

Exhibit 8

**IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF CALIFORNIA**

PEOPLE OF THE STATE OF CALIFORNIA,
et al.,
Plaintiffs,

v.

META PLATFORMS, INC, Instagram, LLC,
Meta Payments, Inc., Meta Platforms
Technologies, LLC., et al.,
Defendants

IN RE: SOCIAL MEDIA ADOLESCENT
ADDICTION/PERSONAL INJURY
PRODUCTS LIABILITY LITIGATION

THIS DOCUMENT RELATES TO:
4:23-cv-05448

MDL No. 3047

Case No. 4:23-cv-05448-YGR

Judge: Hon. Yvonne Gonzalez Rogers

Magistrate Judge: Hon. Peter H. Kang

**TRIAL REPORT OF
Mitch Prinstein, Ph.D.**

May 16, 2025

I. Introduction

I.A. Summary of opinions

- (1) **Youth (beginning ages 10 years until the mid-twenties) are hypersensitive to social feedback, automatic behaviors, and have underdeveloped impulse control. The features and functions embedded within Meta's social media platforms exploit these vulnerabilities in potentially harmful ways.** Due to normative asynchronous development of brain regions, youth are biologically susceptible to cues related to social interaction, evaluation, and attention from peers but are not fully capable of regulating impulses to seek these cues excessively. This biological vulnerability makes youth especially susceptible to Meta platform features including the count of likes, followers, comments, and notifications.
- (2) **Meta platform features encourage problematic social media use, consistent with clinical dependency.** There is considerable overlap in the regions of the brain activated by social media use and those involved in addictions to illegal and dangerous substances. Research has demonstrated that many adolescents report an inability to stop using social media and display other tolerance, withdrawal, and impairment symptoms that overlap with diagnostic criteria for substance use dependencies.
- (3) **Problematic social media use, promoted by Meta platform features, interferes with adaptive relationship development skills and healthy peer socialization processes, posing a risk to adolescents' mental health. Moreover, problematic social media use disrupts opportunities to engage in offline, healthy, necessary activities including sleep.** Insufficient sleep is associated with poor school performance, difficulties with attention and stress regulation, and increased risk for automobile accidents. Neuroscientific research has demonstrated that inconsistent sleep schedules are associated with deleterious changes in structural brain development in adolescent years.
- (4) **Social media platform features change the impact of harmful content and create stress that contributes to mental health symptoms.** Social media platforms such as Instagram serve two domains of problematic material to youth. One domain pertains to posts that actively showcase and promote engagement in psychologically disordered behavior, such as sites that discuss eating disordered behaviors. A second area of concern regarding online content pertains to the frequency of online discrimination and cyberbullying. Social media platforms' design choices amplify the impact this content has on users, creating stress and contributing to mental health symptoms.

III. Social media platform features encourage problematic use by youth, consistent with clinical dependency

- (35) In my experience, scientists do not typically discuss “addiction” to social media use for predominantly semantic reasons, but scientists generally do recognize that youths’ biological vulnerabilities render them particularly susceptible to “problematic social media use,” often defined in the literature as symptoms of clinical dependency to social media, including withdrawal, tolerance, excessive and uncontrolled use, causing impairment in daily tasks.³³ In particular, research has assessed problematic social media use by using the diagnostic criteria for substance use dependencies, revealing that many adolescents report an inability to stop using social media, even when they want to; expend remarkable effort to maintain access to social media; use social media to regulate their emotions; increase their use of social media to achieve the same level of pleasure; experience withdrawal symptoms following abstinence; and report significant impairment in their daily educational, social, work routines due to excessive social media use.³⁴ Note that the regions of the brain activated by social media use overlap considerably with the regions involved in addictions to illegal and dangerous substances.³⁵
- (36) As noted above, the developing brain is built to increase a desire for social rewards (that social media platforms like Instagram deliver abundantly) without the ability to show the capacities of inhibition and restraint available to adults. This suggests that youth are a biologically vulnerable population at risk for problematic use of social media. Meta documents acknowledge the concept of problematic social media use, although their definition is a bit more restrictive than definitions in the literature. Specifically, Meta researchers appear to measure problematic use as self-reported experiences of (1) “lack of control or feelings of guilt over [Facebook] use” and (2) “negative impact in at least one of the following areas: sleep, parenting, social relationships, or productivity,” with both of these issues occurring “very often” or “all the time.”³⁶ Internal Meta memos acknowledge problematic social media use, indicating that their own internal research “suggests it affects ~3% of US Facebook MAP [Monthly Active Persons]. This increases to 10% if the definition is broadened to include feelings of

³³ Maartje Boer, Gonneke W. J. M. Stevens, Catrin Finkenauer, and Regina J. J. M. Van Den Eijnden, “The Course of Problematic Social Media Use in Young Adolescents: A Latent Class Growth Analysis,” *Child Development* 93, no. 2 (2022): e168–e187. Edmund WJ Lee, Shirley S. Ho, and May O. Lwin, “Explicating problematic social network sites use: A review of concepts, theoretical frameworks, and future directions for communication theorizing,” *New Media & Society* 19, no. 2 (2017): 308–326.

³⁴ Anne J. Maheux, Kaitlyn Burnell, Maria T. Maza, Kara A. Fox, Eva H. Telzer, and Mitchell J. Prinstein, “Annual Research Review: Adolescent Social Media Use Is Not a Monolith: Toward the Study of Specific Social Media Components and Individual Differences,” *Journal of Child Psychology and Psychiatry* 66, no. 4 (2025): 440–459.

³⁵ José De-Sola Gutiérrez, Fernando Rodríguez De Fonseca, and Gabriel Rubio, “Cell-Phone Addiction: A Review,” *Frontiers in Psychiatry* 7 (2016): 175. Mark D. Griffiths, Daria J. Kuss, and Zsolt Demetrovics, “Social Networking Addiction,” *Behavioral Addictions* (2014): 119–141. Bridget Kirby, Ashley Dapore, Carl Ash, Kaitlyn Malley, and Robert West, “Smartphone Pathology, Agency and Reward Processing,” *Information Systems and Neuroscience* 43 (2020): 321–329.

³⁶ META3047MDL-044-00111865 at -1866. See also META3047MDL-020-00005380 at -5581.

guilt about Facebook use [...]. External estimates are even more wide-ranging, from ~2.8% to as high as 48%, depending on definition.”³⁷ A June 2018 Facebook-internal presentation also finds “Facebook may be rewarding and habit-forming. Therefore some people may experience genuine problems related to their Facebook use;”³⁸ and “Though there is no clinical diagnosis of Facebook addiction, there are parts of the addictive process that may be at play and contributing to common issues for people.”³⁹ An October 2020 Meta-internal assessment stated that starting in 2018, “efforts were spun up across Facebook and Instagram to understand these concerns.”⁴⁰

- (37) Several bodies of research reveal that youths’ vulnerability to problematic social media use is indeed a significant concern. For instance, research finds that youth spend a remarkable amount of time using social media, such as Instagram.⁴¹ An independent 2023 survey on adolescents finds that the median number of times participants pick up their smartphones is 51 times per day, with more than half receiving over 200 daily notifications, the majority of which come from social media apps.⁴² A 2023 survey of more than 1,500 adolescents finds that youth spent, on average, 4.8 hours per day on social media platforms.⁴³ Perhaps most concerning, however, are data indicating that over 54% of 11–13-year-old youth report they are experiencing at least one symptom of problematic social media use, consistent with the medical definition of clinical dependency, in a manner strikingly similar to

³⁷ META3047MDL-003-00190634 at -0638 (For the Facebook-internal statistics, the document references “Source: ██████, ██████, & ██████. 2019).”).

