Les écrans interactifs

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Quels effets ont les téléphones intelligents et les réseaux sociaux ?

Les téléphones ont aujourd'hui la particularité de pouvoir être utilisés pour de multiples raisons, incluant la recherche d'information, la détente, les interactions sociales ou encore le divertissement[1]. Mais, malheureusement, **une utilisation excessive peut entraîner des problèmes chez certains individus, notamment lorsqu'elle interfère avec le travail, l'école ou la vie sociale[2].** Une telle utilisation peut alors impacter négativement sur la santé mentale (dépression, anxiété)[3] aussi bien que physique (par exemple problèmes de dos)[4–6], ainsi que la productivité[7] ou les performances scolaires[8]. **On peut aussi observer des symptômes d'addiction lorsque l'individu n'a pas accès à son téléphone[9].** Certains traits de personnalité semblent favoriser cette utilisation excessive, comme le besoin d'être rassuré, l'impulsivité, et l'extraversion[2]. Les réseaux sociaux sont considérés comme étant la cause principale de l'utilisation problématique du téléphone[10].

Alors est-ce que l'utilisation des réseaux sociaux peut clairement avoir des effets négatifs ?

Cette question reste controversée. Certaines études ont montré que le temps passé sur les réseaux sociaux favorise les émotions négatives (tristesse, culpabilité)[11,12], une mauvaise image de soi[13], et que réciproquement des états dépressifs ou d'anxiété favorisent l'utilisation des réseaux sociaux[14,15]. Pourtant, **des méta-analyses ne rapportent que de faibles corrélations entre l'utilisation des réseaux sociaux et des mesures de bien-être, d'estime de soi, de dépression, de solitude[16] ou de performances scolaires[17]**. D'autres variables comme le type d'utilisation, l'âge de la personne, ses traits de personnalité ou encore son milieu socioculturel doivent donc être prises en compte.

Quels effets ont les jeux vidéo divertissants ?

Dans les pays dits « développés », plus de 1,2 milliard d'individus joueraient régulièrement à des jeux vidéo, incluant plus de 80 % des enfants à partir de huit ans[18–20]. Concernant les jeunes enfants, on sait que l'utilisation d'appareils électroniques mobiles (téléphone, tablette) par les parents réduit significativement la quantité d'interactions qu'ils ont avec leurs enfants[21,22], ce qui peut avoir un impact sur leur développement.

On sait aussi que **la plupart des jeunes enfants commencent aujourd'hui à interagir avec une tablette ou un téléphone avant l'âge d'un an**[23], et que **cela peut avoir possiblement des conséquences négatives sur leur développement cognitif**[24] **et sur leur sommeil**[25]**.** Par contre, **chez les enfants plus âgés et les adolescents, jouer à des jeux vidéo a, bien au contraire, des effets positifs sur les compétences perceptuelles, attentionnelles ou cognitives, selon celles que les jeux auxquels ils jouent sollicitent**[26–29]**.** Ainsi, bien évidemment, jouer à un jeu vidéo calme qui ne sollicite pas énormément ces compétences (par exemple, *Farmville*) n'aura pas le même effet qu'un jeu d'action qui les sollicite davantage (par exemple, *Call of Duty*). L'âge reste aussi un facteur important, et **les effets bénéfiques n'apparaissent que pour les jeux qui ont été conçus pour le groupe d'âge testé**[27,28]
.

Du point de vue de la santé mentale, certains travaux suggèrent que **les jeux vidéo peuvent avoir un effet positif sur la motivation, l'humeur et la vie sociale**[30,31]**, voire augmenter la créativité parmi les enfants plus jeunes**[32]. Il existe aussi plusieurs études montrant que **jouer à des jeux coopératifs ou à des jeux dit prosociaux (par exemple *Spock*), dans lesquels on doit aider d'autres personnages, induisent davantage d'empathie et de comportements d'entraide en dehors du jeu**[33–36]. Chez des enfants et des adultes subissant une chimiothérapie ou devant être anesthésiés, jouer aux jeux vidéo semble même pouvoir réduire l'anxiété et les nausées[37–39].

Mais que sait-on sur les jeux violents ?

L'idée que jouer aux jeux vidéo violents entraînerait des comportements violents reste aujourd'hui très controversée dans la communauté scientifique[40,41]. Ce n'est pas étonnant étant donné que plusieurs travaux, et notamment des méta-analyses récentes, n'aboutissent pas aux mêmes conclusions. Certains confirment ce lien[42–45], d'autres non[46–50]. Un article récent parle même de guerre de méta-analyses[51] ! **Les raisons sont liées à la diversité des variables et des études prises en compte, et qui peuvent varier énormément concernant la manière dont l'agressivité a été mesurée (sur quelle durée ? Sur quelle population ? Avec quels jeux ? ...),** sans parler des biais de publication qui restent difficiles à contrôler (comme la tendance qu'ont les études qui trouvent des effets spectaculaires à être davantage publiées). **Une analyse récente concernant les données issues de toutes ces méta-analyses conflictuelles, réalisée en collaboration avec leurs principaux auteurs, conclut que globalement, dans la grande majorité des cas, les jeux violents augmenteraient bien les comportements agressifs, mais que ces effets restent presque toujours très faibles**[51]**.**

Et que sait-on sur les gros joueurs ? Peut-il y avoir des problèmes d'addiction aux jeux vidéo ?

