Development and User Satisfaction of "Plan-It Commander," a Serious Game for Children with ADHD

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1   **Title page**

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3 **Manuscript title:** Development and user-satisfaction of "Plan-It Commander", a serious game for children with

4 ADHD.

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6 **Running title:** A SERIOUS GAME FOR CHILDREN WITH ADHD

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61   **Abstract**

62   The need for, engaging treatment approaches within mental health care has led to the application of gaming

63   approaches to existing behavioral training programs (i.e., gamification). Since children with ADHD tend to have

64   fewer problems with concentration and engagement when playing digital games, applying game technologies

65   and design approaches to complement may be a useful means to engage this population in their treatment.

66   Unfortunately, gamified training programs currently available for ADHD have been limited in their ability to

67   demonstrate in-game behavior skills that generalize to daily life situations. Therefore, we developed a new

68   serious game (called "Plan-It Commander") that was specifically designed to promote behavioral learning and

69   promotes strategy use in domains of daily life functioning such as time management, planning/organizing and

70   prosocial skills that are known to be problematic for children with ADHD. An interdisciplinary team contributed

71   to the development of the game. The game's content and approach is based on psychological principles from the

72   self-regulation model, social cognitive theory and learning theory. In this article, game development and the

73   scientific background of the behavioral approach are described, as well as results of a survey (n=42) to gather

74   user feedback on the first prototype of the game. The findings suggest that participants were satisfied with this

75   game and provided the basis for. Further development and research to the game implications for developing

76   serious games and applying user feedback in game development are discussed.

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78   Keywords: e-mental health; serious game development; ADHD; children.

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89   Digital approaches have been increasingly applied to support and improve primary care processes in mental

90   health care and are often referred to as e-mental health.[1,2] Clinicians and educators are interested in applying

91   game technologies and game design approaches (e.g., serious games) because of their potential to increase

92   patient engagement with existing behavioral training programs.[3] Game elements that increase patient

93   engagement in therapeutic activities have the potential to increase the effectiveness of neurocognitive training

94   and behavioral learning in different domains of functioning for patients being treated in mental health care.[4-6]

95   Game design and approaches are seen as a natural tool to make existing training and therapeutic

96   programs more appealing to young patients with ADHD for several reasons. First, it is well known that children

97   with ADHD experience motivation deficits and react differently to rewards compared to typically developing

98   children.[7,8] Because game approaches help to balance motivating and learning elements and integrate game goals

99   and behavioral/cognitive challenges, they have the potential to keep these children more motivated and

100 positively engaged in therapy processes.[9-11] Also, despite their poor attention span, distractibility and difficulty

101 staying on task, children with ADHD often show sustained concentration and engagement when playing digital

102 games.[12] Therapeutic goals that are pursued in the context of an engaging game environment thus present the

103 opportunity to improve behavioral learning and outcomes in this population.

104   A large number of gamified training programs for ADHD have been designed to improve working

105 memory and executive functioning thereby addressing specific neurocognitive deficits.[13-16] While these programs

106 show some evidence for short term effects on targeted working memory outcomes, as measured by

107 neurocognitive tests that are similar to the ones presented in the games, they have not shown compelling

108 evidence that these effects generalize beyond neurocognitive outcomes to important domains of functioning in

109 the every day lives of children with ADHD.[13-16] The core symptoms of inattention, impulsivity and hyperactivity

110 among children with ADHD are related to their difficulties in executive and social functioning in their daily

111 lives. These problems include difficulties managing time, keeping deadlines, planning/organizing schoolwork

112 and making friends.[17-20] These executive functioning and social problems not only affect daily life for the

113 children and their families, they also predict a poor prognosis of ADHD even into adulthood.[20] Gamified

114 interventions for children with ADHD that address the current difficulties in daily life functioning thus have the

115 potential to not only tackle difficulties in the short-term but in the long term as well. While the research on