³⁸ META3047MDL-022-00022318 (Facebook “Addiction” – A response to the public narrative based on clinical and neuroscience research) at -2321.

³⁹ META3047MDL-022-00022318 (Facebook “Addiction” – A response to the public narrative based on clinical and neuroscience research) at -2332.

⁴⁰ META3047MDL-020-00005380 at -5380 (“Starting in 2018, there was growing concern in the public (amongst media, academics, policy elites, and everyday users) that technology companies were deliberately manipulating users by designing addictive products that can harm well-being and subvert control, labelling these concerns “Facebook Addiction.” Efforts were spun up across Facebook and Instagram to more deeply understand these concerns. Initial products were launched to give people more control over their use, though efforts were defunded end of 2019 with additional opportunities still available.”).

⁴¹ In a survey of teen users, my colleagues and I found that 85% of participants moderately or severely endorsed the statement that they spent more time on social media than intended, and 61% endorsed the statement that they had tried to spend time away from social media but could not. Kaitlyn Burnell, Jessica S. Flannery, Kara A. Fox, Mitchell J. Prinstein, and Eva H. Telzer, “US Adolescents’ daily social media use and well-being: Exploring the role of addiction-like social media use,” *Journal of Children and Media* 19, no. 1 (2025): 194–212.

⁴² “Youth Statistics: Internet and Social Media,” Act for Youth, accessed April 25, 2025, <https://actforyouth.org/adolescence/demographics/internet.cfm> (“Smartphones are becoming a core component of young people’s daily lives. According to Common Sense Media, half of adolescents (age 11-17) use their smartphones for over 4.5 hours a day. The median number of times that adolescents pick up their smartphones is 51 times per day, with 44% of older adolescents (age 16-17) picking up their smartphones more than 100 times per day. Throughout the day, more than half of adolescents receive over 200 notifications from their smartphones, with 23% of notifications arriving during school hours and 5% during school night hours. The majority of daily smartphone usage comes from social media apps (42%), YouTube (19%), and mobile games (11%).”).

⁴³ Jonathan Rothwell, “Teens Spend Average of 4.8 Hours on Social Media Per Day,” Gallup, October 13, 2023, <https://news.gallup.com/poll/512576/teens-spend-average-hours-social-media-per-day.aspx>.

dependency on illegal substances.^{44,45} About 85% of youth report spending more time than intended online, and 61% report failing when trying to stop or reduce their use of social media.⁴⁶

- (38) Meta’s internal research is consistent with the notion that youths’ vulnerability to problematic social media use is a significant concern. Meta researchers surveyed 19,768 users from nine countries regarding Instagram users’ perceptions of the time they spend on that platform.⁴⁷ They found that more than a third (38%) of survey respondents “feel they have spent more than they’ve liked on Instagram” and that “[a]bout one in five respondents think they have a problem controlling their time” (23%).⁴⁸ Users who spent more than 1 hour on Instagram per day felt “[s]ignificantly less in control than people” who spent less than 1 hour per day on the platform.⁴⁹ This same research found that “[p]eople who spend longer than 3 hours a day on Instagram have lower positive affect and lower overall life satisfaction” and that “[t]hose who spend longer than 1 hour on IG have higher negative WB [well-being].”⁵⁰
- (39) Meta marketing research consisting of interviews with American and British teen users of Instagram, as well as surveys of over 2,000 American and British teen users,⁵¹ found that while teens identify many positive aspects of Instagram that play in their well-being,⁵² they also find:

“Teens talk about the amount of time they spend on Instagram as one of the ‘worst’ aspects of their relationship to the app. They have an addicts’ narrative about their use -- it can make them feel good, feel bad. They wish they could spend less time caring about it, but they can’t help themselves. Teens recognize the amount of time

⁴⁴ Maartje Boer, Gonneke W. J. M. Stevens, Catrin Finkenauer, and Regina J. J. M. Van Den Eijnden, “The Course of Problematic Social Media Use in Young Adolescents: A Latent Class Growth Analysis,” *Child Development* 93, no. 2 (2022): e168–e187.

See also META3047MDL-014-00255333, slide 3.

⁴⁵ Problematic social media use, as cited in the study, is the preferred term to describe the addictive, negative effects of social media use “because it avoids premature diagnosis of a pathological problem, and yet is broad enough to encompass differing levels of compulsivity and negative consequences related to [social media] use. Edmund WJ Lee, Shirley S. Ho, and May O. Lwin, “Explicating problematic social network sites use: A review of concepts, theoretical frameworks, and future directions for communication theorizing,” *New Media & Society* 19, no. 2 (2017): 308–326.

⁴⁶ Victoria Rideout, Alanna Peebles, Supreet Mann, and Michael B. Robb, “Common Sense census: Media use by tweens and teens, 2021,” (2021) https://www.commonsensemedia.org/sites/default/files/research/report/8-18-census-integrated-report-final-web_0.pdf.

⁴⁷ META3047MDL-032-00000933 at -0933 and -0937.

⁴⁸ META3047MDL-032-00000933 at -0944–0945.

⁴⁹ META3047MDL-032-00000933 at -0947.

⁵⁰ META3047MDL-032-00000933 at -0966.

⁵¹ META3047MDL-003-00109173 at -9173–9175.

⁵² META3047MDL-003-00109173 at -9192. These include connecting with friends/family, entertainment, information about current events, and pursuing a passion and self expression.

they spend online isn't good for them but at the same time know they lack the willpower to control the time spent themselves.”⁵³

- (40) Another of Meta's internal assessments illustrates how often teen users engage in frequent phone “pickups” to check Instagram, prolonged sessions on Instagram, and nighttime use. In a February 11, 2022 Meta document discussing Instagram's “Take a Break” tool, Meta noted that 15% of teens have “long duration” sessions on Instagram that are 20 minutes or longer daily; 26% of teens have 20 or more app sessions per day, with half of those sessions being 10 minutes or less apart; and that 9% of teens spend 10 minutes or more on Instagram between midnight and 4 a.m. According to that same internal assessment, 35% of teen Instagram users exhibit at least one of these three types of use, and 2.6% of teen users exhibit all three.⁵⁴
- (41) Several Meta documents acknowledge the biological processes that underlie youths' vulnerability to problematic social media use and the proportion of youth suffering from dependency due to Instagram features. For instance, an internal May 2020 Instagram presentation notes teens' vulnerability, absent a mature frontal cortex, caused by behavior seeking emotion, novelty, and reward,⁵⁵ and that:

“Teens brains are much more sensitive to dopamine, one of the reasons that the risk of drug addiction is higher for adolescents and keeps them scrolling and scrolling. And due to the immature brain they have a much harder time stopping even though they want to – our own product foundation research has shown teens are unhappy with the amount of time they spend on our app.”⁵⁶

- (42) The same presentation notes the role of Instagram features:

“Approval and acceptance are huge rewards for teens and interactions are the currency on IG [Instagram]. DMs, notifications, comments, follows, likes, etc. encourage teens to continue engaging and keep coming back to the app.”⁵⁷

The presentation also highlights how Meta's algorithmic recommendation systems deliver dopamine hits to teen users.⁵⁸ In addition to this algorithmically primed content, in an October 2020 internal

⁵³ META3047MDL-003-00109173 at -9221.

⁵⁴ META3047MDL-035-00001018, slide 4.

⁵⁵ META3047MDL-031-00191726 at -1736 (“Teens' decisions and behavior are mainly driven by emotion, the intrigue of novelty and reward... While these all seem positive, they make teens very vulnerable at the elevated levels they operate on. Especially in the absence of a mature frontal cortex to help impose limits on the indulgence in these.”).

⁵⁶ META3047MDL-031-00191726 at -1773.

