 2023).

Daily Business Review. 2015. FTC consent decrees are best guide to cybersecurity policies. https://www.bsfllp.com/news-events/ftc-consent-decrees-are-best-guide-to-cybersecurity-policies.html (accessed September 18, 2023).

Douek, E. 2019. Verified accountability: Self-regulation of content moderation as an answer to the special problems of speech regulation. *Hoover Working Group on National Security, Technology, and Law.* https://www.hoover.org/sites/default/files/research/docs/douek_verified_accountability_aegisnstl1903_webreadypdf.pdf (accessed September 18, 2023).

Farthing, R., R. Abbas, K. Michael, and G. Smith-Nunes. 2021. Age appropriate digital services for young people: Major reforms. *IEEE Consumer Electronics Magazine* (July/August):40-48.

Franqueria, V., J. Annor, and O. Kafali. 2022. Age appropriate design: Assessment of TikTok, Twitch, and YouTube Kids. https://doi.org/10.48550/arXiv.2208.0263.

FTC (Federal Trade Comission). 2003. *The FTC's use of unfairness authority: Its rise, fall, and resurrection.* https://www.ftc.gov/news-events/news/speeches/ftcs-use-unfairness-authority-its-rise-fall-resurrection (accessed September 18, 2023).

FTC. 2021. *Federal Trade Commission 2020 privacy and data security update.* https://www.ftc.gov/system/files/documents/reports/federal-trade-commission-2020-privacy-data-security-update/20210524_privacy_and_data_security_annual_update.pdf (accessed July 12, 2023).

FTC. 2023. *Privacy and security enforcement.* https://www.ftc.gov/news-events/topics/protecting-consumer-privacy-security/privacy-security-enforcement (accessed July 12, 2023).

Gebru, T., J. Morgenstern, B. Vecchione, J. W. Vaughan, H. Wallach, H. Daumé III, and K. Crawford. 2021. Datasheets for datasets. *Communications of the ACM* 64(12):86–92.

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Goldman, E. 2022. *California legislators seek to burn down the internet—for the children*. https://www.techdirt.com/2022/06/29/california-legislators-seek-to-burn-down-the-internet-for-the-children (accessed September 18, 2023).

Henderson, R., A. Migdal, and T. He. 2016. *Note: Industry self-regulation sustaining the commons in the 21st century?* Harvard Business School Background Note 315-074, March 2015. (Revised March 2016.)

IEEE (Institute of Electrical and Electronics Engineers). 2021. *IEEE standard for an age appropriate digital services framework based on the 5Rights principles for children*. https://doi.org/10.1109/IEEESTD.2021.9627644.

Information Comissioner's Office. 2023. *Introduction to the children's code*. https://ico.org.uk/for-organisations/uk-gdpr-guidance-and-resources/childrens-information/childrens-code-guidance-and-resources (accessed September 18, 2023).

ISO (International Organisation for Standardization). 2021. *ISO strategy 2030*. Geneva: International Organisation for Standardization.

ISO. 2022. *ISO/IEC 27000 family: Information security management*. https://www.iso.org/standard/iso-iec-27000-family (accessed June 1, 2023).

ISO. 2023. *Standards*. https://www.iso.org/standards.html (accessed October 17, 2023).

ISO. n.d. *About us*. https://www.iso.org/about-us.html (accessed July 12, 2023).

Kang, C. 2018. Tech industry pursues a federal privacy law, on its own terms. *The New York Times*. https://www.nytimes.com/2018/08/26/technology/tech-industry-federal-privacy-law.html (accessed September 18, 2023).

Kelly, H., and E. Guskin. 2021. Americans widely distrust Facebook, TikTok and Instagram with their data, poll finds. *The Washington Post*. https://www.washingtonpost.com/technology/2021/12/22/tech-trust-survey (accessed September 18, 2023).

Klonick, K. 2020. The Facebook Oversight Board: Creating an independent institution to adjudicate online free expression. *Yale Law Journal* 129:2418-2499.

Knight First Amendment Institute. 2021. *Researchers, NYU, Knight Institute condemn Facebook's effort to squelch independent research about misinformation*. https://knightcolumbia.org/content/researchers-nyu-knight-institute-condemn-facebooks-effort-to-squelch-independent-research-about-misinformation (accessed September 18, 2023).

Krass, P. 2022. *Transparency: The first step to fixing social media*. https://ide.mit.edu/insights/transparency-the-first-step-to-fixing-social-media (accessed May 31, 2023).

MacCarthy, M. 2021. *How online platform transparency can improve content moderation and algorithmic performance*. The Brookings Institution. https://www.brookings.edu/blog/techtank/2021/02/17/how-online-platform-transparency-can-improve-content-moderation-and-algorithmic-performance (accessed September 18, 2023).

MacCarthy, M. 2022. *Transparency recommendations for regulatory regimes of digital platforms*. Centre for International Governance Innovation. https://www.cigionline.org/publications/transparency-recommendations-for-regulatory-regimes-of-digital-platforms (accessed September 18, 2023).

Maroni, M. 2019. *Some reflections on the announced Facebook Oversight Board*. https://cmpf.eui.eu/some-reflections-on-the-announced-facebook-oversight-board (accessed September 18, 2023).

Mitchell, M., S. Wu, A. Zaldivar, P. Barnes, L. Vasserman, B. Hutchinson, E. Spitzer, I. D. Raji, and T. Gebru. 2019. *Model Cards for model reporting*. Paper presented at the Conference on Fairness, Accountability, and Transparency, Atlanta, GA.

Napoli, P. M. 2018. What social media platforms can learn from audience measurement: Lessons in the self-regulation of "black boxes." Paper presented at 2018 Telecommunications Policy Research Conference, Washington, DC.

Panditharatne, M. 2022. *Law requiring social media transparency would break new ground*. https://www.brennancenter.org/our-work/research-reports/law-requiring-social-media-transparency-would-break-new-ground (accessed September 18, 2023).

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Pertschuk, M., P. R. Dixon, D. A. Clanton, R. Pitofsky, and P. P. Bailey. 1980. *FTC policy statement on unfairness*. December 17. https://www.ftc.gov/legal-library/browse/ftc-policy-statement-unfairness (accessed July 12, 2023).

Rideout, V., A. Peebles, S. Mann, and M. B. Robb. 2021. *The common sense census: Media use by tweens and teens*. Common Sense Media. https://www.commonsensemedia.org/sites/default/files/research/report/8-18-census-integrated-report-final-web_0.pdf (accessed September 18, 2023).

Rosch, J. T. 2011. *Consent decrees: Is the public getting its money's worth?* https://www.ftc.gov/sites/default/files/documents/public_statements/consent-decrees-public-getting-its-moneys-worth/110407roschconsentdecrees.pdf (accessed September 18, 2023).

Shahriari, K., and M. Shahriari. 2017. IEEE standard review - ethically aligned design: A vision for prioritizing human wellbeing with artificial intelligence and autonomous systems. *2017 IEEE Canada International Humanitarian Technology Conference (IHTC)*:197–201.

Wong, R. Y., M. A. Madaio, and N. Merrill. 2023. Seeing like a toolkit: How toolkits envision the work of AI ethics. *Proceedings of the ACM on Human–Computer Interaction* 7(CSCW1):Article 145.

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Training and Education

As this report shows, social media has the potential to both harm and benefit young users. Some of the harms can be mitigated and the benefits realized through reliance on product design features as set out in the previous chapter. But there will always be a role for individual choice in managing the risks of the online world. The opacity of the algorithmic processes that drive social media, combined with the appeal of the products and the stickiness of their design, can make the relative importance of user choices seem insignificant. There is, nevertheless, an important role for education in enabling people to identify and break self-destructive habits, to be more sophisticated consumers of social media, and more discerning in what they authorize technology companies to do with their data.

There is evidence to suggest that ignorance of how online media work is a serious problem. A recent nationally representative survey assessing adults' knowledge of digital media found that 77 percent of respondents failed the test and 92 percent scored a D or lower (Turow et al., 2023). Answers to questions evaluating knowledge of the legal protections of user data indicated surprisingly high knowledge gaps. Three out of every four respondents incorrectly answered the true-false question, "The U.S. federal government requires that companies ask Internet users to opt-in to being tracked" (it does not); 82 percent either incorrectly affirmed or did not know if the statement "The Health Insurance Portability and Accountability Act (HIPAA) prevents apps that provide information about health from selling data collected about app users to marketers" were true or

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false (it is false) (Turow et al., 2023). Perhaps more telling from the survey was a sense of fatalism. Although only 14 percent of respondents trusted companies' motives in using their personal data and 91 percent would want control over that information, 79 percent agreed with the statement, "I have come to believe that I have little control over what marketers can learn about me online" (Turow et al., 2023). Less can be said about what children and adolescents understand about how to effectively manage the online world, and social media in particular (Livingstone, 2014). Evidence from the UK, for example, indicates that a sizable minority of young people are overconfident in their abilities to correctly identify misinformation. Of the three-quarters of 12- to 17-year-olds surveyed who indicated that they could distinguish between real and fake online profiles, about a quarter failed to do so accurately in a test (Ofcom, 2023). Nor is it clear that young people have a good understanding of how to maintain privacy online even as there is growing public emphasis on protecting their private information, such as the California age-appropriate design law, for example (Andrews et al., 2023).

Given the role digital media has to shape society (i.e., influencing politics, health, culture, and self-expression), there is an urgent need for more explicit attention to digital media competency in the school system. Schools have already played a role in influencing young people to use electronic devices and social media. Especially since the start of the COVID-19 pandemic, the use of YouTube, Google Classroom, and other digital learning tools (e.g., Canvas, Blackboard, Schoology) has grown; many teachers also use educational games (e.g., Prodigy, Animal Crossing), online blogs, and social media platforms (e.g., Facebook, Instagram) for instruction (Askari et al., 2018; Kurtz, 2020). The reliance on technology in schools can lead to a situation where children are exposed to social media platforms at an early age, even if their parents may prefer a more limited and controlled digital environment.

Interactions between teachers and students that may have happened in person are increasingly occurring through social media, and children may use the platforms to communicate with their classmates as well (Ong and Quek, 2023). Teachers may be reluctant to use social media in the classroom because of its distracting potential, but a 2020 review described it as "somewhat ubiquitous" in K through 12 classrooms (Dennen et al., 2020). In short, schools and teachers play a pivotal role in the initial exposure of children to social media. As devices and social media become entrenched in the school curriculum, parents necessarily cede some control of their children's online presence.

This chapter recommends educational strategies that aim to improve the online experience for adolescents as well as the contextual understanding of their teachers and health providers.

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COMPREHENSIVE DIGITAL MEDIA LITERACY EDUCATION

The absence of a clear understanding of how digital media work and the effects they can have will continue to limit consumers from using social media in the safest and most beneficial ways possible. The unique vulnerability of young people to toxic content or misinformation is clear, but, in the committee's assessment, setting up additional age bars and time restrictions to online access is neither practical nor entirely desirable. It is therefore necessary both to create an online environment that protects young people and social media consumers who are empowered to protect themselves. In the same way that improving health literacy can provoke healthier life choices, so can improving media literacy enable better choices online (McAnally and Hagger, 2023).

Failure to invest in young people's ability to navigate the complex world of online news and media has consequences for the young people themselves and for society at large (Cho et al., 2022; Crosling et al., 2022; Jones-Jang et al., 2021). Shortfalls in media literacy contribute to social problems and the circulation of misinformation; it can also give young people skewed perceptions of online risks. Some evidence indicates that education can counter this effect (Guess et al., 2020). Media literacy training in schools has been shown to decrease body dissatisfaction in adolescents, for example (Kurz et al., 2022; Zuair and Sopory, 2022). Some evidence suggests that drawing adolescents' attention to privacy controls on social media can prompt them to greater scrutiny of targeted advertising (Zarouali et al., 2018). For reasons such as these, media education is sometimes framed as *digital citizenship*, recognizing the civic responsibility that compels attention to this topic (Hobbs, 2007; Lenhart et al., 2011).

Although specific conceptions of media literacy or digital citizenship may vary, most discussions of the topic include a common emphasis on the ability to "access, analyze, and evaluate, and produce communication in a variety of forms" (Huguet et al., 2019; KFF, 2003). Updated standards for digital media are sorely needed, and a lack of clear curriculum standards for teaching modern media literacy has led to inaction in many school systems (Baker et al., 2021). A 2014 review of the effectiveness of media literacy found that most programs were falling well short of their promise, often because of uneven content or curriculum length, or poorly qualified instructors (McCannon et al., 2014). Further hampering the evolution of the field, there is no standard digital media literacy curriculum in the United States (Andrews et al., 2023).

Recommendation 6-1: The U.S. Department of Education should draw national attention to the importance of comprehensive digital media literacy and state boards of education should set standards for the same in grades K through 12.

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The committee recognizes that a challenge to this recommendation is that there is limited empirical evidence on which to build comprehensive digital media literacy programs (Guess et al., 2020; Jones-Jang et al., 2021). That is not to say that there is insufficient evidence that media literacy education is effective. A meta-analysis comparing the effectiveness of 51 media literacy programs found that the media literacy improved on students' knowledge of media by more than 1 standard deviation (d = 1.12, 95 percent confidence interval 0.77 to 1.47); the programs' association with a reduction in unhealthy behavior was understandably less, but still meaningful (d = 0.23, 95 percent confidence interval 0.15 to 0.31) (Jeong et al., 2012). A more recent meta-analysis of randomized interventions found media literacy to be a modestly effective counter even to body dissatisfaction, a problem with an extensive social and psychological roots (Kurz et al., 2022).

At the same time, published literature offers fewer specifics on the content of an ideal media literacy curricula, possibly because the field changes so rapidly (Huguet et al., 2019). Few studies have been conducted in a manner that would allow for isolating the effects of interventions or establishing a causal relationship between education and behavior change (Huguet et al., 2019).

These are not, however, valid reasons for schools to avoid providing students with the tools they need to navigate their digital lives, especially when the school uses digital platforms and gives digital assignments. There are ample resources that the Department of Education and state authorities could build on in encouraging digital media literacy: Canada and England have content standards and validated methods to assess media literacy in schools (Nkana, 2010). The sources noted in Box 6-1 would form a valuable starting point in this discussion. While the cited sources vary in their scope (some are designed to combat misinformation, others emphasize the skills needed to consume media, or on the potential effects of media), all could be used to inform the comprehensive standard envisioned.

The main goal of education in digital citizenship is to give young people the tools they need to evaluate the relative risks and benefits of their online experience and use online tools responsibly. But the most successful educational programs are set up to include parents and guardians, an inclusion that is all the more important when the curriculum emphasizes practical life skills. Complementary parent education materials would therefore be an important component of the program developed.

The National Association of State Boards of Education recognizes the importance of parental involvement and encourages state boards to implement policies to engage parents (Slone, 2021). There is also precedent for developing companion materials for parents on life-skills programs. For

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BOX 6-1
Standards to Inform a Digital Media Curriculum

The Institute of Electrical and Electronics Engineers (IEEE) standard framework for digital intelligence, literacy, skills, and readiness provides the broadest approach to education for competency online. It includes eight areas of training: digital identity, use, safety, security, emotional intelligence, literacy, communication, and rights. Each of these eight areas can be developed in three levels: citizenship, creativity, and competitiveness. The global think tank DQ Institute has developed the IEEE standard into a framework for educators.

The European Digital Competence Framework for Citizens emphasizes five areas: information and data literacy, communication and collaboration, content creation, safety, and problem solving, each of which is developed at different proficiency levels. Formal guidance on the framework provides examples of skills students would master at different levels of proficiency. While the framework gives relatively little attention to the effect of media on consumer behavior, this could be supplemented from other sources. A weakness of this approach is that it does not appear to include much on understanding media effects on consumers.

The Poynter Institute's MediaWise program has resources on teaching youth how to detect misleading or inaccurate information on the internet. There are also several organizations that provide an information clearinghouse for media literacy tools, such as:

- The United Nations Alliance of Civilizations maintains a partial list of organizations and resources on working in media literacy and a searchable database on media resources.
- The National Association for Media Literacy Education has guides on the content and manner of teaching media literacy, as well as guides for parents and resources that focus on misinformation, privacy, and access.
- Iowa Digital Literacy, a program of the Partnership for a Healthy Iowa, has an online list of resources including teaching aids, presentations, and lesson plans for teaching the harms and benefits of digital media.
- The Association for the Advancement of Artificial Intelligence and Computer Science Teachers Association have a national guideline for teaching about artificial intelligence in K to 12.

SOURCES: Carretero et al., 2017; DQ Institute, 2021; IEEE, 2021; Partnership for A Healthy Iowa, 2023; Poynter Institute, 2023; Touretzky et al., 2019; UNAOC, 2023.

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Social Media and Adolescent Health

example, the Department of Education and state authorities in Maryland and California have resources for parents as part of their financial literacy curricula (CDE, 2022; Salmon, 2017; Y4Y, n.d.). The committee recognizes that not all parents will be able or inclined to take part in training but envisions a similar effort where information is at least made available to parents as part of the recommended program on digital media literacy.

The involvement of parents in digital media education programming can help broaden the public discussion of this important topic. Ultimately the education envisioned in this recommendation will help build a more sophisticated society able to understand the systemic effects of digital platforms on politics, culture, and social dynamics. It is the committee's hope that digital media literacy can be an entry point for school systems to develop the teaching of computational thinking and skills such as data visualization broadly applied to any number of questions (K12 Computer Science, 2023). In this way, the education envisioned could have transformative effects across society.

The development and rollout of a digital media literacy curriculum standard would also be a valuable opportunity to remedy the relatively limited information on the ability of media literacy education to change behavior (Huguet et al., 2019). For example, an analysis of media literacy education in Europe questioned if the subject would be better treated through integrating it across the curriculum, or if that would lead to neglect on the logic that every teacher's responsibility might as well be no one's (McDougall et al., 2018). Such questions could be answered if the proposed educational standards were rolled out in a way to allow for rigorous evaluation of both the content of curriculum and the way it is taught. These evaluations would inform an iterative process of revising and updating the educational standards and could eventually facilitate consensus on outcome measures of proficiency. This process would gradually contribute to a better understanding of the most effective strategy.

INTEGRATING DIGITAL MEDIA COMPETENCY INTO PROFESSIONAL EDUCATION

The committee recognizes that the media literacy education proposed will be most successful if teachers have a good understanding of the complicated reality of how social media work. Given that U.S. teachers[1] are a subset of U.S. adults, whose digital media knowledge has been recently shown to be poor, it seems likely that few would be approaching the topic from an informed position (Turow et al., 2023). For the teaching of digital

[1] Referring here to primary and secondary school teachers.

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media literacy to be effective, teachers will need training on the content of the new curriculum and some guidance on the best way to implement it.

Most of the roles teachers have historically played in children's education offline have now been extended to include parallels in the digital world. Before the advent of communication technologies, students learned how to find, evaluate, and use information from teachers and librarians. Similarly, teachers had always played a role in helping students build healthy peer relationships. Teachers are essential in deterring negative social interactions like school violence, harassment, and school bullying (Eliot et al., 2010).

Nowadays, with the ubiquity of communication technologies and social media, the role of teachers has inevitably expanded to the online world. Teachers are critical players in fostering digital literacy among their students, especially in teaching them how to use technology safely and responsibly, critically evaluate online information, and create and share digital content, all essential skills for 21st-century citizens (OECD, 2019). Current learning and socializing tools have a range of alternate uses, and thus, teachers play a role in educating students about the dangers and opportunities that those alternate uses can bring. Therefore, the first important part of the teacher's role in the digital education ecosystem is selecting and using the appropriate technologies. Teachers need to be familiar with a variety of technologies and be able to choose the right tools for the job (Voogt et al., 2013).

Teachers also need to be able to use technology effectively in their teaching and help their students develop a critical eye for online information and learn how to evaluate the credibility and suitability of online content (Hämäläinen et al., 2021; Paniagua and Istance, 2018). Teachers are vital in fostering positive social interactions online and deterring negative ones. They can educate children in the respectful and responsible way of using social media and teach students about the appropriate levels of sharing in a public forum. Similarly, they are crucial in preventing cyberbullying and the other forms of harassment by protecting victims and teaching students how to deal with those situations (Guarini et al., 2019).

Most schools must give students opportunities to practice their digital skills, and teachers can provide the guardrails to make those initial interactions in the digital world safe and enriching (OECD, 2019). Teachers need to support and foster digital education within their schools and communities. Together with parents, teachers are guides in the complex, heterogeneous, and ever-changing digital world that children need to navigate. As such, sustainable success in building digital literacy lies in teachers' flexibility, inventiveness, and responsiveness within their day-to-day interactions with students.

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There is some evidence that teenagers take a more favorable view of digital media literacy when their teachers are seen as knowledgeable about the topic, while those who overemphasize the dangers are generally perceived at less credible (De Leyn et al., 2022). It is difficult to say how well teachers can maintain up-to-date knowledge of the subject without more training, however. In the past, teachers responsible for media literacy education have been self-taught or trained through one-off staff development programs or conferences (Hobbs, 2007). There is growing recognition that teacher training and a formal curriculum for digital literacy is needed; at least 18 state legislatures have taken steps to reform media education in schools (McNeill, 2023). There is, nevertheless, inadequate funding to train teachers in the topic, leading the Data & Society Research Institute to describe such training as "primarily a grassroots effort led by impassioned educators" (Bulger and Davison, 2018, p. 5).

The committee commends teachers for bottom-up efforts to empower young people to manage the digital world. But relying on teachers' initiative can no longer be the main strategy; the material changes too rapidly, and the stakes of misinformation are too high. If students are to absorb digital media literacy they will need to be educated by teachers who are themselves proficient in the topic and who have been trained in how to convey the subject to their students (Simmons et al., 2017). Given the rapid pace of change, teachers also will need continuing education to stay abreast of new technological trends.

Recommendation 6-2: The Council for the Accreditation of Educator Preparation should set requirements for digital media literacy education for student teachers and as part of ongoing professional development for veteran teachers. Teacher training interventions should be designed to allow for rigorous evaluation to measure their effectiveness.

Media literacy as an area of proficiency for teacher training that is neglected, possibly because it is not included in the Common Core Standards, which are in turn reflected in the Council for the Accreditation of Educator Preparation (CAEP) standards (Meehan et al., 2015). Given the competing demands on student teachers' time, it may not be feasible to add to their training requirements without the formal endorsement of the accreditation organization.

This is not a new problem. There have been pushes to incorporate more technology into classrooms for decades, with little commensurate investment in teacher training. For example, the 1980s saw a tremendous push in the United States to include computers in the classroom, but evidence of their effectiveness relative to traditional teaching tools proved

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lackluster (Fouts, 2000). A lack of teacher training and a lack of integration with existing curricula may be partly to blame for this disappointing result.

What is more, media literacy is a constantly changing topic, as media are dynamic as are the most pressing social questions related to media use (Santo, 2013). Questions related to corporate control of online speech, for example, need to be examined from both the one-to-many model familiar to print and broadcast media as well as the participatory many-to-many model of social media (Santo, 2013).

A tertiary meta-analysis found, not surprisingly, that digital literacy training was effective particularly when teachers were well trained to provide it (Archer et al., 2014). Any effort to improve young people's use of technological tools will depend on their teachers' ability to integrate these tools into the curriculum. In New Mexico for example, where media literacy education was a high priority in 1990s and 2000s, the state media literacy curriculum was accompanied by a week-long teacher training course emphasizing the need to integrate media education across the curriculum (Nkana, 2010).

Given the competing priorities facing student teachers, CAEP might consider a strategy of promoting media literacy in teacher training by integrating it into other subjects' coursework. English or reading teachers, for example, could plan lessons around discerning the credibility of online news sources; math lessons might ask students to analyze how different platforms present data, and social studies lessons could review how certain points of view are advanced or ignored on social media (Meehan et al., 2015).

At the same time, integrating media education across the curriculum runs the risk of diffusion of responsibility: If everyone is responsible for teaching the material, it is possible that no one will. For this reason, it could be helpful to have a school district leader responsible for ensuring the goals of the training are met. There are also topics such as embedded marketing, data privacy, and the reputational consequences of oversharing that can be difficult to integrate into curricula (Livingstone and Brake, 2010).

When done properly, digital media education is less about warning students and more about increasing their ability to think critically (Buckingham, 2020). As with other forms of education, critical thinking skills can be cultivated in a way that disproportionately benefits schools and students who are already well off. Teacher quality, school funding, and educational needs are not distributed evenly across the country (Adamson and Darling-Hammond, 2012). Perhaps the biggest challenge this recommendation will pose is the equitable allocation of training resources to teachers in poorly resourced districts.