Plusieurs études soulignent que **certains enfants, qui jouent plus de trois heures par jour, peuvent perdre le contrôle au point que jouer aux jeux vidéo entraînerait des problèmes d'isolement social, de mauvais résultats scolaires, de dépression, d'anxiété et de sommeil**[52–57]**. L'enfant peut alors devenir extrêmement irritable et agressif si les parents tentent de limiter l'accès aux jeux vidéo**[58]. Plusieurs études rapportent qu'entre 3 et 8 % des adolescents et jeunes adultes souffrent de ce type de problème avec les jeux vidéo[59,60], et les garçons auraient environ cinq fois plus de chances que les filles d'être concernés[61]. Ce type de problème avec les jeux vidéo a, par ailleurs, été associé avec de l'impulsivité, des troubles du déficit de l'attention avec hyperactivité[62,63], de l'agressivité[63–65], de la timidité ou de l'anxiété sociale[57,61,66,67], de l'anhédonie[61,68] et de la solitude[69].

Certains chercheurs ont même commencé à parler très sérieusement de possible addiction aux jeux vidéo ou à internet[70–72], mais cela reste controversé. Très rapidement, d'autres chercheurs se sont manifestés pour exprimer leur désaccord pour plusieurs raisons. Tout d'abord, on ne voit pas de symptômes physiologiques d'habituation en cas de jeu régulier, ou de sevrage quand un individu est privé d'écran. Ensuite, parler d'addiction risque de détourner l'attention d'autres facteurs comme l'environnement de l'enfant qui peuvent être à l'origine des comportements à problèmes[70,73,74].

Quels effets ont les jeux vidéo éducatifs ? Fonctionnent-ils vraiment ?

Depuis plusieurs années, les tablettes et les ordinateurs apparaissent dans les écoles, souvent dès la primaire[75]. Les jeux éducatifs numériques sont des jeux conçus pour être à la fois agréables, motivants et éducatifs. Certains jeux sont conçus pour acquérir des compétences scolaires, d'autres pour améliorer la santé physique ou mentale. Alors sont-ils vraiment efficaces ?

En ce qui concerne les jeunes enfants, même s'il n'y a encore que trop peu d'études pour pouvoir généraliser à tous les contenus, **les quelques méta-analyses et revues de littérature scientifique récentes rapportent des effets bénéfiques du numérique sur les compétences littéraires, mathématiques et sociales chez les jeunes enfants de moins de six ans, surtout lorsqu'ils sont utilisés avec un parent ou un éducateur**[76–78]**.**

Pour les enfants plus âgés ou les adolescents, **plusieurs méta-analyses sur le sujet existent et s'accordent toutes sur l'efficacité des jeux éducatifs numériques pour aider aux apprentissages, notamment à l'acquisition de connaissances**[79–83]**.** La question est donc maintenant de savoir comment les utiliser pour s'adapter au mieux au niveau et au besoin de chaque élève. On sait, par exemple, que les tablettes semblent être plus efficaces que les ordinateurs de bureau (en favorisant le déplacement et les interactions entre élèves). Le numérique semble être plus efficace lors

d'apprentissages inquisitifs/actifs que lors d'apprentissages passifs, dans des cadres informels (comme lors de sorties scolaires) plutôt que formels (en classe), et que les durées courtes (moins de six mois) sont plus efficaces que les durées longues, car le support numérique est alors en général plus ciblé, mieux encadré par l'enseignant et l'effet de nouveauté favorise l'engagement des élèves[84].

Concernant la santé physique, **adopter un mode de vie plus sain reste un défi, souvent à cause de problèmes de temps et de motivation**[85,86]. Des jeux vidéo ont alors été conçus pour surmonter ces obstacles, ainsi que d'autres logiciels ou applications qui intègrent des éléments typiques des jeux vidéo (feedback, points, niveaux, défis, compétitions, avatars, comme *Zombies*, *Run ! ou SuperBetter).* **Ces alternatives numériques ont en général montré une certaine efficacité pour promouvoir l'activité physique et un meilleur régime alimentaire**[87–90]**.**

Concernant les jeux conçus pour améliorer la santé mentale (par exemple *SPARX*, *Mindlight*), **ils ont, eux aussi, globalement montré leur efficacité pour diminuer l'anxiété et les symptômes dépressifs chez les enfants et les adolescents**[91–93].

Références

1 van Deursen, Alexander J. A. M., Bolle, Colin L., Hegner, Sabrina M. and Kommers, Piet A. M. (2015) 'Modeling habitual and addictive smartphone behavior: The role of smartphone usage types, emotional intelligence, social stress, self-regulation, age, and gender'. *Computers in Human Behavior*, 45, pp. 411–420. [online] Available from: http://www.sciencedirect.com/science/article/pii/S0747563214007626 (Accessed 13 January 2020)

2 Billieux, Joël, Maurage, Pierre, Lopez-Fernandez, Olatz, Kuss, Daria J. and Griffiths, Mark D. (2015) 'Can Disordered Mobile Phone Use Be Considered a Behavioral Addiction? An Update on Current Evidence and a Comprehensive Model for Future Research'. *Current Addiction Reports*, 2(2), pp. 156–162. [online] Available from: https://doi.org/10.1007/s40429-015-0054-y (Accessed 13 January 2020)

3 Elhai, Jon D., Dvorak, Robert D., Levine, Jason C. and Hall, Brian J. (2017) 'Problematic smartphone use: A conceptual overview and systematic review of relations with anxiety and depression psychopathology'. *Journal of Affective Disorders*, 207, pp. 251–259. [online] Available from: http://www.sciencedirect.com/science/article/pii/S0165032716303196 (Accessed 13 January 2020)

