

with free-wheeling personal interaction can successfully be transferred to the online space. Technical solutions regarding proximity-graded sharing of virtual spaces such as GatherTown or Mozilla Hubs have potential here, but more innovation is needed. Making online conferences feel great and personal is the ultimate goal that we need to innovate towards.

### Concluding Remarks

Once the technical issues are resolved, online conferences can be organized by relatively small teams. Our experience, and that of others such as Federation of European Neuroscience Society Forum 2020 (<https://forum2020.fens.org/>), Organization for Human Brain Mapping (<https://www.humanbrainmapping.org/>), ICLR 2020 ([https://medium.com/@iclr\\_conf/gone-virtual-lessons-from-iclr2020-1743ce6164a3](https://medium.com/@iclr_conf/gone-virtual-lessons-from-iclr2020-1743ce6164a3)), and NeurIPS 2020 [14], has shown that online conferences have potential to establish a forum for scientific exchange with numerous advantages to physical meetings: less costly, environmentally friendly, more inclusive, and largely interactive. The Neuromatch Conferences serve as proof that moving conferences online can alleviate inclusivity issues associated by reducing the barriers to participation for people from many areas of the world [6], people who cannot afford expensive accommodation and registration, those subject to travel restrictions, or those with caring responsibilities who cannot leave for long periods of time.

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### Supplemental Information

Supplemental information associated with this article can be found online at <https://doi.org/10.1016/j.tics.2021.01.007>.

### Resources

<sup>i</sup><https://www.cis.upenn.edu/~cjtaylor/PUBLICATIONS/pdfs/TaylorTR08.pdf>

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### Letter

## On Corporate Responsibility When Studying Social Media Use and Well-Being

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We read the review on social media (SM) and well-being by Kross *et al.* [1] with great interest. We appreciate the overview and avenues discussed by the authors to improve research in this vivid area. From our perspective, the most important take-home message from Kross *et al.* is that whether SM ‘enhances or diminishes well-being depends on how and why people use it, as well as who uses it’ (page 55). In light of many findings illustrating small effect sizes when investigating single associations between a variable, such as personality, and SM use [2,3], we share the opinion that considering each of the how, who, and why questions independently will not provide a complete picture of the relationship between SM use and well-being. Such insights can only be derived when the dynamic interplay of many important variables is considered (see Key Figure in [1]).

What was addressed at the end of Kross *et al.* under the term ‘platform-centered interventions’ (page 64) in our view represents perhaps the most relevant research focus to be followed in the SM well-being

complex; aside from raising questions, such as whether passive SM use causes more problems than active SM use, one might wonder how and why people are constantly lured into SM platforms to increase their screen time.

As for the how question, push notifications, read receipts, likes, and other features are commonly thought to ‘nudge’ people to spend excessive amounts of time on SM [4,5]. However, we lack numbers describing the actual influence of these features on usage time. Of note, psychological processes, such as Fear of Missing Out (FoMO), that are triggered by design elements and were highlighted in Kross *et al.* are robustly linked to negative affect [6]. Psychological processes related to upward social comparison (e.g., comparing number of likes or followers) were also mentioned in the review by Kross *et al.* as having the potential for lowering well-being.

As for the why question, the main reason is the data business model (DBM). In essence, every SM user pays with his/her own data for the allowance to use a SM service instead of paying with actual money. The user data, in turn, can be used to create individual in-house user profiles, which can be targeted with ads. By offering the possibility of targeted advertisement, SM platforms earn money. To enhance payoffs, targeting must become more precise, which can be achieved by collecting more user data. This, in turn, can be accomplished if users spend more time on the platforms supported by SM design [4]. In addition, many SM platforms systematically present content the user will most likely react to, and this can be personalized information or highly emotionalized content [7,8]. The business logic behind this is that each reaction reveals more information about the user and makes her/him an easier target for advertisement purposes.

As a consequence of this DBM, we believe that it is essential to ask which design elements of SM platforms impact users’ time spent on SM and, in turn, well-being [4]? This question can be expanded by taking into account personal characteristics and reasons of usage as well as how SM is used [9]. Following such an agenda would supplement Kross *et al.*’s view that each SM service can only be compared with another service to some extent, as they differ in their architecture and ‘addictive potential’ [10]. As a consequence, research needs to shift attention to the question of how SM services should be designed to foster well-being (in Kross *et al.*’s work ‘platform-centered interventions’, page 64). The ethical design manifesto (<https://2017.ind.ie/ethical-design/>), as proposed by ind.ie, might provide some initial ideas on which direction to take [7].

