



## **EndeavorRx, the first video game approved by the FDA for marketing as a medical therapeutic, has significant benefits for children with ADHD.**

**Eve Kelly | November 9, 2022**

This case study investigates the game EndeavorRx to identify how it acts as an effective tool within a treatment program for children with attention deficit hyperactivity disorder (ADHD). Firstly, I explain how and why EndeavorRx was developed and give a basic overview of ADHD. While children with ADHD playing EndeavorRx experience benefits, problems are associated with gaming, such as the triggering of negative emotional feelings, the use of gamification elements, risks of addiction, the ethics of using manipulation and barriers to access. We then explore the power of games. Described as both a good 'casual game' due to its game characteristics and familiar features, EndeavorRx is also a 'serious game' as a therapeutic. Playing EndeavorRx helps ADHD children feel better, and in this sense, games can be seen as tools of 'care' with lasting emotional, psychological, cognitive and physical benefits. EndeavorRx is an interactive game that uses immersion elements to engage and focus players; immersion's mental and physical effects are beneficial for improving attention skills in children with ADHD. EndeavorRx's effectiveness is further enhanced using personalisation elements through algorithms, game consequences including rewards, and platform/game delivery on personal devices. Furthermore, EndeavorRx responds to shortfalls of current treatment regimes, including medication and lack of cognitive and motivational training and may also fill gaps in access to services due to distance barriers or lack of trained professionals. EndeavorRx, the first video game approved by the FDA for marketing as a medical therapeutic, has significant benefits for children with ADHD.

In 2020, the U.S. Food and Drug Administration (FDA) approved the marketing of a video game as a prescription-based therapeutic device for children with ADHD (U.S. Food and Drug Administration, 2020). EndeavorRx is a game developed by Akili Interactive specifically for children between the ages of eight to twelve diagnosed with inattentive or combined-type ADHD (Akili Interactive, 2022; Kurtzman, 2020). Indicated for use in conjunction with pharmaceutical and psychological interventions, EndeavorRx addresses symptoms of ADHD (Akili Interactive, 2022). EndeavorRx evolved from a research project that found adults playing a simulated racing game, NeuroRacer, had impressive improvements in their attention skills (Kurtzman, 2020). ADHD is a common life-long neurodevelopmental disorder affecting around 4.2% of Australian children under fourteen (Deloitte Access Economics, 2019, pp. ii & iv). Children with ADHD may have high inattention, hyperactivity, impulsiveness or poor behaviour control (Johnstone, 2013, p. 20). With difficulty sustaining focus, these symptoms negatively impact day-to-day life and educational and social activities (Johnstone, 2013, p. 20). The NeuroRacer study concluded that adults

playing the game had improved attention because it "enhanced function in a brain network involved in cognitive control, which is necessary to pursue goals" (Kurtzman, 2020). As such, Akili Interactive developed EndeavorRx, to help treat children with ADHD. Akili Interactive believe "effective medicine can also be fun and engaging", with early studies indicating children playing EndeavorRx for the recommended twenty-five minutes a day, five days a week, for at least four weeks, showed improved attention (Akili Interactive, 2022; Akili Interactive Labs, 2020, p. 11).

EndeavorRx is a traditional first-person racing game accessed via a mobile device (Anderson, 2020, p. 9; Akili Interactive Labs, 2020, p. 8). The game is action-packed, fun, and visually and aurally stimulating. Child players race through the frozen planet Frigidus on a spacecraft, discovering new worlds in the EndeavorRx galaxy (EndeavorRx, 2020). The game becomes more challenging as it progresses, with players having to multitask, avoiding obstacles while speeding through winding channels, hitting targets, and aiming for 'power zones' simultaneously. Children must also maintain focus above distracting visual and aural stimuli (Aungst, 2021; EndeavorRx, 2020). The game harnesses the power of closed-loop algorithms through its patented Selective Stimulus Management Engine (SSME). SSME uses 'specific sensory stimuli' and 'simultaneous motor challenges' to specifically target and activate the area of the brain associated with attention – the prefrontal cortex (Akili Interactive Labs, 2020, p. 7; Omernick, 2020, as cited in Anderson, 2020, pp. 9-10). The SSME system also uses algorithms to monitor the child's progress to inform the game's adaptation in real-time, to personalise treatment for difficulty and stage progression to challenge players to improve their skills (Akili Interactive Labs, 2020, p. 7). I will explore the specific benefits of EndeavorRx later; however, first, I will investigate the possible problems associated with using EndeavorRx or similar games as a therapeutic.