⁵⁷ META3047MDL-031-00191726 at -1779.

⁵⁸ META3047MDL-031-00191726 at -1747 (“When it comes to discovery - finding something new or novel, much like our big bro FB, IG has a pretty good hold on the serendipitous aspect of discovery through our Explore surface,

document, features such as notifications, time-bound content, and auto-play have been identified by Meta researchers as triggers for problematic use.⁵⁹

- (43) Meta claims it has introduced tools aimed at curbing problematic use or limiting time spent on Instagram. These tools may offer the appearance of attempts to assist youth, but they are insufficient given the powerful biological processes that drive youths' dependency on social media, as discussed by Meta staff in the excerpts highlighted above. Rather, these tools are more akin to "tissue-paper barriers" that may appear to be meaningful, but do not actually offer meaningful resistance for youth to continue engagement on the platform. Note that a 2022 Meta document states that less than one-third of one percent of youth meaningfully used these tools to reduce Instagram use.⁶⁰
- (44) Youths' biological vulnerability to technology and social media, and their resulting frequent use of these platforms, can also alter youths' neural development since our brains develop in response to the environment we live in. Recent studies have revealed that technology and social media use may be associated with changes in functional brain development.⁶¹ For instance, research with colleagues at UNC using annual fMRI brain scans revealed that more frequent use of adolescents' devices (i.e., predominantly for social media) was associated with unique development of brain regions, including hyperreactivity to social cues and diminished activation of youths' inhibitory responses. In short, results found that high social media may have promoted brain development in a way that may make adolescents more inclined to focus on social rewards (e.g., attention from peers) and altered self-control.⁶²

recommendations, and social graphs. And everytime one of our teen users finds something unexpected their brains deliver them a dopamine hit.”).

META3047MDL-003-00191207 at -1215 (“**Teen brains are much more sensitive to dopamine**, one of the reasons that the risk of drug addiction is higher for adolescents and it’s the same thing that keeps them scrolling and scrolling. Due to the immature brain, **they have a much harder time stopping** even though they want to -- our own production foundation research has shown teens are unhappy with the amount of time they spend on our app.”) (emphasis in original).

⁵⁹ META3047MDL-020-00005380 at -5384. The October 2020, “Problematic Use Overview” was compiled by Jennifer Guadagno, previously Director of UX Research, Social Impact, at Meta and [REDACTED], a Quantitative UX Researcher at Meta.

⁶⁰ According to Meta engineers in 2022, teens had not meaningfully adopted Meta’s Take a Break tool (0.165%) or Meta’s Alternative Topic Nudges tool (0.137%). META3047MDL-047-01170167.

⁶¹ Anne J. Maheux, Kaitlyn Burnell, Maria T. Maza, Kara A. Fox, Eva H. Telzer, and Mitchell J. Prinstein, “Annual Research Review: Adolescent Social Media Use Is Not a Monolith: Toward the Study of Specific Social Media Components and Individual Differences,” *Journal of Child Psychology and Psychiatry* 66, no. 4 (2025): 440–459.

⁶² “High” social media use being defined as >15 “pickups” a day. Maria T. Maza, Kara A. Fox, Seh-Joo Kwon, Jessica E. Flannery, Kristen A. Lindquist, Mitchell J. Prinstein, and Eva H. Telzer, “Association of habitual checking behaviors on social media with longitudinal functional brain development,” *JAMA Pediatrics* 177, no. 2 (2023): 160–167.

- (48) These features of social media, and the resulting behaviors of those who use social media, create the exact opposite qualities needed for successful and adaptive relationships (i.e., disingenuous, anonymous, depersonalized). In other words, social media offers the “empty calories of social interaction” that appear to help satiate our biological and psychological needs, but does not contain any of the healthy ingredients necessary to reap benefits. Anecdotally, teens’ behavior reflects this issue—the “Finsta” phenomenon reflects users’ attempt to find more honest and intimate relationships with one another, but without experience in doing so first offline.⁷¹ Scientific data also support this claim; research reveals that in the hours following social media use, teens paradoxically report *increases* rather than decreases in loneliness.⁷² Instagram researchers found that 45% of teen respondents to a 10,625 person survey indicated that they hesitated to share photos or videos on Instagram because they had “[n]othing good enough to share,” and 33% provided that they were concerned about being “judged” for showing a different side to their self. These rates were higher than what was reported by adult Instagram users.⁷³

III.B. Social media features can interfere with healthy peer socialization processes

- (49) Social media platforms like Instagram frequently expose adolescents to images depicting illegal, immoral, dangerous, and unethical behavior.⁷⁴ The architecture of many social media platforms like

⁷¹ Finsta is short for Finstagram, or “fake Instagram,” referring to an account made so that a user can post images and interact with other accounts in a more private way, usually reserving the account’s followers to close friends. “Finsta,” Merriam-Webster, accessed April 29, 2025, <https://www.merriam-webster.com/wordplay/what-does-finsta-mean-fake-instagram>.

⁷² Kara A. Fox, Elizabeth Nick, Jacqueline Nesi, Eva H. Telzer, and Mitchell J. Prinstein. “Why Haven’t You Texted Me Back? Adolescents’ Digital Entrapment, Friendship Conflict, and Perceived General Health,” *Journal of Clinical Child & Adolescent Psychology*, (2023): 1–11. Elizabeth A. Nick, Zelal Kilic, Jacqueline Nesi, Eva H. Telzer, Kristen A. Lindquist, and Mitchell J. Prinstein, “Adolescent digital stress: Frequencies, correlates, and longitudinal association with depressive symptoms,” *Journal of Adolescent Health* 70, no. 2 (2022): 336–339.

⁷³ META3047MDL-031-00191726 at -1758; statistics are taken from “Less Engaged, Single-Account Users: Barriers & Opportunities for Multiple Accounts, [REDACTED], April 2020.”

⁷⁴ A 2021 survey of over 200,000 Instagram users sought to measure exposure to “bad experiences and encounters” and found that 13–15-year-olds were exposed to the highest rates of 8 out of the 22 “bad experiences and encounters” surveyed. For example, 19.2% were exposed to content with nudity, 21.4% to content inspiring negative comparison, 8.4% to self-harm content, and 10.8% were the target of bullying – all the highest of any age group. It further found that 16–17-year-olds were the most frequent viewers of hate and violence at 28.5% and 14.3%, respectively. META3047MDL-004-00015029 at -5035 and -5049.

Users do not necessarily elect to see this content. On Instagram, Feed contains “all the recent posts shared by the people you [a user] follow. There are a few exceptions, like ads, but the vast majority of what you see is shared by those you follow.” On the other hand, Explore is “made up of recommendations – photos and videos that we [Instagram] go out and find for you – which is very different from Feed and Stories, where the vast majority of what you see is from the accounts you follow.” (Adam Mosseri, “Shedding More Light on How Instagram Works,” Instagram, June 8, 2021, see <https://about.instagram.com/blog/announcements/shedding-more-light-on-how-instagram-works>). An estimated “17% of people see substantially more (at least 20 percentage points)” content associated with higher negative appearance comparison algorithmically on Explore than they implicitly elect to see, based on the accounts they follow on Feed. META3047MDL-003-00048634 on -8634 (a July 22, 2021 article by Justin Cheng, Moira Burke, and Shilpa Mody, researchers at Meta).