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Better-endowed school districts and schools within those districts have access to time, expertise, staff, and even digital devices to use in education. Further, children in those schools are more likely to enjoy a higher baseline level of support and guidance regarding media consumption, while children at the greatest risk of harm are overrepresented in underfunded school systems. Research on special education programs, for example, suggests that lack of teacher training is a barrier to using technological tools in the classroom, as are students' access to the internet and devices at home (Starks and Reich, 2023). Research during the COVID-19 pandemic found that access to internet connectivity varies widely by state, but between one-quarter to half of students live in homes without the broadband connectivity needed to support distance learning (Chandra et al., 2020). Nationally, more than a quarter of Latino and Latina students, 30 percent of Black students, and 35 percent of Native American students do not have adequate access to internet, nor do an estimated 37 percent of students in rural areas (Chandra et al., 2020). With this basic disparity in access comes a subsequent disparity in skills, wherein in students from disadvantaged groups have fewer opportunities to cultivate advanced digital skills (Reynolds et al., 2022).

To complicate the matter, providing additional media literacy programming and pursuing their own training are additional burdens for teachers (Buckingham, 2020). These burdens will quickly become unreasonable or ignored when they carry an implicit request to stretch existing funds to meet new programming and training goals.

For this reason, both the proposed teacher training and the digital media literacy education in grades K through 12 would be best accompanied by marshalling resources to support the program. The Title I-A program of the Elementary and Secondary Education Act (ESEA) provides federal aid for the education of disadvantaged students; Title II supports programs for teachers and administrators, including literacy and civics education (CRS, 2022). In recent years, appropriations for Title I-A grants to schools have ranged from $15.5 to $17.5 billion; another $2 billion a year is set aside under Title II-A for supporting instruction with additional, varying amounts of Title II funding available for civics and teacher training (CRS, 2022).

Title I allocates funds according to a formula based on the percentage of low-income students enrolled in a given school (U.S. Department of Education, 2018). It is designed to promote fairness and equity in education by making resources available to schools in historically underserved areas. In 2015, the Every Student Succeeds Act (ESSA) reauthorized the ESEA, allowing state and local education agencies more freedom in tailoring local plans to close "achievement gaps" (U.S. Department of Education, n.d.). The act puts particular emphasis on the importance

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of well-rounded education, calling out the importance of, among other subjects, civics, computer science, and technology training (Every Student Succeeds Act, 2023; Jones and Workman, 2016). Such well-rounded education can and should have room for the inclusion of digital media literacy programs.

The Department of Education has a particular interest, articulated in its *2022 Agency Equity Plan,* to support states and school districts to make educational opportunities available to all students (U.S. Department of Education, 2022). Through its influence on policy and certain funds the agency exerts a soft power on state educational authorities (Pelsue, 2017). For this reason, the committee envisions cooperation between federal, state, and local authorities as being central to the success of the teaching and teacher training programs recommended.

Programming to Provide Evidence of Best Strategies

As the previous section explained, there is a paucity of large-scale causal evidence on the effectiveness of education to change behavior. Despite an interest in the subject going back years, including a 2010 Aspen Institute call for rigorous program evaluations of both teacher training and student's retained knowledge, such evaluations are uncommon (Aspen Institute Communications and Society Program, 2010). Part of the challenge comes from the relative newness of the field; there is not yet wide agreement on what skills would need to be measured to track digital media literacy (Julien, 2018). There is also considerable variability in educational standards. The IEEE 2020 standard on digital literacy cited 25 different digital skills frameworks, most of them developed by industry, governments, or civil society groups (IEEE, 2021).

The lack of a shared understanding of what digital literacy entails can make it challenging to develop evaluation criteria that are widely accepted and applicable across different initiatives. Because digital literacy interventions can be diverse in their content, providers, and target populations, evaluation of them poses methodological challenges. When the content of an educational intervention is characterized by such heterogeneity, the data collection demands of evaluation are high and can quickly surpass the capacity of the implementing organization. Perhaps for this reason digital literacy interventions are not usually designed with an eye to rigorous impact evaluation, leaving any estimate of the training's effectiveness subject to confounding.

The push for a national standard for media literacy education and related teacher training programs provides the opportunity to improve the understanding of what makes some programs successful and some failures. The committee therefore seconds recent calls for more prospec-

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tive research to identify the essential skills that make up digital media literacy and the most equitable strategy to promote it (Turner et al., 2017). With an evaluation framework in place, it will be easier to identify effective practices and compare the outcomes of different digital literacy initiatives. Interventions at the level of the school district or county can be implemented in a manner that allows for post-hoc evaluations that account for possible confounders. The committee recognizes the considerable front-end effort involved in planning for such evaluations, collecting data from teachers and students, and following them over time. The knowledge generated from these causal evaluations will provide valuable feedback to policy makers and stakeholders and inform an iterative process of curricula improvement. This will also serve an end goal of a more rigorous and evidence-based approach to digital literacy education to ensure that all children and adolescents have the knowledge they need to thrive in an increasingly digital world.

Training for Health Professionals

The recommendations presented so far in this chapter are consistent with an emerging consensus on the importance of media literacy for society, among them a 2016 statement from the American Academy of Pediatrics encouraging its members to "advocate for and promote information and training in media literacy" (CCM et al., 2016). The academy further encouraged pediatricians to "promote understanding of the benefits and risks of media" in schools and with their patients and their families, citing risks of internet gaming disorder and problematic internet use both being relatively common (estimates ranging from 4 to 8.5 percent prevalent) among U.S. youth (CCM et al., 2016). A recent American Psychological Association report echoed similar concerns, calling for routine screening for problematic social media use (APA, 2023).

Young people who are struggling with underlying psychological problems may be using social media and gaming to cope (Oldt, 2016). To an adolescent who sees social media as a vehicle for entertainment, connection, or learning (Serra et al., 2021), it would not necessarily be clear that the same pastime that helps them to manage stress is itself a stressor. Published guidance therefore encourages pediatric clinicians to inquire about children's media use, especially when there are concerns about mental health problems such as depression, anxiety, or attention-deficit hyperactivity disorder (Gentile et al., 2017).

There is good consensus that pediatricians and other providers should discuss social media use in routine visits and encourage the limiting of electronic media (Hill, 2020). A recognition of the influence of social media on the mental health of young people prompted a recent Surgeon Gen-

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eral's report to recommend routine screening for mental health problems in primary care (OSG, 2021). A similar concern with compulsive use has lead pediatrics organizations in Europe to call for building awareness and support for members to correctly identify problematic use (Ferrara et al., 2017).

There is a difference, however, between what is recommended and what is practiced. In the same way that students in grades kindergarten through 12 need knowledgeable teachers if they are to achieve mastery of digital media, so do patients need providers who are in a position to counsel them on social media use and spot potential warning signs.

Recommendation 6-3: The Liaison Committee on Medical Education, the Accreditation Commission for Education in Nursing, the Commission on Collegiate Nursing Education, and the Council on Social Work Education should incorporate training on the multiple effects of social media on children's and adolescents' well-being into professional education.

The Liaison Committee on Medical Education (LCME) is the accrediting body for medical education in the United States and Canada (LCME, 2023b). The Accreditation Commission for Education in Nursing and the Commission on Collegiate Nursing Education accredit nursing schools (Gaines, 2023). These organizations have a commitment to evolving and dynamic clinical education in an effort to respond to corresponding changes in society (Kirch, 2017). There is also precedent for these organizations making changes in response to social problems. A recognition of deficiencies in nutrition education in medical school caused LCME to create standards for nutrition education, for example (Hark et al., 2015). Over time, this may be a curriculum revision that other accrediting organizations undertake.

The committee recognizes the challenges associated with updating health professional curricula (Gleason et al., 2021). A recent survey found the vast majority (84 percent) of U.S. medical schools were either starting, finishing, or in the midst of a curriculum overhaul (AAMC, 2023). Nevertheless, there is reason to believe that the proposed revision could be integrated into existing guidelines. Standards for curricular content aim to ensure clinicians have sufficient breadth of knowledge to succeed in their residencies. The LCME standards specifically call out "instruction in the diagnosis, prevention, appropriate reporting, and treatment of the medical consequences of common societal problems" (LCME, 2023a, p. 10).

It would be inadequate to treat the symptoms of gaming addiction or signs of problematic social media use without acknowledging the role of social media and the context in which the problems flourish. Even when

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clinicians recognize that their patients' social media use may be related to a condition such as depression, they will need tools to support the unique challenges related to social media use, tools that could help them evaluate their patients' media habits, for example. It will be important for providers to assess when and how their patients use social media and how this use affects them. To this end, the American Academy of Pediatrics' new National Center of Excellence of Social Media and Mental Wellness will be a helpful resource for those already in practice as well as students (SAMHSA, 2022). One of the center's main goals is to "build the capacity of individuals who work with children and teens to mitigate harmful impacts of social media on youth mental health and promote healthy social media use" (AAP, 2023). Working with the center might also be an effective way to help providers who already have child and adolescent patients adapt to changing clinical demands (Cass et al., 2020).

REFERENCES

AAMC (American Association of Medical Colleges). 2023. *Curriculum reports: Curriculum change in medical schools*. https://www.aamc.org/data-reports/curriculum-reports/data/curriculum-change-medical-schools (accessed November 9, 2023).

AAP (American Academy of Pediatrics). 2023. *More about the Center of Excellence on Social Media and Youth Mental Health*. https://www.aap.org/en/patient-care/media-and-children/center-of-excellence-on-social-media-and-youth-mental-health/more-about-us (accessed November 9, 2023).

Adamson, F., and L. Darling-Hammond. 2012. Funding disparities and the inequitable distribution of teachers: Evaluating sources and solutions. *Education Policy Analysis Archives* 20(0):37.

Andrews, J. C., K. L. Walker, R. G. Netemeyer, and J. Kees. 2023. Helping youth navigate privacy protection: Developing and testing the children's online privacy scale. *Journal of Public Policy & Marketing* 39(2):074391561988363.

APA (American Psychological Association). 2023. *Health advisory on social media use in adolescence. American Psychological Association*. https://www.apa.org/topics/social-media-internet/health-advisory-adolescent-social-media-use (accessed September 19, 2023).

Archer, K., R. Savage, S. Sanghera-Sidhu, E. Wood, A. Gottardo, and V. Chen. 2014. Examining the effectiveness of technology use in classrooms: A tertiary meta-analysis. *Computers & Education* 78:140-149.

Askari, E., D. Brandon, S. Galvin, and C. Greenhow. 2018. Youth, learning and social media in K-12 education: The state of the field. *Rethinking Learning in the Digital Age: Making the Learning Sciences Count, 13th International Conference of the Learning Sciences (ICLS) 2018* 1.

Aspen Institute Communications and Society Program. 2010. *Digital and media literacy: A plan of action*, edited by R. Hobbs. https://files.eric.ed.gov/fulltext/ED523244.pdf (accessed September 18, 2023).

Baker, G., S. Faxon-Mills, A. Huguet, J. F. Pane, and L. S. Hamilton. 2021. *Approaches and obstacles to promoting media literacy education in U.S. schools*. Santa Monica, CA: RAND Corporation.

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Buckingham, D. 2020. Epilogue: Rethinking digital literacy: Media education in the age of digital capitalism. *Digital Eduaction Review* 37.

Bulger, M., and P. Davison. 2018. The promises, challenges, and futures of media literacy. In *Data & Society*. Analysis & Policy Observatory. https://digitalcommons.uri.edu/jmle/vol10/iss1/1 (accessed October 19, 2023).

Carretero, S., R. Vuorikari, and Y. Punie. 2017. *Digcomp 2.1. The digital competence framework for citizens with eight proficiency levels and examples of use*. https://doi.org/10.2760/38842.

Cass, H., S. Barclay, C. Gerada, D. E. Lumsden, and K. Sritharan. 2020. Complexity and challenge in paediatrics: A roadmap for supporting clinical staff and families. *Archives of Disease in Childhood* 105(2):109.

CCM (Council on Communications and Media), D. Hill, N. Ameenuddin, Y. R. Chassiakos, C. Cross, J. Radesky, J. Hutchinson, A. Levine, R. Boyd, R. Mendelson, M. Moreno, and W. S. Swanson. 2016. Media use in school-aged children and adolescents. *Pediatrics* 138(5).

CDE (California Department of Education). 2022. Grades K-12 financial literacy resources. In *Resources for individuals interested in financial literacy for kindergarten through grade twelve students*. California Department of Education. https://www.cde.ca.gov/pd/ca/hs/finlitk12.asp (accessed September 18, 2023).

Chandra, S., A. Chang, L. Day, J. Liu, L. McBride, T. Mudalige, D. Weiss, and A. Fazlullah. 2020. *Closing the K-12 digital divide in the age of distance learning*. San Francisco, CA: Common Sense Media. Boston, MA: Boston Consulting Group. https://www.commonsensemedia.org/sites/default/files/featured-content/files/common_sense_media_report_final_7_1_3pm_web.pdf (accessed December 31, 2023).

Cho, H., J. Cannon, R. Lopez, and W. Li. 2022. Social media literacy: A conceptual framework. *New Media & Society*. https://doi.org/10.1177/14614448211068530.

Crosling, G., G. Atherton, and A. Lee Siew Hoong. 2022. TVET: Scaffolding digital skills to the future. *TVET Journal*. https://tvetjournal.com/tvet-tools/tvet-digital-skills-frameworks (accessed December 3, 2023).

CRS (Congressional Research Service). 2022. *The Elementary and Secondary Education Act (ESEA), as amended by the Every Student Succeeds Act (ESSA): A primer*, edited by R. R. Skinner. Congressional Research Service. https://crsreports.congress.gov/product/pdf/R/R45977#:~:text=The%20purpose%20of%20Title%20I,for%20school%20improvement%20activities%20and (accessed September 18, 2023).

De Leyn, T., C. Waeterloos, R. De Wolf, B. Vanhaelewyn, K. Ponnet, and L. De Marez. 2022. Teenagers' reflections on media literacy initiatives at school and everyday media literacy discourses. *Journal of Children and Media* 16(2):221-239.

Dennen, V. P., H. Choi, and K. Word. 2020. Social media, teenagers, and the school context: A scoping review of research in education and related fields. *Educational Technology, Research and Development* 68(4):1635-1658.

DQ Institute. 2021. What is the DQ framework? Global standards for digital literacy, skills, and readiness. https://www.dqinstitute.org/global-standards (accessed September 18, 2023).

Eliot, M., D. Cornell, A. Gregory, and X. Fan. 2010. Supportive school climate and student willingness to seek help for bullying and threats of violence. *Journal of School Psychology* 48(6):533-553.

Every Student Succeeds Act. 2023. *Every Student Succeeds Act* (ESSA): A comprehensive guide. Section 4109: Activities to support the effective use of technology. https://www.everystudentsucceedsact.org/title-iv-sec-4108-activities-to-support-safe-and-healthy-students (accessed January 12, 2024).

Ferrara, P., G. Corsello, F. Ianniello, A. Sbordone, J. Ehrich, I. Giardino, and M. Pettoello-Mantovani. 2017. Internet addiction: Starting the debate on health and well-being of children overexposed to digital media. *The Journal of Pediatrics* 191:280-281.

Copyright National Academy of Sciences. All rights reserved.

Fouts, J. T. 2000. *Research on computers and education: Past, present, and future*. Seattle, WA: Bill and Melinda Gates Foundation.

Gaines, K. 2023. *Why nursing school accreditation matters*. https://nurse.org/education/nursing-school-accreditation (accessed July 12, 2023).

Gentile, D. A., K. Bailey, D. Bavelier, J. F. Brockmyer, H. Cash, S. M. Coyne, A. Doan, D. S. Grant, C. S. Green, M. Griffiths, T. Markle, N. M. Petry, S. Prot, C. D. Rae, F. Rehbein, M. Rich, D. Sullivan, E. Woolley, and K. Young. 2017. Internet gaming disorder in children and adolescents. *Pediatrics* 140:S81-S85.

Gleason, K., G. Harkless, J. Stanley, A. P. J. Olson, and M. L. Graber. 2021. The critical need for nursing education to address the diagnostic process. *Nursing Outlook* 69(3):362-369.

Guarini, A., D. Menin, L. Menabo, and A. Brighi. 2019. RPC teacher-based program for improving coping strategies to deal with cyberbullying. *International Journal of Environmental Research and Public Health* 16(6):948.

Guess, A. M., M. Lerner, B. Lyons, J. M. Montgomery, B. Nyhan, J. Reifler, and N. Sircar. 2020. A digital media literacy intervention increases discernment between mainstream and false news in the United States and India. *Proceedings of the National Academy of Sciences USA* 117(27):15536-15545.

Hämäläinen, E. K., C. Kiili, E. Räikkönen, and M. Marttunen. 2021. Students' abilities to evaluate the credibility of online texts: The role of internet-specific epistemic justifications. *Journal of Computer Assisted Learning* 37(5):1409-1422.

Hark, L. A., D. D. Deen, and G. Morrison. 2015. Learner-directed nutrition content for medical schools to meet LCME standards. *Journal of Biomedical Education* 2015:469351.

Hill, D. 2020. Social media: Anticipatory guidance. *Pediatrics in Review* 41(3):112-119.

Hobbs, R. 2007. Approaches to instruction and teacher education in media literacy. In *Research paper commissioned within the United Nations Literacy Decade*. United Nations Literacy Decade. https://mediaeducationlab.com/sites/default/files/Hobbs%25202007%2520Approaches%2520to%2520Teacher%2520Education%2520in%2520ML_0.pdf (accessed September 18, 2023).

Huguet, A., J. Kavanagh, G. Baker, and M. S. Blumenthal. 2019. *Exploring media literacy education as a tool for mitigating truth decay*. Santa Monica, CA: RAND Corporation.

IEEE (Institute of Electrical and Electronics Engineers). 2021. *IEEE standard for digital intelligence (DQ)—framework for digital literacy, skills, and readiness*. https://standards.ieee.org/ieee/3527.1/7589 (accessed September 18, 2023).

Jeong, S. H., H. Cho, and Y. Hwang. 2012. Media literacy interventions: A meta-analytic review. *Journal of Communication* 62(3):454-472.

Jones-Jang, S. M., T. Mortensen, and J. Liu. 2021. Does media literacy help identification of fake news? Information literacy helps, but other literacies don't. *American Behavioral Scientist* 65(2):371-388.

Jones, S. D., and E. Workman. 2016. *ESSA's well-rounded education*. Education Commission of the States. https://www.ecs.org/essas-well-rounded-education (accessed December 31, 2023).

Julien, H. 2018. Digital literacy in theory and practice. In *Encyclopedia of Information Science and Technology, fourth edition*, edited by D. B. A. M. Khosrow-Pour. Hershey, PA: IGI Global. Pp. 2243-2252.

K12 Computer Science. 2023. *Framework statements by concept*. https://k12cs.org/framework-statements-by-concept/#jump-impacts-computing (accessed October 19, 2023).

KFF (Kaiser Family Foundation). 2003. *Key facts: Media literacy*. https://www.kff.org/wp-content/uploads/2013/01/key-facts-media-literacy.pdf (accessed July 12, 2023).

Kirch, D. G. 2017. *Looking back and moving forward—75 years of the LCME*. Association of American Medical Colleges. https://www.aamc.org/news/viewpoints/looking-back-and-moving-forward-75-years-lcme (accessed September 18, 2023).

Copyright National Academy of Sciences. All rights reserved.

Kurtz, H. 2020. *National survey tracks impact of coronavirus on schools: 10 key findings*. https://www.edweek.org/teaching-learning/national-survey-tracks-impact-of-coronavirus-on-schools-10-key-findings/2020/04? (accessed July 12, 2023).

Kurz, M., J. Rosendahl, J. Rodeck, J. Muehleck, and U. Berger. 2022. School-based interventions improve body image and media literacy in youth: A systematic review and meta-analysis. *Journal of Prevention (2022)* 43(1):5-23.

LCME (Liaison Committee on Medical Education). 2023a. *Functions and structure of a medical school: Standards for accreditation of medical education programs leading to the MD degree*. https://lcme.org/publications/#Standards (accessed July 12, 2023).

LCME. 2023b. *Scope and purpose of accreditation*. ACME. https://lcme.org/about (accessed September 18, 2023).

Lenhart, A., M. Madden, A. Smith, K. Purcell, K. Zickuhr, and L. Rainie. 2011. *Teens, kindness, and cruelty on social network sites: How American teens navigate the new world of "digital citizenship."* Washington, DC: Pew Research Center.

Livingstone, S. 2014. Developing social media literacy: How children learn to interpret risky opportunities on social network sites. *Communications* 39(3):283-303.

Livingstone, S., and D. R. Brake. 2010. On the rapid rise of social networking sites: New findings and policy implications. *Children and Society* 24.

McAnally, K., and M. S. Hagger. 2023. Health literacy, social cognition constructs, and health behaviors and outcomes: A meta-analysis. *Health Psychology* 42(4):213-234.

McCannon, R., V. C. Strasburger, B. J. Wilson, and A. B. Jordan. 2014. Media literacy/media education. In *Children, adolescents, and the media*. Third edition ed. Los Angeles: SAGE.

McDougall, J., M. Zezukolva, and B. van Driel. 2018. Teaching media literacy in Europe: Evidence of effective school practices in primary and secondary education. In *NSET II Report*. Publications Office of the European Union. https://eprints.bournemouth.ac.uk/31574/1/AR2_Teaching%20Media%20Literacy_NESET.pdf (accessed September 18, 2023).

McNeill, E. 2023. *U.S. media literacy policy report 2022: A state-by-state status of media literacy education laws for K-12 schools*. https://medialiteracynow.org/wp-content/uploads/2023/05/MediaLiteracyPolicyReport2022.pdf (accessed November 12, 2023).

Meehan, J., B. Ray, A. Walker, S. Wells, and G. Schwarz. 2015. Media literacy in teacher education: A good fit across the curriculum. *Journal of Media Literacy Education* 7(2):81-86.

Nkana, S. 2010. Media literacy education: A case study of the New Mexico media literacy project. *Dissertations* 602.

OECD (Organisation for Economic Co-operation and Development). 2019. Educating 21st century children: Emotional well-being in the digital age. In *Educational Research and Innovation*, edited by T. Burns and F. Gottschalk. Paris: OECD Publishing. https://doi.org/10.1787/b7f33425-en.

Ofcom (UK Office of Communications). 2023. *Children and parents: Media use and attitudes. Ofcom*. https://www.ofcom.org.uk/research-and-data/media-literacy-research/childrens/children-and-parents-media-use-and-attitudes-report-2023 (accessed September 18, 2023).

Oldt, A. 2016. *Addiction to video games, social media linked to mental health*. https://www.healio.com/news/psychiatry/20160509/addiction-to-video-games-social-media-linked-to-mental-health (accessed July 12, 2023).

Ong, S. G. T., and G. C. L. Quek. 2023. Enhancing teacher-student interactions and student online engagement in an online learning environment. *Learning Environments Research*:1-27.

OSG (Office of the U.S. Surgeon General). 2021. *Protecting youth mental health: The U.S. Surgeon General's advisory*. Washington, DC: Health and Human Services.

Copyright National Academy of Sciences. All rights reserved.

Paniagua, A., and D. Istance. 2018. Teachers as designers of learning environments: The importance of innovative pedagogies. In *Educational Research and Innovation*. Organisation for Economic Cooperation & Development. https://dx.doi.org/10.1787/9789264085374-en.

Partnership for A Healthy Iowa. 2023. Iowa digital literacy critical thinking tools that make sense. In *Digital Literacy*. https://ahealthyiowa.org/programs/digital-literacy (accessed September 18, 2023).

Pelsue, B. 2017. When it comes to education, the federal government is in charge of... Um, what? *Harvard Graduate School of Education Magazine*. https://www.gse.harvard.edu/ideas/ed-magazine/17/08/when-it-comes-education-federal-government-charge-um-what (accessed December 31, 2023).

Poynter Institute. 2023. *Digital media literacy for all*. https://www.poynter.org/mediawise (accessed September 18, 2023).

Reynolds, R., J. Aromi, C. McGowan, and B. Paris. 2022. Digital divide, critical-, and crisis-informatics perspectives on K-12 emergency remote teaching during the pandemic. *Journal of the Association for Information Science and Technology* 73(12):1665-1680.

Salmon, K. B. 2017. *Personal financial literacy education presentation*. Maryland Public Schools. https://www.marylandpublicschools.org/stateboard/Documents/12052017/TabD-FinancialLiteracy.pdf (accessed September 18, 2023).

SAMHSA (Substance Abuse and Mental Health Services Agency). 2022. *HHS announces award of $2 million grant to the American Academy of Pediatrics to establish National Center of Excellence on Social Media and Mental Wellness*. SAMHSA. https://www.samhsa.gov/newsroom/press-announcements/20220902/hhs-announces-award-national-center-of-excellence-on-social-media-mental-wellness (accessed September 18, 2023).