4 Shan, Zhi, Deng, Guoying, Li, Jipeng, Li, Yangyang, et al. (2013) 'Correlational Analysis of neck/shoulder Pain and Low Back Pain with the Use of Digital Products, Physical Activity and Psychological Status among Adolescents in Shanghai'. *PLOS ONE*, 8(10), p. e78109. [online] Available from: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0078109 (Accessed 13 January 2020)

5 İNal, Esra Erkol, Demİrcİ, kadİr, Çetİntürk, Azİze, Akgönül, Mehmet and Savaş, Serpİl (2015) 'Effects of smartphone overuse on hand function, pinch strength, and the median nerve'. *Muscle & Nerve*, 52(2), pp. 183–188. [online] Available from: https://onlinelibrary.wiley.com/doi/abs/10.1002/mus.24695 (Accessed 13 January 2020)

6 Xie, Yanfei, Szeto, Grace P. Y., Dai, Jie and Madeleine, Pascal (2016) 'A comparison of muscle activity in using touchscreen smartphone among young people with and without chronic neck–shoulder pain'. *Ergonomics*, 59(1), pp. 61–72. [online] Available from: https://doi.org/10.1080/00140139.2015.1056237 (Accessed 13 January 2020)

7 Duke, Éilish and Montag, Christian (2017) 'Smartphone addiction, daily interruptions and self-reported productivity'. *Addictive Behaviors Reports*, 6, pp. 90–95. [online] Available from: http://www.sciencedirect.com/science/article/pii/S2352853217300159 (Accessed 13 January 2020)

8 Samaha, Maya and Hawi, Nazir S. (2016) 'Relationships among smartphone addiction, stress, academic performance, and satisfaction with life'. *Computers in Human Behavior*, 57, pp. 321–325. [online] Available from: http://www.sciencedirect.com/science/article/pii/S0747563215303162 (Accessed 13 January 2020)

9 Clayton, Russell B., Leshner, Glenn and Almond, Anthony (2015) 'The Extended iSelf: The Impact of iPhone Separation on Cognition, Emotion, and Physiology'. *Journal of Computer-Mediated Communication*, 20(2), pp. 119–135. [online] Available from: https://academic.oup.com/jcmc/article/20/2/119/4067530 (Accessed 13 January 2020)

10 Carbonell, Xavier, Chamarro, Andrés, Oberst, Ursula, Rodrigo, Beatriz and Prades, Mariona (2018) 'Problematic Use of the Internet and Smartphones in University Students: 2006–2017'. *International Journal of Environmental Research and Public Health*, 15(3), p. 475. [online] Available from: https://www.mdpi.com/1660-4601/15/3/475 (Accessed 13 January 2020)

11 Bennett, Brooke L., Whisenhunt, Brooke L., Hudson, Danae L., Wagner, Allison F., et al. (2019) 'Examining the impact of social media on mood and body dissatisfaction using ecological momentary assessment'. *Journal of American College Health*, 0(0), pp. 1–7. [online] Available from: https://doi.org/10.1080/07448481.2019.1583236 (Accessed 9 January 2020)

12 Tatangelo, Gemma L and Ricciardelli, Lina A (2017) 'Children's body image and social comparisons with peers and the media'. *Journal of Health Psychology*, 22(6), pp. 776–787. [online] Available from: https://doi.org/10.1177/1359105315615409 (Accessed 12 January 2020)

13 Murray, Marisa, Maras, Danijela and Goldfield, Gary S. (2016) 'Excessive Time on Social Networking Sites and Disordered Eating Behaviors Among Undergraduate Students: Appearance and Weight Esteem as Mediating Pathways'. *Cyberpsychology, Behavior, and Social Networking*, 19(12), pp. 709–715. [online] Available from: https://www.liebertpub.com/doi/abs/10.1089/cyber.2016.0384 (Accessed 13 January 2020)

14 Oberst, Ursula, Wegmann, Elisa, Stodt, Benjamin, Brand, Matthias and Chamarro, Andrés (2017) 'Negative consequences from heavy social networking in adolescents: The mediating role of fear of missing out'. *Journal of Adolescence*, 55, pp. 51–60. [online] Available from: http://www.sciencedirect.com/science/article/pii/S0140197116301774 (Accessed 13 January 2020)

15 Twenge, Jean M., Joiner, Thomas E., Rogers, Megan L. and Martin, Gabrielle N. (2018) 'Increases in Depressive Symptoms, Suicide-Related Outcomes, and Suicide Rates Among U.S. Adolescents After 2010 and Links to Increased New Media Screen Time'. *Clinical Psychological Science*, 6(1), pp. 3–17. [online] Available from: https://doi.org/10.1177/2167702617723376 (Accessed 13 January 2020)

16 Huang, Chiungjung (2017) 'Time Spent on Social Network Sites and Psychological Well-Being: A Meta-Analysis'. *Cyberpsychology, Behavior, and Social Networking*, 20(6), pp. 346–354. [online] Available from: https://www.liebertpub.com/doi/abs/10.1089/cyber.2016.0758 (Accessed 13 January 2020)

17 Huang, Chiungjung (2018) 'Social network site use and academic achievement: A meta-analysis'. *Computers & Education*, 119, pp. 76–83. [online] Available from: http://www.sciencedirect.com/science/article/pii/S0360131517302750 (Accessed 12 January 2020)

18 Lenhart, A., Kahne, J., Middaugh, E., Macgill, A.R., et al. (2010) *Teens, Video Games and Civics*, Pew Research Center. [online] Available from: https://www.pewresearch.org/internet/2008/09/16/teens-video-games-and-civics/ (Accessed 10 January 2020)