- (53) These findings are corroborated by an internal presentation on “Late Night Use” shared among Meta staff in August 2022. The memo identifies 11.7% (~1.5 million) of US teen users as having at least one late-night problematic use case behavioral proxy on Instagram.⁸⁵ The presentation also confirms that 33% of teen sessions between 12 a.m. and 4 a.m. start due to a notif[ication] (26% receive and click after midnight).⁸⁶ The presentation notes that a previous “study found that 12.5% of FB [Facebook] app users worldwide experience PU [problematic use] based on user self-report.”⁸⁷
- (54) Screen time may affect sleep in at least three ways. First, active engagement with screens keeps youth awake.⁸⁸ Second, there is a link between the effects of blue light emitted from personal devices and the release of melatonin in the brain, which is critical for sleep onset.⁸⁹ Third, and perhaps most relevant, is that much of adolescents’ screen time on social media is emotionally salient content. Highly emotional stimuli immediately before bedtime interfere with sleep onset, sleep quality, and sleep disruptions.⁹⁰ Nighttime social media use is also much more likely to lead to problematic use than during the day.⁹¹ As detailed above, neuroscientific research has demonstrated that inconsistent sleep schedules are associated with changes in structural brain development in adolescent years. In

⁸⁵ META3047MDL-035-00005017 at pp. 4, 11, 47, and 50, where late night is defined as 12-4am (p. 46) and problematic use case behavioral proxies are “1. No engagement late night session; 2. Late night high volume product switching; 3. No-engagement repeat sessions (Less than 10 min from end of prior session); 4. High volume of short sessions (< 15 sec); 5. High Frequency notifications checking; Using these signals, plus late night long sessions (since displacing sleep is one of the negative life impacts of PU [problematic use]), we estimate that 18.3% of IG [Instagram] teen users exhibit behavior associated with problematic use.”

⁸⁶ The presentation compares Instagram to TikTok and notes that on “TikTok all teens do not receive notifications at night by default.” (META3047MDL-035-00005017, p. 46) and that TikTok has other late night interventions not (at the time) available on Instagram (META3047MDL-035-00005017, p. 41).

⁸⁷ META3047MDL-035-00005017, p. 47.

⁸⁸ Michael Gradisar, Greg Gardner, and Hayley Dohnt, “Recent worldwide sleep patterns and problems during adolescence: a review and meta-analysis of age, region, and sleep,” *Sleep Medicine* 12, no. 2 (2011): 110–118. Judith Owens, Rolanda Maxim, Melissa McGuinn, Chantelle Nobile, Michael Msall, and Anthony Alario, “Television-viewing habits and sleep disturbance in school children,” *Pediatrics* 104, no. 3 (1999): e27–e27.

⁸⁹ Christian Cajochen, Sylvia Frey, Doreen Anders, Jakub Späti, Matthias Bues, Achim Pross, Ralph Mager, Anna Wirz-Justice, and Oliver Stefani, “Evening exposure to a light-emitting diodes (LED)-backlit computer screen affects circadian physiology and cognitive performance,” *Journal of Applied Physiology* (2011): 1432–1438. Stephanie Van der Lely, Silvia Frey, Corrado Garbaza, Anna Wirz-Justice, Oskar G. Jenni, Roland Steiner, Stefan Wolf, Christian Cajochen, Vivien Bromundt, and Christina Schmidt, “Blue blocker glasses as a countermeasure for alerting effects of evening light-emitting diode screen exposure in male teenagers,” *Journal of Adolescent Health* 56, no. 1 (2015): 113–119. Anne-Marie Chang, Daniel Aeschbach, Jeanne F. Duffy, and Charles A. Czeisler, “Evening use of light-emitting eReaders negatively affects sleep, circadian timing, and next-morning alertness,” *Proceedings of the National Academy of Sciences* 112, no. 4 (2015): 1232–1237.

⁹⁰ Xuewen Wang and Arlette C. Perry, “Metabolic and physiologic responses to video game play in 7-to 10-year-old boys,” *Archives of Pediatrics & adolescent medicine* 160, no. 4 (2006): 411–415. Anne Bartsch, Roland Mangold, Reinhold Viehoff, and Peter Vorderer, “Emotional gratifications during media use—An integrative approach,” *Communications* 31, no. 3 (2006): 261–278.

⁹¹ Facebook internal research showed that “People who feel like their use of Facebook is problematic spend more time on the site and have more sessions than people who don’t experience problematic use. They have about 15 more sessions per day, and spend a greater proportion of their sessions late at night.” Furthermore, “late night sessions (12–4am) are more than twice as predictive of problematic use as is time spent.” META3047MDL-046-00087227 at -7227.

other words, youths' preoccupation with technology and social media may deleteriously affect the size of their brains.⁹²

- (55) In addition, social media interferes with or displaces other activities critical for youth development. Note that youth also engage with online and social media apps *while participating* in other activities. Indeed, studies show that when youth are doing schoolwork, they often are doing so alongside the use of social media platforms, a phenomenon called “media multitasking.”⁹³ Research demonstrates that most humans cannot multitask, but rather are rapidly task-shifting — a process associated with poorer memory and comprehension among youth.⁹⁴ Evidence shows that these phenomena only worsen with heavier use of social media, with more common symptoms such as mind wandering and higher levels of impulsivity among young adults who use social media more frequently.⁹⁵

⁹² Michelle Achterberg, Andrik Becht, Renske van der Crujisen, Ilse H. van de Groep, Jochem P. Spaans, Eduard Klapwijk, and Eveline A. Crone, “Longitudinal associations between social media use, mental well-being and structural brain development across adolescence,” *Developmental Cognitive Neuroscience* 54 (2022): 101088.

⁹³ Se-Hoon Jeong and Yoori Hwang, “Does multitasking increase or decrease persuasion? Effects of multitasking on comprehension and counterarguing,” *Journal of Communication* 62, no. 4 (2012): 571–587. Winneke A. Van Der Schuur, Susanne E. Baumgartner, Sindy R. Sumter, and Patti M. Valkenburg, “The consequences of media multitasking for youth: A review,” *Computers in Human Behavior* 53 (2015): 204–215. L. Mark Carrier, Larry D. Rosen, Nancy A. Cheever, and Alex F. Lim, “Causes, effects, and practicalities of everyday multitasking,” *Developmental Review* 35 (2015): 64–78.

⁹⁴ Brandon CW Ralph, David R. Thomson, James Allan Cheyne, and Daniel Smilek, “Media multitasking and failures of attention in everyday life,” *Psychological Research* 78 (2014): 661–669.

⁹⁵ Eyal Ophir, Clifford Nass, and Anthony D. Wagner, “Cognitive control in media multitaskers,” *Proceedings of the National Academy of Sciences* 106, no. 37 (2009): 15583–15587. Brandon CW Ralph, David R. Thomson, James Allan Cheyne, and Daniel Smilek, “Media multitasking and failures of attention in everyday life,” *Psychological Research* 78 (2014): 661–669. Susanne E. Baumgartner, Wouter D. Weeda, Lisa L. van der Heijden, and Mariëtte Huizinga, “The relationship between media multitasking and executive function in early adolescents,” *The Journal of Early Adolescence* 34, no. 8 (2014): 1120–1144. Susanne E. Baumgartner, Winneke A. van der Schuur, Jeroen S. Lemmens, and Fam te Poel, “The relationship between media multitasking and attention problems in adolescents: Results of two longitudinal studies,” *Human Communication Research* 44, no. 1 (2018): 3–30.