While EndeavorRx has its benefits, there are problems associated with gaming, including negative emotional responses, the use of gamification elements that give rise to addiction and the ethics of manipulation. Furthermore, barriers to access for children who need interventions, such as cost and a lack of access, are problematic for some patients. Children with ADHD have difficulty regulating their emotional behaviour. Playing video games may further trigger feelings of anger, frustration and anxiety (Granic et al., 2014, as cited in Pandian et al., 2021, p. 3). Presently, digital mental health (DMH) apps have limited effectiveness due to low engagement and inconsistent use, problems significant to children with depression (Hui et al., 2022, p. 194). 14% of children with ADHD have depression, as opposed to 1% of children without ADHD (Deloitte Access Economics, 2019, p. 8; Hui et al., 2022, p. 194). As such, the symptoms of low energy and lack of motivation reduce engagement in games. Thus, designers incorporate gamification elements of rewards or rankings to increase engagement. These features may lead children to develop addiction behaviours, including playing for extended periods, being chronically absent from responsibilities and/or "experiencing clinically significant distress due to gaming habits" (Mathews et al., 2019, p. 67; Hui et al., 2022, p. 194). Gaming addiction has similar presentations and causes as gambling and drug addiction, occurring due to activation of the brain's

reward pathway associated with the release of dopamine in the mesolimbic system and the amygdala (Mathews et al., 2019, p. 67; Masi et al., 2021, p. 6). Games that use 'reinforcement structures', including incremental rewards or recognition of level or skill progression, are more attractive to gamers (Mathews et al., 2019, p. 68). Children playing EndeavorRx aim to intermittently enter 'The Zone' to accumulate 'reward orbs' used to unlock worlds (Akili Interactive Labs, 2020, p. 12). Once all worlds are unlocked, players can revisit their favourite worlds and try to beat their previous scores, and players can also 'unlock' costumes in the game store (Akili Interactive Labs, 2020, pp. 12-13). Such gamification elements increase engagement and may increase the risk of addiction for children.

Gamification has moral or ethical problems due to elements of manipulation (Gorin, 2022, p. 213). Robert Noggle explains, "There are certain norms or ideals that govern beliefs, desires, and emotions. Manipulative action is the attempt to get someone's beliefs, desires, or emotions to violate these norms, to fall short of these ideals" (Noggle, 1996, as cited in Gorin, 2022, p. 202). Ethical concerns are unreasonable when children take on 'norm-violating' mental states that are either outside their control or designed to have a particular effect – or when designers (the manipulators) are more concerned with engagement outcomes than therapeutic outcomes (Gorin, 2022, p. 203). Ethical concerns are less problematic when the outcome for the player is positive, for example, the child with ADHD benefits from improved attention. Nevertheless, there may be drawbacks when such mental manipulations give rise to dependency or addictive behaviours, particularly in those with ADHD who are already 'psychologically vulnerable' (Hui et al., 2022, p. 194).

Games are transmedial, whereby they traverse different mediums, including digital, the latest, which enables greater access, interactivity and participation (Juul, 2010, p. 248; Liebe, 2008, p. 330; Everett & Watkins, 2008, pp. 158-159). However, there is a concern for children with ADHD with limited or no access to tech. If DMH apps become ubiquitous in society, as seen with other digital products, disadvantaged children, already vulnerable to medical shortfalls, will become more impacted by the divide between those with access to technology and those without (Everett & Watkins, 2008, p. 159). EndeavorRx is available via a U.S. prescription and generally covered by health insurance; otherwise, with no payment plan available, the game costs \$99, a restrictive cost for some patients (Akili Interactive Labs, 2022). Nonetheless, withstanding potential problems, research has shown that games like EndeavorRx have the power to improve ADHD symptoms in some children.