Santo, R. 2013. Hacker literacies: User-generated resistance and reconfiguration of networked publics. In *Critical Digital Literacies as Social Praxis: Intersections & Challenges*, edited by J. Avila and J. Zacher-Pandya. New York: Peter Lang.

Serra, G., L. Lo Scalzo, M. Giuffrè, P. Ferrara, and G. Corsello. 2021. Smartphone use and addiction during the coronavirus disease 2019 (COVID-19) pandemic: Cohort study on 184 Italian children and adolescents. *Italian Journal of Pediatrics* 47(1):150.

Simmons, M., W. Meeus, and J. T'Sas. 2017. Measuring media literacy for media education: Development of a questionaire for teachers' competencies. *Journal of Media Literacy Education* 9(1):99-115.

Slone, A. 2021. *Policy update: Developing state and district parent engagement policies*. National Associate of State Boards of Education. https://nasbe.nyc3.digitaloceanspaces.com/2021/03/Slone_Family-Engagement-Final.pdf (accessed September 18, 2023).

Starks, A. C., and S. M. Reich. 2023. "What about special ed?:" Barriers and enablers for teaching with technology in special education. *Computers & Education* 193:104665.

Touretzky, D. S., C. Gardner-McCune, F. Martin, and D. Seehorn. 2019. *K-12 guidelines for artificial intelligence: What students should know*. Paper presented at ISTE 2019, June 23-26, Philadelphia, PA.

Turner, K. H., T. Jolls, M. S. Hagerman, W. O'Byrne, T. Hicks, B. Eisenstock, and K. E. Pytash. 2017. Developing digital and media literacies in children and adolescents. *Pediatrics* 140(Supplement_2):S122-S126.

Turow, J., Y. Lelkes, N. A. Draper, and A. E. Waldman. 2023. *Americans can't consent to companies' use of their data: They admit they don't understand it, say they're helpless to control it, and believe they're harmed when firms use their data—making what companies do illegitimate*. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4391134 (accessed September 18, 2023).

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Social Media and Adolescent Health

U.S. Department of Education. 2018. *Improving basic programs operated by local education agencies (Title I, Part A)*. U.S. Department of Education. https://www2.ed.gov/programs/titleiparta/index.html (accessed September 18, 2023).

U.S. Department of Education. 2022. *2022 Agency Equity Plan related to Executive Order 13985.* https://www2.ed.gov/documents/equity/2022-equity-plan.pdf (accessed December 31, 2023).

U.S. Department of Education. n.d. *Every Student Succeeds Act (ESSA)*. U.S. Department of Education. https://www.ed.gov/essa?src=rn (accessed September 18, 2023).

UNAOC (United Nations Alliance of Civilizations). 2023. *Media & information literacy clearinghouse*. https://milunesco.unaoc.org/welcome (accessed November 9, 2023).

Voogt, J., P. Fisser, N. Pareja Roblin, J. Tondeur, and J. Van Braak. 2013. Technological pedagogical content knowledge—A review of the literature. *Journal of Computer Assisted Learning* 29(2):109-121.

Y4Y. n.d. *Building financial literacy: Achieve student success.* You for Youth. https://y4y.ed.gov/y4yclickandgo/building-financial-literacy/2583 (accessed September 18, 2023).

Zarouali, B., K. Poels, K. Ponnet, and M. Walrave. 2018. "Everything under control?": Privacy control salience influences both critical processing and perceived persuasiveness of targeted advertising among adolescents. *Cyberpsychology: Journal of Psychosocial Research on Cyberspace* 12(1):Article 5.

Zuair, A. A., and P. Sopory. 2022. Effects of media health literacy school-based interventions on adolescents' body image concerns, eating concerns, and thin-internalization attitudes: A systematic review and meta-analysis. *Health Communication* 37(1):20–28.

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7

Online Harassment

Previous chapters in this report have described how digital media and their affordances can influence adolescents' response to stressors and how the affordances themselves can become stressors. The use of digital technology can also facilitate a novel type of problem, often by providing an anonymity that emboldens perpetrators. Behavior that would be unacceptable in person can flourish in digital worlds.

Part of the harm associated with social media lies in the harassment some young people experience. These forms of harassment run from the relatively common, as in cyberbullying, to the rare but serious, as in child sexual exploitation. This chapter sets out some steps that social media companies and the federal government could take against digital harassment, thereby reducing the harms associated with exposure to social media.

CYBERBULLYING

The public and connected affordances of social media, much like a school yard or school bus, enable bullying to occur before an audience of bystanders or even encouragers, though the number of bystanders online has almost no limit. The size of the social network and the anonymity of the participants can both influence the likelihood of people intervening to stop the harassment, though not in ways that are easy to predict (Machackova, 2020; You and Lee, 2019). The significance of peer feedback and social norms for adolescent development, along with a tendency

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during this life stage to conceive of oneself as the center of others' attention, sometimes called an imaginary audience (Elkind and Bowen, 1979), makes adolescents particularly vulnerable to cyberbullying.

Monitoring young people's safety online is, at its heart, a matter of trade-offs between protection and autonomy. For example, the efforts of teachers and the school system to monitor online harassment among students has been met with criticism for being an invasion of privacy and more often used for disciplining students than for helping them (Laird et al., 2022). Furthermore, bullying, whether online or in person, is fundamentally a matter of group dynamics (DeSmet et al., 2018). There is good evidence that digital learning tools can be harnessed to alter these dynamics, changing behavior of bystanders and even improving coping skills, though such interventions are more effective for face-to-face interactions than for cyberbullying (Chen et al., 2023). Such tools may nevertheless have promise for reducing the overall burden of victimization. Research from England found in-person bullying to be vastly more common than cyberbullying (Przybylski and Bowes, 2017).

There is also some suggestion that social media companies can take policy measures to limit bullying, although it is not always clear if or how the companies could do this in a way that does not amount to an overly simplified blaming strategy (Milosevic, 2017). It is also not clear what types of interventions from the companies might best advance the end goal of helping young people build resilience or learn to navigate social processes. Social media platforms may have an incentive to overcorrect in the interest of protecting their reputation (Milosevic, 2017). Additionally, while teens tend to view their parents' efforts to control online harassment favorably, they have a far less positive impression of the efforts of their teachers, law enforcement, social media companies, or elected officials (see Figure 7-1) (Vogels, 2022).

Digital harassment may be difficult for schools or social media companies to police alone given larger cultural forces at play. A recent survey of American adults found over 40 percent have experienced offensive name calling, stalking, physical threats and other forms of harassment online, with a majority saying they find such harassment to be a major problem (Vogels, 2021). A similar survey among teens found that almost half have experienced some form of cyberbullying (see Figure 7-2) (Vogels, 2022). A recent systematic review of the experience of Black Americans on social media found some suggestion that Black teens experience considerably more bullying on social media, though other studies in the review suggested the problem was worse among White teens. There was some concern that social media can impede Black people's sense of well-being through exposure to disturbing images of racial discrimination (Park et al., 2023).

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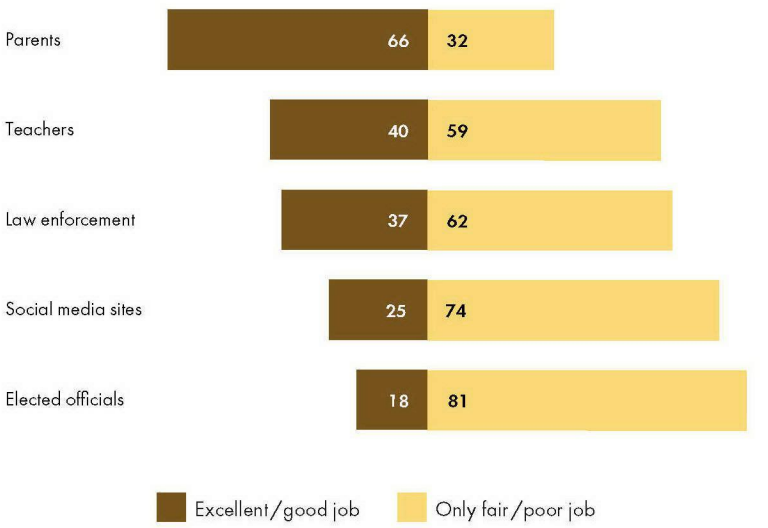


FIGURE 7-1 Percentage of respondents ages 13 to 17 who have favorable or unfavorable impressions of the efforts various authority figures are taking to stop online harassment and bullying.
SOURCE: Vogels, 2022.
NOTE: Teens are those aged 13 to 17. Excellent or good job or only fair to poor job responses are combined. Those who did not give an answer are not shown.

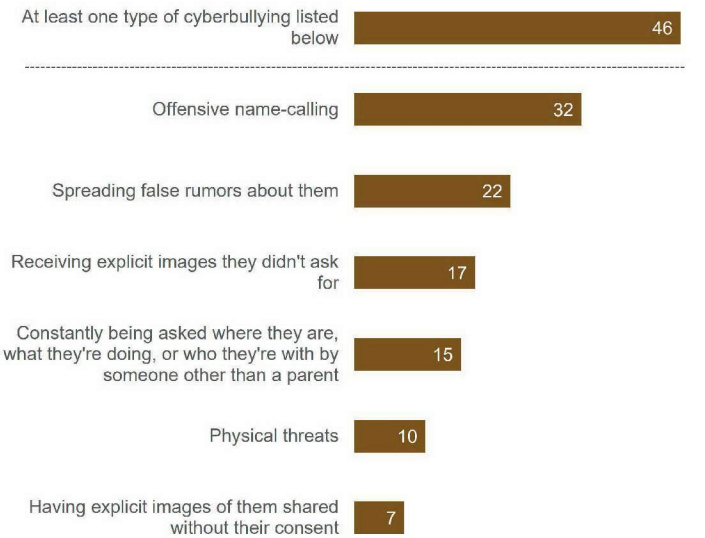


FIGURE 7-2 Percentage of respondents ages 13 to 17 who say they have ever experienced cyberbullying when online or on their cell phone.
SOURCE: Vogels, 2022.
NOTE: Teens are those aged 13 to 17. Those who did not give an answer are not shown.

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Among adults, political name calling on social media is cited as a starting point for digital harassment (Vogels, 2021). Research has raised the concern that the normalization of a "mob vigilante" mindset may be a more widespread phenomenon of which teen bullying is just one piece (Milosevic, 2017).

Among gamers, reports of harassment are even more common (see Figure 7-3). This is not surprising; the experience and the enjoyment of playing video games involves, by definition, winners and losers and some potential for arguments and hurt feelings. These platforms can also harbor serious forms of toxic content; a recent survey found 10 percent of teenage gamers have encountered white supremacist ideology while gaming and 7 percent of adults on the platforms have been exposed to Holocaust denial while playing (ADL, 2021).

Qualitative research among female gamers suggests that sexual harassment is an unfortunately common feature of their experience, in part because of the continued stigma against women participating in a stereotypically male activity (Kuss et al., 2022; McLean and Griffiths, 2019). Such harassment is cause for particular concern given gaming's

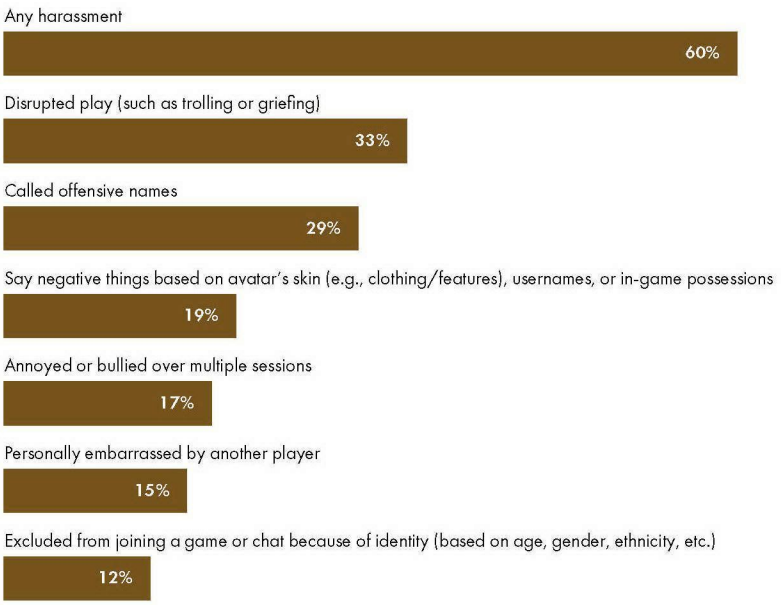


FIGURE 7-3 Percentage of respondents ages 13 to 17 who have experienced the listed form of disruptive behavior in online multiplayer games in the last 6 months.
SOURCE: ADL, 2021. Reprinted with permission from "Hate is no game: Harassment and positive social experiences in online games 2021" in Social Media and Adolescent Health (New York: Anti-Defamation League, 2021), www.adl.org. All rights reserved.

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association with hypermasculine aggression (Lorenz and Browning, 2020; Mortensen, 2016). Games may portray female characters with highly sexualized avatars, a feature that has been shown to influence adolescents to accept sexual harassment and stereotyped, hostile narratives about sexual assault, and this perpetuates the exclusion of girl and women participants (Driesmans et al., 2014; Lynch et al., 2016). Although the number of female primary characters in games has increased in recent decades, female characters are still more secondary and more sexualized than primary characters (Lynch et al., 2016).

As with harassment on social networking sites, it is hard to say how gaming platforms should handle this problem. Industry research indicates that only 1 percent of users are consistently toxic and that these players account for 5 percent of harassment incidents (Pappas, 2023; Robinson, 2018). While no one would object to banning these players, doing so could not be expected to dramatically improve a game's overall environment. Context and situation are important determinants of trolling behavior online, which makes banning players a flawed strategy. As a 2017 study concluded, "Not only are some banned users likely to be ordinary users just having a bad day, but [banning] does little to curb...situational trolling" (Cheng et al., 2017).

Asking players to flag and report offensive content is one strategy to combat harassment, but industry estimates suggest that only between 10 and 15 percent of these reports are legitimately harassment (Pappas, 2023). What is more, the most insidious forms of harassment are the sort that would not be noticed or reported: Young gamers who are being groomed for sexual predation or incited to radicalization do not, almost by definition, realize that there is something wrong with the behavior to which they are being exposed (Pappas, 2023).

This puts the companies in a difficult position. If neither deplatforming users nor relying on firsthand reports is effective, their best strategies to forestall harassment involve some invasion of privacy, mostly likely through using machine learning to identify suspect interactions and some combination of human and automated tools to follow up. But collecting information about children potentially subjects companies to liability under the Children's Online Privacy Protection Act (COPPA). Monitoring children's messaging or accounts, even if only rarely and with the best intentions, could be even riskier and something that most companies might be disinclined to do.

Any remedies a company takes to surface information about bullying, harassment, or incitement to radicalization could expose them to privacy liability. But sometimes the severity of the risk to society, especially a risk to children, warrants an invasion of privacy. Mandatory reporting laws, whether requiring disclosure to public health or law enforcement authorities, recognize that service of the public good sometimes over-

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rides important concerns such as patient confidentiality (Geiderman and Marco, 2020). The delicate balancing of individual risks against societal benefits is not something that any company should have to manage for itself and is a topic revisited in later in this chapter.

SEXUAL OFFENSES

Social media can be a means to perpetrate sexual offenses against minors (Bergman, 2023). The people who commit these crimes benefit from the anonymity and easy access to potential victims the platforms provide (Bleakley et al., 2023). These crimes cover a range of severity and are occurring at a pace that has so far exceeded society's effort to protect children and support victims and law enforcement's capacity to respond (Bursztein et al., 2019).

Cyberflashing

Cyberflashing, the electronic transmission of sexually explicit photos without the recipient's request, is one troubling manifestation of online harassment (Miller, 2021). The practice can occur through direct messaging features of apps or on social media. Bypassing social media altogether, short-range wireless transmission such as AirDrop can be used to send images anonymously in crowded places (Freeman, 2020). The anonymity of such transmission complicates the government's ability to take action against it. In Maryland, for example, flashing is punishable by up to 3 years in prison but only if it happens in person (Gaskill, 2023). In California, victims can sue for civil damages,[1] while Texas passed a law criminalizing cyberflashing.[2] These policies are indicative of wide support for combating the problem in Congress and in state legislatures, but prosecution is challenging partly because the offense is rarely reported (Lima and Schaffer, 2022; Miller, 2021; Wang, 2023).

Estimates of the frequency of cyberflashing, even among adults, are relatively scarce (Freeman, 2020; Miller, 2021; Salerno-Ferraro et al., 2022). A survey in the UK found nearly half of women aged 18 to 24 years have received unsolicited lewd photographs (Smith, 2018). A recent, smaller study of Canadian college women, most of them 18 or 19 years old, found that almost a quarter had received unsolicited nude pictures online or on their phones; more than half had experienced some form of online sexual harassment. Among those who had experienced sexual harassment,

[1] California Civil Code § 1708.88.
[2] Texas Penal Code Annotated § 21.19.

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propositioning, or flashing, more than 6 percent reported the first incident happening between the ages of 12 and 14 (Salerno-Ferraro et al., 2022).

Less has been published about the online sexual harassment of minors. In 2020, a British survey of adolescents aged 12 to 18 years found that 37 percent of girls and 20 percent of boys had received sexual photos or videos online, often from adult strangers (Ringrose et al., 2021a). Focus group participants reported feelings of shame and disgust elicited by such harassment but also reported doing nothing in response, either from embarrassment, not knowing what action to take, or worrying that reporting might aggravate the perpetrator (Ringrose et al., 2021a). Focus group data from adolescents aged 12 to 19 suggests that young people are disinclined to tell their parents about their experiences out of concern that it would be upsetting to the parents or that they would be advised to quit the platforms the images were sent through (Mishna et al., 2023).

Reporting unwanted images in also logistically complicated. The sender's identity is not often obvious in these images (Ringrose et al., 2021b). On platforms such as Snapchat, saving the image to report it to a trusted adult triggers a screen save notification to the sender, an action that could be interpreted as encouragement or make it obvious, in the case of report, who the aggrieved reporter was (Ringrose et al., 2021b).

The receipt of unsolicited sexual images or videos is distressing in itself; it is also associated with sexual coercion. The receipt of unwanted sexual images is often accompanied by requests for intimate photos in return (Mishna et al., 2023). A survey of cisgender teenage girls who had sexted in the previous year found that over 70 percent had sent a sexual image in response to their partners' coercion (Bragard and Fisher, 2022).

Qualitative research indicates that blocking users can be met with manipulative or victim-blaming responses, especially if the request comes from an offline acquaintance or friend (Ringrose et al., 2021b).

Cyberflashing is rarely untraceable. Regardless of how long the content is visible to the victim or the username from which it was sent, the platform would typically have a record of the shared illicit content (Meta, 2023; TikTok, 2023). Given the infrequency with which this crime is reported, however, perpetrators may continue to have online access to youth without consequences.

Grooming and the Sexual Extortion of Minors

The capacity of social media to connect minors with strangers and in spaces designed for adults introduces vulnerability for other forms of sexual abuse or unwanted contact. A nationally representative 2018 survey of young adults aged 18 to 28 found that 22.5 percent (standard error 1.2 percent) had experienced some form of online sexual solicitation in child-

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hood, 10.3 percent (standard error 0.8 percent) had been threatened or coerced for sexual images, and 3.1 percent (standard error 0.5 percent) had experience revenge pornography, the nonconsensual sharing of images designed to intentionally hurt the target (Finkelhor et al., 2022). The same data indicate that adolescents of high school age make up the majority of targets, with female and transgender young people being more vulnerable than males (Finkelhor et al., 2022). Perpetrators were often known to their victims offline and, though the age of these offenders is often unknown, many were themselves minors (Finkelhor et al., 2022).

Puberty and sexual maturation are central experiences of adolescence, which carry with them increasing interest in sex. Coupled with immature cognitive control processes (e.g., heightened pleasure from risk taking and low ability to think through consequences and delay gratification) and heightened identity experimentation, adolescence is an especially vulnerable time for interactions to people who appear to be possible romantic partners.

Presenting as a potential friend or romantic partner can be a strategy used in grooming, "a process to gain, persuade, and engage a child in sexual activity where the internet is used as a medium for access" (Borj et al., 2023). Grooming often involves deception, as in the deceptive portrayal of age or mutual friends. It can also involve the adult providing emotional support, sympathy, and even gifts (Calvete et al., 2022). Such behaviors prey on teens' natural curiosity about sex as well as their impulsivity and need for acceptance (Whittle et al., 2013).

It is difficult to comment on the frequency of grooming for obvious reasons; grooming is, by design, stealth. A recent survey of undergraduates found that over 20 percent recalled interactions as minors that met criteria for online grooming; 38 percent of these young people (about 8 percent of the total sample) eventually met the adult in person, and a sizable majority of those who made in-person contact (68 percent or roughly 5 percent of the total sample) eventually had sex with the adult (Greene-Colozzi et al., 2020). This study is consistent with other research that indicates most youth are resistant to grooming and those that initially engage find ways to separate (Whittle et al., 2013). But for those who do not, often socially isolated young people with low self-esteem, the consequences can be devastating (Whittle et al., 2013).

One consequence is sextortion, a form of blackmail hinging the threat of exposing intimate images against a demand for money, more images, or sex (National Center for Missing & Exploited Children, 2023). A nationally representative survey of middle and high school students in the United States estimated that 5 percent had been victims and 3 percent perpetrators of sextortion (Patchin and Hinduja, 2020). Since then, the National Center for Missing & Exploited Children has reported an alarming spike

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in reports of sextortion, which more than doubled between 2019 and 2021 (National Center for Missing & Exploited Children, 2023). The Federal Bureau of Investigation's most recent records contain almost 15,000 reports of sextortion (FBI, 2021). Perpetrators of sextortion usually have multiple victims; the Department of Justice estimates that there are more victims per offender in sextortion cases than in any other type of child sexual exploitation (Jurecic et al., 2016; Wittes et al., 2016). Some research from Europe indicates that teenagers who are transgender and gender nonconforming may be at increased risk for being pressured into sending sexual images (Van Ouytsel et al., 2020).

The Sexual Abuse of Minors

Social media can also facilitate egregious forms of sexual exploitation (O'Brien and Li, 2020). Research among teenagers who were sexually abused found that almost 6 percent met their abuser online; this digital component was associated with recurrent, violent abuse by multiple assailants (Say et al., 2015). While there is little hard evidence on the prevalence of child sex trafficking dependent on the internet, there is reason for concern (Gezinski and Gonzalez-Pons, 2022). The National Center for Missing & Exploited Children has received an exponentially growing number reports of child sexual abuse online since it started collecting them, many from internet service providers (Bursztein et al., 2019) (see Figure 7-4). An exponential increase in report volume has led to 9.6 million reports in the last year alone. Whether this increase is the result of a true change in the perpetration of the crime or improved reporting is impossible to say, however.

Recent public attention to this problem has highlighted the role social media companies can play in child sexual abuse. In June 2023, a *Wall Street Journal* investigation found that Instagram's recommendation algorithms promoted child sexual abuse material and was being used to connect pedophiles (Horowitz and Blunt, 2023). The investigation made clear that the social media platforms were aware of the child sexual abuse material they were hosting. A series of unambiguously graphic hashtags were attached to warnings, "these results may contain images of child sexual abuse" material that causes "extreme harm to children," but users were then given the option to "see results anyway" (Horowitz and Blunt, 2023).

Social media companies are aware of the harms their platforms can facilitate. Meta, the parent company of Facebook, Instagram, and WhatsApp, accounts for 85 percent of child pornography reports filed with the National Center for Missing & Exploited Children (Horowitz and Blunt, 2023). The end-to-end encryption that the companies value as a means to assure privacy, can also give cover to people involved with the worst forms of exploitation online (Salter and Hanson, 2021).

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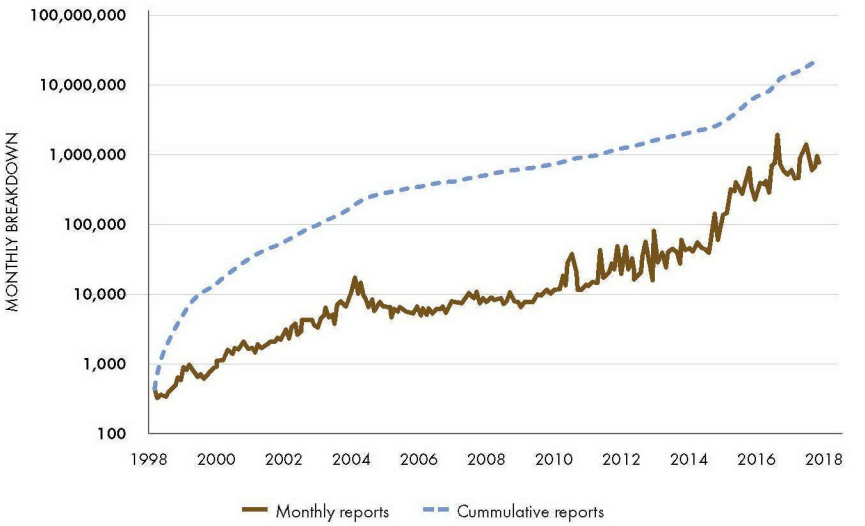


FIGURE 7-4 Monthly volume of child sexual abuse images, log scale, received by the National Center for Missing & Exploited Children since the creation of its cyber tipline in 1998.
SOURCE: Bursztein et al., 2019.