VI. Conclusions

- (65) The features and functions embedded within Meta’s social media platforms exploit youths’ hypersensitivity to social feedback, automatic behaviors, and underdeveloped impulse control in potentially harmful ways. Youth are biologically susceptible to cues related to social interaction, evaluation, and attention from peers but are not fully capable of regulating impulses to seek these cues excessively.¹²³ This biological vulnerability makes youth especially susceptible to Meta platform features including the count of likes, followers, comments, and notifications.
- (66) Meta platform features encourage problematic social media use, consistent with clinical dependency. There is considerable overlap in the regions of the brain activated by social media use and those involved in addictions to illegal and dangerous substances.¹²⁴ Research has demonstrated that many adolescents report an inability to stop using social media; expend remarkable effort to maintain access to social media; use social media to regulate their emotions; and display other tolerance, withdrawal, and impairment symptoms that overlap with diagnostic criteria for substance use dependencies.¹²⁵
- (67) Problematic social media use, promoted by Meta platform features, interferes with adaptive relationship development skills and healthy peer socialization processes, posing a risk to adolescents’ mental health. Moreover, problematic social media use disrupts opportunities to engage in healthy offline activities including sleep. Recent studies have revealed that screen time is the main reason for low sleep duration, disrupted sleep, and poor quality sleep,¹²⁶ with the vast majority of adolescents’ nighttime screen time use occurring on social media platforms, including Instagram.¹²⁷ Sleep delay or

¹²³ I note that Instagram’s Head of Research testified, “Teens and actually up through—and some scholarly literature suggests that that happens up through the age of even like 25 to 28, but yes, and teens, roughly speaking, are still developing aspects of self-control. Not every teen. Obviously, there are differences between some teens.” Deposition of Kristin Hendrix, January 22, 2025, 278:14–25.

¹²⁴ José De-Sola Gutiérrez, Fernando Rodríguez De Fonseca, and Gabriel Rubio, “Cell-Phone Addiction: A Review,” *Frontiers in Psychiatry* 7 (2016): 175. Mark D. Griffiths, Daria J. Kuss, and Zolt Demetrovics, “Social Networking Addiction,” *Behavioral Addictions* (2014): 119–141. Bridget Kirby, Ashley Dapore, Carl Ash, Kaitlyn Malley, and Robert West, “Smartphone Pathology, Agency and Reward Processing,” *Information Systems and Neuroscience* 43 (2020): 321–329.

¹²⁵ Anne J. Maheux, Kaitlyn Burnell, Maria T. Maza, Kara A. Fox, Eva H. Telzer, and Mitchell J. Prinstein, “Annual Research Review: Adolescent Social Media Use Is Not a Monolith: Toward the Study of Specific Social Media Components and Individual Differences,” *Journal of Child Psychology and Psychiatry* 66, no. 4 (2025): 440–459.

¹²⁶ Meta-analyses of literature examining the effect of portable media device usage on sleep outcomes found that children who use media devices at bedtime were 2.17 times more likely to have inadequate sleep quality, 1.46 times more likely to have poorer sleep, and 2.72 times more likely to be excessively sleepy during the day. Ben Carter, Philippa Rees, Lauren Hale, Darshana Bhattacharjee, and Mandar Paradkar, “A meta-analysis of the effect of media devices on sleep outcomes,” *JAMA Pediatrics* 170, no. 12 (2016): 1202. Xiaoning Han, Enze Zhou, and Dong Liu, “Electronic media use and sleep quality: updated systematic review and meta-analysis,” *Journal of Medical Internet Research* 26 (2024): e48356. Further research has shown statistically significant correlations between social media use and sleep problems. Aurore A. Perrault, Laurence Bayer, Mathias Peuvrier, Alia Afyouni, Paolo Ghisletta, Celine Brockmann, Mona Spiridon et al, “Reducing the use of screen electronic devices in the evening is associated with improved sleep and daytime vigilance in adolescents,” *Sleep* 42, no. 9 (2019): 1–10.

¹²⁷ Kaitlyn Burnell, Shedrick L. Garrett, Benjamin W. Nelson, Mitchell J. Prinstein, and Eva H. Telzer, “Daily links between objective smartphone use and sleep among adolescents,” *Journal of Adolescence* 96, no. 6 (2024): 1171–1181.

disruptions have significant negative effects on youths' attention, behavior, mood, stress regulation, safety, body shape, and academic performance.¹²⁸ Neuroscientific research has demonstrated that maladaptive sleep habits are associated with less growth in adolescents' brains¹²⁹ and differences in how the brain functions over time.¹³⁰

- (68) Social media platform features change the impact of harmful content and create stress that contributes to mental health symptoms. Social media platforms such as Instagram serve two domains of problematic material to youth: (1) posts that actively showcase and promote engagement in psychologically disordered behavior and (2) online discrimination and cyberbullying. Research suggests that the features and functions that accompany this content on social media platforms, such as the likes, number of followers, and notifications, might affect the activation of adolescent brains as well as a wide array of social, emotional, and behavioral outcomes.¹³¹ Social media platforms' design choices thereby amplify the impact this content has on users, creating stress and contributing to mental health symptoms.
- (69) Social media platform features promote harmful social comparison processes for youth that are subsequently linked to psychological symptoms. The quantitative nature of social media, promoting metrics such as likes and follower counts, combined with the focus on videos and pictures rather than text, creates a fertile ground for social comparisons. Research suggests that these social comparison processes, and youths' tendency to seek positive feedback or status (i.e., more likes, followers, online praise) are associated with a risk for depressive symptoms.¹³² Psychological science also

¹²⁸ "Potential risks of content, features, and functions: The science of how social media affects youth," American Psychological Association, accessed April 25, 2025, <https://www.apa.org/topics/social-media-internet/youth-social-media-2024>. Aurore A. Perrault, Laurence Bayer, Mathias Peuvrier, Alia Afyouni, Paolo Ghisletta, Celine Brockmann, Mona Spiridon et al, "Reducing the use of screen electronic devices in the evening is associated with improved sleep and daytime vigilance in adolescents," *Sleep* 42, no. 9 (2019): 1–10. Eva H. Telzer, Diane Goldenberg, Andrew J. Fuligni, Matthew D. Lieberman, and Adriana Gálvan, "Sleep variability in adolescence is associated with altered brain development," *Developmental Cognitive Neuroscience* 14 (2015): 16–22.

For a Meta-internal perspective on late night social media use, see META3047MDL-035-00001018, slide 27 ("Internal surveys on FB [Facebook] show an association with greater problematic use; In a qual study on spirals, 'teens say they need the most help during longer sessions that happen in evening hours;' Academic research finds that poor sleep is associated with night-time use, and that late-night smartphone use impairs next day behavior.').

¹²⁹ Eva H. Telzer, Diane Goldenberg, Andrew J. Fuligni, Matthew D. Lieberman, and Adriana Gálvan, "Sleep variability in adolescence is associated with altered brain development," *Developmental Cognitive Neuroscience* 14 (2015): 16–22.

¹³⁰ Eva H. Telzer, Diane Goldenberg, Andrew J. Fuligni, Matthew D. Lieberman, and Adriana Gálvan, "Sleep variability in adolescence is associated with altered brain development," *Developmental Cognitive Neuroscience* 14 (2015): 16–22.

¹³¹ Lauren E. Sherman, Patricia M. Greenfield, Leanna M. Hernandez, and Mirella Dapretto, "Peer influence via Instagram: Effects on brain and behavior in adolescence and young adulthood," *Child Development* 89, no. 1 (2018): 37–47. Jacqueline Nesi, Sophia Choukas-Bradley, and Mitchell J. Prinstein, "Transformation of adolescent peer relations in the social media context: Part 1—A theoretical framework and application to dyadic peer relationships," *Clinical Child and Family Psychology Review* 21 (2018): 267–294. Jacqueline Nesi, Sophia Choukas-Bradley, and Mitchell J. Prinstein, "Transformation of adolescent peer relations in the social media context: Part 2—application to peer group processes and future directions for research," *Clinical Child and Family Psychology Review* 21 (2018): 295–319.