19 Spil Games (2013) *State of online gaming report*, [online] Available from: http:// auth-83051f68-ec6c-44e0-afe5-bd8902acff57.cdn.spilcloud.com/v1/ archives/1384952861.25_State_of_Gaming_2013_US_FINAL.pdf

20 The Entertainment Software Association (2015) *Essential facts about the computer and video game industry*, [online] Available from: http://www.theesa.com/ wp-content/uploads/2015/04/ESA-Essential-Facts-2015.pdf

21 Kildare, Cory A. and Middlemiss, Wendy (2017) 'Impact of parents mobile device use on parent-child interaction: A literature review'. *Computers in Human Behavior*, 75, pp. 579–593. [online] Available from: http://www.sciencedirect.com/science/article/pii/S0747563217303722 (Accessed 10 January 2020)

22 Radesky, Jenny S., Kistin, Caroline J., Zuckerman, Barry, Nitzberg, Katie, et al. (2014) 'Patterns of Mobile Device Use by Caregivers and Children During Meals in Fast Food Restaurants'. *Pediatrics*, 133(4), p. e843. [online] Available from: http://pediatrics.aappublications.org/content/133/4/e843.abstract

23 Kabali, Hilda K., Irigoyen, Matilde M., Nunez-Davis, Rosemary, Budacki, Jennifer G., et al. (2015) 'Exposure and Use of Mobile Media Devices by Young Children'. *Pediatrics*, 136(6), pp. 1044–1050. [online] Available from: https://pediatrics.aappublications.org/content/136/6/1044 (Accessed 10 January 2020)

24 Antrilli, Nick K. and Wang, Su-hua (2018) 'Toddlers on touchscreens: immediate effects of gaming and physical activity on cognitive flexibility of 2.5-year-olds in the US'. *Journal of Children and Media*, 12(4), pp. 496–513. [online] Available from: https://doi.org/10.1080/17482798.2018.1486332 (Accessed 10 January 2020)

25 Cheung, Celeste H. M., Bedford, Rachael, Saez De Urabain, Irati R., Karmiloff-Smith, Annette and Smith, Tim J. (2017) 'Daily touchscreen use in infants and toddlers is associated with reduced sleep and delayed sleep onset'. *Scientific Reports*, 7, p. 46104. [online] Available from: https://www.nature.com/articles/srep46104 (Accessed 11 November 2018)

26 Powers, Kasey L., Brooks, Patricia J., Aldrich, Naomi J., Palladino, Melissa A. and Alfieri, Louis (2013) 'Effects of video-game play on information processing: A meta-analytic investigation'. *Psychonomic Bulletin & Review*, 20(6), pp. 1055–1079. [online] Available from: https://doi.org/10.3758/s13423-013-0418-z (Accessed 10 January 2020)

27 Wang, Ping, Liu, Han-Hui, Zhu, Xing-Ting, Meng, Tian, et al. (2016) 'Action Video Game Training for Healthy Adults: A Meta-Analytic Study'. *Frontiers in Psychology*, 7. [online] Available from: https://www.frontiersin.org/articles/10.3389/fpsyg.2016.00907/full (Accessed 10 January 2020)

28 Bediou, Benoit, Adams, Deanne, Mayer, Richard, Tipton, Elizabeth, et al. (2018) 'Meta-Analysis of Action Video Game Impact on Perceptual, Attentional, and Cognitive Skills'. *Psychological Bulletin*, 144(1), pp. 77–110. [online] Available from: insights.ovid.com (Accessed 10 January 2020)

29 Anderson, Daniel R., Subrahmanyam, Kaveri and Workgroup, on behalf of the Cognitive Impacts of Digital Media (2017) 'Digital Screen Media and Cognitive Development'. *Pediatrics*, 140(Supplement 2), pp. S57–S61. [online] Available from:

https://pediatrics.aappublications.org/content/140/Supplement_2/S57 (Accessed 9 January 2020)

30 Adachi, Paul J. C. and Willoughby, Teena (2013) 'Do Video Games Promote Positive Youth Development?' *Journal of Adolescent Research*, 28(2), pp. 155–165. [online] Available from: https://doi.org/10.1177/0743558412464522 (Accessed 10 January 2020)

31 Kovess-Masfety, Viviane, Keyes, Katherine, Hamilton, Ava, Hanson, Gregory, et al. (2016) 'Is time spent playing video games associated with mental health, cognitive and social skills in young children?' *Social Psychiatry and Psychiatric Epidemiology*, 51(3), pp. 349–357. [online] Available from: https://doi.org/10.1007/s00127-016-1179-6 (Accessed 12 January 2020)

32 Jackson, Linda A., Witt, Edward A., Games, Alexander Ivan, Fitzgerald, Hiram E., et al. (2012) 'Information technology use and creativity: Findings from the Children and Technology Project'. *Computers in Human Behavior*, 28(2), pp. 370–376. [online] Available from: http://www.sciencedirect.com/science/article/pii/S0747563211002147 (Accessed 10 January 2020)

33 Gentile, Douglas A., Anderson, Craig A., Yukawa, Shintaro, Ihori, Nobuko, et al. (2009) 'The Effects of Prosocial Video Games on Prosocial Behaviors: International Evidence from Correlational, Longitudinal, and Experimental Studies'. *Personality & social psychology bulletin*, 35(6), pp. 752–763. [online] Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2678173/ (Accessed 10 January 2020)