116 gaming approaches to addressing daily life functioning of children is limited, several controlled trials of serious

117 games developed for other patient groups have been shown promise of impacting "real world" behaviors.[21]

118   In addition to the importance of designing a serious game intervention to impact important outcomes

119 that support their functioning in daily life, the intervention itself needs to be designed to be effective and

120 engaging in order to ultimately have an impact. Previous studies provided evidence that gamified interventions

121 based on theoretical concepts tend to be more effective than those without a theoretical framework.[22] Integrating

122 appropriate behavioral theories into the design of the game is an ongoing challenge for serious game designers

123 but is a key to its ultimate success.[23] The focus on integrating behavior change theories and therapeutic content

124 in serious game design needs to be balanced by technology acceptance through the target audience of children

125 with ADHD and their parents who will likely play a key role in accessing, facilitating and monitoring the use of

126 the serious games technology. A broad body of evidence has shown that the success of Information

127 Technologies (IT), such as serious games, depends on user beliefs and attitudes about the technology (e.g., "The

128 game performs reliably and it is easy to interact with this game") as well as their behavioral beliefs and attitudes

129 about using the system (e.g., "This game helps me understand how I can plan and organize my time").[24]

130 Gathering this information is an important part of the development process to provide an intermediate evaluation

131 of design decisions and a basis for major or minor design decisions to promote the success of the product.[25]

132   In this study, we describe the development process of a serious game we developed for children with

133 ADHD that encourages behavioral learning and promotes strategy use in important domains of daily life

134 functioning, namely; time management, planning/organizing and prosocial skills. We also present results of a

135 user satisfaction survey we conducted on a pilot version of the game.

136

137 **Theoretical Basis for the Serious Game Intervention**

138   We developed a serious game called "Plan-It Commander" for a target population of children with

139 ADHD aged 8 to 12 years. The therapeutic behavioral learning objectives of the serious game were to promote

140 the use of strategies in important domains of daily life functioning, namely time management,

141 planning/organizing and prosocial skills. These behavioral objectives were translated into a suitable game based

142 on relevant psychological theories such as, (1) the self-regulation model,[26] (2) social cognitive theory[27] and (3)

143 learning theory.[12,28]

144   "The self-regulation model of health and illness behavior focuses on how individuals direct and monitor

145 their activities and emotions in order to attain their goals.[12,26] Children with ADHD often lack self regulation and

146 as a consequence, they master skills at a lower level. In addition, they feel incompetent about their performance

147 and think that they can not cope with situations in which these skills have to be used. The serious game

148 contained components that helped them direct and monitor their activities (e.g., predict how long it would take

149 them to complete a "mission"), regulate their emotions (e.g., slow down to help other characters in the game in

150 order to "win"), and practice as many times as needed in order to reach mastery (e.g., no overt or explicit

151 penalties for "mission failure"). Components such as these were explicitly built into the system to provide a safe

152 environment to practice skills that could be applied in their daily life.

153   The serious game also included elements from social cognitive theory.[27] According to this theory,

154 children's learning is influenced by interactions between the environment, personal factors and behavior. The

155 environment supports mastery of target behaviors by providing models for target behaviors and positive support

156 for behavior change. This theory was translated into the game by offering children with ADHD structured

157 behavioral goals to reach in the game (e.g., collect minerals with the time that you estimate it will take to

158 complete the task). These goals were presented in an environment that included a virtual mentor figure who was

159 a model of positive behavior (e.g., polite in social interactions) and also provided emotional encouragement and

160 positive feedback for success and multiple opportunities to practice behaviors to reach mastery. The game

161 environment also included a social community in which peers (other children with ADHD) could interact with

162 each other. Players could also directly or indirectly benefit from positive reinforcements they observed others

163 received or that they received directly as a result of their own successful efforts to reach goals in the game. The

164 concepts of vicarious learning, emotional support, provision of mastery experiences are key components of

165 behavior change in social cognitive theory,[27] that were implemented in the game design.