¹³² Sophia Choukas-Bradley, Jacqueline Nesi, Laura Widman, and Brian M. Galla, "The appearance-related social media consciousness scale: Development and validation with adolescents," *Body Image* 33 (2020): 164–174. Tanya Hawes, Melanie J. Zimmer-Gembeck, and Shawna M. Campbell, "Unique associations of social media use and online

Appendix A. Materials considered

In addition to all materials below, I incorporate by reference all materials used or cited in footnotes or my reliance materials.¹³⁵

A.1. Legal and other case documents

- Complaint for Injunctive and Other Relief. *People of the State of California, et al. v. Meta Platforms, Inc., et al.* (N.D. Cal. Nos. 4:22-md-03047-YGR-PHK and 4:23-cv-05448-YGR) (November 22, 2023).
- Defendants’ Objections and Responses to Plaintiff’s Second Set of Interrogatories. *Commonwealth of Massachusetts v. Meta Platforms, Inc. and Instagram, LLC.* (Mass. Super. Ct. No. 2384CV02397-BLS1) (August 20, 2024).
- Meta Defendants’ Responses and Objections to Plaintiffs’ Second Set of Interrogatories. *People of the State of California, et al. v. Meta Platforms, Inc., et al.* (N.D. Cal. No. 4:22-md-03047-YGR) (November 27, 2024).
- Meta Defendants’ Third Supplemental and Amended Responses and Objections to Plaintiffs’ Second Set of Interrogatories. *People of the State of California, et al. v. Meta Platforms, Inc., et al.* (N.D. Cal. No. 4:22-md-03047-YGR) (February 28, 2025).
- Defendants’ Sixth Supplemental Responses and Objections to Second Set of Interrogatories. *People of the State of California, et al. v. Meta Platforms, Inc., et al.* (N.D. Cal. No. 4:22-md-03047-YGR) (April 04, 2025).

A.2. Books and academic papers

- Adrienne L. Tierney and Charles A. Nelson III, “Brain development and the role of experience in the early years,” *Zero to Three* 30, no. 2 (2009): 9.
- Allan Colver and Sarah Longwell, “New understanding of adolescent brain development: relevance to transitional healthcare for young people with long term conditions,” *Archives of Disease in Childhood* 98, no. 11 (2013): 902–907.

¹³⁵ My staff and I were provided access to an electronic database that I understand includes all the discovery materials produced in this matter. My staff conducted searches of this database at my direction. This appendix includes documents that I cited in footnotes throughout the report as well as documents that I considered, but did not cite explicitly.

- Amy Orben, Andrew K. Przybylski, Sarah-Jayne Blakemore, and Rogier A. Kievit, “Windows of developmental sensitivity to social media,” *Nature Communications* 13, no. 1 (2022): 1649.
- Anna CK Van Duijvenvoorde, Sabine Peters, Barbara R. Braams, and Eveline A. Crone, “What motivates adolescents? Neural responses to rewards and their influence on adolescents’ risk taking, learning, and cognitive control,” *Neuroscience & Biobehavioral Reviews* 70 (2016): 135–147.
- Anne Bartsch, Roland Mangold, Reinhold Viehoff, and Peter Vorderer, “Emotional gratifications during media use—An integrative approach,” *Communications* 31, no. 3 (2006): 261–278.
- Anne G. Wheaton, Gabrielle A. Ferro, and Janet B. Croft, “School start times for middle school and high school students—United States, 2011–12 school year,” *Morbidity and Mortality Weekly Report* 64, no. 30 (2015): 809.
- Anne J. Maheux, Kaitlyn Burnell, Maria T. Maza, Kara A. Fox, Eva H. Telzer, and Mitchell J. Prinstein, “Annual Research Review: Adolescent Social Media Use Is Not a Monolith: Toward the Study of Specific Social Media Components and Individual Differences,” *Journal of Child Psychology and Psychiatry* 66, no. 4 (2025): 440–459.
- Anne Zimmerman, Joel Janhonen, and Emily Beer, “Human/AI relationships: challenges, downsides, and impacts on human/human relationships,” *AI and Ethics* 4, no. 4 (2024): 1555–1567.
- Anne-Marie Chang, Daniel Aeschbach, Jeanne F. Duffy, and Charles A. Czeisler, “Evening use of light-emitting eReaders negatively affects sleep, circadian timing, and next-morning alertness,” *Proceedings of the National Academy of Sciences* 112, no. 4 (2015): 1232–1237.
- Aurore A. Perrault, Laurence Bayer, Mathias Peuvrier, Alia Afyouni, Paolo Ghisletta, Celine Brockmann, Mona Spiridon et al, “Reducing the use of screen electronic devices in the evening is associated with improved sleep and daytime vigilance in adolescents,” *Sleep* 42, no. 9 (2019): 1–10.
- Ben Carter, Philippa Rees, Lauren Hale, Darsharna Bhattacharjee, and Mandar Paradkar, “A meta-analysis of the effect of media devices on sleep outcomes,” *JAMA Pediatrics* 170, no. 12 (2016): 1202.
- Betty J. Casey, Sarah Getz, and Adriana Galvan, “The adolescent brain,” *Developmental Review* 28, no. 1 (2008): 62–77.
- Brandon CW Ralph, David R. Thomson, James Allan Cheyne, and Daniel Smilek, “Media multitasking and failures of attention in everyday life,” *Psychological Research* 78 (2014): 661–669.

- Brendesha M. Tynes, Michael T. Giang, David R. Williams, and Geneene N. Thompson, “Online racial discrimination and psychological adjustment among adolescents,” *Journal of Adolescent Health* 43, no. 6 (2008): 565–569.
- Bridget Kirby, Ashley Dapore, Carl Ash, Kaitlyn Malley, and Robert West, “Smartphone Pathology, Agency and Reward Processing,” *Information Systems and Neuroscience* 43 (2020): 321–29.
- Charles A. Nelson and Laurel J. Gabard-Durnam, “Early adversity and critical periods: neurodevelopmental consequences of violating the expectable environment,” *Trends in Neurosciences* 43, no. 3 (2020): 133–143.
- Charles E. Basch, Corey H. Basch, Kelly V. Ruggles, and Sonali Rajan, “Prevalence of sleep duration on an average school night among 4 nationally representative successive samples of American high school students, 2007–2013,” *Preventing Chronic Disease* 11 (2014): E216.
- Christian Cajochen, Sylvia Frey, Doreen Anders, Jakub Späti, Matthias Bues, Achim Pross, Ralph Mager, Anna Wirz-Justice, and Oliver Stefani, “Evening exposure to a light-emitting diodes (LED)-backlit computer screen affects circadian physiology and cognitive performance,” *Journal of Applied Physiology* (2011): 1432–1438.
- Dale S. Cannon, Stephen T. Tiffany, Hilary Coon, Mary Beth Scholand, William M. McMahon, and Mark F. Leppert, “The PHQ-9 as a brief assessment of lifetime major depression,” *Psychological Assessment* 19, no. 2 (2007): 247–251.
- Daniel J. Simmonds, Michael N. Hallquist, Miya Asato, and Beatriz Luna, “Developmental stages and sex differences of white matter and behavioral development through adolescence: a longitudinal diffusion tensor imaging (DTI) study,” *Neuroimage* 92 (2014): 356–368.
- David Hill, “Media use in school-aged children and adolescents,” *Pediatrics* 138, no. 5 (2016): 1.
- Dustin Albert and Laurence Steinberg, “Judgment and decision making in adolescence,” *Journal of Research on Adolescence* 21, no. 1 (2011): 211–224.
- Edmund WJ Lee, Shirley S. Ho, and May O. Lwin, “Explicating problematic social network sites use: A review of concepts, theoretical frameworks, and future directions for communication theorizing,” *New Media & Society* 19, no. 2 (2017): 308–326.
- Eleonora Gullone, “Risk factors for the development of animal cruelty,” *Journal of Animal Ethics* 4, no. 2 (2014): 61–79.
- Elise R. Carrotte, Alyce M. Vella, and Megan SC Lim, “Predictors of “liking” three types of health and fitness-related content on social media: a cross-sectional study,” *Journal of Medical Internet Research* 17, no. 8 (2015): e205.

