Author response to reviews of

Benefits and risks associated with children's and adolescents' interactions with electronic screens: An umbrella review

Taren Sanders on behalf of co-authors
submitted to *Nature Human Behaviour*

[RC] Reviewer comment Manuscript text

Dear Dr Charlotte Payne,

Thank you for considering our manuscript for publication at *Nature Human Behaviour*. We appreciate the feedback that you and the reviewers have provided. In the following itemised list we respond to each comment point-by-point.

1. Reviewer 1

RC: **COMMENT 1**

As the authors note, "screen time" as a metric is highly criticized and problematic. This begs the question, though, of whether a wide-scale review of this sort, which retains a focus on screen time (although it also acknowledges other more nuanced metrics of exposure), is further perpetuating the issues seen by the broader field.

AR: We agree with the reviewer that the term 'screen time' is problematic. Indeed, as our results show, the influence of screen time on children is a less a function of a physical screen, and more a function of the activity that the screen provides. But, we feel that a review such as this is needed in order to emphasise the diverse influence that screens can have. If the results are not collated into a single place, it is difficult to see how the field will begin to progress away from 'screen time' as a concept. We have included this in the *Implications for Future Research* section:

> Our results highlight the need for the field to more carefully consider if the term 'screen time' remains appropriate for providing advice to parents. Instead, our results suggest that more nuanced and detailed descriptions of the behaviours to be modified may be required. Rather than suggesting parents limit 'screen time', for example, it may be better to suggest that parents promote interactive educational experiences but limit exposure to advertising.
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RC: **COMMENT 2**

The authors note that "no review has synthesized the evidence available across a broad range of outcome domains, such as physical health, education, physical and cognitive development, behaviours, and wellbeing." The authors end up concluding that there are different magnitude and directions of

associations for different outcomes and exposures (and, indeed, the mechanisms of these are highly different depending on the predictor-outcome combination), which makes me wonder whether casting such a wide net is helping the reader understand more or less about the research to date on technology use and child/adolescent outcomes? I would want to hear more justification in the manuscript itself on why they assert it is helpful to try and paint them with one broad brush?

AR: **Work in progress**

Suggestions welcome here

Our goal with this review was to provide an overview of the field of screen time research. A summary of the field will, out of necessasity, be more broad that a typical systematic review. We beleive that there is significant value in providing a single overview to summarise the state of the field. We have added some additional information to the introduction on this point.

> Yet, no review has synthesised the evidence available across a broad range of outcome domains, such as physical health, education, physical and cognitive development, behaviour, and well-being. We aim to provide a summary on the current research into children's screen time. By summarising and synthesising all evidence in one overview, we provide a reference point for the field and allow for easier comparison of risks and benefits for the same behaviour.
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RC: **COMMENT 3**

Page 10 notes that the study "examined the combinations of exposure and outcomes and removed any effects that appeared more than once, keeping the effect with the largest total sample size." Did this take into consideration whether some meta-analyses of the same exposure-outcome pairs may have included mostly different studies (i.e., because they focused on different date ranges or some other inclusion criteria)?

AR: We intended to include the review which best captured the information on the exposure/outcome combination. The assumption was that the largest review would be the most recent, unless a more recent review had been targeted at a specific population (e.g., those with a disability). Manual inspection of the reviews which did not contribute any effects suggests that this heuristic was successful.

Does anyone know if we based this on a previous review? It's not cited in the registration.

RC: **COMMENT 4**

Causal language- The present study sought to "provide a holistic perspective on the influence of screens on children's lives across a broad range of outcomes," but I am not convinced that the studies included in the meta-analyses are designed in ways that allow us to understand causal IMPACT at all. Many have criticized this literature for being largely self-reported (with flaws inherent to this method, which are reviewed in the present manuscript's discussion), observational, and cross-sectional, with very few rigorous experimental or well-controlled longitudinal designs that would enable researchers or the public to draw robust conclusions about the direction of associations. I fear that this comprehensive review, though rigorous, does not adequately attend to the fact that we do not usually know whether screens are causing helps or harms for youth, if different types of youth behaviors may be causing them to engage more with screens (e.g., sedentary youth may seek out more screen time; depressed youth may turn more to social media as an avoidance strategy), or if indeed there are third variables driving observed associations. Although the review here does a great job of summarizing the direction and strengths of associations across studies, I fear that it does not attend to these important issues in terms of how one ought to interpret them.

AR: Yes, we agree that the body of evidence does not lend itself to strong causal conclusions. We note that we deliberately chose to avoid using strong causal language as much as possible, instead indicating that the evidence suggests associations with outcomes. We have reread the manuscript and removed any remaining causal language that we found. We have also added the following to the *Discussion* section:

> Our high-level approach also means that we could not engage with the specific mechanisms behind each association, and as such, we cannot comment on the evidence for causality. Instead, readers who wish to more deeply understand one specific relationship are directed to the cited review for that effect, where the authors could engage more deeply with the mechanisms.
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Note that we do use causal langauge when describing hypothesised mechanisms, and when describing guidelines. We feel that this is sensible — guidelines are based on causal assumptions, and while our evidence does not always support them, we are refering to them in the context that they are made (i.e., to instruct parents).

RC: **COMMENT 5**

The manuscript notes that the nature of the data allowed for few age-based conclusions- I fear that this is a substantial limitation that deserves more discussion. It seems difficult to characterize all children's media use from age 0-18 in the same way, especially across such a wide range of developmental outcomes. A more nuanced treatment of developmental considerations would have been appreciated.

AR: One of the benefits of the other reviewers' and editor's suggestion to update the search is that some of this limitation has been addressed in more recent literature. Newer papers were more likely to provide moderation by age group, or new reviews targeting specific age groups were now available. Unfortunately, many of these still failed to meet our criteria for statistical certainty. Inspecting the results in the supplementary material still reveal fewer differences by age group than may be expected. In some cases this is because there is still only an effect for a single age group, as many reviews target behaviours or outcomes which are more common in one age group (e.g., sexting in adolescents, or developmental outcome in young children). For the effects where there were multiple age groups, differences tended to be small (e.g., body composition).