166   Lastly, principles of learning theory were incorporated in the serious game. Learning theories are based

167 on the general idea that individuals learn behavior through behavioral consequences and positive

168 reinforcement.[12,28,29] Children with ADHD are less sensitive to negative feedback and learn the most through

169 repetitive positive feedback. In this game we immediately reward positive behavior, based on this principle. As a

170 result, extensive practice of desired behaviors is stimulated".

171

172 **Collaborative Game Development**

173 Interdisciplinary collaboration is a key factor in developing a serious (either educative or therapeutic) game, as

174 different expertise from various areas (clinical, research, technical and game design) needs to be integrated.[23]

175 Therefore, different parties (i.e., sponsor, game development company, health care professionals, researchers,

176 parents and children with ADHD) were involved in the development of the "Plan-It Commander" game. In

177 collaboration with a community board of parents, the learning goals (e.g., time management,

178   planning/organizing and prosocial skills) were proposed by health care professionals based on scientific

179   literature and practical clinical experience. Furthermore, these professionals provided input on the game goals

180   and advised the game designers on how to give feedback to children with ADHD. Frequent interactive sessions

181   between the behavior experts, researchers and game designers took place to optimize the link between game

182   elements and the principles of behavioral intervention, allowing game designers to gain additional expertise and

183   knowledge to develop an attractive game that "works" for this target population.[23]

184   Results of important deliverables and milestones were presented to the advisory board consisting of

185   professionals familiar with the content of gaming, research and clinical practice. Researchers were involved to

186   design and set-up research trajectories to test game usability and effectiveness. After each prototype, usability

187   tests were iteratively performed to examine whether children liked the game, and understood how to use it and

188   navigate within the game. These user data were evaluated and incorporated in the design process. Parallel to

189   testing the first prototype in a pilot study, the game was further developed and extended resulting in the final

190   version of the game described in this article. The stages of game development and evaluation are illustrated in

191   Figure 1.

192

193   Figure 1 around here.

194

195   **Game Description**

196   "Plan-It Commander" is an online computer game with a futuristic and adventurous character consisting of two

197   parts: (1) the mission game; a game environment with missions and three isolated minigames with embedded

198   learning goals and; (2) a closed social community for interaction through predefined messages. Each minigame

199   has levels of increasing complexity and performance challenges. In the game the player is a space captain

200   undertaking missions assigned by his mentor who guides the player, gives him/her feedback and helps wherever

201   he can. The player's goal is to collect and recover rare minerals. Characteristics of "Plan-It Commander" are

202   described in Table 1.

203

204   Table 1 around here.

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207   To motivate and engage children throughout the game a number of special features were designed (see Table 2

208   and Figure 2).

209

210   Table 2 and Figure 2 around here.

211

212   *Missions and side-missions*

213   The game is divided into ten different missions and several side-missions. Missions guide the player's behavior

214   throughout the game as they follow the story line and are confronted with assignments requiring specific skills to

215   solve problems. Completing these assignments ensures skills concerning time management, planning/organizing

216   and prosocial behavior are practiced and trained. Each mission has different tasks and the player has a mission

217   board to check which missions he/she has completed. Once a mission is completed the next mission becomes

218   available. Side missions are independent missions, separate from the main storyline and are optional. Several

219   side-missions focus on triggering player's prosocial behavior, e.g., players can ask other players for assistance

220   (e.g., finding special items) and in turn decide whether to provide assistance. In addition, players can make short-

221   term and long-term agreements with other non-playable characters (NPC's), e.g., to retrieve items. Further

222   general learning goals throughout the game include; listening to the mentor, dealing with frustration, ignoring

223   distraction, learning to concentrate, being attentive and inhibiting impulses.