- Elizabeth A. Nick, Zelal Kilic, Jacqueline Nesi, Eva H. Telzer, Kristen A. Lindquist, and Mitchell J. Prinstein, “Adolescent digital stress: Frequencies, correlates, and longitudinal association with depressive symptoms,” *Journal of Adolescent Health* 70, no. 2 (2022): 336–339.
- Emma Armstrong-Carter, Shedrick L. Garrett, Elizabeth A. Nick, Mitchell J. Prinstein, and Eva H. Telzer, “Momentary links between adolescents’ social media use and social experiences and motivations: Individual differences by peer susceptibility,” *Developmental Psychology* 59, no. 4 (2023): 707–719.
- Eva H. Telzer and Maria T. Maza, “Social media and the developing brain,” In *Handbook of Media Psychology: The Science and The Practice*, pp. 33-43. Cham: Springer Nature Switzerland, 2024.
- Eva H. Telzer, Diane Goldenberg, Andrew J. Fuligni, Matthew D. Lieberman, and Adriana Gálvan, “Sleep variability in adolescence is associated with altered brain development,” *Developmental Cognitive Neuroscience* 14 (2015): 16–22.
- Eyal Ophir, Clifford Nass, and Anthony D. Wagner, “Cognitive control in media multitaskers,” *Proceedings of the National Academy of Sciences* 106, no. 37 (2009): 15583–15587.
- Jacqueline Nesi and Mitchell J. Prinstein, “Using social media for social comparison and feedback-seeking: Gender and popularity moderate associations with depressive symptoms,” *Journal of Abnormal Child Psychology* 43 (2015): 1427–1438.
- Jacqueline Nesi, Sophia Choukas-Bradley, and Mitchell J. Prinstein, “Transformation of adolescent peer relations in the social media context: Part 1—A theoretical framework and application to dyadic peer relationships,” *Clinical Child and Family Psychology Review* 21 (2018): 267–294.
- Jacqueline Nesi, Sophia Choukas-Bradley, and Mitchell J. Prinstein, “Transformation of adolescent peer relations in the social media context: Part 2—application to peer group processes and future directions for research,” *Clinical Child and Family Psychology Review* 21 (2018): 295–319.
- Jacqueline Nesi, W. Andrew Rothenberg, Andrea M. Hussong, and Kristina M. Jackson, “Friends' alcohol-related social networking site activity predicts escalations in adolescent drinking: mediation by peer norms,” *Journal of Adolescent Health* 60, no. 6 (2017): 641–647.
- Jamil Zaki, Jessica Schirmer, and Jason P. Mitchell, “Social influence modulates the neural computation of value,” *Psychological Science* 22, no. 7 (2011): 894–900.
- Janis L. Whitlock, Jane L. Powers, and John Eckenrode, “The virtual cutting edge: the internet and adolescent self-injury,” *Developmental Psychology* 42, no. 3 (2006): 407.

- Jay N. Giedd, Jonathan Blumenthal, Neal O. Jeffries, F. Xavier Castellanos, Hong Liu, Alex Zijdenbos, Tomáš Paus, Alan C. Evans, and Judith L. Rapoport, “Brain development during childhood and adolescence: a longitudinal MRI study,” *Nature Neuroscience* 2, no. 10 (1999): 861–863.
- Jessica L. Hamilton, Emily Hutchinson, Maria R. Evankovich, Cecile D. Ladouceur, and Jennifer S. Silk, “Daily and average associations of physical activity, social media use, and sleep among adolescent girls during the COVID-19 pandemic,” *Journal of Sleep Research* 32, no. 1 (2023): e13611.
- Johan Egebark, and Mathias Ekström, “Liking what others “Like”: Using Facebook to identify determinants of conformity,” *Experimental Economics* 21 (2018): 793–814.
- Jonathan D. Lane, Henry M. Wellman, Sheryl L. Olson, Jennifer LaBounty, and David CR Kerr, “Theory of mind and emotion understanding predict moral development in early childhood,” *British Journal of Developmental Psychology* 28, no. 4 (2010): 871–889.
- José De-Sola Gutiérrez, Fernando Rodríguez De Fonseca, and Gabriel Rubio, “Cell-Phone Addiction: A Review,” *Frontiers in Psychiatry* 7 (2016): 175.
- Juan Jose Carballo, C. Llorente, L. Kehrmann, Itziar Flamarique, A. Zuddas, D. Purper-Ouakil, P. J. Hoekstra et al, “Psychosocial risk factors for suicidality in children and adolescents,” *European Child & Adolescent Psychiatry* 29 (2020): 759–776.
- Judith Owens, Rolanda Maxim, Melissa McGuinn, Chantelle Nobile, Michael Msall, and Anthony Alario, “Television-viewing habits and sleep disturbance in school children,” *Pediatrics* 104, no. 3 (1999): e27–e27.
- Kaitlyn Burnell, Jessica S. Flannery, Kara A. Fox, Mitchell J. Prinstein, and Eva H. Telzer, “US Adolescents’ daily social media use and well-being: Exploring the role of addiction-like social media use,” *Journal of Children and Media* 19, no. 1 (2025): 194–212.
- Kaitlyn Burnell, Shedrick L. Garrett, Benjamin W. Nelson, Mitchell J. Prinstein, and Eva H. Telzer, “Daily links between objective smartphone use and sleep among adolescents,” *Journal of Adolescence* 96, no. 6 (2024): 1171–1181.
- Kara A. Fox, Elizabeth Nick, Jacqueline Nesi, Eva H. Telzer, and Mitchell J. Prinstein. “Why Haven’t You Texted Me Back? Adolescents’ Digital Entrapment, Friendship Conflict, and Perceived General Health,” *Journal of Clinical Child & Adolescent Psychology*, (2023): 1–11.
- Kathryn L. Mills, François Lalonde, Liv S. Clasen, Jay N. Giedd, and Sarah-Jayne Blakemore, “Developmental changes in the structure of the social brain in late childhood and adolescence,” *Social Cognitive and Affective Neuroscience* 9, no. 1 (2014): 123–131.
- Kent C. Berridge, “From prediction error to incentive salience: mesolimbic computation of reward motivation,” *European Journal of Neuroscience* 35, no. 7 (2012): 1124–1143.

