

AMENDED Exhibit 546

PLAINTIFFS' OMNIBUS OPPOSITION TO DEFENDANTS' MOTIONS FOR SUMMARY JUDGMENT

Case No.: 4:22-md-03047-YGR

MDL No. 3047

In Re: Social Media Adolescent Addiction/Personal Injury Products Liability Litigation

Optimizing Long-Term User Utility with



Brain/SIR: [REDACTED], <add yourselves here>

Youtube: [REDACTED]@, <add yourselves here>

Reviewers: <add yourselves here>

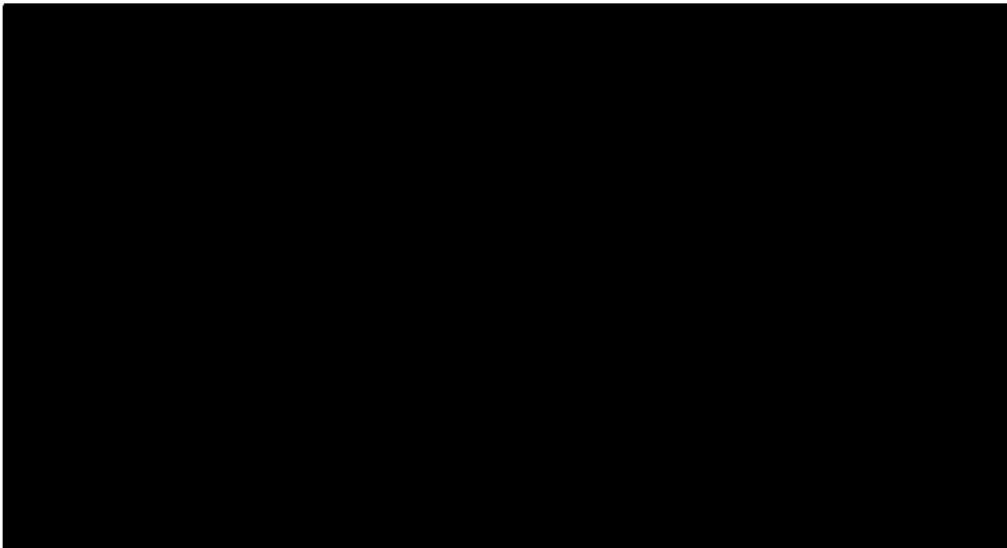
Self Link: [HYPERLINK [REDACTED] \h]

Status: Draft

Originally Proposed: 2020-10-13 / Last Updated: 2020-10-26

[TOC \h \u \z \t "Heading 1,1,Heading 2,2,Heading 3,3,Heading 4,4,Heading 5,5,Heading 6,6,"]

Problem Statement



Background & Motivation

Casual-to-Core (C2C) Initiatives

There have been a series of ongoing efforts on retaining less active users (low-state users / casual users) on YouTube by improving the recommendation experience for them ([HYPERLINK [REDACTED] \h]). On understanding user behaviors, there are extensive analysis on [REDACTED] ([HYPERLINK [REDACTED] "https://docs.google.com [REDACTED] \h]), [REDACTED] ([REDACTED] [REDACTED] ([HYPERLINK [REDACTED] "https://docs.google.com [REDACTED] \h]), [REDACTED] ([HYPERLINK [REDACTED] "https://docs.google.com [REDACTED] \h]). The goal of our work is closely aligned with the casual-to-core objectives.

Commented [1]: What are the key findings from this work?

Reward Shaping in YouTube Home Sequence Nominator

The reward for the YouTube Home Sequence nominator ([HYPERLINK \h]) has been defined as the [REDACTED] Some recent improvements on Home Sequence nominator focus on [REDACTED] ([HYPERLINK \h]), and incorporates [REDACTED] into the reward function ([HYPERLINK \h]). Our proposal is related to those reward shaping efforts. For example for the application in YouTube Home Sequence nominator, we can potentially incorporate an objective for [REDACTED]

Commented [3]: Thanks for the summary.

Commented [4]: How is this defined?

Commented [5]: Actually I raised the question too early. I think the rest of the doc describes finding patterns that correlate to the casual-to-core conversion.

Counterfactual Modeling of User Utility

One of the factors in YouTube Home ranking function ([HYPERLINK])

The recent proposal on optimizing for Daily Active Users (DAUs) relies [HYPERLINK "https://docs.google.com/"]\h).

Proposed Approach

Mining and Understanding User Long-Term Behavior

[REDACTED]
[REDACTED] [HYPERLINK
"https://docs.google.com

[REDACTED] \h]

[REDACTED] [HYPERLINK

[REDACTED] \h]

Mining: From Observational Data

Commented [6]:

[REDACTED] his should be very relevant.

Assigned to [REDACTED]

Commented [7]: Indeed, thanks for the reference!
Added here.

Commented [8]: Finding user behavior patterns will be
challenging but highly valuable, and might be
leveraged across the system beyond just the [REDACTED]

There is actually a data science team proposal to dig
into the same or very similar space, with the goal of
leveraging whatever insights they can find in
recommendation and notifications. Would it make
sense to join forces?
@ [REDACTED]

Commented [9]: yes, we would love to work with the
data science team together on the analysis. here're two
analyses we are
aware: https://docs.google.com [REDACTED]

https://docs.google.com [REDACTED]

please let us know who we should reach out.

Commented [10]: https://docs.google.com [REDACTED]

Commented [11]: Thanks! Added here.