The committee recognizes that social media platforms do not cause harassment or sexual offenses against children, nor are they to blame for the existence of egregious forms of human behavior. At the same time, any company that makes a product central to unconscionable crimes has a role to play in stopping them. In the same way that hotel and airline companies have made prevention of human trafficking an industry-wide corporate social responsibility, so should the technology industry take steps to ensure their users can easily report online abuse and to follow up on those reports (Mohn, 2012; Winters, 2017). Social media companies' responsibility would extend to sharing information with law enforcement and working with them to build evidence against criminals.

Recommendation 7-1: Social media companies should develop systems for reporting, follow-up, and adjudication for cases of online harassment and abuse. These systems should be easy to use, universal, accountable, and transparent.

It is not clear how best to respond to the proliferation of child sexual abuse material online, nor is it clear how to manage more commonplace forms of harassment. There is likely a role for legislative and systemwide

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change (Bleakley et al., 2023). Social media sites have also considered responses to online harassment that emphasize support for targets and practices such as mediation that may be restorative and help mend the conflict (Schoenebeck et al., 2021). This committee was not, however, charged nor suitably constituted to recommend changes to the legal framework governing the abuse of online privacy protections. At the same time, the abuses described in this chapter represent an important harm of social media to children's and adolescents' well-being and one that social media companies have a responsibility to mitigate.

The committee recognizes that social media platforms already rely on flagging and reporting systems to handle online harassment and abuse. No system is perfect, however. Flagging systems, for example, offer users a way for users to communicate problems to a platform but in a relatively broad-brush way that has been described as "remarkable more for what [it] cannot express than what [it] can" (Crawford and Gillespie, 2016). Some platforms allow users to simply flag content, while others may accompany the action with an optional multiple choice list of reasons for flagging (Crawford and Gillespie, 2016). What is more, flagging can often be deployed in an insincere way: posts can be flagged jokingly among friends or in retaliatory way; some flags are deployed to express disapproval for a person or their ideas or as an act of bullying (Allen et al., 2022; Crawford and Gillespie, 2016). A tendency to misuse flagging systems, deliberately or by accident, makes them not representative of the harm experienced on a platform (Coscia and Rossi, 2020). What is more, users flagging generates a massive number of actions requiring platforms evaluation, resulting in a significant burden for the companies. Comparative analysis of the reporting systems across 20 different social networking, messaging, and virtual reality platforms shows wide variability in reporting procedure and follow-up[3] (Leavitt and Lo, 2023). Only 30 percent of platforms notify reporters that their report was received (Leavitt and Lo, 2023). The internal processes the platforms use to act on these reports are largely unknown to outside researchers (Henry and Witt, 2021).

In cases of severe online abuse, mainstream social media companies face reputational risk for failure to act. The traditional authorities in the offline world, law enforcement and prosecutors, have reduced ability online, partly from a lack of awareness of what crimes are happening (Bleakley et al., 2023). By making the reporting of crimes easier and guaranteeing prompt follow-up, the companies could take a meaningful step to reduce the harms associated with their product. By facilitating

[3] Including the design and language used to solicit reports, the categories and details provided to guide the reporter, the information about the platform's adjudication policy available to the reporter, and the information provided after submission of a report.

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easy reporting, they would also be in a better position to work with law enforcement in assembling evidence toward a prosecution.

The committee recognizes that the intervention suggested in Recommendation 7-1 rests in uneasy tension with companies' obligations under COPPA. While major social media platforms often require users to be at least 13, survey research suggests that almost one-fifth of children as young as 8 to 12 years use social media every day (Rideout et al., 2021). This discrepancy in enforcement makes it difficult to design child protective features into platforms, but attention from the Federal Trade Commission (FTC) could help remove the incentive companies have had to ignore the presence of children under 13 on their platforms.

In 2013, the FTC amended its regulations implementing COPPA to expand the definition of personal information to include persistent identifiers "that can be used to recognize a user over time and across different Web sites or online services."[4] Persistent identifiers can include information held in cookies, IP addresses,[5] or any unique device identifier (Miller, 2023). Collecting information about which young people are experiencing harassment or exploitation would almost always involve the collection of prohibited personal identifiers.

What is more, pending legislation in Congress, such as the Kids Online Safety Act, emphasizes platforms' "duty of care" to mitigate mental health problems, addictive behaviors, online bullying and harassment, and exploitation.[6] The same interest is reflected in Chapter 5 of this report, which encourages companies to report on their efforts to remediate young people's mental health problems and report these measures to the FTC. The committee shares the admirable goal reflected in this legislation of protecting young people from sexual exploitation and abuse online but acknowledges that these societal protections may come at the cost of ceding individual privacy protections, including the privacy protections guaranteed to minors under COPPA.

Social media companies must strike a delicate balance between their obligation to protect children's privacy and their responsibility to protect minors from online harassment and abuse. Lack of clarity regarding how to satisfy these competing duties simultaneously may have the unintended effect of encouraging social media companies and gaming studios to turn a blind eye to patterns of interaction online that suggest abuse. Both the companies and society would thus benefit from clear guidance regarding how to manage the trade-offs between child protection and data privacy.

[4] 16 C.F.R. § 312.2.

[5] Officially, Internet Protocol addresses

[6] Kids Online Safety Act, S. 3663, 117th Congress, 2d Session (2022).

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Recommendation 7-2: The Federal Trade Commission should revise its regulations to clarify how to make systems for reporting cases of online harassment and abuse comply with the Children's Online Privacy Protection Act.

COPPA and its implementing regulations permit the collection of a child's personal information under certain circumstances. For example, operators may collect "the name of the child and online contact information (to the extent reasonably necessary to protect the safety of a child participant on the site" so long as the purpose is to protect the safety of a child, the information is not used or disclosed for any purposes unrelated to the child's safety and is not disclosed on the site, and the operators make reasonable efforts to notify the child's parent as specified by the regulation.[7] The rule implementing this provision also authorizes the collection of a parent or guardian's name and contact information, suggesting some flexibility to expand this exception beyond the strict letter of the law.[8] Whether this latitude is broad enough to include data about incidents of harassment and abuse remains uncertain.

COPPA also permits industry groups to create self-regulatory "safe harbor programs" so long as they provide substantially the same or greater protections as the requirements of COPPA.[9] None of the safe harbors that the FTC has approved to date authorizes the collection of information beyond the child's and parent's name and online contact information in order to protect the child's safety.

A subsequent provision authorizing disclosure of information to law enforcement agencies applies only "[t]o the extent permitted under other provisions of law."[10] This latter phrase suggests that this provision permits the disclosure of lawfully gathered information to law enforcement rather than serving as an independent basis for collecting data.

These ambiguities suggest that both the social media companies and society would benefit from greater clarity of the circumstances under which COPPA permits the collection of information necessary to address the problem of online harassment and exploitation. Any such guidance should reflect the fact that the appropriateness of actions that override legal protections on privacy necessarily depend on the severity of the problem those actions aim to solve. The Health Insurance Portability and Accountability Act of 1996 (HIPAA), for example, sets an extremely high bar as to how health providers, insurers, and other covered entities

[7] U.S. Code 15 (1998), § 6502(b)(2)(D).
[8] U.S. Code 16 CFR § 312.5(c)(5).
[9] U.S. Code 15 § 6503.
[10] U.S. Code 16 C.F.R. § 312.5(c)(6)(iv).

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disclose personal health information, including how they share information with their "business associates" (HHS, 2003). During the COVID-19 pandemic, however, the Department of Health and Human Services announced that it would exercise "enforcement discretion" and would not penalize the disclosure of protected information for public health oversight (HHS, 2020). Given that the pandemic created an unprecedented health emergency, the scope of the associated privacy protection was proportionately adjusted. In the same way, the privacy protections on social media may need to take into account the magnitude of problems faced even under less extraordinary conditions. The FTC may want to consider if similar discretion is necessary for COPPA violations in light of growing concerns about the mental health and potential exploitation of young people online.

In setting out its guidance, the FTC should be mindful of the compliance burden that their rules can place on small and medium-sized firms. The European Union's General Data Protection Regulation (GDPR), for example, requires data collection, storage, and processing to a standard described as "the toughest...in the world" (GDPR, 2023). This standard poses particularly onerous burdens for smaller firms (Klinger et al., n.d.; Official Journal of the European Union, 2016). As the FTC confronts the trade-offs between individual privacy and social welfare, the agency should also take compliance costs into account and recognize that privacy's importance as a value does not necessarily entail the adoption and enforcement of every conceivable privacy protection.

SUPPORT FOR VICTIMS AND MOMENTUM FOR PROSECUTION

Some professions, by virtue of their privileged glimpses into people's personal lives, have a legal obligation to report the abuse of children to the authorities; in some states this obligation extends to all adults (NAMR, 2023). What is more, most people would want to support young victims and bring the perpetrators to justice. The best pathway to do this is not always clear.

The crime of cyberflashing, for example, is so little discussed that few adults would be able to advise on exactly what should be reported or to whom. Police would not necessarily know how to collect evidence on the crime. When the victims of cyberflashing are adolescents and children, society's first concern must be protecting them from the fear, shame, and intimidation such images elicit. Support for these young people, while not primarily intended to curb the abuse, could have a positive downstream effect of bringing attention to the problem and consequences of online

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sexual harassment, serving an end goal of greater accountability and prosecution of the perpetrators.

Similar challenges persist in supporting victims of sextortion and online grooming. Children may be reluctant to identify inappropriate actions of an adult online for many reasons, the most obvious being that they do not realize there is something wrong with the interaction until it is too late. For this reason, the educational programs described in the previous chapter should include information on how to identify and report inappropriate sexual advances made online. For children under 13, who are likely using social media in violation of the platform's terms, there could be an added element of fear of being found out and kicked off the platform.

When young people are bullied, harassed, or preyed on by sexual predators, and when that abuse is inextricably tied to the reach and anonymity of the internet, society has an obligation to help them. The U.S. Substance Abuse and Mental Health Services Administration (SAMHSA) has the mandate "to lead public health and service delivery efforts that promote mental health ... and provide treatments and supports to foster recovery" (SAMHSA, 2023c). The agency also has the expertise to provide support and intervention services for children and adolescents who are harmed by their experiences on social media.

Recommendation 7-3: The U.S. Substance Abuse and Mental Health Services Administration should develop support programs for children and adolescents who experience digital abuse and evaluate the effectiveness of such programs.

The goal of this recommendation is to support young people who have been harassed online. Providing such support is consistent with SAMHSA's mission and consistent with its programming in school and campus health, including the StopBullying.gov program (SAMHSA, 2023b; Vecchio, 2018). In identifying the specific services that victims of online abuse might need the committee would encourage SAMHSA to consider transferable lessons from its experience with both bullying prevention and crisis helplines.

The 988 Suicide and Crisis Lifeline has operated in the United States since July of 2022, building on the National Suicide Prevention Lifeline and network of crisis centers established in 2004, providing confidential support to people in mental health crisis (Ackerman and Horowitz, 2022; Canady, 2022b). The FTC has been involved with the program since its start, smoothing the technical challenges for phone and text service providers and routing calls to the correct regional centers (FCC, 2022). SAMHSA has also developed promotional materials and videos explain-

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ing how the 988 line works, what happens during a call or text, and awareness-generating videos and advertisements (SAMHSA, 2023a). The service has received extensive, generally positive press coverage, despite concerns about the stability of its funding (Bauman, 2023; Blum, 2022; Budds, 2022; Chatterjee, 2023).

During the national rollout of the 988 line, SAMHSA's assistant secretary for mental health and substance abuse described the program as an entry point on a continuum of crisis services, calling attention to a wealth of supportive materials for mental health on the SAMHSA website (Canady, 2022a). A strategy that builds on these resources may be the most efficient use of an existing community network for mental health support. The 988 program recognizes the importance of partnership with a network of crisis centers and local and state health authorities around the country (SAMHSA, 2022). These organizations form a network of partners to help promote public service announcements and social marketing materials about the service. The same channels may be useful starting points to share information about digital abuse and make young people aware of resources they can turn to for support.

Providing support for young people who are victims of digital abuse is the main goal of this recommendation. It is also possible that by providing support, experts at SAMHSA and partner organizations will come to have a clearer picture of who is perpetrating some of the more egregious forms of harassment or abuse. Such information would be useful to law enforcement. For this reason, it would be helpful to include police and district attorneys in the development of the recommended interventions.

Including law enforcement in this discussion of protecting children is important given concerns that laws have not kept pace with online harassment and sexual crimes and with the ever-changing social media platforms. States are increasingly moving to punish cyberflashing; one example is by increasing the pressure on Congress for heightened federal action (Freeman, 2020; Lima and Schaffer, 2022). Greater attention to supporting victims of digital harassment would be a valuable complement to the growing momentum for more clear and consistent punishment for its perpetrators, including perpetrators of crimes against adults.

REFERENCES

Ackerman, J., and L. Horowitz. 2022. Youth suicide prevention and intervention: Best practices and policy implications. *Spring Briefs in Psychology: Advances in Child and Family Policy and Practice.* https://library.oapen.org/bitstream/handle/20.500.12657/58358/978-3-031-06127-1.pdf (accessed September 19, 2023).

ADL (Anti-Defamation League). 2021. *Hate is no game: Harassment and positive social experiences in online games 2021.* https://www.adl.org/resources/report/hate-no-game-harassment-and-positive-social-experiences-online-games-2021 (accessed September 19, 2023).

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Social Media and Adolescent Health

Allen, J., C. Martel, and D. G. Rand. 2022. *Birds of a feather don't fact-check each other: Partisanship and the evaluation of news in Twitter's Birdwatch crowdsourced fact-checking program*. Paper presented at the 2022 CHI Conference on Human Factors in Computing Systems, New Orleans, LA, USA.

Bauman, A. 2023. *Houston suicide call center working to meet surge in calls to new 988 hotline*. February 3. https://www.houstonchronicle.com/news/houston-texas/health/article/988-suicide-and-crisis-lifeline-houston-centers-17760082.php (accessed September 19, 2023).

Bergman, M. 2023. *Social media and sexual violence*. Social Media Victims Law Center. https://socialmediavictims.org/sexual-violence (accessed September 19, 2023).

Bleakley, P., E. Martellozzo, R. Spence, and J. DeMarco. 2023. Moderating online child sexual abuse material (CSAM): Does self-regulation work, or is greater state regulation needed? *European Journal of Criminology*. https://doi.org/10.1177/14773708231181361.

Blum, D. 2022. What to know about 988: The new mental health crisis hotline. *New York Times*. https://www.nytimes.com/2022/07/12/well/988-suicide-prevention-hotline.html (accessed September 19, 2023).

Borj, P. R., K. Raja, and P. Bours. 2023. Online grooming detection: A comprehensive survey of child exploitation in chat logs. *Knowledge-Based Systems* 259:110039.

Bragard, E., and C. B. Fisher. 2022. Associations between sexting motivations and consequences among adolescent girls. *Journal of Adolescence* 94(1):5-18.

Budds, B. 2022. There's nothing weak about seeking help: SC to launch new 988 mental health hotline. News19 WLTX. https://www.wltx.com/article/news/local/sc-implementing-988-mental-health-hotline/101-dee6ff90-2d7d-4913-9bfd-2d23659ccdd0 (accessed September 19, 2023).

Bursztein, E., E. Clarke, M. DeLaune, D. M. Elifff, N. Hsu, L. Olson, J. Shehan, M. Thakur, K. Thomas, and T. Bright. 2019. *Rethinking the detection of child sexual abuse imagery on the internet*. Paper presented at The World Wide Web Conference, San Francisco, CA, USA.

Calvete, E., I. Orue, and M. Gamez-Guadi. 2022. A preventive intervention to reduce risk of online grooming among adolescents. *Psychosocial Intervention* 31(3):177-184.

Canady, V. A. 2022a. Field elated over upcoming 988 MH crisis system, just days away from launch. *Mental Health Weekly* 32(28):1-3.

Canady, V. A. 2022b. Tennessee stakeholders tout success of 988 crisis line following live launch. *Mental Health Weekly* 32(29):1-7.

Chatterjee, R. 2023. 988 lifeline sees boost in use and funding in first months. *NPR*. https://www.npr.org/sections/health-shots/2023/01/16/1149202586/988-lifeline-sees-boost-in-use-and-funding-in-first-months (accessed September 19, 2023).

Chen, Q., K. L. Chan, S. Guo, M. Chen, C. K.-M. Lo, and P. Ip. 2023. Effectiveness of digital health interventions in reducing bullying and cyberbullying: A meta-analysis. *Trauma, Violence, & Abuse* 24(3):1986-2002.

Cheng, J., M. Bernstein, C. Danescu-Niculescu-Mizil, and J. Leskovec. 2017. *Anyone can become a troll: Causes of trolling behavior in online discussions*. Paper presented at the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing, Portland, Oregon, USA.

Coscia, M., and L. Rossi. 2020. Distortions of political bias in crowdsourced misinformation flagging. *Journal of The Royal Society Interface* 17(167):20200020.

Crawford, K., and T. Gillespie. 2016. What is a flag for? Social media reporting tools and the vocabulary of complaint. *New Media & Society* 18(3):410-428.

DeSmet, A., S. Bastiaensens, K. Van Cleemput, K. Poels, H. Vandebosch, G. Deboutte, L. Herrewijn, S. Malliet, S. Pabian, F. Van Broeckhoven, O. De Troyer, G. Deglorie, S. Van Hoecke, K. Samyn, and I. De Bourdeaudhuij. 2018. The efficacy of the Friendly Attac serious digital game to promote prosocial bystander behavior in cyberbullying among young adolescents: A cluster-randomized controlled trial. *Computers in Human Behavior* 78:336-347.

Copyright National Academy of Sciences. All rights reserved.

Driesmans, K., L. Vandenbosch, and S. Eggermont. 2014. Playing a videogame with a sexualized female character increases adolescents' rape myth acceptance and tolerance toward sexual harassment. *Games for Health Journal* 4(2):91-94.

Elkind, D., and R. Bowen. 1979. Imaginary audience behavior in children and adolescents. *Developmental Psychology* 15:38-44.

FBI (Federal Bureau of Investigation). 2021. *Internet crime report 2021*. https://www.ic3.gov/Media/PDF/AnnualReport/2021_IC3Report.pdf (accessed September 19, 2023).

FCC (Federal Communications Commission). 2022. *988 Suicide and Crisis Lifeline*. https://www.fcc.gov/988-suicide-and-crisis-lifeline (accessed September 19, 2023).

Finkelhor, D., H. Turner, and D. Colburn. 2022. Prevalence of online sexual offenses against children in the US. *JAMA Network Open* 5(10):e2234471–e2234471.

Freeman, V. 2020. Cyber flashing: Unwanted and non-consensual lewd photographs as technology enhanced sexual harassment. *Seton Hall Law*. https://scholarship.shu.edu/cgi/viewcontent.cgi?article=2105&context=student_scholarship (accessed December 31, 2023).

Gaskill, H. 2023. Maryland legislation seeks to address penalties for 'cyber flashing.' *Baltimore Sun*. https://www.baltimoresun.com/politics/bs-md-pol-cyber-flashing-taskforce-20230221-chvn2pczs5gd7jkq3wkr36spye-story.html (accessed September 19, 2023).

GDPR (General Data Protection Regulation). 2023. *What is GDPR, the EU's new data protection law?* https://gdpr.eu/what-is-gdpr (accessed September 19, 2023).

Geiderman, J. M., and C. A. Marco. 2020. Mandatory and permissive reporting laws: Obligations, challenges, moral dilemmas, and opportunities. *Journal of the American College of Emergency Physicians Open* 1(1):38-45.

Gezinski, L. B., and K. M. Gonzalez-Pons. 2022. Sex trafficking and technology: A systematic review of recruitment and exploitation. *Journal of Human Trafficking* 8:1-15.

Greene-Colozzi, E. A., G. M. Winters, B. Blasko, and E. L. Jeglic. 2020. Experiences and perceptions of online sexual solicitation and grooming of minors: A retrospective report. *Journal of Child Sexual Abuse* 29(7):836-854.

Henry, N., and A. Witt. 2021. Governing image-based sexual abuse: Digital platform policies, tools, and practices. In *The Emerald International Handbook of Technology-Facilitated Violence and Abuse*, edited by J. Bailey, A. Flynn, and N. Henry. Emerald Publishing Limited. Pp. 749-768.

HHS (U.S. Department of Health and Human Services). 2003. *Summary of the HIPAA Privacy Rule*. https://www.hhs.gov/hipaa/for-professionals/privacy/laws-regulations/index.html (accessed September 19, 2023).

HHS. 2020. *Enforcement discretion under HIPAA to allow uses and disclosures of protected health information by business associates for public health and health oversight activities in response to COVID-19*. https://www.federalregister.gov/documents/2020/04/07/2020-07268/enforcement-discretion-under-hipaa-to-allow-uses-and-disclosures-of-protected-health-information-by (accessed September 19, 2023).

Horowitz, J., and K. Blunt. 2023. *Instagram connects vast pedophile network*. https://www.wsj.com/articles/instagram-vast-pedophile-network-4ab7189 (accessed September 19, 2023).

Jurecic, Q., C. Spera, B. Wittes, and C. Poplin. 2016. *Sextortion: The problem and solutions*. https://www.brookings.edu/blog/techtank/2016/05/11/sextortion-the-problem-and-solutions (accessed September 19, 2023).

Klinger, E., A. Wiesmaier, and A. Heinemann. n.d. *A review of existing GDPR solutions for citizens and SMEs*. Darmstadt, Germany: Hochschule Darmstadt University of Applied Sciences.

Kuss, D. J., A. M. Kristensen, A. J. Williams, and O. Lopez-Fernandez. 2022. To be or not to be a female gamer: A qualitative exploration of female gamer identity. *International Journal of Environmental Research and Public Health* 19(3):1169.

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Laird, E., H. Grant-Chapman, C. Venzke, and H. Quay-de la Vallee. 2022. *Hidden harms: The misleading promise of monitoring students online*. https://cdt.org/insights/report-hidden-harms-the-misleading-promise-of-monitoring-students-online (accessed September 19, 2023).

Leavitt, A., and K. Lo. 2023. A comparative analysis of platform reporting flows. Paper read at Trust & Safety Research Conference 2023, September 28, 29, Palo Alto, CA. https://tinyurl.com/tsrc23reporting (accessed November 17, 2023).

Lima, C., and A. Schaffer. 2022. States are moving to penalize 'cyber-flashing.' *The Washington Post*. https://www.washingtonpost.com/politics/2022/09/27/states-are-moving-penalize-cyber-flashing (accessed September 19, 2023).

Lorenz, T., and K. Browning. 2020. *Dozens of women in gaming speak out about sexism and harassment*. https://openlab.citytech.cuny.edu/emergingmedia/files/2020/09/Dozens-of-Women-in-Gaming-Speak-Out-About-Sexism-and-Harassment-The-New-York-Times.pdf (accessed September 19, 2023).

Lynch, T., J. E. Tompkins, I. I. van Driel, and N. Fritz. 2016. Sexy, strong, and secondary: A content analysis of female characters in video games across 31 years. *Journal of Communication* 66(4):564-584.

Machackova, H. 2020. Bystander reactions to cyberbullying and cyberaggression: Individual, contextual, and social factors. *Current Opinion in Psychology* 36:130-134.

McLean, L., and M. D. Griffiths. 2019. Female gamers' experience of online harassment and social support in online gaming: A qualitative study. *International Journal of Mental Health and Addiction* 17(4):970-994.

Meta. 2023. *Privacy policy: What is the privacy policy and what does it cover?* https://www.facebook.com/privacy/policy (accessed September 19, 2023).

Miller, B. 2021. Fact or phallus? Considering the constitutionality of Texas's cyber-flashing law under the true threat doctrine. *Texas A&M Law Review* 8(2):424-449.

Miller, T. C. 2023. *Protecting children online: Evaluating possible reforms in the law and the application of COPPA*. https://www.mercatus.org/media/161586/download?attachment (accessed November 12, 2023).

Milosevic, T. 2017. Protecting children online?: Cyberbullying policies of social media companies. The MIT Press. https://library.oapen.org/viewer/web/viewer.html?file=/bitstream/handle/20.500.12657/30535/645372.pdf (accessed September 19, 2023).