- L. Mark Carrier, Larry D. Rosen, Nancy A. Cheever, and Alex F. Lim, “Causes, effects, and practicalities of everyday multitasking,” *Developmental Review* 35 (2015): 64–78.
- Lauren E. Sherman, Leanna M. Hernandez, Patricia M. Greenfield, and Mirella Dapretto, “What the brain ‘Likes’: neural correlates of providing feedback on social media,” *Social Cognitive and Affective Neuroscience* 13, no. 7 (2018): 699–707.
- Lauren E. Sherman, Patricia M. Greenfield, Leanna M. Hernandez, and Mirella Dapretto, “Peer influence via Instagram: Effects on brain and behavior in adolescence and young adulthood,” *Child Development* 89, no. 1 (2018): 37–47.
- Laurence Steinberg, “A social neuroscience perspective on adolescent risk-taking,” *Biosocial Theories of Crime*, Routledge (2017): 435–463.
- Laurence Steinberg, “The influence of neuroscience on US Supreme Court decisions about adolescents' criminal culpability,” *Nature Reviews Neuroscience* 14, no. 7 (2013): 513–518.
- Leah H. Somerville, “The teenage brain: Sensitivity to social evaluation,” *Current Directions in Psychological Science* 22, no. 2 (2013): 121–127.
- Lisa J. Knoll, Lucía Magis-Weinberg, Maarten Speekenbrink, and Sarah-Jayne Blakemore, “Social influence on risk perception during adolescence,” *Psychological Science* 26, no. 5 (2015): 583–592.
- Maartje Boer, Gonneke W. J. M. Stevens, Catrin Finkenauer, and Regina J. J. M. Van Den Eijnden, “The Course of Problematic Social Media Use in Young Adolescents: A Latent Class Growth Analysis,” *Child Development* 93, no. 2 (2022): e168–e187.
- Maria T. Maza, Kara A. Fox, Seh-Joo Kwon, Jessica E. Flannery, Kristen A. Lindquist, Mitchell J. Prinstein, and Eva H. Telzer, “Association of habitual checking behaviors on social media with longitudinal functional brain development,” *JAMA Pediatrics* 177, no. 2 (2023): 160–167.
- Mark D. Griffiths, Daria J. Kuss, and Zsolt Demetrovics, “Social Networking Addiction,” *Behavioral Addictions* (2014): 119–141.
- Mary A. Carskadon, “Sleep in adolescents: the perfect storm,” *Pediatric Clinics* 58, no. 3 (2011): 637–647.
- Merry Bullock, “Animism in childhood thinking: A new look at an old question,” *Developmental Psychology* 21, no. 2 (1985): 217.
- Michael Gradisar, Greg Gardner, and Hayley Dohnt, “Recent worldwide sleep patterns and problems during adolescence: a review and meta-analysis of age, region, and sleep,” *Sleep Medicine* 12, no. 2 (2011): 110–118.
- Michelle Achterberg, Andrik Becht, Renske van der Crujsen, Ilse H. van de Groep, Jochem P. Spaans, Eduard Klapwijk, and Eveline A. Crone, “Longitudinal associations between social

media use, mental well-being and structural brain development across adolescence,” *Developmental Cognitive Neuroscience* 54 (2022): 101088.

- Mitchell J. Prinstein, and Matteo Giletta, “Future directions in peer relations research,” *Journal of Clinical Child & Adolescent Psychology* 49, no. 4 (2020): 556–572.
- Nicola Luigi Bragazzi, Andrea Crapanzano, Manlio Converti, Riccardo Zerbetto, and Rola Khamisy-Farah, “The impact of generative conversational artificial intelligence on the Lesbian, gay, Bisexual, transgender, and queer community: scoping review,” *Journal of Medical Internet Research* 25 (2023): e52091.
- Nicola Luigi Bragazzi, Andrea Crapanzano, Manlio Converti, Riccardo Zerbetto, and Rola Khamisy-Farah, “The impact of generative conversational artificial intelligence on the Lesbian, gay, Bisexual, transgender, and queer community: scoping review,” *Journal of Medical Internet Research* 25 (2023): e52091.
- Ric G. Steele, Jeffrey A. Hall, and Jennifer L. Christofferson, “Conceptualizing digital stress in adolescents and young adults: Toward the development of an empirically based model,” *Clinical Child and Family Psychology Review* 23, no. 1 (2020): 15–26.
- Roberto Navigli, Simone Conia, and Björn Ross, “Biases in large language models: origins, inventory, and discussion,” *ACM Journal of Data and Information Quality* 15, no. 2 (2023): 1–21.
- Ronald E. Dahl, Nicholas B. Allen, Linda Wilbrecht, and Ahna Ballonoff Suleiman, “A Developmental Science Perspective on Investing in Adolescence,” *Nature* 554, no. 7693 (2018): 441–450.
- Se-Hoon Jeong and Yoori Hwang, “Does multitasking increase or decrease persuasion? Effects of multitasking on comprehension and counterarguing,” *Journal of Communication* 62, no. 4 (2012): 571–587.
- Shalini Paruthi, Lee J. Brooks, Carolyn D’Ambrosio, Wendy A. Hall, Suresh Kotagal, Robin M. Lloyd, Beth A. Malow et al, “Recommended amount of sleep for pediatric populations: a consensus statement of the American Academy of Sleep Medicine,” *Journal of Clinical Sleep Medicine* 12, no. 6 (2016): 785–786.
- Sophia Choukas-Bradley, Jacqueline Nesi, Laura Widman, and Brian M. Galla, “The appearance-related social media consciousness scale: Development and validation with adolescents,” *Body Image* 33 (2020): 164–174.
- Stephanie Van der Lely, Silvia Frey, Corrado Garbazza, Anna Wirz-Justice, Oskar G. Jenni, Roland Steiner, Stefan Wolf, Christian Cajochen, Vivien Bromundt, and Christina Schmidt, “Blue blocker glasses as a countermeasure for alerting effects of evening light-emitting diode screen exposure in male teenagers,” *Journal of Adolescent Health* 56, no. 1 (2015): 113–119.

- Stephen P. Lewis, Nancy L. Heath, Jill M. St Denis, and Rick Noble, “The scope of nonsuicidal self-injury on YouTube,” *Pediatrics* 127, no. 3 (2011): e552–e557.
- Susan Harter, *The construction of the self: Developmental and sociocultural foundations*, Guilford Publications, 2015.
- Susanne E. Baumgartner, Winneke A. van der Schuur, Jeroen S. Lemmens, and Fam te Poel, “The relationship between media multitasking and attention problems in adolescents: Results of two longitudinal studies,” *Human Communication Research* 44, no. 1 (2018): 3–30.
- Susanne E. Baumgartner, Wouter D. Weeda, Lisa L. van der Heijden, and Mariëtte Huizinga, “The relationship between media multitasking and executive function in early adolescents,” *The Journal of Early Adolescence* 34, no. 8 (2014): 1120–1144.
- Tanya Hawes, Melanie J. Zimmer-Gembeck, and Shawna M. Campbell, “Unique associations of social media use and online appearance preoccupation with depression, anxiety, and appearance rejection sensitivity,” *Body Image* 33 (2020): 66–76.
- Thomas R. Insel, and Russell D. Fernald, “How the brain processes social information: searching for the social brain,” *Annual Review of Neuroscience* 27, no. 1 (2004): 697–722.
- Winneke A. Van Der Schuur, Susanne E. Baumgartner, Sindy R. Sumter, and Patti M. Valkenburg, “The consequences of media multitasking for youth: A review,” *Computers in Human Behavior* 53 (2015): 204–215.
- Wolfram Schultz, “Reward Signaling by Dopamine Neurons,” *The Neuroscientist* 7, no. 4 (2001): 293–302.
- Xiaoning Han, Enze Zhou, and Dong Liu, “Electronic media use and sleep quality: updated systematic review and meta-analysis,” *Journal of Medical Internet Research* 26 (2024): e48356.
- Xuewen Wang and Arlette C. Perry, “Metabolic and physiologic responses to video game play in 7-to 10-year-old boys,” *Archives of Pediatrics & Adolescent Medicine* 160, no. 4 (2006): 411–415.
- Zachary McClain and Rebecka Peebles, “Body image and eating disorders among lesbian, gay, bisexual, and transgender youth,” *Pediatric Clinics* 63, no. 6 (2016): 1079–1090.

A.3. Websites, articles, and press releases

- “10 Things to Know About How Social Media Affects Teens’ Brains,” NPR, February 16, 2023, <https://www.npr.org/2023/02/16/1157180971/10-things-to-know-about-how-social-media-affects-teens-brains>.