Casual and serious games have unique power and therapeutic benefits. Playing EndeavorRx helps ADHD children feel better, exemplifying a tool of 'care' with lasting emotional, psychological, cognitive and physical benefits. With EndeavorRx's therapeutic effects and FDA approval, it qualifies as a 'serious game' because its simulated and interactive worlds enable psychological and neurophysical changes in players (Hooker & Karnes, 2022, pp. 1-2). However, it also exemplifies a good *casual* game – a game you want to play repeatedly because it's "easy to learn but hard to master" (Bogost, 2011, p. 125). The game's familiar characteristics, for example, its racing style derived from sport and its sci-fi

theme from popular culture, make it easier to learn; familiarity helps it make sense (Bogost, 2011, pp. 126-127). EndeavorRx is familiar to children who have played similar racing games, for example, Sonic Dash or Mario Kart. EndeavorRx, accessed on a mobile device, starts with a friendly, age-appropriate doctor-like character that introduces players to the controls, tilting your device to direct your craft and move forward at varying speeds and tapping the screen to hit targets as they appear (Akili Interactive, 2022). EndeavorRx's visual and aural stimuli are also familiar to players. The cartoonish animations are reminiscent of children's cartoons or animated sci-fi/discovery films. Similarly, the soundtrack has a cinematic theme. Digital platforms are attractive to children and, therefore, useful for those who don't respond to traditional ADHD interventions. The transmedial nature of games, the Internet and computers present unique strengths for games where players have a vast array of tools, visuals, sounds and systems to use (Bogost, 2008, p. 121). Gaming academics have long championed the idea that video games are a 'magical cultural artifact' affecting the body and the brain by influencing gamers' emotions, social behaviours and cognitive skills (Hooker & Karnes, 2022, p. 2; Anthropy, 2012; Isbister, 2016; McGonigal, 2011, as cited in Hooker & Karnes, 2022, p. 2). Games like EndeavorRx use algorithmic power to transcend entertainment and push games beyond the realm of casual games and even past 'serious games' into a sphere of 'caring'; "games as care" (Hooker & Karnes 2022, pp. 1-2 & 9). Gamification elements, like reward systems – that activate the release of dopamine in the brain – engage children who are depressed or lack motivation, and thus gaming presents a meaningful way to break cycles of inactivity (Masi et al., 2021, p. 6; Ferguson, 2020, as cited in Anderson, 2020, p. 10). The motivational feelings and 'intense emotional positive experiences' derived from playing persist in children's everyday lives (Granic et al., 2014, as cited in Pandian et al., 2021, p. 3). Children with ADHD playing EndeavorRx may experience further emotional benefits from accomplishments they achieve in the game that they otherwise may not achieve in the real world (Masi et al., 2021, p. 6). The entanglement of engagement, personalised interactivity and real-world habits forming through repeated gameplay gives games unique potential for lasting therapeutic effects (Colby, 2014; Holmes, 2017, as cited in Hooker & Karnes, 2022, p. 2; Uttal et al., 2013; Granic et al., 2014, as cited in Pandian et al., 2021, p. 3). The effects of EndeavorRx are further enhanced by the game's immersive characteristics that help improve attention in children with ADHD.