34 Saleem, Muniba, Anderson, Craig A. and Gentile, Douglas A. (2012) 'Effects of Prosocial, Neutral, and Violent Video Games on Children's Helpful and Hurtful Behaviors'. *Aggressive Behavior*, 38(4), pp. 281–287. [online] Available from: https://onlinelibrary.wiley.com/doi/abs/10.1002/ab.21428 (Accessed 12 January 2020)

35 Cejudo, Javier, López-Delgado, Mari Luz and Losada, Lidia (2019) 'Effectiveness of the videogame "Spock" for the improvement of the emotional intelligence on psychosocial adjustment in adolescents'. *Computers in Human Behavior*, 101, pp. 380–386. [online] Available from: http://www.sciencedirect.com/science/article/pii/S0747563218304692 (Accessed 13 January 2020)

36 Ewoldsen, David R., Eno, Cassie A., Okdie, Bradley M., Velez, John A., et al. (2012) 'Effect of Playing Violent Video Games Cooperatively or Competitively on Subsequent Cooperative Behavior'. *Cyberpsychology, Behavior, and Social Networking*, 15(5), pp. 277–280. [online] Available from: https://www.liebertpub.com/doi/abs/10.1089/cyber.2011.0308 (Accessed 13 January 2020)

37 Redd, William, Jacobsen, Paul, Die-Trill, Maria, Dermatis, Helen, et al. (1987) 'Cognitive/Attentional Distraction in the Control of Conditioned Nausea in Pediatric Cancer Patients Receiving Chemotherapy'. *Journal of Consulting and Clinical Psychology*, 55(3), pp. 391–395. [online] Available from: insights.ovid.com (Accessed 13 January 2020)

38 Vasterling, Jennifer, Jenkins, Richard A., Tope, Denise Matt and Burish, Thomas G. (1993) 'Cognitive distraction and relaxation training for the control of side effects due to cancer chemotherapy'. *Journal of Behavioral Medicine*, 16(1), pp. 65–80. [online] Available from: https://doi.org/10.1007/BF00844755 (Accessed 13 January 2020)

39 Patel, Anuradha, Schieble, Thomas, Davidson, Melissa, Tran, Minh C. J., et al. (2006) 'Distraction with a hand-held video game reduces pediatric preoperative anxiety'. *Pediatric*

Anesthesia, 16(10), pp. 1019–1027. [online] Available from: https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1460-9592.2006.01914.x (Accessed 13 January 2020)

40 Ferguson, Christopher J. (2015) 'Clinicians' attitudes toward video games vary as a function of age, gender and negative beliefs about youth: A sociology of media research approach'. *Computers in Human Behavior*, 52, pp. 379–386. [online] Available from: http://www.sciencedirect.com/science/article/pii/S0747563215004562 (Accessed 11 January 2020)

41 Quandt, Thorsten, Van Looy, Jan, Vogelgesang, Jens, Elson, Malte, et al. (2015) 'Digital Games Research: A Survey Study on an Emerging Field and Its Prevalent Debates'. *Journal of Communication*, 65(6), pp. 975–996. [online] Available from: https://academic.oup.com/joc/article/65/6/975/4082337 (Accessed 11 January 2020)

42 Tian, Yu, Gao, Mingjian, Wang, Peng and Gao, Fengqiang (2020) 'The effects of violent video games and shyness on individuals' aggressive behaviors'. *Aggressive Behavior*, 46(1), pp. 16–24. [online] Available from: https://onlinelibrary.wiley.com/doi/abs/10.1002/ab.21869 (Accessed 13 January 2020)

43 Greitemeyer, Tobias (2019) 'The contagious impact of playing violent video games on aggression: Longitudinal evidence'. *Aggressive Behavior*, 45(6), pp. 635–642. [online] Available from: https://onlinelibrary.wiley.com/doi/abs/10.1002/ab.21857 (Accessed 13 January 2020)

44 Prescott, Anna T., Sargent, James D. and Hull, Jay G. (2018) 'Metaanalysis of the relationship between violent video game play and physical aggression over time'. *Proceedings of the National Academy of Sciences*, 115(40), pp. 9882–9888. [online] Available from: https://www.pnas.org/content/115/40/9882 (Accessed 13 January 2020)

45 Anderson, Craig A., Shibuya, Akiko, Ihori, Nobuko, Swing, Edward L., et al. (2010) 'Violent video game effects on aggression, empathy, and prosocial behavior in Eastern and Western countries: A meta-analytic review'. *Psychological Bulletin*, 136(2), pp. 151–173.

46 Ferguson, Christopher J. and Olson, Cheryl K. (2014) 'Video Game Violence Use Among "Vulnerable" Populations: The Impact of Violent Games on Delinquency and Bullying Among Children with Clinically Elevated Depression or Attention Deficit Symptoms'. *Journal of Youth and Adolescence*, 43(1), pp. 127–136. [online] Available from: https://doi.org/10.1007/s10964-013-9986-5 (Accessed 10 January 2020)

47 Ferguson, Christopher J. (2015) 'Do Angry Birds Make for Angry Children? A Meta-Analysis of Video Game Influences on Children's and Adolescents' Aggression, Mental Health, Prosocial Behavior, and Academic Performance'. *Perspectives on Psychological Science*, 10(5), pp. 646–666. [online] Available from: https://doi.org/10.1177/1745691615592234 (Accessed 10 January 2020)

48 Ferguson, Christopher J. and Wang, John C. K. (2019) 'Aggressive Video Games are Not a Risk Factor for Future Aggression in Youth: A Longitudinal Study'. *Journal of Youth and Adolescence*, 48(8), pp. 1439–1451. [online] Available from: https://doi.org/10.1007/s10964-019-01069-0 (Accessed 10 January 2020)