Mishna, F., E. Milne, C. Cook, A. Slane, and J. Ringrose. 2023. Unsolicited sexts and unwanted requests for sexts: Reflecting on the online sexual harassment of youth. *Youth & Society* 55(4):630-651.

Mohn, T. 2012. The travel industry takes on human trafficking. *The New York Times*. https://www.nytimes.com/2012/11/09/giving/the-travel-industry-takes-on-human-trafficking.html (accessed September 19, 2023).

Mortensen, T. E. 2016. Anger, fear, and games: The long event of #gamergate. *Games and Culture* 13(8):787-806.

NAMR (National Association of Mandated Reporters). 2023. *About NAMR*. https://namr.org/about (accessed September 19, 2023).

National Center for Missing & Exploited Children. 2023. *Sextortion*. https://www.missingkids.org/theissues/sextortion (accessed September 19, 2023).

O'Brien, J. E., and W. Li. 2020. The role of the internet in the grooming, exploitation, and exit of United States domestic minor sex trafficking victims. *Journal of Children and Media* 14(2):187-203.

Official Journal of the European Union. 2016. *Regulation (EU) 2016/679 of the European Parliament and of the Council of 27, April 2016, on the protection of natural persons with regard to the processing of personal data on the free movement of such data, and repealing directive 95/46/EC (General Data Protection Regulation)*. https://eur-lex.europa.eu/eli/reg/2016/679/oj (accessed September 19, 2023).

Copyright National Academy of Sciences. All rights reserved.

Pappas, M. 2023. *Challenges inhibiting platforms from effective moderation*. Paper presented at Committee on Social Media Impacts on the Health and Wellbeing of Children and Adolescents: Meeting 4, Washington, DC.

Park, J., J. Hallman, X. S. Liu, and J. Hancock. 2023. Black representation in social media well-being research: A scoping review of social media experience and psychological well-being among Black users in the United States. *New Media & Society*. https://doi.org/10.1177/14614448231191542.

Patchin, J. W., and S. Hinduja. 2020. Sextortion among adolescents: Results from a national survey of U.S. Youth. *Sexual Abuse* 32(1):30-54.

Przybylski, A. K., and L. Bowes. 2017. Cyberbullying and adolescent well-being in England: A population-based cross-sectional study. *The Lancet Child & Adolescent Health* 1(1):19-26.

Rideout, V., A. Peebles, S. Mann, and M. B. Robb. 2021. *The common sense census: Media use by tweens and teens*. San Francisco, CA: Common Sense.

Ringrose, J., K. Regehr, and B. Mikne. 2021a. *Understanding and combatting youth experiences of image-based sexual harassment and abuse*. ASCL. https://www.ascl.org.uk/ASCL/media/ASCL/Our%20view/Campaigns/Understanding-and-combatting-youth-experiences-of-image-based-sexual-harassment-and-abuse-full-report.pdf (accessed September 19, 2023).

Ringrose, J., K. Regehr, and S. Whitehead. 2021b. Teen girls' experiences negotiating the ubiquitous dick pic: Sexual double standards and the normalization of image based sexual harassment. *Sex Roles* 85(9):558-576.

Robinson, M. 2018. *Toxic players and the power of positive engagement*. https://www.gamesindustry.biz/toxic-players-and-the-power-of-positive-engagement (accessed September 19, 2023).

Salerno-Ferraro, A. C., C. Erentzen, and R. A. Schuller. 2022. Young women's experiences with technology-facilitated sexual violence from male strangers. *Journal of Interpersonal Violence* 37(19-20):NP17860-NP17885.

Salter, M., and E. Hanson. 2021. "I need you all to understand how pervasive this issue is:" User efforts to regulate child sexual offending on social media. In *The Emerald International Handbook of Technology-Facilitated Violence and Abuse*, edited by J. Bailey, A. Flynn, and N. Henry. Emerald Publishing Limited. Pp. 729-748.

SAMHSA (Substance Abuse and Mental Health Services Agency). 2022. 988 partner community. https://www.samhsa.gov/find-help/988/partners (accessed September 19, 2023).

SAMHSA. 2023a. *988 social media shareables*. https://www.samhsa.gov/find-help/988/partner-toolkit/social-media-shareables (accessed September 19, 2023).

SAMHSA. 2023b. *School and campus health*. https://www.samhsa.gov/school-campus-health (accessed October 19, 2023).

SAMHSA. 2023c. *Who we are*. https://www.samhsa.gov/about-us/who-we-are#:~:text=SAMHSA's%20mission%20is%20to%20lead,equitable%20access%20and%20better%20outcomes (accessed October 19, 2023).

Say, G. N., Z. Babadagi, K. Karabekiroglu, and S. Akbas. 2015. Abuse characteristics and psychiatric consequences associated with online sexual abuse. *Cyberpsychology, Behavior, and Social Networking* 18(6):333-336.

Schoenebeck, S., O. L. Haimson, and L. Nakamura. 2021. Drawing from justice theories to support targets of online harassment. *New Media & Society* 23(5):1278-1300.

Smith, M. 2018. *Four in ten female millenials have been sent an unsolicited penis photo*. https://yougov.co.uk/topics/politics/articles-reports/2018/02/16/four-ten-female-millennials-been-sent-dick-pic (accessed September 19, 2023).

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Social Media and Adolescent Health

TikTok. 2023. *Privacy policy*. https://www.tiktok.com/legal/page/us/privacy-policy/en (accessed September 19, 2023).

Van Ouytsel, J., M. Walrave, L. De Marez, B. Vanhaelewyn, and K. Ponnet. 2020. A first investigation into gender minority adolescents' sexting experiences. *Journal of Adolescence* 84(1):213-218.

Vecchio, P. D. 2018. This school year, let's erase bullying. In *SAMHSA Blog*. https://www.samhsa.gov/blog/school-year-lets-erase-bullying (accessed November 28, 2023).

Vogels, E. 2021. *The state of online harassment.* Pew Research Center. https://www.pewresearch.org/internet/2021/01/13/the-state-of-online-harassment (accessed September 19, 2023).

Vogels, E. 2022. *Teens and cyberbullying 2022.* Pew Research Center. https://www.pewresearch.org/internet/2022/12/15/teens-and-cyberbullying-2022/ (accessed September 19, 2023).

Wang, B. 2023. A critical analysis of the Law Commission's proposed cyberflashing offence. *The Journal of Criminal Law* 87(1):39-52.

Whittle, H., C. Hamilton-Giachritsis, A. Beech, and G. Collings. 2013. A review of young people's vulnerabilities to online grooming. *Aggression and Violent Behavior* 18(1):135-146.

Winters, B. R. 2017. *The hotel industry's role in combatting sex trafficking*. Monterey, CA: Naval Postgraduate School.

Wittes, B., C. Poplin, Q. Jurecic, and C. Spera. 2016. *Closing the sextortion sentencing gap: A legislative proprosal*. Center for Technology Innovation. https://www.brookings.edu/wp-content/uploads/2016/05/sextortion2.pdf (accessed September 19, 2023).

You, L., and Y.-H. Lee. 2019. The bystander effect in cyberbullying on social network sites: Anonymity, group size, and intervention intentions. *Telematics and Informatics* 45 (December):101284.

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8

Research

As previous chapters in this report have discussed, social media poses both risks and benefits to young people, but quantifying these risks and benefits is difficult for many reasons. Some of the barriers are logistical. It is difficult to do research on the differential effects of a ubiquitous exposure; in a population made up entirely of smokers, for example, smoking could not possibly explain much of the likelihood of developing lung cancer (Pearce, 2011). Mental health outcomes are also complicated to study. The same clinical presentation may be produced by any number of brain dysfunctions, and the same mental problems can manifest in widely different ways (Maung, 2016; Paulus and Thompson, 2019). Given the challenges in measuring both exposures and outcomes, to say nothing of the variability in psychological responses to stimuli, it is hard to offer an overall summary about the relationship between social media and mental health beyond observing that the effects, both helpful and harmful, accrue differently to different users.

There are potential harms and benefits associated with social media that might come to light through careful analysis of the platforms' algorithms over which, as Chapter 5 discussed, social media companies retain extremely tight control. This report has advocated for greater openness to algorithmic audit on the part of platforms, but some of the barriers to algorithmic research are more subtle. Facebook whistleblower Frances Haugen suggested that only 300 or 400 experts *in the world* design social media algorithms (Krass, 2022). In such a rarefied field, the small pool of qualified researchers poses an impediment to better insight into the

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workings of these platforms. Scarcity of expertise in turn compels careful stewardship of the resources remaining for operational research.

This chapter discusses bottleneck problems holding back research on the harms and benefits of social media use. The first section presents a research agenda that elevates pressing unanswered questions in the field. Next, we set out a strategy to make such a research agenda possible through facilitating independent research on platform algorithms.

A RESEARCH AGENDA

As Chapters 3 and 4 made clear, despite many years of research assessing the relationship between social media and health and well-being, the evidence about specific factors linked to harms and benefits remains limited. Some of this challenge is inherent in the nature of the research itself. The standard of evidence needed to establish a causal relationship between an outcome and exposure is high. Most of the studies on this relationship have only established an association between social media use and different mental and physical health outcomes. As Chapter 4 explained, evidence of such association is useful and can drive hypothesis formation and further inquiry but is not sufficient, on balance, to lead this committee to recommend additional restrictions on young people's access to social media.

Consider, for example, the Utah legislation putting age and time limits on children and teens' social media use. The legislators' intent to protect time for sleep and schoolwork and to prevent at least some compulsive use could just as easily have unintended consequences, perhaps isolating young people from their support systems when they need them. The committee recognizes that policy makers must make decisions under uncertainty, and some policies present interesting natural experiments that could inform our understanding of the field. Nevertheless, a stronger evidence base on certain key question could remove much uncertainty from the work of policy makers.

Recommendation 8-1: The National Institutes of Health, the National Science Foundation, and other research funders should support a research agenda that gives priority to the health consequences of social media use, the epidemiology of problematic use, the mechanisms through which social media use influences health, efforts to remediate harms associated with social media use, the role of parents and other adults in influencing positive use, and algorithmic audits. Across topics, the agencies should emphasize the need for validated tools to measure exposure to social media affordances, data sharing, and the establishment of long-term cohort

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studies. Special emphasis should be given to study designs that attempt to understand causal directions.

As previous chapters in this report have made clear, social media as a category includes a wide range of applications and websites: the affordances that drive the social media experience of a video game differ from those of a video sharing site; the affordances central to the social networking sites differ from those involved in group chats. For research to be more useful to both industry and policy makers, better effort might be made to unpack how specific affordances influence health. This is, in theory, something that could be manipulated experimentally if the research team designed a platform offering or withholding the affordances being studied. The committee commends the Templeton Foundation's recent effort to develop an experimental social media platform for algorithmic research and to recruit 5,000 participants to use this platform (Bail et al., 2022). A wider use of this strategy, especially if pursued over the long term, would give valuable insight into how social media algorithms could be harnessed for users' benefit.

Industry collaboration might also be a venue for these types of questions, depending on industry's willingness to collaborate with academic researchers. Users who express interest in joining a study could have certain affordances (auto scroll, for example) deactivated. Comparison with a participating control group could yield useful insights into the extent to which the affordance in question influences health.

Much of the committee's assessment of the research agenda in this area underscores the need for more experimental and controlled study designs. Problems of reverse causation are particularly vexing when studying mental health outcomes; it is difficult to say if a problem such as depression is the cause or the effect of spending excessive amounts of time on social media. For this reason, the committee encourages rigorous study designs and statistical methods that allow for causal statistical inference on an interconnected network (Ogburn et al., 2022).

The committee commends research using randomized designs to study social networks, such as paying an experimental group of participants to stop using social media and following them over time (Allcott et al., 2019; Baym et al., 2020). Such research is difficult and expensive to conduct and would therefore benefit from being an explicit priority of the major government funders. There are also less onerous ways to answer key questions through capitalizing on natural experiments. Analysis of the staggered rollout of Facebook across college campuses and the simultaneous deterioration in student mental health provided compelling evidence of the platform's potential to harm (Braghieri et al., 2022). As new waves of public policy attempt to limit media use in young people, it will

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be critical to study the consequences of such restrictions. Adolescents in Utah, for example, should be followed for changes in measures of physical and mental health attributable to the restrictions that will go into effect in 2024 (Metz and Ortutay, 2023).

An Approach to Research Questions

Through their position as large, government funders of academic research, the National Institutes of Health (NIH) and the National Science Foundation (NSF) could encourage a more standardized approach to social media research. The development of validated measures of social media use would be an important first step.

Measuring Exposure and Outcomes

One barrier to better research is a problem with measuring a person's media use. Researchers have developed apps, for example, that passively monitor screen time with relativly good accuracy (Wade et al., 2021). Perhaps for this reason, there is an overreliance on screen time as a measure of exposure. It is difficult to get beyond this relatively crude measure of online engagement, which is a barrier to a more nuanced understanding of the field.

In the absence of validated measurement tools, the field has developed an overreliance on self-reported frequency and duration of media use (Hancock et al., 2022). While this work has been useful in generating hypotheses, its use is limited as a way of guiding policy more precisely. It is difficult for users to provide reliable estimates of how much time they spend using various apps and websites, both because it is common to use several media at the same time and because all of these uses are relatively mundane, not occasions that would stand out in a person's memory with sufficient clarity to be reported later to a researcher (Hancock et al., 2022). These measures do not capture the affordances used. More importantly, measures of time spent on a social networking site does not capture if the time was spent happily, enviously, or in a neutral state.

The same attention to measurement would also bring more clarity to the concept of well-being, an oft discussed but poorly operationalized outcome. There are many scales to measure well-being, although far fewer have been validated for adolescents (Rose et al., 2017). Research funders could help introduce more comparability into research through attention to the toolboxes researchers use to measure both social media exposures and well-being.

NIH has previously engaged in the development of standardized data collection tools for uniform measurement of complex variables. Over

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several years in the 2010s for example, the agency worked with scientists around the country to develop the NIH Toolbox for Assessment of Neurological and Behavioral Function (Hodes et al., 2013). The value of this toolbox comes from both introducing standardized assessments and in capturing comparable information across studies and over time (Hodes et al., 2013). Social media research would benefit from a similar attention to standardization of measurement. Given that the field is still relatively new, prompt investment in a measurement tool kit for social media exposure could forestall continued disagreement about the validity of comparison among different studies.

Larger Samples, Longer Study Time

The committee recognizes that the appropriate measures of how users interact with various social media affordances will take time to develop and validate. The differential harms and benefits of social media may accrue differently in different demographic groups. Therefore, it will be particularly important to validate measures on large, nationally representative samples and to undertake additional validation among small but important populations. Transgender and gender nonconforming youth, for example, may be a population of particular concern owing to a combination of factors including vulnerability to bullying, heightened reliance on online support, and a seemingly increased risk of excessively using social media (Cingel et al., 2022).

Data repositories and data sharing are useful tools to make good use of scarce data on small populations. The committee applauds NIH's new data sharing policy and similar efforts at NSF (NIH, 2020; NSF, 2018). Yet it is difficult for researchers studying social media to cooperate with these policies if they are using real-world, platform data, as the platforms generally disallow such sharing. It is possible that the same end goal of the data repository might be served through growing the field of algorithmic researchers and removing some of the legal barriers to their work, a topic discussed later in this chapter. Investigators may benefit from guidance as the most suitable repository for their data, one that would be well known to colleagues in the field and reliably funded more than 5 years out (BU Data Services, n.d.).

For understandable logistical reasons, cross-sectional studies have dominated the research on social media to date (Hancock et al., 2022). A longer time horizon on research will be particularly valuable in studying the effects of social media on young people. Ongoing longitudinal studies, such as the Adolescent Brain Cognitive Development (ABCD) Study, have already uncovered some associations between the length of time teens spend using screen media and poorer academic performance, sleep,

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and behavioral problems (Paulich et al., 2021). An 8-year, nationally representative cohort study has provided some of the strongest evidence to date on both the risks and protective factors for problematic social media use (Coyne et al., 2020). Ongoing cohort studies by the same team have identified psychological and demographic characteristics associated with using social media in problematic ways, such as being bullied, being a member of a racial or ethnic group other than white, and having limited ability to self-regulate emotions (Coyne, 2023).

More long-term cohort studies are needed to understand the risks and benefits of social media and to determine how social media exposures influence development over the life course. Such studies are expensive and logistically complicated and may therefore require more explicit attention from funders (Caruana et al., 2015). There is also room to embed some attention to media use in existing ongoing national studies, such as the National Institute on Drug Abuse's Monitoring the Future study and the Centers for Disease Control and Prevention's Youth Risk Behavior Surveillance System. Across projects, there should be a greater emphasis on understanding both the risk and protective factors that are associated with various physical and mental health indicators.

Incorporating a Diversity of Experiences

This report has emphasized that social media affordances are tools and that these tools are used differently by widely diverse cross-sections of young people. A better understanding of these tools depends on more clarity as to both how they are used differently and the different influences they have on different users.

The sociological concept of intersectionality, referring to the way various social forces and identities manifest themselves in varying levels of power, is important to frame the research approach needed (Crenshaw, 2017). Consider, for example, a relatively accepted finding that social media use can help mitigate feelings of loneliness and isolation for LGBTQ+ teens and give them a space to explore their identities (Karim et al., 2022; Talbot et al., 2022). Given that we see a clear and different dynamic at play among this group than in the population at large, it is reasonable to consider that similar patterns may occur in other historically marginalized groups. The same attention is warranted to consider how young people of color or living in rural areas use social media in different and unique ways. One of the most important sources of heterogeneity among teens is developmental stage, for which age is a rough proxy. A more precise attention to developmental stage accounting for pubertal timing and other accepted indicators of development would bring more clarity to our understanding of various risks and benefits across the sec-

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ond decade of life. Another crucial way to account for the diverse experience of adolescents is to include young people in a participatory research process. Such inclusion can provide a validity check for researchers and could also improve the relevance of proposed research questions. The perspective of people who are living the experience of social media in adolescence also adds nuance to an academic work and allows young people to contribute to research that will affect them and their futures.

An Emphasis on Mechanisms

Both researchers and research funders could advance our understanding of social media and well-being by designing proposals with an emphasis on the mechanisms through which social media use affects health. The displacement of time spent on sleep, exercise, studying, and interacting with people in person is, for example, one pathway through which gaming and social media can influence young people (Hall and Liu, 2022). Displacement may be one of the better-studied mechanisms in Table 8-1, possibly because some displaced behaviors are relatively straightforward to measure. The displacement of negative behaviors, as in using social media to control rumination, is less well studied. A body of research that investigates if and how the social and psychological mechanisms listed in Table 8-1 influence health would improve the field. The committee notes that Table 8-1 does not offer a comprehensive list; there are several other processes, such as self-efficacy and curiosity, that will likely, in the fullness of time, emerge as important mechanisms that explain the link between social media and health.

As Chapter 4 indicates, there is relatively little work in the field linking subjective measures of stressors to physiological endpoints, such as inflammatory markers. Assessment of the physical effects of social media use is mostly limited to either the most extreme (e.g., suicide) or the most obvious (e.g., sleep deprivation) outcomes. Attention to intermediary physiological outcomes could clarify if there is a relationship between social media use and other serious health problems, such as cardiovascular disease or other slowly-developing chronic conditions.

There are also open questions about how psychological and social mechanisms can co-occur and interact. A better understanding of the content to which teenagers are exposed on social media may be crucial to understanding this relationship. Problems related to social comparison or social sharing, for example, depend on some insight into the content that was shared or the pages viewed (Hancock et al., 2022). The experimental social media platforms described earlier in this chapter could be helpful in understanding how content influences the psychological experience of social media and how various mechanisms interact to influence physical

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TABLE 8-1 Conceptual Mechanisms Linking Social Media Use and Well-Being

Conceptual Mechanisms	Description
Social Structure	
Network size	Number of online friends, number of likes received, perceived network size, etc.
Social support and social capital	Perceptions of tangible and intangible assistance from one's social network
Psychological Processes	
Social comparison	Evaluating oneself through comparison with others
Connectedness	Perceptions of feeling socially connected with others
Fear of missing out	Apprehension that others are having experiences without one
Overload	Perceptions of too many social demands
Social compensation	Use of social media to compensate for challenges encountered offline
Behavioral Dynamics	
Displacement and enhancement	Social media use displaces or reinforces meaningful interpersonal communication and social activities

SOURCE: Hancock et al. (2022, p. 206). Reproduced with permission from American Psychological Association. No further reproduction or distribution is permitted.

and psychological outcomes. Such understanding might allow for a better harnessing of contagion in order to constrain excessive or unhealthy use.

Some of the most meaningful dynamics in a social network may be the hardest to measure. People who are connected through social networks have a relationship (of unspecified quality or mutuality) that connects them, meaning that statistical models that assume observations in a dataset to be independent are fundamentally flawed (Ogburn and VanderWeele, 2017). The use of tools, such as linear regression, to estimate causal relationships in a social network is therefore not valid and can result in inflated estimates of cause and effect (Ogburn and VanderWeele, 2017). Pressing questions of emotional and behavioral contagion through social networks depend on better understanding of how to analyze these data where participants are connected to each other and how these relationships influence the outcomes they experience.

Consider, for example, the important outcome of nonuse of social media, either through quitting a platform, taking a break, or uninstalling the application used to access it. It is possible that nonuse could be one of the more influential contagions in a social network but one that is, by definition, silent. Some evidence suggests that teenagers who do not use the major social networking platforms are perceived as less popular but

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are better students (Schwartz et al., 2021). Qualitative research among people who quit social media suggests that despite initial, heightened anxiety about being left out, those feelings dissipate after a few months (Pennington, 2021). A better understanding of how nonuse works over time could inform policy actions such as prompts to users to pause their activity on a platform.

In a similar way, understanding the mechanisms through which social media advertising influences adolescents could help inform decisions as to how ads are targeted to them. Advertising is so central to the experience of social media, in the feeds, the banners, and the promoted content, that it transcends any one platform. As Chapter 2 explained, advertising can be subtle, including the endorsements of influencers or unboxing videos. A better understanding of how advertising interacts with adolescent development is necessary to make the experience of the platforms more positive for young people.

Patterns of Use

One obstacle to making broader policy recommendations regarding social media use and teenagers is our limited understanding of what drives their use and how adolescents use social media differently from young adults or the general population. A recent comprehensive meta-analysis on the influence of social media on well-being found that a modest majority of studies (54 percent) drew participants from a population made up entirely of undergraduates (Hancock et al., 2022). These young adults, as well as the older adults in the general population, are at a different life stage to younger teens and children and would therefore be expected to interact with social media differently. Understanding why children join social media and how they use the platforms will be an important precursor to any policy intervention aimed to change their use patterns.

Measuring how adolescents use social media includes measuring the extent to which they frequent different communities and interact with different affordances. Fanfiction communities, for example, may be supportive online groups, apps that encourage anonymous gossip would be expected to be far less so. Information about the relative prominence of such platforms (similar to what Pew surveys have estimated for the major platforms) would also facilitate a more systematic discussion of the variation in young people's social media use.

At its heart, descriptive research should answer the questions, "how [young people] use social media, in which context, and for which purposes" (Hancock et al., 2022, p. 226). Such research will help explain how social media is used for good or neutral purposes in what evidence

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indicates is the majority of young people (Coyne, 2023). It could also shed light into the epidemiology of problematic use. Despite widespread public concern about the addictive potential of social media, scientific research on the topic is more guarded (Doucleff, 2023; Panova and Carbonell, 2018; Shah, 2023; Waters, 2021). If social media or gaming addiction is similar to physiological addictions (e.g., alcoholism) or other behavioral addictions (e.g., gambling addiction), then the onset of symptoms may be sporadic and could be best studied through long-term prospective cohort designs (Hancock et al., 2022). A better understanding of patterns of overuse would be a necessary precursor to any efforts to include discussion of problematic use at the meetings to update diagnostic guides, such as the *Diagnostic and Statistical Manual of Mental Disorders* (APA, 2013). If the overuse of social media, even among a minority of users, is a serious addiction, then such diagnostic attention will be necessary.

Society would benefit from a more precise understanding of the etiological pathway through which ordinary social media use becomes uncontrolled social media use. Internet gaming disorder and problematic social media use are unambiguously harmful endpoints, yet it is not clear who is at greatest risk to develop them. Identifying teens at risk for these disorders could go a long way to mitigating the harms associated with social media.

Strategies to Mitigate Harm and Maximize Benefits

It is also possible, however, that for many people the framing of social media use or overuse as an addiction may create the perception among users that the technology controls them, driving a mindset that influences users to more negative experiences of mental state and relationships online (Lee and Hancock, 2019). In contrast, users who view the technology as a tool over which they have control have a more positive experience on platforms (Lee and Hancock, 2019). Given the potential power of mindsets to modify the experience of social media, explicit research attention to the role of user mindset would be helpful.