Video games offer a unique medium for children to experience the benefits of immersion through combined visual, narrative/emotional and cognitive features, along with reward systems that improve concentration. Gameplay invokes 'connection', an experiential feature of games ranging from absorption to immersion (Pine & Gillmore, 1999, as cited in Ermi & Mayra, 2005, p. 94). Absorption occurs when a player's attention directs to an experience, but immersion happens when the player becomes part of the game virtually or even physically (Ermi & Mayra, 2005, p. 94). As an immersive game, EndeavorRx enables the player to become part of the game; they are no longer playing it but living it. Immersive elements give particular value to the therapeutic power of games (Bean, 2019, p. 97). Players embody

their character in first-person as they navigate a challenging course through the EndeavorRx galaxy. The integration of first-person 'perceptions, emotions and cognitions' influences players to physically act upon the game's narrative and visual features whereby the "motor cortex and muscles focus the audiovisual attention and provide "muscular" reality and immersion to the perceptions" (Grodal, 2013, p. 132). The child fully engages in the activity, their full attention is captured, and they are 'intensely present' (Bean, 2019, p. 97). Studies of video games prove immersion improves cognitive control and skills such as working memory and sustained attention in non-ADHD adults and children with ADHD (Anguera et al., 2013, pp. 98-99; Kollins et al., 2020, pp. 168-169). A trial of EndeavorRx's precursor game, AKL-T01, concluded that unmedicated children between the ages of eight to twelve had significant gains in cognitive control and attention performance through playing the game (Kollins et al., 2020, as cited in Pandian et al., 2021, p.3; Kollins et al., 2020, pp. 168-169). Immersive games improve attention in children with inattentive or combined-type ADHD with few adverse reactions – results accepted by the FDA (Pandian et al., 2021, pp. 1 & 3). EndeavorRx is also successful through its elements of personalisation, and the game may also address shortfalls in current treatment regimes and barriers to access.

Personalisation enhances the benefits of EndeavorRx. The game's SSME system is "continuously measuring their performance and using adaptive algorithms to adjust the difficulty and personalise the treatment experience for each individual" (Omernick, 2020, as cited in Anderson, 2020, p. 9). Moreover, this personalisation of the game's difficulty based on the evolving skill of the player is what captures the child's attention. Compared to other forms of media, games' repetitive and interactive nature enhances the emotional connection to the activity (Grodal, 2013, p. 150). When a child is personally responsible for learning and mastering the game, for example, colliding with obstacles or gathering orbs, they may also feel responsible for the feelings that arise from these failures or achievements (Grodal, 2013, p. 150). Every child is different and reacts in unique ways. Thus, the child learns agency and consequences in a process that is algorithmically highly personalised to the individual (Grodal, 2013, p. 150). Many children with ADHD have difficulties with social interaction and thus have poor social outcomes (Deloitte Access Economics, 2019, p. 7; Pandian et al., 2021, p.1). Treatments accessed via a familiar personal device greatly benefit children with ADHD. Reward features, such as collecting orbs to unlock favourite worlds, and desired costumes from the game store, also increase feelings of participation and personalisation for children (Akili Interactive Labs, 2020, pp. 7 & 12-13).

Current ADHD treatments include a combination of behavioural therapy and expert-led educational interventions and/or medication (Akili Interactive Labs, 2020, p. 6). However, not all children respond positively to treatment regimes, with research indicating that medications don't effectively treat neurocognitive symptoms (Davis et al., 2018, as cited in Pandian et al., 2021, p. 4). ADHD medications are stimulant-based and may cause psychological and cardiac side effects; therefore, medications are not recommended for children with mild ADHD symptoms (Davis et al., 2018; Toomey et al., 2012, as

cited Pandian et al., pp.1-3; Deloitte Access Economics, 2019, p. 8). Thus, EndeavorRx has the potential to address treatment shortfalls. DMH apps and mobile games present new pathways to accessing treatment for ADHD. With shortfalls in trained mental health professionals, children and their parents needing ADHD interventions have limited access and high medical and educational costs (Pandian et al., 2021, pp.1-4; Deloitte Access Economics, 2019, p. 46). Another barrier to treatment is distance, with regional children even more disadvantaged in accessing treatment. Research reports that as far as XR technology is concerned, treatments are becoming more accessible through virtual cognitive interventions, closing distance barriers for remote and socially anxious patients (Shaikh et al., 2022, pp. 5-6). EndeavorRx accessed via a mobile device offers similar benefits.