49 Kühn, Simone, Kugler, Dimitrij Tycho, Schmalen, Katharina, Weichenberger, Markus, et al. (2019) 'Does playing violent video games cause aggression? A longitudinal intervention

study'. *Molecular Psychiatry*, 24(8), pp. 1220–1234. [online] Available from: https://www.nature.com/articles/s41380-018-0031-7 (Accessed 10 January 2020)

50 Przybylski, Andrew K. and Weinstein, Netta (2019) 'Violent video game engagement is not associated with adolescents' aggressive behaviour: evidence from a registered report'. *Royal Society Open Science*, 6(2), p. 171474. [online] Available from: https://royalsocietypublishing.org/doi/full/10.1098/rsos.171474 (Accessed 10 January 2020)

51 Mathur, Maya B. and VanderWeele, Tyler J. (2019) 'Finding Common Ground in Meta-Analysis "Wars" on Violent Video Games'. *Perspectives on Psychological Science*, 14(4), pp. 705–708. [online] Available from: https://doi.org/10.1177/1745691619850104 (Accessed 13 January 2020)

52 Brunborg, Geir Scott, Mentzoni, Rune Aune and Frøyland, Lars Roar (2014) 'Is video gaming, or video game addiction, associated with depression, academic achievement, heavy episodic drinking, or conduct problems?' *Journal of Behavioral Addictions*, 3(1), pp. 27–32. [online] Available from: https://akademiai.com/doi/abs/10.1556/JBA.3.2014.002 (Accessed 11 January 2020)

53 Lemmens, Jeroen S., Valkenburg, Patti M. and Peter, Jochen (2011) 'Psychosocial causes and consequences of pathological gaming'. *Computers in Human Behavior*, 27(1), pp. 144–152. [online] Available from: http://www.sciencedirect.com/science/article/pii/S0747563210002116 (Accessed 11 January 2020)

54 Mentzoni, Rune Aune, Brunborg, Geir Scott, Molde, Helge, Myrseth, Helga, et al. (2011) 'Problematic Video Game Use: Estimated Prevalence and Associations with Mental and Physical Health'. *Cyberpsychology, Behavior, and Social Networking*, 14(10), pp. 591–596. [online] Available from: https://www.liebertpub.com/doi/abs/10.1089/cyber.2010.0260 (Accessed 11 January 2020)

55 Kuss, Daria Joanna and Griffiths, Mark D. (2012) 'Internet Gaming Addiction: A Systematic Review of Empirical Research'. *International Journal of Mental Health and Addiction*, 10(2), pp. 278–296. [online] Available from: https://doi.org/10.1007/s11469-011-9318-5 (Accessed 11 January 2020)

56 Kuss, Daria, Griffiths, Mark, Karila, Laurent and Billieux, Joël (2014) 'Internet Addiction: A Systematic Review of Epidemiological Research for the Last Decade.' *Current Pharmaceutical Design*, 20, p. 4026. [online] Available from: https://dial.uclouvain.be/pr/boreal/object/boreal:145221 (Accessed 11 January 2020)

57 Rooij, Antonius J. Van, Schoenmakers, Tim M., Vermulst, Ad A., Eijnden, Regina J. J. M. Van Den and Mheen, Dike Van De (2011) 'Online video game addiction: identification of addicted adolescent gamers'. *Addiction*, 106(1), pp. 205–212. [online] Available from: https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1360-0443.2010.03104.x (Accessed 11 January 2020)

58 Singh, Meharban (2019) 'Compulsive Digital Gaming: An Emerging Mental Health Disorder in Children'. *The Indian Journal of Pediatrics*, 86(2), pp. 171–173. [online] Available from: https://doi.org/10.1007/s12098-018-2785-y (Accessed 11 January 2020)

59 Feng, Wendy, Ramo, Danielle, Chan, Steven and Bourgeois, James (2017) 'Internet Gaming Disorder: Trends in Prevalence 1998–2016'. *Addictive behaviors*, 75, pp. 17–24. [online]

Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5582011/ (Accessed 10 January 2020)

60 Fam, Jia Yuin (2018) 'Prevalence of internet gaming disorder in adolescents: A meta-analysis across three decades'. *Scandinavian Journal of Psychology*, 59(5), pp. 524–531. [online] Available from: https://onlinelibrary.wiley.com/doi/abs/10.1111/sjop.12459 (Accessed 10 January 2020)

61 Lau, Chloe, Stewart, Shannon L., Sarmiento, Catalina, Saklofske, Donald H. and Tremblay, Paul F. (2018) 'Who Is at Risk for Problematic Video Gaming? Risk Factors in Problematic Video Gaming in Clinically Referred Canadian Children and Adolescents'. *Multimodal Technologies and Interaction*, 2(2), p. 19. [online] Available from: https://www.mdpi.com/2414-4088/2/2/19 (Accessed 11 January 2020)

62 Yen, Ju-Yu, Yen, Cheng-Fang, Chen, Cheng-Sheng, Tang, Tze-Chun and Ko, Chih-Hung (2008) 'The Association between Adult ADHD Symptoms and Internet Addiction among College Students: The Gender Difference'. *CyberPsychology & Behavior*, 12(2), pp. 187–191. [online] Available from: https://www.liebertpub.com/doi/abs/10.1089/cpb.2008.0113 (Accessed 11 January 2020)

