Commentary: Let's get digital: a commentary on Halldorsson et al.'s call for more rigorous development and evaluation of immersive digital interventions for children and young people's mental health

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With the growth and spread of the Internet, and continued rapid pace and accessibility of digital hardware and software – such as tablets, smartphones and wearables – there has been a concomitant interest in how these digital technologies can be harnessed to improve health. This includes applications to mental health, where there are numerous opportunities for digital technologies, and the data they produce, to impact on mental health care. Digital technologies can help systems be more proactive and provide more personalised care, and connect patients and healthcare professionals across the cycle of health promotion, prevention, treatment and recovery (Hollis et al., 2015). In 2020, one in six children and young people in the UK had a probable mental disorder – yet only a quarter of these had been in contact with mental health specialists (Vizard et al., 2018). Evidence-based digital health interventions (DHIs) offer an opportunity to narrow the gap between service need and service use. Researchers have reasoned that DHIs may be particularly effective in expanding access to and improving take-up of treatments for young people in need because they are already such high users of technology. However, this presumes that children and young people share a similar view of DHIs within their mental health care and treatment.

The review by Halldorsson and colleagues focuses on two approaches in which DHIs have been harnessed for children and young people's mental health and also explores children and young people experience of receiving treatment through digital methods. The first approach relates to taking the aspects that make video games engaging and incorporating them into mental health DHIs: this approach is typically called *serious games* or *applied games*. The second approach involves the use of virtual reality (VR) to treat mental health problems. VR has been used in adult populations to deliver therapy and virtual exposure for conditions including anxiety, phobias and psychosis (Cieślik et al.,

2020). The price and availability of VR headsets have decreased rapidly in recent years. Google Cardboard allows users to convert their smartphone into a VR headset in a simple and cheap manner, while fully integrated VR headsets – such as the Oculus and HTC Vive – have rapidly developed from wired to wireless technologies and steadily decreased in cost, making them more affordable and accessible to the general public.

The systematic review by Halldorsson and colleagues provides an up-to-date synthesis of studies looking at the effectiveness of applied games and VR interventions on children and young people's mental health. The review found 19 studies meeting eligibility criteria – this reflected nine distinct applied games and two VR applications. Several of the included papers evaluating applied games were authored by two research groups, with appropriate experimental designs (e.g. RCTs) used to evaluate DHIs. The applied games evaluated mostly took a cognitive behavioural therapy (CBT) approach and focused on treating elevated anxiety or depressive symptomology in children and young people. Evidence for the two VR applications was more limited, with smaller samples when compared to the applied games studies and only one RCT found.

Looking at symptomology change, four of the six studies evaluating the *MindLight* applied game found small-to-large post-treatment effects upon child- and parent-rated anxiety outcomes, but greater symptom reduction was not found when compared to another nontherapeutic game. Likewise, the three out of the four studies using SPARX to treat depression found medium-to-large group effects at post-treatment and follow-up. Finally, the three studies using VR used this to treat specific phobias, with two studies finding small-to-medium effect sizes on reducing child- and parent-reported anxiety and phobia symptoms.

The authors also rated the quality of the 19 included studies: while quantitative studies were strong in describing participant eligibility and sample selection, they lacked more in describing randomisation

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techniques, providing adequate detail about outcome measures and minimal information about blinding research personnel. The included qualitative studies tended to be limited in applying findings to relevant theory and how the data were collected.

In addition to exploring the impact of applied games and VR interventions on mental health symptomology, Halldorsson and colleagues also looked at data collected by researchers using several methods (including completion rates, satisfaction questionnaires and interviews) on children and young people's experience and engagement with the interventions. The review found that applied games were often viewed as helpful and enjoyable, and both they and those using VR improved adherence. However, children and young people also reported that they did not always find the interventions relevant to their mental health. These mechanisms of change are important, as they are predictors of symptomology change (Andersson, 2018). Within this review, participant 'experience' reflected many different aspects of using the intervention, and the terms *adherence*, *acceptability* and *engagement* have been mentioned several times. It is important to note their differences as they can often be used interchangeably in digital mental health research (Sieverink, Kelders, & van Gemert-Pijnen, 2017). Furthermore, these outcomes were evaluated in different ways – for example, subjective measures, such as self-reported use of intervention vs. more objective measures such as examining analytics collected from automated data within the software – and are something to consider in interpreting evidence. More research is needed to explore how children and young people's user experiences shape interventions and their delivery: complex interventions with many different components require a complex evaluation. Finally, we need to better understand the negative consequences that can occur – not just in thinking about the adverse outcomes that would typically be considered in delivering mental health interventions, but additional areas introduced by the move to digital such as data security, confidentiality and children and young people's feelings around involvement in their treatment (Murray et al., 2016).