EndeavorRx is a unique tool used as part of a treatment program for children with ADHD. While problems are associated with its use as a therapeutic, it is proven to have significant benefits for some children with ADHD by improving cognitive control, attention, and psychological symptoms. EndeavorRx may also address shortfalls in current treatment regimes and problems with access.

## References

- Akili Interactive. (2022, September 21). *Akili launches EndeavorRx Expedition: A direct-to-patient product registry*. <https://www.akiliinteractive.com/news-collection/akili-launches-endeavorrx-expedition-a-direct-to-patient-product-registry>
- Akili Interactive Labs. (2020). EndeavorRx: Instructions for use. [https://static1.squarespace.com/static/5a0457fa18b27dc7e8aef79b/t/5f3af4a2060f1a613ede6a61/1597699249752/5011\\_Rev\\_C\\_EndavorRx\\_IFU.pdf](https://static1.squarespace.com/static/5a0457fa18b27dc7e8aef79b/t/5f3af4a2060f1a613ede6a61/1597699249752/5011_Rev_C_EndavorRx_IFU.pdf)
- Anderson, M. (2020). Prescription-strength gaming: ADHD treatment now comes in the form of a first-person racing game. *IEEE Spectrum*, 57(8), 9-10. <https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=9150542>
- Anguera, J. A., Boccanfuso, J., Rintoul, J. L., Al-Hashimi, O., Faraji, F., Janowich, J., Kon, E., Larraburo, Y., Rolle, C., Johnston, E., & Gazzaley, A. (2013). Video game training enhances cognitive control in older adults. *Nature*, 501, 97-101. <https://doi.org/10.1038/nature12486>
- Aungst, C. (2021, September 24). *What is EndeavorRx, the video game for ADHD?* Good RX Health. <https://www.goodrx.com/conditions/adhd/does-endeavorrx-adhd-treatment-gamification-work>
- Bean, A. M. (2019). I am my avatar and my avatar is me: Utilizing video games as therapeutic tools. In *Integrating technology into modern therapies* (pp. 94-106). Routledge. <https://ebookcentral.proquest.com/lib/curtin/reader.action?docID=5720588>
- Bogost, I. (2008). The rhetoric of video games. In K. Salen (Ed.), *The ecology of games: Connecting youth, games, and learning* (pp. 117-140). The MIT Press. <https://mitpress.mit.edu/9780262693646/>
- Bogost, I. (2011). *How to do things with videogames*. University of Minnesota Press. <http://ebookcentral.proquest.com/lib/curtin/detail.action?docID=776547>
- Deloitte Access Economics. (2019). *The social and economic costs of ADHD in Australia*. Australian ADHD Professionals Association.

<https://www2.deloitte.com/content/dam/Deloitte/au/Documents/Economics/deloitte-au-economics-social-costs-adhd-australia-270819.pdf>

EndeavorRx (v. 12.0) [iOS]. (2020). Akili Interactive Labs, Inc.

[https://play.google.com/store/apps/details?id=com.akiliinteractive.t01&hl=en\\_AU&gl=US](https://play.google.com/store/apps/details?id=com.akiliinteractive.t01&hl=en_AU&gl=US)

Ermi, L. and Mayra, F. (2005). *Fundamental components of the gameplay experience: Analysing immersion* [Paper presentation]. Proceedings of DiGRA 2005 Conference: Changing Views - Worlds in Play, Canada. [https://homepages.tuni.fi/frans.mayra/gameplay\\_experience.pdf](https://homepages.tuni.fi/frans.mayra/gameplay_experience.pdf)

Everett, A., & Watkins, S. C. (2008). The power of play: The portrayal and performance of race in video games. In K. Salen (Ed.), *The ecology of games: Connecting youth, games, and learning* (141-166). The MIT Press. <https://mitpress.mit.edu/9780262693646/>

Gorin, M. (2022). Gamification, manipulation, and domination. In F. Jongepier & M. Klenk (Eds.), *The philosophy of online manipulation* (pp. 199-215). Routledge. <https://library.oapen.org/handle/20.500.12657/57070>