63 Gentile, Douglas, Swing, Edward, Lim, Choon and Khoo, Angeline (2012) 'Video Game Playing, Attention Problems, and Impulsiveness: Evidence of Bidirectional Causality'. *Psychology of Popular Media Culture*, 1(1), pp. 62–70. [online] Available from: insights.ovid.com (Accessed 11 January 2020)

64 Mehroof, Mehwash and Griffiths, Mark D. (2010) 'Online Gaming Addiction: The Role of Sensation Seeking, Self-Control, Neuroticism, Aggression, State Anxiety, and Trait Anxiety'. *Cyberpsychology, Behavior, and Social Networking*, 13(3), pp. 313–316. [online] Available from: https://www.liebertpub.com/doi/abs/10.1089/cyber.2009.0229 (Accessed 11 January 2020)

65 Kim, Eun Joo, Namkoong, Kee, Ku, Taeyun and Kim, Se Joo (2008) 'The relationship between online game addiction and aggression, self-control and narcissistic personality traits'. *European Psychiatry*, 23(3), pp. 212–218. [online] Available from: http://www.sciencedirect.com/science/article/pii/S0924933807014459 (Accessed 11 January 2020)

66 Porter, Guy, Starcevic, Vladan, Berle, David and Fenech, Pauline (2010) 'Recognizing problem video game use'. *Australian and New Zealand Journal of Psychiatry*, 44(2), pp. 120–128. [online] Available from: https://www.tandfonline.com/doi/abs/10.3109/00048670903279812 (Accessed 11 January 2020)

67 Cole, Sadie H. and Hooley, Jill M. (2013) 'Clinical and Personality Correlates of MMO Gaming: Anxiety and Absorption in Problematic Internet Use'. *Social Science Computer Review*, 31(4), pp. 424–436. [online] Available from: https://doi.org/10.1177/0894439312475280 (Accessed 11 January 2020)

68 Guillot, Casey R., Bello, Mariel S., Tsai, Jennifer Y., Huh, Jimi, et al. (2016) 'Longitudinal associations between anhedonia and internet-related addictive behaviors in emerging adults'. *Computers in Human Behavior*, 62, pp. 475–479. [online] Available from:

http://www.sciencedirect.com/science/article/pii/S0747563216302941 (Accessed 11 January 2020)

69 Caplan, Scott, Williams, Dmitri and Yee, Nick (2009) 'Problematic Internet use and psychosocial well-being among MMO players'. *Computers in Human Behavior*, 25(6), pp. 1312–1319. [online] Available from: http://www.sciencedirect.com/science/article/pii/S0747563209001101 (Accessed 11 January 2020)

70 Griffiths, Mark D., Rooij, Antonius J. van, Kardefelt-Winther, Daniel, Starcevic, Vladan, et al. (2016) 'Working towards an international consensus on criteria for assessing internet gaming disorder: a critical commentary on Petry et al. (2014)'. *Addiction*, 111(1), pp. 167–175. [online] Available from: https://onlinelibrary.wiley.com/doi/abs/10.1111/add.13057 (Accessed 11 January 2020)

71 Hellman, Matilda, Schoenmakers, Tim M., Nordstrom, Benjamin R. and Holst, Ruth J. van (2013) 'Is there such a thing as online video game addiction? A cross-disciplinary review'. *Addiction Research & Theory*, 21(2), pp. 102–112. [online] Available from: https://doi.org/10.3109/16066359.2012.693222 (Accessed 11 January 2020)

72 APA, American Psychiatric (2013) *Diagnostic and Statistical Manual of Mental Disorders (DSM-5®)*, American Psychiatric Pub.

73 Aarseth, Espen, Bean, Anthony M., Boonen, Huub, Colder Carras, Michelle, et al. (2016) 'Scholars' open debate paper on the World Health Organization ICD-11 Gaming Disorder proposal'. *Journal of Behavioral Addictions*, 6(3), pp. 267–270. [online] Available from: https://akademiai.com/doi/full/10.1556/2006.5.2016.088 (Accessed 11 January 2020)

74 van Rooij, Antonius J., Ferguson, Christopher J., Colder Carras, Michelle, Kardefelt-Winther, Daniel, et al. (2018) 'A weak scientific basis for gaming disorder: Let us err on the side of caution'. *Journal of Behavioral Addictions*, 7(1), pp. 1–9. [online] Available from: https://akademiai.com/doi/full/10.1556/2006.7.2018.19 (Accessed 11 January 2020)

75 Zucker, Andrew A. and Light, Daniel (2009) 'Laptop Programs for Students'. *Science*, 323(5910), pp. 82–85. [online] Available from: https://science.sciencemag.org/content/323/5910/82 (Accessed 13 January 2020)

76 Herodotou, C. (2018) 'Young children and tablets: A systematic review of effects on learning and development'. *Journal of Computer Assisted Learning*, 34(1), pp. 1–9. [online] Available from: https://onlinelibrary.wiley.com/doi/abs/10.1111/jcal.12220 (Accessed 13 January 2020)

77 Griffith, Shayl F., Hagan, Mary B., Heymann, Perrine, Heflin, Brynna H. and Bagner, Daniel M. (2020) 'Apps As Learning Tools: A Systematic Review'. *Pediatrics*, 145(1). [online] Available from: https://pediatrics.aappublications.org/content/145/1/e20191579 (Accessed 13 January 2020)

78 Kostyrka-Allchorne, Katarzyna, Holland, Amanda, Cooper, Nicholas R., Ahamed, Woakil, et al. (2019) 'What helps children learn difficult tasks: A teacher's presence may be worth more than a screen'. *Trends in Neuroscience and Education*, 17, p. 100114. [online] Available from: http://www.sciencedirect.com/science/article/pii/S2211949319300018 (Accessed 13 January 2020)