Of notable interest within Halldorsson et al.'s review is that several interventions targeted children and young people across a broad range of ages, meaning children were at differing levels of development and as such have different support needs in completing the intervention. Traditionally, the therapist can play the role of tailoring an intervention to support the individual but, as one of the benefits highlighted in DHIs is the reduced need for therapist input, it is important to consider different ways this can be done. In a qualitative meta-synthesis of adults' experiences of computerised CBT for common mental health problems, Knowles et al., (2014) report that mental health DHIs require the user to take responsibility and tailor the intervention

content by themselves. This may be challenging for children and young people, who may still be learning what their needs are, and an area where parents/caregivers could provide support. The authors acknowledge the important role of parents/caregivers in supporting their child's engagement in implementing the intervention, but evidence regarding this is lacking, perhaps as little research has involved younger children who are more dependent on parental support (Bergin et al., 2020). Some DHIs do involve complementary aspects for parents/caregivers that align with what their child is undertaking in the intervention. For example, the online CBT-based *BRAVE* programme (www.brave-online.com) has sessions specifically for parents, while the ORBIT trial involves an online behavioural therapy intervention (*BIP TIC*) that has corresponding sessions for parents focusing on coping strategies and how to support their child's learning (Hall et al., 2019). In evaluating such interventions, one approach could be to look at parental involvement as a potential mediating factor upon their child's mental health outcomes.

The present review found that many children and young people did not consider the applied games fully relevant to their mental health needs. Our recent scoping review found that relevance was key to implementation (Bergin et al., 2020). One way to address this is through co-design processes: Halldorsson and colleagues acknowledge that the included studies appeared to make little reference to co-design in designing their interventions. We know that co-design is important in mental health research, not only in logistical aspects of studies and designing interventions to be relevant to their needs, but also in addressing how children and young people see novel digital technologies fitting within their treatment. Furthermore, the nature of publishing research (e.g. word limits of manuscripts, cost of publication, funding to publish) means it may be difficult for researchers to adequately share the co-design and involvement processes that they have undertaken. A place where researchers can share these is needed, so that we can work better together in achieving adequate co-design.

Within the review, three of the included studies evaluated *SPARX* (an applied CBT-based game: www.sparx.org.nz) and overall found medium-to-large effects in improving depressive symptomology and remission status. It is worthy to note that SPARX has been an ongoing, iterative project, both in research and commercially, across many years and is available free of charge to New Zealand residents. It has been improved and tested in several settings and populations, such as for LGBT + youth and outside of New Zealand. This highlights how an existing DHI can be adapted and translated into different languages and cultures, rather than starting a new intervention from scratch. Taking this approach – getting interventions that work in one

context and adapting and trying them out in another – could be an effective and efficient use of research resources and funding. Evidence of *SPARX*'s effectiveness, which stands out clearly within this review, should reinforce that the more effective digital mental health interventions are those that have been invested in, have taken a longitudinal approach to development and design, and are reflective of working with multiple stakeholders and across disciplines, and improving as the technologies evolve. This is not an easy and quick process, and certainly not cheap to achieve. While health economic evaluations, which this review finds few of, are an important component of health research, it is also important to consider the broader value proposition of DHIs, especially as digital technologies become cheaper and more ubiquitous.

Halldorsson and colleagues conclude their review by highlighting a number of limitations arising from the current small field of studies – and these limitations should also be considered in the context of evaluating more traditional treatments within this population. Certainly, while more established face-to-face interventions can be adapted to the different needs of patients by the clinicians delivering them, this kind of adaptation is more complex in DHIs that are self-delivered or automated. However, many traditional treatments and services are also not co-designed and yet children and young people's non-adherence and nonengagement are not considered the fault of the intervention's 'design'. Variability and nonengagement in treatment approaches are often overcome in traditional services through utilisation of different tools and methods by the clinician (e.g. a simple phone call to check in), suggesting that there is a need for more DHIs to be delivered as part of a package of care, for instance through platforms with multiple treatment components which can be delivered and tailored as needed for the patient. Something that could be useful here is to see how children and young people's opinions of digital interventions contrast with traditional therapeutic interventions (e.g. face-to-face CBT), and whether digital tools could help *enhance* or *complement* the therapy experience, rather than *replacing* it. In the review, the exclusion of studies that used games within a wider treatment package may make the presumption that applied games alone will be able to emulate entire treatment packages, whereas DHIs may be more suitable as tools to be used in adjunct with or to enhance therapeutic processes rather than replace them. Clinicians and researchers will need to work alongside children and young people to explore how DHIs can be personalised to the individual, with potential applications of machine learning and Artificial Intelligence. Without this understanding, it is unlikely that the more traditional treatments can be accurately or effectively ported as they are to a digital means of delivery.