Therapeutic efforts to alter mindset might prove helpful to those young people suffering from an unpleasant or compulsive relationship with social media. There may also be room to use online platforms to reach young people who are suffering from any number of mental health difficulties. Ultimately a concern with this population of users is at the heart of most of the public discussion about teens and social media. For this reason, research funders would do well to consider treatment and remediation strategies to help adolescents who are harmed online. Some of these may be behavioral treatments or coping strategies for young people who have a problem with overuse or unhealthy use of social

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media. There are also harms associated with social media use that come from victimization, with relatively little research on the best strategies to counter it (Foody et al., 2015). It would be valuable to compare different therapeutic strategies' ability to alleviate the distress of being victimized and to cultivate resilience (Foody et al., 2015). The same types of comparison could give insight into the best strategies to remediate less common online harms, such as the rehabilitation of young people who were radicalized online. While some evidence suggests that the more heavy-handed actions relying on law enforcement are less successful, the best cognitive and emotional strategies for deradicalization are not clear (Brown et al., 2021).

The move to longer-term prospective studies described earlier in this chapter would shed light on the developmental trajectory for young people who are harmed online through victimization, radicalization, problematic use, or other means. Such research would also help identify potential cognitive and intellectual effects associated with use of social media starting in childhood. There is wide concern, for example, that social media and technology use poses a distraction to young people that could take a toll on their capacity for concentration and memory but only modest evidence that it is so (Firth et al., 2019; Siebers et al., 2022). A recent review of strategies to improve attention and concentration among children and adolescents found preliminary suggestions that mindfulness training and physical activity could improve capacity for sustained attention but cautioned that these results "need to be replicated with greater methodological rigor" (Slattery et al., 2022, p. 17).

The same need for rigor and attention applies to many of the important questions of how to maximize the benefits of social media. As Chapter 3 explained, publication bias may partly account for a relatively small body of evidence on the benefits of social media. Harmful outcomes such as depression and anxiety are investigated frequently, but beneficial ones are not. A greater research emphasis on positive outcomes, such as feelings of connectedness and support, could help reframe this discussion.

The Role of Parents

Concrete evidence as to how young people are helped or harmed online is important partly because in the absence of evidence, advice reverts to strategies based on accepted wisdom and common sense. The recent Surgeon General's report *Social Media and Youth Mental Health*, for example, included advice that parents keep regular family meal times free of devices and to work with other parents to set consistent boundaries on social media (HHS, 2023). Most people would agree that these are good things. At the same time, the causal pathway through which these

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behaviors mitigate the harms of adolescents' social media use is not clear or direct. There are many overburdened and well-meaning parents for whom regular family mealtimes and relationships with other adults in their children's friend group remain aspirational. With these parents in mind, the committee encourages more research exploring precisely how parents and other adult authority figures can best influence adolescents' use of social media and their safety online.

There is evidence that poor relationships with parents are associated with internet gaming disorder, excessive social media use, and overuse of technology in general, but the direction of this relationship is not clear (Schneider et al., 2017; Trumello et al., 2021; White-Gosselin and Poulin, 2022). Good quality longitudinal studies have identified the distracting interruption of technology in parent–child interactions as an influence on adolescents' anxiety, depression, civic engagement, and prosocial behavior (Stockdale et al., 2018). Both adolescents and their parents are concerned about the distractions of phone use, especially during family time, but there is little evidence as to how this problem is best overcome, and what studies there are come from a relatively homogenous population of middle-class, White Americans (McDaniel, 2019).

When young people are suffering, looking for a cause in their home environments is an understandable reaction. Yet many parents already blame themselves for their children's mental health problems (Moses, 2010). Targeted research could inform a more productive discussion of how parents encourage healthy media habits. Researchers may do well to consider sensitive windows when parents are open to instruction and use these to promote warm and supportive parenting (Zurcher et al., 2018). A better understanding of how parents mediate young people's healthy or unhealthy use of social media could help inform more specific, targeted advice that both parents and policy makers would welcome.

ENCOURAGING THE USE OF REAL-WORLD DATA

Attention to the research questions laid out in the previous section would give powerful insight into the influence social media has on adolescents. At the same time, there are only so many questions that can be answered without the platforms' explicit cooperation. In Chapter 5, the committee recommended that researchers and platforms formally collaborate, taking steps to standardize a format for data at the application program interface (API), for example. The committee recognizes, however, that this recommendation might take considerable time to implement. In the meantime, there are researchers and journalists with pressing questions about the advertising, recommendation, and content moderation actions of social media companies. They pursue these questions to the benefit of society and at potential personal liability.

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By way of illustration, some research designs aim to give insight into the platforms' advertising and recommendation algorithms that lie at the heart of social media operations. A process called web scraping, which uses automated software to efficiently pull data from websites at large scale, sometimes provides the data for such research. For example, New York University researchers used a web scraping tool, a browser plug-in called Ad Observer, to collect information about the advertisements Facebook shows its users (with the users' explicit authorization) (Edelson and McCoy, 2021b; NYU Cybersecurity for Democracy, 2023). Their research suggested inconsistencies in the way Facebook enforces rules on political advertising (Abdo et al., 2022; Edelson and McCoy, 2021a).

Web scraping is in a legal gray area, although the scraping of publicly available information is usually permissible. However, if data scraping is not welcome by the platform, it can be characterized as unauthorized access akin to hacking (Roberts, 2018). Under the Computer Fraud and Abuse Act (CFAA) subjects who exceed their authorized access to a protected computer risk civil and criminal liability.[1]

Yet what constitutes authorized access is often unclear. The Supreme Court decision in *Van Buren v. United States* provided some additional guidance on this situation.[2] That decision clarified that publicly available data can be scraped from websites without violating the CFAA regardless of the platforms' attitude toward their research provided the web scraping did not access an off-limits area of a computer.

The precise implications of the decision for web scraping that violates a platform's terms of service remain unclear. On the one hand, the Supreme Court reserved the question whether exceeding authorized access applies only to areas of computers that are protected by "technological (or 'code-based') limitations on access" or whether it also applies "to limits contained in contracts or policies."[3] This reservation leaves open the possibility that web scraping could lead to CFAA liability (Abdo et al., 2022).

At the same time, the Supreme Court's opinion in *Van Buren* contains multiple indications that it would not regard those who breached a policy, rather than a technical barrier, as having violated the CFAA. As an initial matter, the court's ruling that a police officer's accessing a law enforcement database in violation of department policy did not constitute exceeding authorized access under the statute clearly establishes that the mere breach of a document prohibiting certain uses of a computer is not necessarily sufficient to give rise to a CFAA violation. The court also noted

[1] 18 U.S. Code. § 1030.

[2] *Van Buren v. United States*, 141 S. Ct. 1659 (2021).

[3] *Van Buren v. United States*, 141 S. Ct. 1659 (2021).

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that the CFAA limits civil liability to access to computers that inflict damage or loss, which the court equated to "technological harms—such as the corruption of files," a standard that likely does not apply to web scraping.[4] Furthermore, the Supreme Court disparaged constructions of what constitutes exceeding authorized access that would "criminalize[] every violation of a computer-use policy."[5] In so doing, it criticized the possibility of treating failure to follow specified terms of service as a CFAA violation. Doing so would "criminalize everything from embellishing an online-dating profile to using a pseudonym on Facebook."[6] In short, the decision warned that treating every violation of a computer-use policy as exceeding authorized access would have the nonsensical result of turning "millions of otherwise law-abiding citizens [into] criminals."[7]

In addition, commentators have found it unlikely that "obscure provisions buried in unread terms of service" would constitute the type of "gates-up" protection necessary to give rise to CFAA liability (Goldman, 2021; Ohm, 2023). Indeed, when reaffirming that the CFAA did not permit LinkedIn to prevent a data analytics firm from scraping data off its website, the U.S. Court of Appeals for the Ninth Circuit interpreted *Van Buren* as holding the CFAA inapplicable to public websites that lack any limitations on access.[8] The U.S. Department of Justice further reduced the likelihood of criminal liability by announcing that it would not prosecute "good-faith security research" under CFAA (DOJ, 2022).

The *Van Buren* decision thus greatly reduces but does not completely eliminate the risk that journalists and researchers who violate platforms' terms of service in the course of digital investigations may be subject to liability under the CFAA, particularly if a platform employs technical barriers such as rate limits and challenge-response authentication tests that are meant to deter accessing a website too frequently or with the assistance of an automated script.[9] Researchers might circumvent these barriers, with unclear implications for their liability under CFAA.

In short, many of the digital tools necessary for independent research into a platform's policies and practices may present a degree of risk under the CFAA. This lack of clarity has a chilling effect on research, which in turn limits our understanding of the platforms that play a crucial role in society. Those conducting extensive scraping of social media sites to col-

[4] *Van Buren vs. United States*, 593 U. S. ____ 15; 141 S. Ct. 1659–1660 (2021).
[5] *Van Buren vs. United States*, 593 U. S. ____ 17; 141 S. Ct. (2021).
[6] *Van Buren vs. United States*, 593 U. S. ____ 18; 141 S. Ct. (2021).
[7] *Van Buren vs. United States*, 593 U. S. ____ 17; 141 S. Ct. (2021).
[8] *hiQ Labs, Inc. v. LinkedIn Corp.*, 31 F.4th 1180 (9th Circuit 2022)
[9] Automated scripts are short pieces of code that can be triggered to work automatically.

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lect data for research may also face potential liability under the Federal Trade Commission (FTC) Act, contract law, and tort law.

Recommendation 8-2: Social media companies should make a good faith effort to ensure access to data that would make research on the effects of social media on child and adolescent health possible, including the omission from their terms of service any prohibitions on researchers' use of publicly available data.

A good faith effort to allow researchers to access social media data could be valuable to companies facing a great deal of public distrust and scrutiny. Companies can also help enable stronger research designs by partnering in the design of experimental studies. Much of the uncertainty regarding the harms and benefits of social media use stems from the opacity of the process of data gathering.

There is also evidence that the industry is moving away from an inclination to share data. In early 2023, for example, Twitter, once known for allowing relatively open use of its data, put restrictions on this policy including charging for access to the platforms' data and its API at a relatively unclear rate (Jingnan, 2023). In an open letter, various civil society groups and researchers criticized this policy as a step backward for data access, transparency, and accountability (CITR, 2023a).

A few months after the Twitter decision, Reddit followed suit, restricting access to its API, Pushshift, and requiring payment for data (Isaac, 2023; Wiggers, 2023). In an open letter, the Coalition for Independent Technology Research pointed out that this abrupt withdrawal of this interface, cited in more than 1,700 scholarly papers, put the future of independent research at risk (CITR, 2023b).

Given the current efforts to restrict data access, it is reasonable to consider that social media companies may not voluntarily cooperate with Recommendation 8-2. And, people conducting extensive scraping of social media sites to collect data for research may also face potential liability under the FTC Act, contract law, and tort law. Indeed, in the current climate companies are becoming progressively more opposed to data sharing and cooperation with researchers. In addition, the committee recognizes that companies may prefer not to share with researchers data they would otherwise sell, as they do to advertisers. For this reason, it is prudent to consider that more compelling steps may be needed.

Researchers' lack of access to social media data is a problem and one that has attracted congressional attention in recent years (Vogus, 2022). Some proposed legislation requires companies to share data with researchers; others are concerned with a strategy to protect user privacy in the data sharing process. Table 8-2 shows key similarities and differences

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among prominent legislative proposals. The committee does not endorse or oppose any piece of legislation shown in Table 8-2. Rather, it commends the common concern with ensuring research access to social media data. The committee shares this goal, an overriding one for anyone concerned with understanding the effects of social media on adolescents.

Recommendation 8-3: Congress should pass legislation to ensure researchers can access data to examine the effects of social media on child and adolescent health.

In its spirit, making data accessible to researchers is a matter of openness to people with a legitimate public interest need. As Table 8-2 makes clear, the momentum to encourage research on social media platforms has not so far been insensitive to the platforms' need to protect users' privacy and their own proprietary information. Proposal vetting from the NSF, for example, is an unambiguously high bar on the quality of the proposed research and qualifications of the researchers. Such vetting could do much to assuage the platforms' concerns about the credibility of the people accessing their platform.

The committee recognizes that increasing data access will pose thorny challenges. Additional steps can be taken to ensure researchers treat proprietary or confidential data with professionalism; the use of a code of conduct, for example, can help build trust between researchers and companies (OECD, 2007). In advancing the legislation recommended, it will be important to articulate technical steps that could improve the anonymization of user data, recognizing nonetheless that complete anonymization of social media data is not always possible or entirely effective (Keller, 2022). There is no easy or obvious answer to questions of how to balance society's interest in greater transparency of social media operations against individual users' expectations of privacy (Keller, 2022). It is the committee's hope that by showing commitment to this question Congress can encourage an open discussion among researchers, industry executives, and privacy experts. The FTC guidance recommended in the previous chapter would also facilitate the process of data sharing by being clear about the companies' competing obligations to cooperate with external researchers and to protect the customers' privacy.

By providing protection against exorbitant penalties and certifications for confidentiality, legislative action could help tip the risk-to-benefit calculation for researchers. These steps are also necessary in service of an important end goal: advancing society's understanding of how social media influences young people. In the long run, this research could also benefit the platforms, improving their public image and perceptions of openness around their policies.

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TABLE 8-2 Recent Legislative Proposals on Social Media Platform Research

	Access to Whom?	What Types of Data?	Restrictions on the Research Project?	Which Applications and Websites Must Make Data Available?	Data Privacy Safeguards?	Safe Harbor for Independent Access?
Platform Accountability and Transparency Act **117th Congress, 2nd Session (2021–2022)**	Researcher affiliated with a university ad proposal vetted by NSF	Determined by NSF to be feasible, proportionate, and not an undue burden on platform	Project must be approved by NSF, have IRB approval or be IRB exempt, "aim to study activity on a platform," and meet other criteria determined by NSF	More than 25 million unique users per month for the previous year, allows for user-generated content and sells advertising	FTC can set requirements for data sharing, such as data encryption, deidentified data delivery, etc.	Yes; no civil or criminal liability for the researchers
Social Media Disclosure and Transparency of Advertising Act **117th Congress, 2nd Session (2021–2022)**	Academic researchers and FTC	An ad library with information about advertisers who buy ≥$500 of ads in a year	None	More than 100 million users per month for the majority of the previous 12 months, sells advertising; FTC can update definition	None	No.

(*continued*)

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TABLE 8-2 Continued

	Access to Whom?	What Types of Data?	Restrictions on the Research Project?	Which Applications and Websites Must Make Data Available?	Data Privacy Safeguards?	Safe Harbor for Independent Access?
Digital Services Oversight and Safety Act **117th Congress, 2nd Session (2021-2022)**	Researchers affiliated with institution of higher education or relevant nonprofit	To be determined by FTC regulations	Related to content moderation, product design, and algorithms and their effect on society, including health effects	More than 10 million active users in a month, platform stores information at request of users, FTC may vary specifications	Tiered access with more sensitive information having more safeguards, made available to fewer researchers	Yes; immunity from laws related to violating terms of service, if researcher is creating a research account or data donated by informed users; platform cannot discriminate against researcher
Kids Online Safety Act **117th Congress, 2nd Session (2021–2022)**	Researchers affiliated with institution of higher education or relevant nonprofit and approved by the Assistant Secretary of Commerce for Communications and Information	Data relating to the harms and safety of minors such as promotion of self-harm or eating disorders, patterns of use that suggest addiction, promotion of unlawful products or service	Public interest research on the safety and well-being of minors	A site used or reasonably expected to be used by minors	NTIA to establish standards including confidentiality standard	Yes; no action may be taken for violating terms of service

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American Data Privacy and Protection Act **117th Congress, 2nd Session (2021–2022)**	Any research project	What is "reasonably necessary, proportionate, and limited" for the scientific project	Public interest research	No mandatory data sharing	All relevant research laws and human subjects protections	No

NOTE: NSF = National Science Foundation; IRB = institutional review board; FTC = Federal Trade Commission; NTIA = National Telecommunications and Information Administration.
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REFERENCES

Abdo, A., R. Krishnan, S. Krent, E. W. Falcon, and A. K. Woods. 2022. *A safe harbor for platform research*. https://knightcolumbia.org/content/a-safe-harbor-for-platform-research (accessed September 19, 2023).

Allcott, H., L. Braghieri, S. Eichmeyer, and M. Gentzkow. 2019. *The welfare effects of social media*. https://www.nber.org/system/files/working_papers/w25514/w25514.pdf (accessed September 19, 2023).

APA (American Psychiatric Association). 2013. *Diagnostic and Statistical Manual of Mental Disorders: DSM-5*. 5th ed. Arlington, VA/Washington, DC: American Psychiatric Association.

Bail, C., D. S. Hillygus, and A. Volfovsky. 2022. *Can social media promote intellectual humility?* https://www.templeton.org/grant/can-social-media-promote-intellectual-humility (accessed September 19, 2023).

Baym, N. K., K. B. Wagman, and C. J. Persaud. 2020. Mindfully scrolling: Rethinking Facebook after time deactivated. *Social Media + Society* 6(2).

Braghieri, L., R. Levy, and A. Makarin. 2022. Social media and mental health. *American Economic Review* 112(11):3660-3693.

Brown, R. A., T. C. Helmus, R. Ramchand, A. I. Palimaru, S. Weilant, A. L. Rhoades, and L. Hiatt. 2021. *What do former extremists and their families say about radicalization and deradicalization in America?* Santa Monica, CA: RAND Corporation.

BU Data Services. n.d. *Selecting a data repository*. https://www.bu.edu/data/share/selecting-a-data-repository (accessed September 19, 2023).

Caruana, E. J., M. Roman, J. Hernández-Sánchez, and P. Solli. 2015. Longitudinal studies. *Journal of Thoracic Disease* 7(11):E537-E540.

Cingel, D. P., A. R. Lauricella, L. B. Taylor, H. R. Stevens, S. M. Coyne, and E. Wartella. 2022. U.S. adolescents' attitudes toward school, social connection, media use, and mental health during the COVID-19 pandemic: Differences as a function of gender identity and school context. *PLOS ONE* 17(10):e0276737.

CITR (Coalition for Independent Technology Research). 2023a. *Letter: Imposing fees to access the Twitter API threatens public-interest research*. https://independenttechresearch.org/letter-twitter-api-access-threatens-public-interest-research (accessed July 12, 2023).

CITR. 2023b. *Restricting Reddit data access threatens online safety & public-interest research*. https://independenttechresearch.org/reddit-data-access-letter (accessed July 12, 2023).

Coyne, S. 2023. Who is most at risk and who is most likely to benefit from using social media long-term?: A differential susceptibility approach. Paper presented at Assessment of the Impact of Social Media on the Health and Wellbeing of Children and Adolescents Meeting 1, Washington, DC, January 9. https://www.nationalacademies.org/event/01-05-2023/assessment-of-the-impact-of-social-media-on-the-health-and-wellbeing-of-adolescents-and-children-meeting-1 (accessed January 12, 2023).

Coyne, S. M., A. A. Rogers, J. D. Zurcher, L. Stockdale, and M. Booth. 2020. Does time spent using social media impact mental health?: An eight year longitudinal study. *Computers in Human Behavior* 104.

Crenshaw, K. 2017. *On intersectionality: Essential writings*. New York: The New Press.

DOJ (U.S. Department of Justice). 2022. *Department of Justice announces new policy for charging cases under the Computer Fraud and Abuse Act*. https://www.justice.gov/opa/pr/department-justice-announces-new-policy-charging-cases-under-computer-fraud-and-abuse-act (accessed July 12, 2023).

Doucleff, M. 2023. Teens say social media is stressing them out. Here's how to help them. *The Guardian*. https://www.theguardian.com/global/2021/aug/22/how-digital-media-turned-us-all-into-dopamine-addicts-and-what-we-can-do-to-break-the-cycle (accessed September 19, 2023).

Copyright National Academy of Sciences. All rights reserved.

Edelson, L., and D. McCoy. 2021a. Facebook is obstructing our work on disinformation. Other researchers could be next. *The Guardian.* https://www.theguardian.com/technology/2021/aug/14/facebook-research-disinformation-politics (accessed September 19, 2023).

Edelson, L., and D. McCoy. 2021b. We research misinformation on Facebook. It just disabled our accounts. *The New York Times.* https://www.nytimes.com/2021/08/10/opinion/facebook-misinformation.html (accessed September 19, 2023).

Firth, J., J. Torous, B. Stubbs, J. A. Firth, G. Z. Steiner, L. Smith, M. Alvarez-Jimenez, J. Gleeson, D. Vancampfort, C. J. Armitage, and J. Sarris. 2019. The "online brain": How the internet may be changing our cognition. *World Psychiatry* 18(2):119-129.

Foody, M., M. Samara, and P. Carlbring. 2015. A review of cyberbullying and suggestions for online psychological therapy. *Internet Interventions* 2(3):235-242.

Goldman, E. 2021. *Do we even need the Computer Fraud & Abuse Act (CFAA)?–Van Buren v. US.* https://blog.ericgoldman.org/archives/2021/06/do-we-even-need-the-computer-fraud-abuse-act-cfaa-van-buren-v-us.htm (accessed July 12, 2023).

Hall, J. A., and D. Liu. 2022. Social media use, social displacement, and well-being. *Current Opinion in Psychology* 46:101339.

Hancock, J. T., S. X. Liu, M. Luo, and H. Mieczkowski. 2022. Social media and psychological well-being. In *Technology: Social Science Research in the Age of Big Data,* edited by S. C. Matz. American Psychological Association. Pp. 195-238.

HHS (U.S. Department of Health and Human Services). 2023. *Social media and youth mental health: The U.S. Surgeon General's advisory.* https://www.hhs.gov/surgeongeneral/priorities/youth-mental-health/social-media/index.html (accessed January 2, 2024).

Hodes, R. J., T. R. Insel, S. C. Landis, and NIH Blueprint for Neuroscience Research. 2013. The NIH Toolbox: Setting a standard for biomedical research. *Neurology* 80(11 Supplement 3):S1.

Isaac, M. 2023. Reddit wants to get paid for helping to teach big A.I. systems. *New York Times.* https://www.nytimes.com/2023/04/18/technology/reddit-ai-openai-google.html (accessed January 2, 2024).

Jingnan, H. 2023. Twitter's new data access rules will make social media research harder. *NPR.* https://www.npr.org/2023/02/09/1155543369/twitters-new-data-access-rules-will-make-social-media-research-harder (accessed January 2, 2024).

Karim, S., S. Choukas-Bradley, A. Radovic, S. R. Roberts, A. J. Maheux, and C. G. Escobar-Viera. 2022. Support over social media among socially isolated sexual and gender minority youth in rural U.S. during the COVID-19 pandemic: Opportunities for intervention research. *International Journal of Environmental Research and Public Health* 19(23):15611.

Keller, D. 2022. *User privacy vs. platform transparency: The conflicts are real and we need to talk about them.* https://cyberlaw.stanford.edu/blog/2022/04/user-privacy-vs-platform-transparency-conflicts-are-real-and-we-need-talk-about-them-0 (accessed July 12, 2023).

Krass, P. 2022. *Transparency: The first step to fixing social media.* https://ide.mit.edu/insights/transparency-the-first-step-to-fixing-social-media (accessed May 31, 2023).

Lee, A. Y., and J. T. Hancock. 2019. Social media mindsets: A new approach to understanding social media use & psychological well-being. Stanford University. https://osf.io/preprints/psyarxiv/f8wny (accessed January 2, 2024).

Maung, H. H. 2016. Diagnosis and causal explanation in psychiatry. *Studies in History and Philosophy of Science Part C: Studies in History and Philosophy of Biological and Biomedical Sciences* 60:15-24.

McDaniel, B. T. 2019. Parent distraction with phones, reasons for use, and impacts on parenting and child outcomes: A review of the emerging research. *Human Behavior and Emerging Technologies* 1(2):72-80.

Metz, S., and B. Ortutay. 2023. Utah social media law means kids need approval from parents. *AP News.* https://apnews.com/article/social-media-utah-kids-84bd1f6481071726327bce25cf3e7522 (accessed September 19, 2023).

Copyright National Academy of Sciences. All rights reserved.

Moses, T. 2010. Exploring parents' self-blame in relation to adolescents' mental disorders. *Family Relations* 59(2):103-120.

NIH (National Institutes of Health). 2020. *Final NIH policy for data management and sharing*. https://grants.nih.gov/grants/guide/notice-files/NOT-OD-21-013.html (accessed September 19, 2023).

NSF (National Science Foundation). 2018. *Data management guidance for CISE proprosals and awards*. https://www.nsf.gov/cise/cise_dmp.jsp (accessed September 19, 2023).