Commented [12]: https://docs.google.com [REDACTED]

Commented [13]: Thanks for the reference!

Commented [14]: https://docs.google.com [REDACTED]

Commented [15]: Thanks for the reference!

Examples for user behavior patterns to look at are:

"https://docs.google.com

[REDACTED] [HYPERLINK

[REDACTED] \h]

[REDACTED] [HYPERLINK "https://docs.google.com [REDACTED]

• ... [REDACTED] \h]).

See [HYPERLINK [REDACTED] \h] for a design doc on the analysis which contains a complete list of patterns to analyze. It is worth pointing out that, as there is likely to be a number of user behavior patterns that correlate well with their longer term activities, **not** all of them can be easily leveraged by recommendation algorithms in shaping their future journey. For example, even if we know that watching more videos at 9pm on weekdays or increased searching behaviors are critical for users to get more engaged on the platform in the future, it would be hard to nudge existing users to watch in a different time or force them to search more¹. The user behavior patterns that are of our interest here are the ones we can *shape* through changes in recommendation algorithms. For example, user behavior patterns on the diversity of the contents/channel may instruct us to do better personalized diversification.

Understanding: From Counterfactual Experiments

Once we identify a few correlational factors, we can (optionally) run counterfactual experiments to verify the causality of those factors. For example, we find that watching more distinct channels/clusters are correlated with users converting from casual to core users. We can then

Optimizing Long-Term User Utility & C2C Conversion

With the counterfactual data, we would like to build models to learn the counterfactual signals and design recommendation algorithms that optimize for *long-term user utility*. As a simple example, if we identify content diversity as a causal factor for *casual-to-core conversion*, then it makes sense to develop a personalized diversification algorithm with long-term retention as the objective.

Commented [16]: You may already be aware of this effort, but we've built up some nice tools for running these randomized experiments and analyzing them in the Long Term Ranking project.

Commented [17]: Hi [REDACTED] thank you for the pointers! Yes would love to learn more about the ongoing efforts and join force on the potential intervention experiments. Will you be available for a meeting sometime to talk about potential next steps?

/cc @ [REDACTED] @ [REDACTED]

Commented [18]: Sure, open slots on my calendar (over limited time blocks okay) on afternoons MTW, F work for me. thanks!

[more technical details to follow]

Analysis

See [HYPERLINK "[REDACTED]" \h].

Reference

Internal

[1] Improve Experience for Low State Users: [HYPERLINK "[REDACTED]" \h].

[2] User Longitudinal Analysis ([HYPERLINK

"https://docs.google.com/[REDACTED]"
[REDACTED] "slide=id.p" \h]).

[3] Deep Dive: Analyzing User State Transition Analysis: [HYPERLINK [REDACTED]
[REDACTED] \h], [HYPERLINK [REDACTED] \h].

[4] Preliminary analysis on exploitation & exploration on Home for casual vs. core ([HYPERLINK
"https://docs.google.com/[REDACTED]"
[REDACTED] \h]).

[6] Understanding low state users: [HYPERLINK [REDACTED]" \h].

[7] Recurrent Modeling of YouTube Recommendations: [HYPERLINK [REDACTED]" \h].

[8] Launch Doc: Future Prediction in Home Sequence Nominator: [HYPERLINK
 [REDACTED] " \h].

[8] Imputing User Satisfaction in the reward of Home Sequence Nominator: [HYPERLINK
 [REDACTED] " \h].

[9] Home Ranking Function Discovery Check-In: [HYPERLINK " [REDACTED]"
 \h].

[10] Fanships Model: [HYPERLINK [REDACTED] " \h].

[11] Youtube Homepage Diversity 2020: [HYPERLINK [REDACTED] " \h].

[12] Optimizing for Recommender Impact on Daily Activity Uplift ([HYPERLINK
 "https://docs.google.com [REDACTED]
 [REDACTED] \h).

[13] How much long term signal is present in our data? ([HYPERLINK
 "https://docs.google.com [REDACTED]
 [REDACTED] "heading=h.l8nommcej2yx" \h).

[14] One-pager: Retention & Frequency Metrics Proposal for LR: [HYPERLINK [REDACTED]
 [REDACTED] \h].

[15] User-lifetime metrics: [HYPERLINK [REDACTED] \h].

[18] Discovery DAU Growth Plan: Approaching DAU Growth using Proxies and Long-Term
 Holdbacks: [HYPERLINK [REDACTED] \h].

[19] Exploration in Discovery: [HYPERLINK [REDACTED] " \h].

[20] Learned Packing Layer: [HYPERLINK [REDACTED] " \h].

[22] [HYPERLINK "https://docs.google.com [REDACTED]
 [REDACTED] \l "heading=h.qcnzjxy9i5pz" \h].

[25] [HYPERLINK
 "https://docs.google.com [REDACTED]
 [REDACTED] \h] (analysis from DS team).

[26] [HYPERLINK "https://docs.google.com [REDACTED]
 [REDACTED] \h].

[27] [HYPERLINK
 "https://docs.google.com [REDACTED]
 [REDACTED] \h] (qualitative analysis on Casual-to-Core).

[28] [HYPERLINK

"https://docs.google.com [REDACTED]

[REDACTED] \h].

[29] User Evolution and Planning: [HYPERLINK [REDACTED] \h].

[30] Sequential User Behavior Pattern Analysis: [HYPERLINK [REDACTED] \h].

[32] Home Return Head for Home Ranking Model: [HYPERLINK [REDACTED] \h].

External