Finally, it is important to consider the inclusivity and diversity of recruitment to studies evaluating DHIs for children and young people. There is a digital divide in access to technology and the Internet, and the current COVID-19 pandemic has substantially highlighted this issue and socioeconomic inequalities in access (Watts, 2020). Our recent scoping review of 21 preventive mental health DHIs for children and young people found limited reporting of socio-demographic risk factors for mental health, such as socioeconomic status and ethnicity (Bergin et al., 2020), meaning there may not be sufficient evidence for the populations that are in most need of mental health support. In addressing these inequalities in access, a related issue to think about is where these DHIs are best placed: for example, are they accessed in the home, in the child's school or integrated within clinical services? Each location presents additional issues in practicability, implementation and engagement – it is not a straightforward process as emphasised by the silos of traditional care.

In conclusion, Halldorsson and colleagues' systematic review has provided valuable information about where we currently stand with applied games and virtual reality interventions for children and young people's mental health. A big challenge now is how to move forward in addressing the limitations that they have identified and trying to understand who DHIs work for, where, and in what conditions.

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References

Andersson, G. (2018). Internet interventions: Past, present and future. *Internet Interventions, 12*, 181–188.

Bergin, A.D., Vallejos, E.P., Davies, E.B., Daley, D., Ford, T., Harold, G., ... & Hollis, C. (2020). Preventive digital mental health interventions for children and young people: a review of the design and reporting of research. *NPJ Digital Medicine, 3*, 133.

Cieślik, B., Mazurek, J., Rutkowski, S., Kiper, P., Turolla, A., & Szczepańska-Gieracha, J. (2020). Virtual reality in

psychiatric disorders: A systematic review of reviews. *Complementary Therapies in Medicine*, *52*, 102480.

Hall, C.L., Davies, E.B., Andrén, P., Murphy, T., Bennett, S., Brown, B.J., . . . & Hollis, C. (2019). Investigating a therapist-guided, parent-assisted remote digital behavioural intervention for tics in children and adolescents—'Online Remote Behavioural Intervention for Tics' (ORBIT) trial: protocol of an internal pilot study and single-blind randomised controlled trial. *British Medical Journal Open*, *9*, e027583.

Hollis, C., Morriss, R., Martin, J., Amani, S., Cotton, R., Denis, M., & Lewis, S. (2015). Technological innovations in mental healthcare: Harnessing the digital revolution. *British Journal of Psychiatry*, *206*, 263–265.

Knowles, S.E., Toms, G., Sanders, C., Bee, P., Lovell, K., Rennick-Egglestone, S., . . . & Bower, P. (2014). Qualitative meta-synthesis of user experience of computerised therapy for depression and anxiety. *PLoS One*, *9*, e84323.

Murray, E., Hekler, E.B., Andersson, G., Collins, L.M., Doherty, A., Hollis, C., . . . & Wyatt, J.C. (2016). Evaluating digital health interventions: Key questions and approaches. *American Journal of Preventive Medicine*, *51*, 843–851.

Sieverink, F., Kelders, S.M., & van Gemert-Pijnen, J.E. (2017). Clarifying the concept of adherence to ehealth technology: systematic review on when usage becomes adherence. *Journal of Medical Internet Research*, *19*, e402.

Vizard, T., Sadler, K., Ford, T., Newlove-Delgado, . . .T., McManus, S., Marcheselli, F., & Cartwright, C. (2018). NHS Digital Mental Health of Children and Young People in England, 2017. London: Health and Social Care Information Centre. Retrieved from https://digital.nhs.uk/data-and-information/publications/statistical/mental-health-of-children-and-young-people-in-england/2017/2017

Watts, G. (2020). COVID-19 and the digital divide in the UK. *The Lancet Digital Health*, *2*, e395–e396.