NYU Cybersecurity for Democracy. 2023. *Ad observer*. New York University. https://adobserver.org (accessed September 19, 2023).

OECD (Organisation for the Economic Co-operation and Development). 2007. *OECD principles and guidelines for access to research data from public funding*. https://www.oecd.org/sti/inno/38500813.pdf (accessed July 12, 2023).

Ogburn, E. L., O. Sofrygin, I. Díaz, and M. J. van der Laan. 2022. Causal inference for social network data. *Journal of the American Statistical Association* 1-15. https://doi.org/10.1080/01621459.2022.2131557.

Ogburn, E. L., and T. VanderWeele. 2017. Vaccines, contagion, and social networks. *The Annals of Applied Statistics* 11(2):919-948.

Ohm, P. 2023. *The Computer Fraud and Abuse Act after Van Buren*. https://www.acslaw.org/analysis/acs-journal/2020-2021-acs-supreme-court-review/the-computer-fraud-and-abuse-act-after-van-buren (accessed July 12, 2023).

Panova, T., and X. Carbonell. 2018. Is smartphone addiction really an addiction? *Journal of Behavioral Addictions* 7(2):252-259.

Paulich, K. N., J. M. Ross, J. M. Lessem, and J. K. Hewitt. 2021. Screen time and early adolescent mental health, academic, and social outcomes in 9- and 10- year old children: Utilizing the Adolescent Brain Cognitive Development[SM] (ABCD) Study. *PLOS ONE* 16(9):e0256591.

Paulus, M. P., and W. K. Thompson. 2019. The challenges and opportunities of small effects: The new normal in academic psychiatry. *JAMA* 76(April):353-354.

Pearce, N. 2011. Epidemiology in a changing world: Variation, causation and ubiquitous risk factors. *International Journal of Epidemiology* 40(2):503-512.

Pennington, N. 2021. Quitting social media: A qualitative exploration of communication outcomes. *Qualitative Research Reports in Communication* 22(1):30-38.

Roberts, E. 2018. Is web scraping illegal? Depends on what the meaning of the word is. https://www.imperva.com/blog/is-web-scraping-illegal (accessed September 19, 2023).

Rose, T., S. Joe, A. Williams, R. Harris, G. Betz, and S. Stewart-Brown. 2017. Measuring mental wellbeing among adolescents: A systematic review of instruments. *Journal of Child and Family Studies* 26(9):2349-2362.

Schneider, L. A., D. L. King, and P. H. Delfabbro. 2017. Family factors in adolescent problematic internet gaming: A systematic review. *Journal of Behavioral Addictions* 6(3):321-333.

Schwartz, D., H. L. Fritz, A. R. Kelleghan, Y. Ryjova, A. Omary, L. M. Taylor, and T. Luo. 2021. Adolescents who are nonusers of fashionable social networking platforms. *Cyberpsychology: Journal of Psychosocial Research on Cyberspace* 15(3):Article 7.

Shah, S. 2023. *Let's free teens from social media addiction*. https://www.tampabay.com/opinion/2023/06/03/lets-free-teens-social-media-addiction-column (accessed September 19, 2023).

Siebers, T., I. Beyens, J. L. Pouwels, and P. M. Valkenburg. 2022. Social media and distraction: An experience sampling study among adolescents. *Media Psychology* 25(3):343-366.

Slattery, E. J., E. O'Callaghan, P. Ryan, D. G. Fortune, and L. P. McAvinue. 2022. Popular interventions to enhance sustained attention in children and adolescents: A critical systematic review. *Neuroscience & Biobehavioral Reviews* 137:104633.

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Stockdale, L. A., S. M. Coyne, and L. M. Padilla-Walker. 2018. Parent and child technoference and socioemotional behavioral outcomes: A nationally representative study of 10- to 20-year-old adolescents. *Computers in Human Behavior* 88:219-226.

Talbot, C. V., A. Talbot, D. J. Roe, and P. Briggs. 2022. The management of LGBTQ+ identities on social media: A student perspective. *New Media & Society* 24(8):1729-1750.

Trumello, C., L. Vismara, C. Sechi, P. Ricciardi, V. Marino, and A. Babore. 2021. Internet addiction: The role of parental care and mental health in adolescence. *International Journal of Environmental Research and Public Health* 18(24).

Vogus, C. 2022. *Independent researcher access to social media data: Comparing legislative proposals*. Center for Democracy and Technology. https://cdt.org/insights/independent-researcher-access-to-social-media-data-comparing-legislative-proposals (accessed September 19, 2023).

Wade, N. E., J. M. Ortigara, R. M. Sullivan, R. L. Tomko, F. J. Breslin, F. C. Baker, B. F. Fuemmeler, K. Delrahim Howlett, K. M. Lisdahl, A. T. Marshall, M. J. Mason, M. C. Neale, L. M. Squeglia, D. L. Wolff-Hughes, S. F. Tapert, and K. S. Bagot. 2021. Passive sensing of preteens' smartphone use: An Adolescent Brain Cognitive Development (ABCD) cohort substudy. *JMIR Mental Health* 8(10):e29426.

Waters, J. 2021. Constant craving: How digital media turned us all into dopamine addicts. *The Guardian*. https://www.theguardian.com/global/2021/aug/22/how-digital-media-turned-us-all-into-dopamine-addicts-and-what-we-can-do-to-break-the-cycle (accessed September 19, 2023).

White-Gosselin, C.-É., and F. Poulin. 2022. Associations between young adults' social media addiction, relationship quality with parents, and internalizing problems: A path analysis model. *Canadian Journal of Behavioural Science / Revue canadienne des sciences du comportement*. https://doi.org/10.1037/cbs0000326.

Wiggers, K. 2023. *Reddit will begin charging for access to its API*. https://techcrunch.com/2023/04/18/reddit-will-begin-charging-for-access-to-its-ap/ (accessed July 12, 2023).

Zurcher, J. D., H. G. Holmgren, S. M. Coyne, C. P. Barlett, and C. Yang. 2018. Parenting and cyberbullying across adolescence. *Cyberpsychology, Behavior, and Social Networking* 21(5):294-303.

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Appendix A

Committee Member Biosketches

Sandro Galea, Dr.PH., M.D., M.P.H. (*Chair*), a physician, epidemiologist, and author, is dean and Robert A. Knox Professor at Boston University School of Public Health. One of the most widely cited scholars in the social sciences, Dr. Galea has published more than 1,000 scientific journal articles, 75 chapters, and 20 books. He has published extensively in the peer-reviewed literature about the social causes of health, mental health, and trauma. He has documented the consequences of mass trauma and conflict worldwide, including as a result of the September 11 attacks, Hurricane Katrina, conflicts in sub-Saharan Africa, and the American wars in Iraq and Afghanistan. His research has been principally funded by the National Institutes of Health, Centers for Disease Control and Prevention, and philanthropic foundations.

Dr. Galea serves frequently on advisory groups to national and global organizations. He currently serves as the chair of the board of the Boston Board of Health, and of John Snow Inc., a global public health consultancy, as well as chair of the Boston Public Health Commission Board of Health. He formerly served as chair of the New York City Department of Health and Mental Hygiene's Community Services Board and as a member of its Health Board. He is past chair of the board of the Association of Schools and Programs of Public Health and past president of the Society for Epidemiologic Research and of the Interdisciplinary Association for Population Health Science. He is an elected member of the National Academy of Medicine. Galea has received several lifetime achievement awards for his research, including the Rema Lapouse Award from the American

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Public Health Association and the Robert S. Laufer, Ph.D., Memorial Award from the International Society for Traumatic Stress Studies. He is a regular contributor to a range of public media.

Galea was born in Malta and emigrated to Canada with his family at the age of 14. After receiving his medical degree, Galea worked in Somalia with Doctors Without Borders before attending graduate school in the United States. Galea holds a medical degree from the University of Toronto, graduate degrees from Harvard University and Columbia University, and an honorary doctorate from the University of Glasgow. Prior to his appointment at Boston University, Galea served as the Gelman Professor and chair of the Department of Epidemiology at the Columbia University Mailman School of Public Health. He previously held academic and leadership positions at the University of Michigan and at the New York Academy of Medicine.

Ceren Budak, Ph.D., is an associate professor at the School of Information, an associate professor of electrical engineering and computer science and a faculty associate at the Center for Political Studies at the University of Michigan. Her research interests lie in the area of computational social science. She uses network science, machine learning, and crowdsourcing methods and draws from scientific knowledge across multiple social science communities to contribute computational methods to the field of political communication.

Her work appears in conferences and journals that span disciplines such as computer science, communication, and political science; she recently coauthored *Words that Matter: How the News and Social Media Shaped the 2016 Presidential Campaign* (Brookings Institution Press, 2020). She served as an editor-in-chief and a program chair for the International AAAI Conference on Web and Social Media (ICWSM). Her work is supported by the National Science Foundation (through NSF: CAREER, NSF: CISE, and NSF: GCR awards), the Social Science Research Council, and the Michigan Institute for Data Science.

Munmun De Choudhury, Ph.D., is an associate professor of interactive computing at Georgia Tech. Dr. De Choudhury is best known for laying the foundation of a new line of research that develops computational techniques toward understanding and improving mental health outcomes, through ethical analysis of social media data. To do this work, she adopts a highly interdisciplinary approach, combining social computing, machine learning, and natural language analysis with insights and theories from the social, behavioral, and health sciences. Dr. De Choudhury has been recognized with the 2023 SIGCHI Societal Impact Award, the 2022 Web Science Trust Test-of-Time Award, the 2021 ACM-W Rising Star Award,

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the 2019 Complex Systems Society—Junior Scientific Award, numerous best paper and honorable mention awards from the ACM and AAAI, and features and coverage in popular press like the *New York Times*, the NPR, and the BBC. Earlier, Dr. De Choudhury was a faculty associate with the Berkman Klein Center for Internet and Society at Harvard, a postdoc at Microsoft Research, and obtained her PhD in computer science from Arizona State University. She founded and directs the Social Dynamics and Well-Being Lab at Georgia Tech, which previously received funding from Instagram and Yahoo. In the past, she has attended meetings at Google, Meta, and Twitter for which the companies paid travel expenses. More than 5 years ago her lab had funding from Instagram and Yahoo. A grant from Microsoft currently funds a research project at her lab using artificial intelligence to match volunteers and callers to a crisis phone line.

Douglas Gentile, Ph.D., M.A., is an award-winning research scientist, educator, author, and a distinguished professor of psychology at Iowa State University. His experience includes more than 30 years conducting research with children and adults. He is the editor of the book *Media Violence and Children* (two editions), and co-author of the books *Violent Video Game Effects on Children and Adolescents: Theory, Research, and Public Policy, Game On! Sensible Answers about Video Games and Media Violence, Learning from Video Games (and Everything Else)*, and *Finding the Freedom to Get Unstuck and Be Happier*. He has authored over 150 peer-reviewed scientific journal articles, including studies on the positive and negative effects of mass media on children in several countries, video game addiction, and mindfulness practices for reducing anxiety and increasing happiness.

He is a fellow of the American Psychological Association, the Association for Psychological Science, the Society for the Psychological Study of Social Issues, and the Society for Personality and Social Psychology. He was honored with the Distinguished Lifetime Contributions Award to Media Psychology and Technology by the American Psychological Association, and he was named one of the Top 300 Professors in the United States by the Princeton Review. Dr. Gentile runs the Media Research Lab at Iowa State University where he conducts research on media's impact on children and adults. As the leader of this effort, Dr. Gentile develops and conducts research projects designed to give parents and other caregivers the kind of information they need and want to make informed media choices for their children. His research has been supported by several grants, including grants from the National Institute of Child Health and Human Development, and the Centers for Disease Control and Prevention.

Dr. Gentile speaks internationally to community, education, health care, and parent groups. Praised as an engaging and energetic speaker,

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he speaks about issues such as the connection between media and brain development, the effects of television and video game violence, the effects of tobacco and alcohol advertising on adolescents, and the psychology of advertising. Dr. Gentile has consulted in the past with DQ Institute and Partnership for a Healthy Iowa; he serves on the advisory board for the Partnership for a Healthy Iowa. He has formerly served on advisory committees for the World Health Organization, the *Diagnostic and Statistical Manual of Mental Disorders*, Screen Time Network, and Fair Play for Kids' Screen Time Action Network.

Amanda Guyer, Ph.D., M.Phil., M.S., is a developmental psychologist and professor in the Human Development and Family Studies unit of the Department of Human Ecology at the University of California, Davis. She is also the associate director of the Center for Mind and Brain and is affiliated with the Center for Poverty and Inequality Research. She is a fellow of the Association for Psychological Science and an associate editor for *Developmental Psychology and Emotion*. Dr. Guyer has expertise in the biological, cognitive and social-emotional aspects of human development during adolescence—notably, the behavioral and neural mechanisms that may underlie the way that adolescents think and feel. She investigates neural and behavioral underpinnings of adolescent mental health (e.g., depression, anxiety, substance use) via social, emotional, and cognitive processes. She has identified behavioral responses and neural activity and brain networks involved when children and adolescents attend to, evaluate, and remember facial emotions, social threats, peer evaluation, and rewards. She considers age, temperament, and sex differences in these processes, and variability related to adverse and stressful life events, and peer and family factors. She has articulated new conceptual models of neurobiological sensitivity to social context and environmental stressors to enhance understanding of child and adolescent mental health. Her work has been supported by the National Institutes of Health, the National Science Foundation, Brain and Behavior Research Foundation, and William T. Grant Foundation Scholars Program.

Jeff Hancock, Ph.D., M.Sc., is the Harry and Norman Chandler Professor of Communication at Stanford University and founding director of the Stanford Social Media Lab. A leading expert in social media behavior and the psychology of online interaction, Dr. Hancock studies the impact of social media and AI technology on social cognition, well-being, deception and trust, and how we use and understand language. His award-winning research has been published in over 100 journal articles and conference proceedings and has been supported by funding from the National Science Foundation and the Department of Defense. Dr. Hancock's TED Talk

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on deception has been seen over 1 million times and his research has been frequently featured in the popular press, including the *New York Times*, CNN, NPR, CBS, and the BBC.

Julianne Holt-Lunstad, Ph.D., conducts research focused on understanding the long-term health effects, biological mechanisms, and effective strategies to mitigate risk and promote protection associated with social connection. Her work has been seminal in the recognition of social isolation and loneliness as risk factors for early mortality. She serves as a scientific advisor and regularly consults for organizations across sectors aimed at addressing this issue. She has provided expert testimony in a U.S. congressional hearing, served as a member of a National Academy of Sciences consensus committee, scientific advisory for the U.S. Surgeon General, the UK Cross Departmental Loneliness Team, European Joint Research Council, World Health Organization, and a subject matter expert for the Gravity Project and Commit to Connect, the national clearinghouse of interventions. She served as the lead scientific editor on the *Our Epidemic of Loneliness and Isolation: The U.S. Surgeon General's Advisory on the Healing Effects of Social Connection and Community*. She has also provided uncompensated input on the Gallup/Meta survey of social connectedness. Her work has been widely recognized within her discipline, including several awards, and is regularly highlighted in major media outlets.

Stephanie Reich, Ph.D., is professor of education at the University of California, Irvine, with appointments in informatics and psychological science. She is director of the Development in Social Context lab and member of the Connected Learning Lab. Dr. Reich's research focuses on understanding and improving the social context of children's lives. As such, her empirical investigations center on direct, indirect, and reciprocal influences on children, specifically through the family, digital, and school environments. Her work spans from infancy through college, with particular focus on individual, familial, and community assets. As such, her research is often in partnership with schools, medical settings, and nonprofit organizations. She is a fellow of the American Psychological Association and Society for Community Research and Action. She is recipient of the Distinguished Early Career Applied Contributions to Media Psychology and the Technology Award from the American Psychological Association. She serves on the advisory boards of Raising Good Gamers, Future of Childhood, and Next Gen Public Media (By/With/For Tweens and Teens). Having earned her Ph.D. in psychology and human development with a focus on community psychology and program evaluation, her work is largely applied and in collaboration with other disciplines and community members.

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Miguel Sarzosa, Ph.D., is an assistant professor of economics at Purdue University. He received his Ph.D. in 2015 from the University of Maryland, College Park. Dr. Sarzosa's research fields are applied microeconomics and labor economics. He focuses on understanding the impact various contexts have on the accumulation of skills in infants, children, and adolescents, and how these skills can affect their outcomes later in life. Dr. Sarzosa examines factors such as prenatal health, grade retention, in-classroom social interactions, teacher quality, gender norms, and discrimination. He investigates how children learn, how resource scarcity and peer interactions can affect learning, and how learning differentials affect success in adulthood. His work emphasizes socio-emotional skills (also known as noncognitive, or soft, skills) as essential components of the learning process and critical drivers of social interactions and adult outcomes.

Leslie Walker-Harding, M.D., is the Ford/Morgan Endowed Professor and chair of the Department of Pediatrics as well as associate dean for the University of Washington. She is also the chief academic officer and senior vice president for Seattle Children's Hospital. She has been dedicated to the health and well-being of children and adolescents for more than 25 years, particularly in the area of prevention of adolescent substance use and promotion of healthy adolescent development. Her current focus is to raise awareness of, and bring to national scale, proven interventions to prevent the development of substance use and mental health conditions in children and adolescents. In this effort she is cochair of the Forum for Children's Well-Being: Promoting Cognitive, Affective, and Behavioral Health for Children and Youth in the National Academies of Sciences, Engineering, and Medicine.

Christopher Yoo, J.D., M.B.A., is the John H. Chestnut Professor of Law, Communication, and Computer & Information Science at the University of Pennsylvania. He is also founding director of the Center for Technology, Innovation & Competition, an independent research center that receives unrestricted funding from a variety of organizations, including internet- and broadband-based companies. Mr. Yoo has emerged as one of the world's leading authorities on law and technology. One of the most cited scholars in administrative and regulatory law as well as intellectual property, he has authored or edited five books and more than 100 scholarly works. In the past, he had research support from Google.

His major research projects include investigating innovative ways to connect more people to the internet; comparing and examining proposals to apply antitrust law in China, Europe, and the United States; law to big tech firms; analyzing the technical determinants of optimal interoper-

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ability; promoting privacy and security for autonomous vehicles; medical devices; cyber-physical systems and the internet's routing architecture; and studying the regulation of internet platforms. He has also created innovative joint degree programs designed to produce a new generation of professionals with advanced training in both law and engineering. He is frequently called to testify before the U.S. Congress, Federal Communications Commission, Federal Trade Commission, Antitrust Division of the U.S. Department of Justice, foreign governments, and international organizations. He recently served as an expert witness in litigation involving internet service providers. He has served as a member of the Federal Communication Commission's Broadband Deployment Advisory Committee, the Board of Advisors for the American Law Institute's Project on Principles of Law for Data Privacy and the Restatement of Principles for a Data Economy, and as co-convener of the United Nations Internet Governance Forum's Initiative on Connecting and Enabling the Next Billions. Before entering academia, he served as a law clerk to Justice Anthony M. Kennedy of the Supreme Court of the United States and Judge A. Raymond Randolph of the U.S. Court of Appeals for the DC Circuit.

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Appendix B

Open Session Meeting Agendas

Committee on the Impact of Social Media on the Health Effects of Adolescents and Children

JANUARY 5, 2023

3:00[1]	Welcome **Sandro Galea,** *Committee Chair*
3:00–4:00	Sponsor Presentation of Charge **Gus Rossi,** *Director, Responsible Tech,* The Omidyar Network **Laura Quinn,** *Advisor,* Reset Tech, Luminate **Laurie Moskowitz,** *Advisor,* Reset Tech, Luminate
4:00	Adjourn

JANUARY 6, 2023

12:00–12:05	Welcome **Sandro Galea,** *Committee Chair*

[1] All schedules listed in Eastern Time.

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12:05–12:30 Opening Comments
Frances Haugen, *Cofounder,* Beyond the Screen

12:30–12:50 American Academy of Pediatrics Position on Media and Children
Megan Moreno, *Professor, Vice Chair of Academic Affairs, Division of General Pediatrics & Adolescent Medicine,* University of Wisconsin School of Medicine and Public Health

12:50–1:10 Adolescent Mental Health and Digital Technology
Candice Odgers, *Associate Dean for Research and Professor of Psychological Science and Informatics,* School of Social Ecology, University of California, Irvine

1:10–1:30 The Role of Digital Technology in Shaping Attention and Cognitive Development
Francesca Borgonovi, *Head of Skills Analysis,* OECD Skills Center, Organization for Economic Cooperation and Development; *British Academy Global Professor,* Department of Social Science, Institute of Education, University College London

1:30–1:50 Beyond Platform Features and Individual Traits—How Culture, Activity, and Inequality Determine Risks and Benefits
Mimi Ito, *Professor in Residence and Director of the Connected Learning Lab,* University of California, Irvine

1:50–2:20 Question and Answer Session with Presenters
Miguel Sarzosa, *Moderator*

2:20–2:35 Break

2:35–4:00 Panel Discussion on Harms and Benefits to Youth
Jean Twenge, *Professor, Department of Psychology,* San Diego State University
Jonathan Haidt, *Thomas Cooley Professor of Ethical Leadership,* Stern School of Business, New York University
Monica R. Anderson, *Associate Director,* Pew Research Center
Marie Bragg, *Assistant Professor, Department of Population Health,* NYU Grossman School of Medicine; *Assistant*

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Professor, Marketing Department, NYU Stern School of Business
Jeff Hancock, *Moderator*

4:00 Adjourn

JANUARY 9, 2023

1:00–1:05 Welcome
Sandro Galea, *Committee Chair*

1:05– 1:30 How to Move Social Media Research Beyond "It's Complicated"
Amy Orben, *Programme Leader Track Scientist,* MRC Cognition and Brain Sciences Unit, University of Cambridge

1:30–1:55 Who Is Most at Risk and Who Is Most Likely to Benefit from Using Social Media Long Term? A Differential Susceptibility Approach
Sarah Coyne, *Professor,* School of Family Life, Brigham Young University

1:55–2:20 What Can Be Learned from Randomized Designs?
Matthew Gentzkow, *Landau Professor of Technology and the Economy,* Stanford University

2:20–2:55 Why Are Findings Inconsistent?
Margarita Panayiotou, *Lecturer in Education Psychology,* Manchester Institute of Education, University of Manchester

2:45–3:30 Question and Answer Session with Presenters
Douglas Gentile, *Moderator*

3:30 Break

3:45–4:45 Panel Discussion on Physical Health and Digital Media
Lauren Hale, *Professor of Family, Population and Preventive Medicine,* Program in Public Health, Renaissance School of Medicine at Stony Brook University

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Jonathan S. Hausmann, *Assistant Professor of Medicine,* Harvard Medical School
Amanda E. Staiano, *Associate Professor, Pediatric Obesity and Health Behavior Lab,* Pennington Biomedical Research Center, Louisiana State University
Leslie Walker-Harding, *Moderator*

5:00 Adjourn

FEBRUARY 6, 2023

1:00 Welcome
Sandro Galea, *Committee Chair*

1:05–1:30 Ethics of the Attention Economy
James Williams, *Author and Technology Ethicist*

1:30–1:55 Algorithms Affect People and Society
Piotr Sapiezynski, *Associate Research Scientist,* Khoury College of Computer Sciences, Northeastern University

1:55–2:20 Challenges of Algorithmic Auditing
Aleksandra Korolova, *Assistant Professor of Computer Science and Public Affairs,* Center for Information Technology Policy, Princeton University

2:20–2:50 Question and Answer Session with Presenters
Sandro Galea, Moderator

2:50–3:05 Break

3:05–4:05 Panel Discussion on Advertising Transparency
Damon McCoy, *Associate Professor, Computer Science and Engineering,* Tandon School of Engineering, New York University
Jenny Radesky, *Associate Professor of Pediatrics,* University of Michigan Medical School
Ari E. Waldman, *Professor of Law and Computer Science,* Northeastern University; *Faculty Director,* Center for Law, Information, and Creativity
Juliane Holt-Lunstad, *Moderator*

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4:05–4:40	Closing Comments **Mitchell Baker,** *Executive Chair and CEO,* Mozilla Foundation and Mozilla Corporation
4:40	Adjourn