Grodal, T. (2013). Stories for eye, ear, and muscles: Video games, media, and embodied experiences. In M. J. Wolf & B. Perron (Eds.), *The video game theory reader* (pp. 129-155). Taylor & Francis. <https://www.taylorfrancis.com/books/edit/10.4324/9780203700457/video-game-theory-reader-mark-wolf-bernard-perron>

Hooker, T. B., & Karnes, M. S. (2022). More than serious: Medicine, games, and care. *Computers and Composition*, 65(102727), 1-11. <https://www.sciencedirect.com/science/article/pii/S8755461522000354>

Hui, K., Gorin, M., & Sisti, D. (2022). A call for greater regulation of digital mental health technologies. *AJOB Neuroscience*, 13(3), 193-195. <https://www.tandfonline.com/doi/full/10.1080/21507740.2022.2082595>

Johnstone, S. (2013). Computer gaming and ADHD: Potential positive influences on behavior [Opinion]. *IEEE Technology and Society Magazine*, 32(1), 20-22. <https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=6479437>

- Juul, J. (2010). The game, the player, the world: Looking for a heart of gameness. *Plurais Revista Multidisciplinar*, 1(2), 248-270.  
<https://www.revistas.uneb.br/index.php/plurais/article/download/880/624/>
- Kollins, S. H., DeLoss, D. J., Cañadas, E., Lutz, J., Findling, R. L., Keefe, R. S., Epstein, J.N., Cutler, A.J., & Faraone, S. V. (2020). A novel digital intervention for actively reducing severity of paediatric ADHD (STARS-ADHD): a randomised controlled trial. *The Lancet Digital Health*, 2(4), 168-178.  
[https://www.thelancet.com/journals/landig/article/PIIS2589-7500\(20\)30017-0/fulltext#%20](https://www.thelancet.com/journals/landig/article/PIIS2589-7500(20)30017-0/fulltext#%20)
- Kurtzman, L. (2020, June 15). *FDA approves video game based on UCSF brain research as ADHD therapy for kids*. University of California San Francisco. <https://www.ucsf.edu/news/2020/06/417841/fda-approves-video-game-based-ucsf-brain-research-adhd-therapy-kids>
- Masi, L., Abadie, P., Herba, C., Emond, M., Gingras, M. P., & Amor, L. B. (2021). Video games in ADHD and non-ADHD children: Modalities of use and association with ADHD symptoms. *Frontiers in Pediatrics*, 9, 1-10. <https://www.frontiersin.org/articles/10.3389/fped.2021.632272/full>
- Mathews, C. L., Morrell, H. E., & Molle, J. E. (2019). Video game addiction, ADHD symptomatology, and video game reinforcement. *The American Journal of Drug and Alcohol Abuse*, 45(1), 67-76.  
<https://www.tandfonline.com/doi/full/10.1080/00952990.2018.1472269>
- Pandian, G. S. B., Jain, A., Raza, Q., & Sahu, K. K. (2021). Digital health interventions (DHI) for the treatment of attention deficit hyperactivity disorder (ADHD) in children: A comparative review of literature among various treatment and DHI. *Psychiatry Research*, 297(113742), 1-5.  
<https://www.sciencedirect.com/science/article/pii/S0165178121000391>
- Shaikh, T. A., Dar, T. R., & Sofi, S. (2022). A data-centric artificial intelligent and extended reality technology in smart healthcare systems. *Social Network Analysis and Mining*, 12(1), 1-33.  
<https://link.springer.com/content/pdf/10.1007/s13278-022-00888-7.pdf>
- U.S. Food and Drug Administration (FDA). (2020, June 15). *FDA permits marketing of first game-based digital therapeutic to improve attention function in children with ADHD*.

© *Eve Kelly, 2022. eveandthebird@gmail.com*

<https://www.fda.gov/news-events/press-announcements/fda-permits-marketing-first-game-based-digital-therapeutic-improve-attention-function-children-adhd>