79 Sitzmann, Traci (2011) 'A Meta-Analytic Examination of the Instructional Effectiveness of Computer-Based Simulation Games'. *Personnel Psychology*, 64(2), pp. 489–528. [online] Available from: https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1744-6570.2011.01190.x (Accessed 12 January 2020)

80 Vogel, Jennifer J., Vogel, David S., Cannon-Bowers, Jan, Bowers, Clint A., et al. (2006) 'Computer Gaming and Interactive Simulations for Learning: A Meta-Analysis'. *Journal of Educational Computing Research*, 34(3), pp. 229–243. [online] Available from: https://doi.org/10.2190/FLHV-K4WA-WPVQ-H0YM (Accessed 12 January 2020)

81 Wouters, Pieter, van Nimwegen, Christof, van Oostendorp, Herre and van der Spek, Erik D. (2013) 'A meta-analysis of the cognitive and motivational effects of serious games'. *Journal of Educational Psychology*, 105(2), pp. 249–265.

82 Clark, Douglas B., Tanner-Smith, Emily E. and Killingsworth, Stephen S. (2016) 'Digital Games, Design, and Learning: A Systematic Review and Meta-Analysis'. *Review of Educational Research*, 86(1), pp. 79–122. [online] Available from: https://doi.org/10.3102/0034654315582065 (Accessed 12 January 2020)

83 de Freitas, Sara (2018) 'Are Games Effective Learning Tools? A Review of Educational Games'. *Journal of Educational Technology & Society*, 21(2), pp. 74–84. [online] Available from: https://www.jstor.org/stable/26388380 (Accessed 12 January 2020)

84 Sung, Yao-Ting, Chang, Kuo-En and Liu, Tzu-Chien (2016) 'The effects of integrating mobile devices with teaching and learning on students' learning performance: A meta-analysis and research synthesis'. *Computers & Education*, 94, pp. 252–275. [online] Available from: http://www.sciencedirect.com/science/article/pii/S0360131515300804 (Accessed 12 January 2020)

85 Baert, Veerle, Gorus, Ellen, Mets, Tony, Geerts, Christel and Bautmans, Ivan (2011) 'Motivators and barriers for physical activity in the oldest old: A systematic review'. *Ageing Research Reviews*, 10(4), pp. 464–474. [online] Available from: http://www.sciencedirect.com/science/article/pii/S1568163711000262 (Accessed 13 January 2020)

86 McGuire, Amanda M., Anderson, Debra J. and Fulbrook, Paul (2014) 'Perceived barriers to healthy lifestyle activities in midlife and older Australian women with type 2 diabetes'. *Collegian*, 21(4), pp. 301–310. [online] Available from: http://www.sciencedirect.com/science/article/pii/S1322769613000760 (Accessed 13 January 2020)

87 Johnson, Daniel, Deterding, Sebastian, Kuhn, Kerri-Ann, Staneva, Aleksandra, et al. (2016) 'Gamification for health and wellbeing: A systematic review of the literature'. *Internet Interventions*, 6, pp. 89–106. [online] Available from: http://www.sciencedirect.com/science/article/pii/S2214782916300380 (Accessed 12 January 2020)

88 Gao, Z., Chen, S., Pasco, D. and Pope, Z. (2015) 'A meta-analysis of active video games on health outcomes among children and adolescents'. *Obesity Reviews*, 16(9), pp. 783–794. [online] Available from: https://onlinelibrary.wiley.com/doi/abs/10.1111/obr.12287 (Accessed 12 January 2020)

89 DeSmet, Ann, Van Ryckeghem, Dimitri, Compernolle, Sofie, Baranowski, Tom, et al. (2014) 'A meta-analysis of serious digital games for healthy lifestyle promotion'. *Preventive Medicine*, 69, pp. 95–107. [online] Available from: http://www.sciencedirect.com/science/article/pii/S009174351400317X (Accessed 12 January 2020)

90 Kato, Pamela M. (2010) 'Video Games in Health Care: Closing the Gap'. *Review of General Psychology*, 14(2), pp. 113–121. [online] Available from: https://doi.org/10.1037/a0019441 (Accessed 13 January 2020)

91 Fleming, Theresa M., Bavin, Lynda, Stasiak, Karolina, Hermansson-Webb, Eve, et al. (2017) 'Serious Games and Gamification for Mental Health: Current Status and Promising Directions'. *Frontiers in Psychiatry*, 7. [online] Available from: https://www.frontiersin.org/articles/10.3389/fpsyt.2016.00215/full (Accessed 13 January 2020)

92 Lau, Ho Ming, Smit, Johannes H., Fleming, Theresa M. and Riper, Heleen (2017) 'Serious Games for Mental Health: Are They Accessible, Feasible, and Effective? A Systematic Review and Meta-analysis'. *Frontiers in Psychiatry*, 7. [online] Available from: https://www.frontiersin.org/articles/10.3389/fpsyt.2016.00209/full (Accessed 13 January 2020)

93 Nijhof, Sanne L., Vinkers, Christiaan H., van Geelen, Stefan M., Duijff, Sasja N., et al. (2018) 'Healthy play, better coping: The importance of play for the development of children in health and disease'. *Neuroscience & Biobehavioral Reviews*, 95, pp. 421–429. [online] Available from: http://www.sciencedirect.com/science/article/pii/S0149763418305116 (Accessed 13 January 2020)