FEBRUARY 7, 2023

1:00	Welcome **Sandro Galea,** *Committee Chair*
1:05–1:30	FTC Law Enforcement and Youth Mental Health Online **Alvaro Bedoya,** *Commissioner,* Federal Trade Commission
1:30–1:55	Children's Rights in the Digital Age **Sonia Livingstone,** *Professor, Department of Media and Communications,* London School of Economics and Political Science
1:55–2:20	Age-Appropriate Design Code **Katina Michael,** *Professor,* School for the Future of Innovation in Society, School of Computing, Informatics & Decision Science Engineering; *Director,* Center for Engineering, Policy & Society; *Professor,* School of Computing and Information Technology, University of Wollongong
2:20–2:45	The Children's Online Privacy Protection Act **Kathryn C. Montgomery,** *Research Director and Senior Strategist,* Center for Digital Democracy; *Professor Emerita,* American University
2:45–3:10	Virtual Reality and Children's Privacy **Girard Kelly,** *Senior Counsel and Director, Privacy Program,* Common Sense Media
3:10–3:40	Question and Answer Session with the Presenters **Amanda Guyer,** Moderator
3:40–3:45	Break

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3:45–5:00	Panel Discussion on Data Collection and Privacy **Joe Turow,** *Robert Lewis Shayon Professor of Media Systems and Industries,* Annenberg School for Communication, University of Pennsylvania **Sun Joo Grace Ahn,** *Director of the GAVEL Lab, Associate Professor, Advertising,* Grady College of Journalism and Mass Communication, University of Georgia **Emily Cherkin,** *Cochair Screens in Schools Work Group,* Fair Play for Kids Action Network; *Member,* Fairplay Screens in Schools **Hector Balderas,** *President,* Northern New Mexico College **Stephanie Reich,** *Moderator*
5:00	Adjourn

FEBRUARY 10, 2023

1:00	Welcome **Sandro Galea,** *Committee Chair*
1:05–1:30	Platform Accountability **Dhiraj Murthy,** *Professor,* School of Journalism and Department of Sociology, University of Texas at Austin
1:30–1:55	An Archive for Platform Moderation Decisions **Jonathan Zittrain,** *Director and Faculty Chair,* Berkman Klein Center for Internet & Society at Harvard University
1:55–2:20	Social Media Platforms' Efforts at Addressing Cyberbullying Among Children **Tijana Milosevic,** *Research Fellow,* Anti-Bullying Centre and ADAP SFI, Dublin City University
2:20–2:45	The Challenges of Content Moderation: The Example of Anonymous Apps **Ysabel Gerrard,** *Senior Lecturer (Associate Professor) in Digital Communication,* Department of Sociological Studies, University of Sheffield
2:45–3:10	Content Moderation and Section 230 **Tom Romanoff,** *Director of Technology Project,* Bipartisan Policy Center

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3:10–3:45	Question and Answer Session with the Presenters **Christopher Yoo,** *Moderator*
3:45	Break
4:00–5:00	Panel Discussion on Content Moderation **Brittan Heller,** *Senior Fellow,* Atlantic Council; *Affiliate,* Stanford Cyber Policy Center **Evelyn Douek,** *Assistant Professor of Law,* Stanford Law School, *Senior Research Fellow,* Knight First Amendment Institute, Columbia University **Amy Hasinoff,** *Associate Professor, Director of Graduate Studies,* Department of Communication, University of Colorado Denver **Munmun De Choudhury,** *Moderator*
5:00	Adjourn

APRIL 7, 2023

9:00	Welcome **Sandro Galea,** *Committee Chair*
9:05	Regulatory Strategies and Design **Josh Golin,** *Executive Director,* Fairplay
9:35	The Adolescent Brain and Cognitive Development Study **Terry Jernigan,** *Distinguished Professor of Cognitive Science, Psychiatry, and Radiology and Director,* Center for Human Development, UC San Diego
10:05	Trade-Offs Between Content Moderation and User Privacy **Mike Pappas,** *CEO and Cofounder,* Modulate.ai
10:35	Interpreting Effect Sizes in Psychology **David S. Yeager,** *Associate Professor,* Department of Psychology, University of Texas at Austin (via videoconferencing)
11:05	3D Social Networking and Well-Being **Jeremy Bailenson,** *Professor, Communication,* Stanford Graduate School of Education (via video conferencing)

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11:35	Question and Answer Session with Presenters **Sandro Galea,** *Committee Chair*
12:00	Adjourn Open Session

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Appendix C

Table of Recent Systematic Reviews and Meta-Analyses on the Association Between Social Media and Adolescent Health

Committee and staff conducted three literature searches between January and June 2023, adjusting search terms each time with input from the committee. The terms aimed to find literature reviews, systematic reviews, and meta-analyses with a focus on the health effects of social media exposure on adolescent health that had been published since 2018. In addition, the committee and staff conducted hand searches for relevant landmark reviews or meta-analyses, some of which predate 2018. The results in the table below are not comprehensive but do convey some of the more notable results from the current literature available on the topic.

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TABLE C-1 Select Recent Systematic Reviews and Meta-Analyses on Social Media Exposure and Adolescent Health Outcomes

Reference	Time Period of Review	Number of Studies	Study Designs Included	Populations Included (if specified)	Exposure(s) Included	Study Outcome(s)	Results
Alimoradi et al., 2019	2007–2018	n = 23 studies	Cohort, case-control, cross-sectional	Any age, assessed for internet addiction	Internet addiction	Sleep disturbances (presence of sleep problems and sleep duration)	Internet addiction is associated with sleep problems across all 23 studies, but the relationship may be influenced by the tool used to evaluate sleep problems. Children, teenagers, and young adults appear most susceptible to internet addiction as they are still developing. No evidence of publication bias.
Alonzo et al., 2021	January 1990 to November 2019 AND forward and backward citation tracing until April 2020	n = 42 studies	Prospective cohort Cross sectional	Population of interest: ages 16–25 years Studies included: ages 12–30 years	Active social media use	Sleep quality and mental health outcomes	Longitudinal research suggests that sleep problems (sleep disruption and poor quality sleep) may at least partially explain the relationship between excessive social media use and mental health problems. Cross-sectional research is less conclusive. Social media use can contribute to mental health problems both directly and indirectly through sleep disturbance. No discussion of publication bias.

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Appel et al., 2020	Not specified	Well-being n = 4 Academic performance n = 3 Narcissism n = 3	Meta-analyses	General, students when relevant to question	Social networking site use	General well-being, academic performance, and narcissism	There is no strong linear association between social networking use and loneliness, self-esteem, life satisfaction, or self-reported depression. Social networking sites may provide a venue to create social capital and relationships—both close and shallow, but there is no strong evidence that social networking promotes well-being. There is no evidence of a pronounced effect of social networking use on academic performance. There is evidence of small to moderate associations between social networking site use and narcissism. Tests for publication bias not applicable, but topic discussed.

(*continued*)

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TABLE C-1 Continued

Reference	Time Period of Review	Number of Studies	Study Designs Included	Populations Included (if specified)	Exposure(s) Included	Study Outcome(s)	Results
Berger et al., 2022	January 2012 to March 2021	n = 26 studies	Cohort or cross-sectional; qualitative, quantitative, or mixed methods	LGBTQ youths and adolescents (10–24 years)	Use of social media	Mental health outcomes	The quality of the research is limited, and causation cannot be inferred. Overall, there are both positive and negative aspects for social media use for LGBTQ young people. There is evidence of social media being beneficial for social connection and exploration of identity. Social media is associated with decreased symptoms of mental illness among LGBTQ young people, including decreased feelings of isolation and increased well-being. Heavy social media use can be associated with feelings of loneliness and sensitivity among LGBTQ young people. No discussion of publication bias.
Brautsch et al., 2023	January 2010 to April 2021	n = 42 studies	Cross sectional Longitudinal	16–25 years	Digital media use	Sleep outcomes	There is an association between general screen use and poor sleep quality and reduced duration of sleep; there is an association between use of social media, mobile phone, computer, and the internet and poor sleep quality and reduced duration of sleep.

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							Most studies found an association between digital media use at night or before bed and poor sleep. No discussion of publication bias.
Cataldo et al., 2021	2006 to July 31, 2020	n = 44 studies	Studies assessing mental health and psychological disorders	10–19 years with a profile on a popular social media site	Assessment of psychiatric disorders in developmental ages	Level of psychological well-being or diagnosis of psychiatric disorder	Some evidence of positive associations between having a social media profile and various mental health problems. No discussion of publication bias.

(*continued*)

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TABLE C-1 Continued

Reference	Time Period of Review	Number of Studies	Study Designs Included	Populations Included (if specified)	Exposure(s) Included	Study Outcome(s)	Results
Cunningham et al., 2021	2012–2018	n = 62 studies	Any quantitative studies	Interest in children and adolescents but included studies that had adult-only populations	Social media or social networking site use (examines time spent using social networking sites, intensity of use, and problematic use as three distinct constructs)	Depression or depressive symptoms	There is a weak association between time spent using social networking sites and depressive symptoms. Evidence of publication bias toward reporting higher effect sizes, effect size adjusted. There is a weak association between intensity of social networking site use and depressive symptoms. No evidence of publication bias. There is a moderate association between problematic use of social networking and depressive symptoms. This effect was not moderated by participants age or gender, by year of study, or by method of recruitment. No evidence of publication bias.

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Keles et al., 2020	2011–2018	n = 13 studies	Cross-sectional (12) Longitudinal (1)	Ages 13–18 years	Measurement of social media use	Depression, anxiety, or psychological distress assessed by validated instruments	Time spent on social media; activity on social media; investment in the experience; and addiction were all correlated with depression, anxiety, and psychological distress. The direction of this relationship is not clear. Causality was unclear owing to the cross-sectional study designs and lack of comparator group. No discussion of publication bias.
Kuss et al., 2021	April 2013 to September 2019	n = 64 studies	Cross-sectional studies with quantitative, qualitative, and mixed methods	Not specified, most samples primarily adolescent or young adult	Internet and internet gaming use Online gambling Online pornography use Social media use	Internet and internet gaming addiction Online gambling addiction Online pornography addiction Social media addiction	Estimates of the prevalence of internet addiction range from 12.6% to more than two-thirds. Risk factors for internet addiction include: psychological distress, mood disorders, suicidality, impulsivity, aggression, and sleep problems. Therapy may be effective at combating internet addiction. No discussion of publication bias.

(*continued*)

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TABLE C-1 Continued

Reference	Time Period of Review	Number of Studies	Study Designs Included	Populations Included (if specified)	Exposure(s) Included	Study Outcome(s)	Results
Liu et al., 2016		n = 58 studies	Empirical studies that used a Pearson correlation (r) or sufficient information from which an effect size for the association between social networking site use and social capital could be derived	Not specified in search	Social networking site use	Bonding and/or bridging of social capital	There is a moderate positive association between use of social networking sites and measures of bridging social capital. No evidence of publication bias. There is small positive association between use of social networking sites and bonding social capital. Mixed evidence of publication bias; effect size was adjusted accordingly. Social networking sites are useful to help people build social capital, but more so with bridging than bonding social capital.

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Lozano-Blasco et al., 2022	2017–2020	n = 20 studies k = 28 samples	Experimental and quantitative studies reporting standardized psychometric evaluations	Adolescents	n/a	Prevalence of internet addiction	Heterogeneity of results is high. Internet addiction or problematic use is comorbid with many other problems including obesity, anxiety, depression, stress, and internalizing disorders. There are personality factors that can predispose young people to internet addiction including: "introversion, inhibition, submissiveness, self-evaluation, obsessive-compulsive tendencies, phobic anxiety, hostility, paranoia, borderline personality, hostility, and low self-esteem." Environmental factors such as family dysfunction, bad family communication, and boredom are associated with risk of addiction to technologies. A good relationship with teachers, positive feelings about one's school, academic success, and physical activity are protective against internet addiction. Age explains 24% of the variance in internet addiction; gender does not explain the variance in prevalence of internet addiction.

(*continued*)

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TABLE C-1 Continued

Reference	Time Period of Review	Number of Studies	Study Designs Included	Populations Included (if specified)	Exposure(s) Included	Study Outcome(s)	Results
							Some studies suggest that internet addiction is the effect of other psychopathologies, not a cause of them. No evidence of publication bias.
Mackenzie et al., 2022	Inception until November 26, 2020	n = 14	Studies with a qualitative component with verbatim quotes linking sleep and social media	Studies with at least 80% participants ages 10–24 years	Use of social media, social networks, Twitter, Facebook, smartphones, and screentime	Perceived impact of social media use at bedtime on sleep	Themes of a social motivation for using social media at bedtime, habitual smartphone use, and recognition of the use as a problem emerged from qualitative studies. Tests for publication bias not applicable.
McComb et al., 2023	September 2006 to September 2021	n = 48 studies	Experimental designs with random assignment and a control condition, social comparison through social media was key exposure	General, clinical populations excluded	Upward comparison on any social media platform	Subjective well-being, body image, mental health, and self-esteem	There is a small negative effect of upward social comparison on social media and users' self-evaluation and emotions. There is a small negative effect of upward social comparison on body image, well-being, mental health, and self-esteem. Effects do not vary by age or gender. Mixed evidence of publication bias, effect size adjusted accordingly

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McCrae et al., 2017	No time period applied to search	n = 11 studies	Cross-sectional, longitudinal	Ages 5–18 years	Social media (defined by authors as websites used primarily for social interaction, e.g., Facebook, WhatsApp, Instagram)	Depression or depressive symptoms	Authors found small correlation between social media use and depressive symptoms in children and adolescents. Mixed evidence of publication bias which reduced estimate of random effects.
Meier and Reinecke, 2021	2010 to 2019	n = 34 reviews	Systematic reviews and meta-analyses	General, some children and adolescent, some older adults	Computer-mediated communication: social media use, social networking, internet use, mobile phone use	Various mental health outcomes	Reviews suggest a very small negative association between social networking and mental health, even this depends largely on choice of mental health indicators; for applications other than social networking, evidence shows little to no association with mental health outcomes. Tests for publication bias not applicable to study design. However the meta-analyses included in the meta-review overall found little evidence of publication bias.

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TABLE C-1 Continued

Reference	Time Period of Review	Number of Studies	Study Designs Included	Populations Included (if specified)	Exposure(s) Included	Study Outcome(s)	Results
Memon et al., 2018	No time limit	n = 9 studies	Observational and interventional studies	Ages 13–17 years	Use of social networking sites such as Facebook, Instagram, and Snapchat	Deliberate self-harm or suicidality	More time spent on social media is associated with greater self-harming behavior; social media is also an important medium for suicidal youth to seek help. No discussion of publication bias.
Sedgwick et al., 2019	Database inception through January 25, 2019	n = 9 studies	Cross-sectional	Ages 11–18 years	Social networking site usage, problematic internet use, pathological internet use, or hours of noneducational internet use	Suicide attempts	Heterogeneity of exposures and outcomes prevented the combining of results in a meta-analysis, but data suggest problematic use of social media or the internet are associated with suicide risk; the direction of the potential association is not clear. No discussion of publication bias.
Shannon et al., 2022	January 2017 to April 2021	n = 18 studies	Cross-sectional	Ages 12–30 years	Problematic social media use	Depressive symptoms, anxiety symptoms, and stress measured using validated instruments	There is evidence of a moderate correlation between problematic social media use and depression, anxiety, and stress. No evidence of publication bias on anxiety and stress outcomes, mixed evidence on depressive outcomes.

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Sina et al., 2022	2008 to 2021	n = 35 studies	Randomized, controlled trials, cross-sectional and longitudinal studies	Ages 2–18 years	Social media exposure	Dietary behaviors	There is an association between social media exposure and unhealthy diet in children and adolescents. There was no relationship between exposure to social media and nutrition knowledge. Prolonged smartphone use is associated with unhealthy eating behaviors. No discussion of publication bias.
Sohn et al., 2019	January 1, 2011 to October 15, 2017	n = 41	Cohort (3) Cross-sectional (38)	Eligibility criteria included studies of mobile device exposure focusing on children and young people (with a mean population age of no greater than 25)	Problematic smartphone use	Prevalence of mental health issues, including depression, anxiety, stress, and sleep quality	Of the 41 studies included 22 were of poor methodological quality, 19 of moderate quality. Estimates of the prevalence of problematic smartphone use among children and adolescents was 23.3% (confidence interval 14.0 to 31.2%). No discussion of publication bias.

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TABLE C-1 Continued

Reference	Time Period of Review	Number of Studies	Study Designs Included	Populations Included (if specified)	Exposure(s) Included	Study Outcome(s)	Results
Stevens et al., 2021	2010–2019	n = 53	Studies reporting prevalence of internet gaming disorder or gaming disorder	Age not specified but majority of studies that provided the information had adolescent-only samples	n/a	Global prevalence of gaming disorder	Meta-analysis suggests a prevalence of gaming disorder between 3.05% (confidence interval: 2.38, 3.91 percent), but this figure was adjusted to 1.96% (confidence interval 0.19, 17.12% when considering only studies of higher methodological rigor. Choice of screening tool accounted for more than three-quarters of the variance in these results. Males outnumber females by 2.5 to 1 in prevalence of gaming disorder. The global burden of gaming disorder is comparable to obsessive-compulsive disorder and some substance-use disorders. No evidence of publication bias.

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Tang et al., 2021	2005 through August 2020	n = 35 studies	Longitudinal only	Young people (ages 10–24 years)	Any type of screen time: television or video viewing time, computer/ internet use, mobile phone use, social media use, and videogame use	Mental health outcomes: depression, anxiety, emotional problems, internalizing problems, etc.	"Some evidence to suggest a very small to small positive association between screen time and subsequent depressive symptoms"; relatively few studies find evidence of association between depressive symptoms and subsequent screen time. "Limited evidence of an association between television or videogames and subsequent depression"; "relatively stronger evidence of associations between mobile phone, computer, or internet use and subsequent depression. Evidence of the association between social media use and subsequent depression is mixed."
							No discussion of publication bias.
Valkenburg et al., 2022	2019 to mid-2021	n = 25	Systematic reviews, narrative reviews, and meta-analyses	Focused on adolescents	Active, passive, private, and public social media use, including social networking sites, Facebook	Mental health outcomes	Meta-analyses suggest weak association between social media use and higher ill-being and weak associations between social media use and levels of well-being, with considerable variability in the associations. Systematic and narrative reviews find small effects and inconsistent findings leaving more room from varying interpretations.
							Test for publication bias not applicable.

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TABLE C-1 Continued

Reference	Time Period of Review	Number of Studies	Study Designs Included	Populations Included (if specified)	Exposure(s) Included	Study Outcome(s)	Results
Yin et al., 2019	2005–2016	n = 63 studies	Any quantitative study reporting a correlation or effect size	General population	Social networking site use excluding addictive or problematic behavior	Well-being, life satisfaction, depression, loneliness, anxiety, positive affect, negative affect	Use of social networking sites has small associations with both positive and negative indicators of mental health. These small effects appeared influenced by how social networking is measured, gender, and cultural background. No evidence of publication bias.
Yoon et al., 2019	Before February 2018	Time on social networking n = 33 Frequency of checking social networking n = 12 Social comparison n = 5	Observational studies assessing depression by self-report or clinical interview	General population, including some specific to undergraduates	Time spent on social networking sites, frequency of checking sites, social comparisons	Depression	There is a small, positive correlation between frequency of checking social networking sites and time spent on sites and depressive symptoms, and this effect was not dependent on gender or age. No evidence of publication bias. There is a small-to-medium correlation between depressive symptoms and social comparisons on social networking sites. No evidence of publication bias.

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Vogel et al. (2014)	Meta-analysis	There is a medium correlation between depressive symptoms and upward social comparison. Social comparison, both general and upward, is more correlated with depressive symptoms than social networking usage is.
Wolniewicz et al. (2018)	Meta-analysis	No evidence of publication bias.

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REFERENCES

Alimoradi, Z., C.-Y. Lin, A. Broström, P. H. Bülow, Z. Bajalan, M. D. Griffiths, M. M. Ohayon, and A. H. Pakpour. 2019. Internet addiction and sleep problems: A systematic review and meta-analysis. *Sleep Medicine Reviews* 47:51-61.

Alonzo, R., J. Hussain, S. Stranges, and K. K. Anderson. 2021. Interplay between social media use, sleep quality, and mental health in youth: A systematic review. *Sleep Medicine Reviews* 56.

Appel, M., C. Marker, and T. Gnambs. 2020. Are social media ruining our lives? A review of meta-analytic evidence. *Review of General Psychology* 24(1):60-74.

Berger, M. N., M. Taba, J. L. Marino, M. S. C. Lim, and S. R. Skinner. 2022. Social media use and health and well-being of lesbian, gay, bisexual, transgender, and queer youth: Systematic review. *Journal of Medical Internet Research* 24(9).

Brautsch, L. A. S., L. Lund, M. M. Andersen, P. J. Jennum, A. P. Folker, and S. Andersen. 2023. Digital media use and sleep in late adolescence and young adulthood: A systematic review. *Sleep Medicine Reviews* 68.

Cataldo, I., B. Lepri, M. J. Y. Neoh, and G. Esposito. 2021. Social media usage and development of psychiatric disorders in childhood and adolescence: A review. *Frontiers Psychiatry* 11:508595.

Cunningham, S., C. C. Hudson, and K. Harkness. 2021. Social media and depression symptoms: A meta-analysis. *Research on Child and Adolescent Psychopathology* 49:241-253.

Keles, B., N. McCrae, and A. Grealish. 2020. A systematic review: The influence of social media on depression, anxiety and psychological distress in adolescents. *International Journal of Adolescence and Youth* 25(1):79-93.

Kuss, D. J., A. M. Kristensen, and O. Lopez-Fernandez. 2021. Internet addictions outside of Europe: A systematic literature review. *Computers in Human Behavior* 115.

Liu, D., S.E. Ainsworth, and R.F. Baumeister. 2016. A Meta-Analysis of Social Networking Online and Social Capital. *Review of General Psychology* 20(4): 369-391.

Lozano-Blasco, R., M. P. Latorre-Martínez, and A. Cortés-Pascual. 2022. Screen addicts: A meta-analysis of internet addiction in adolescence. *Children and Youth Services Review* 135.

MacKenzie, M. D., H. Scott, K. Reid, and M. Gardani. 2022. Adolescent perspectives of bedtime social media use: A qualitative systematic review and thematic synthesis. *Sleep Medicine Reviews* 63:101626.

McComb, C. A., E. J. Vanman, and S. J. Tobin. 2023. A meta-analysis of the effects of social media exposure to upward comparison targets on self-evaluations and emotions. *Media Psychology* 26(5):612-635.

McCrae, N., S. Gettings, and E. Purssell. 2017. Social media and depressive symptoms in childhood and adolescence: A systematic review. *Adolescent Research Review* 2:315-330.

Meier, A., and L. Reinecke. 2020. Computer-mediated communication, social media, and mental health: A conceptual and empirical meta-review. *Communication Research* 48(8): 1182-1209.

Memon, A. M., S. G. Sharma, S. S. Mohite, and S. Jain. 2018. The role of online social networking on deliberate self-harm and suicidality in adolescents: A systematized review of literature. *Indian Journal of Psychiatry* 60:384-392.

Sedgwick, R., S. Epstein, R. Dutta, and D. Ougrin. 2019. Social media, internet use and suicide attempts in adolescents. *Current Opinion in Psychiatry* 32(6):534-541.

Shannon, H., K. Bush, P. J. Villeneuve, K. G. Hellemans, and S. Guimond. 2022. Problematic social media use in adolescents and young adults: Systematic review and meta-analysis. *JMIR Mental Health* 9(4):e33450.

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Sina, E., D. Boakye, L. Christianson, W. Ahrens, and A. Hebestreit. 2022. Social media and children's and adolescents' diets: A systematic review of the underlying social and physiological mechanisms. *Advances in Nutrition* 13:913-937.

Sohn, S. Y., P. Rees, B. Wildridge, N. J. Kalk, and B. Carter. 2019. Prevalence of problematic smartphone usage and associated mental health outcomes amongst children and young people: A systematic review, meta-analysis and GRADE of the evidence. *BMC Psychiatry* 19:356.

Stevens, M. W. R., D. Dorstyn, P. H. Delfabbro, and D. L. King. 2021. Global prevalence of gaming disorder: A systematic review and meta-analysis. *Australian and New Zealand Journal of Psychiatry* 55(6):553-568.

Tang, S., A. Werner-Seidler, M. Torok, A. J. Mackinnon, and H. Christensen. 2021. The relationship between screen time and mental health in young people: A systematic review of longitudinal studies. *Clinical Psychology Review* 86:102021.

Valkenburg, P. M., A. Meier, and I. Beyens. 2022. Social media use and its impact on adolescent mental health: An umbrella review of the evidence. *Current Opinion in Psychology* 44:58-68.

Yin, X.-Q., D. A. de Vries, D. A. Gentile, and J.-L. Wang. 2019. Cultural background and measurement of usage moderate the association between social networking sites (SNSS) usage and mental health: A meta-analysis. *Social Science Computer Review* 37(5):631-648.

Yoon, S., M. Kleinman, J. Mertz, and M. Brannick. 2019. Is social network site usage related to depression? A meta-analysis of Facebook-depression relations. *Journal of Affective Disorders* 248:65-72.

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