Answers on how to design a healthy SM architecture ultimately can only be provided by studying the abundantly existing objective SM user data; unfortunately,

these data are often only available to the companies. We are of the opinion that these kinds of data need to be shared with independent scientists under strict guidance of external oversight boards and ethical principles (Box 1). Currently, scientists need to spend taxpayer money on ‘reverse engineering’ of SM platforms, hence mimicking existing platform design in experiments where such data would actually be available. SM companies are still ‘black-boxes’ not sharing this kind of information, and the recent initiative from Facebook, called Social Science One, failed to help in this context [7,11].

Ultimately, the study of the SM well-being complex must also seriously consider alternatives to the current DBM. Would a monetary payment model be better for the well-being of SM users than the DBM [12]? For instance, for a reasonable subscription fee, users could expect that the design of SM platforms will not aim at prolonging online time or will respect the privacy of its users [7,12]. Perhaps another alternative would be if SM

#### Box 1. Towards Sustainable Social Media Platforms via Cooperation Between Social Media Companies and Independent Scientists

As social media (SM) platforms currently are ‘black boxes’, we proposed in this article that SM companies share data with independent scientists. For such projects, applying high research and privacy standards as proposed by ethic committees (ECs) is important to meet concerns regarding data protection. From our perspective, at least two approaches are crucial to help design SM services to reduce detrimental effects on SM users and foster well-being. First, existing data, including information allowing for the study of associations between usage of SM platforms and users’ well-being, should be shared with researchers for independent review and research purposes. Second, if research questions regarding platform design and well-being cannot be answered with existing data, independent scientists should be able to implement such research via the SM platform after consultation with an EC. This would include an in-depth discussion of study design, hypotheses, power analysis, and data protection plans.

Moreover, a few SM companies have become powerful, and their service not only impacts well-being of users but also public discourse. Therefore, we believe it is necessary to monitor the activities of SM companies to protect the users and society from both data scandals and related harm. Accordingly, we are convinced that it is also necessary that changes in platform design implemented by SM companies should undergo approval from ECs because billions of users are affected by such changes.

We argue that SM companies should profit from transparency that can result in higher trust towards a SM platform/company, which is currently lacking. SM companies have mostly denied data access for independent scientists. We are convinced that it is time to implement a right to data access for independent research that has gone through standard evaluation processes. If SM companies are not willing or not able to cooperate in this quest for transparency, the alternative must be to make a public good out of SM.

represented a public good, public SM platforms could be funded by taxpayer money. If the decision is to keep SM private, there should be more rigorous methods of oversight of these companies.

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Spotlight

Visual and Semantic Contributions to Visual Short-Term Memory

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**Liu *et al.* recently demonstrated novel neural evidence for visual and semantic contributions to the encoding and maintenance of object information in a delayed match-to-sample task. Their data highlight the close interaction between sensory experience and prior semantic knowledge in human visual short-term memory for naturalistic stimuli.**

At any instant, our ability to grab on to and remember the information presented in the visual world relies upon our visual short-term memory (VSTM). This core mental faculty briefly retains a small amount of information to support a wide array of mental processes ranging from lower-level trans-saccadic perception to higher cognition [1]. Conventionally, VSTM is considered separate from prior semantic knowledge stored in long-term memory (LTM). To identify unique phenomena in VSTM, previous research has employed simple stimulus features such as color, orientation, and novel shape in studies of VSTM [1]. However, this practice often does not take into account the rich details that are available in our everyday visual environment. Emerging research in cognitive science has therefore turned to using more complex stimuli in experimental

studies in order to improve our understanding of visual cognition in more naturalistic settings [2,3].

The study by Liu and colleagues [4] builds upon these recent efforts by directly recording from the human brain with intracranial electroencephalography (iEEG) during a delayed match-to-sample task using images of real-world objects. Liu *et al.* asked observers to first encode an arbitrary word-object pair and then retain the information about the object while only the word cue remained on the screen for a few seconds. They analyzed similarity patterns of iEEG activity during encoding and maintenance of the same object across different repetitions to identify item-specific neural profiles about the object. They then introduced a novel analysis in which they correlated these neural profiles with visual features of the objects derived from a deep neural network (DNN) and with semantic features of the objects. They observed that both visual and semantic information is represented in the human brain during the early and late phases of VSTM encoding, respectively. This observation is consistent with rich behavioral observations for the contributions of semantic information to rapid visual processing [5]. They then found that both visual and semantic information about the objects appears to have stable representations throughout the 7-s delay period, but these representations during maintenance exhibit fluctuations that often wax and wane. When these representations are more prominent appears tied to the phase of low-frequency activity in the hippocampus.

Liu *et al.*'s findings provide novel insights for our understanding of how visual sensory experience and prior semantic knowledge may be integrated in the formation of human VSTM and also raise some interesting questions about the interaction between VSTM and LTM.