224

225   *Minigames*

226   A minigame is a small, isolated game within the larger game environment that integrates unique game elements

227   offering tools to improve strategic behavior. Players begin with an explanatory tutorial level and progress

228   through the game by accomplishing levels within the minigames and missions. Three minigames with

229   assignments addressing time management, planning/organizing and prosocial behavior are embedded in the

230   game (Figure 3).

231

232   Figure 3 around here.

233

234   *Minigame 1: Labyrinth*

235   Within this minigame the player learns to manage time and to estimate time needed. In addition, players learn

236   that it may be helpful to break down an assignment into pieces or to relax before making decisions. The labyrinth

237 game is divided into two different parts. In the first part the player collects minerals in a maze within a limited

238 time frame. In the second part the player estimates the time needed to collect all the minerals. In both parts of the

239 game several strategies can be used to optimize performance, such as; 1) player planning optimal route on a map

240 before entering cave, 2) clicking on clock to check time and 3) using the so called "safe zones". In these zones

241 time pauses so the player can plan his/her next move or just relax. The player has to collect minerals whilst

242 facing distractions in the maze, thus learning to keep the main goal in mind. For both parts of this minigame

243 there are six different levels, increasing in difficulty. A level is completed when the player collects all the

244 minerals within the restricted time frame or when the player finishes on time i.e. within his/her estimated time

245 frame.

246

247 *Minigame 2: Explorobot*

248 Players learn to plan ahead and break down the total assignment into pieces. The player has to collect several

249 minerals which lay scattered in a sewer, using robot Ico. The player determines the shortest route for Ico and

250 then gives Ico this route description by means of a series of commands. If the player makes a mistake in

251 planning the route all commands will be deleted and the player has to plan the route again. As a strategy to

252 optimize performance, players can use checkpoints. If a player makes a mistake after a checkpoint, the robot will

253 jump back to the last checkpoint and the route can be adjusted from there on. The player can choose to use a

254 limited amount of checkpoints per level. In total there are 51 levels of difficulty with several tutorial levels. As it

255 may be too hard for some players to find the ideal route, a margin is determined, which is the number of steps

256 needed for the optimal route plus 30% (with a maximum of 10 steps). A level is completed when the optimal

257 route (i.e., minimum number of steps) is planned for Ico.

258

259 *Minigame 3: Space Travel Trainer*

260 Here players learn to help their team members and to behave in a more prosocial manner towards others. The

261 player flies his/her space ship from planet to planet to reach the target planet with three team members. These

262 team members (named Nika, Vesto and Kortar) are not real players but are computer generated, and called

263 NPC's. The team members depend on the player when handling obstacles such as a star rain, while they follow

264 their predefined route. If the player does not help his/her team members by giving the right commands (e.g.,

265 shield, boost, cloak) in time, they inevitably get stuck with low energy levels, which the player has to replenish.

266 Team members ask for help and express their emotions when in dangerous situations. The player can thus use

267   more than one channel to interact with the team members. In total there are 31 different levels of difficulty. A

268   level is completed when all team members and the player have finished.

269

270   *Social community*

271   To stimulate prosocial behavior, a social community was developed in which game players can see each other's

272   profiles and space ships and communicate with each other through predefined messages, for example with a

273   'thumbs up' or 'thank you' button (Figure 4). In addition, players can see each other's rank and current mission

274   status. This aims to stimulate game play and generates some competition between players.

275

276   Figure 4 around here.

277

278   Achievements are related to the learning goals of the intervention and to rewarding players for prosocial

279   behavior within the social community, such as helping other players or giving compliments.

280

281   **Acceptance and Usability Study**

282   The initial prototype had three minigames focusing on time management, planning/organizing and prosocial

283   behavior. The player's mission was to collect as many minerals as possible. The above mentioned social

284   community, missions, side-missions and special features had not yet been developed. From October 2011 to

285   March 2012 a pilot study was conducted to test the feasibility of conducting a randomized trial on the full game.

286   As part of the pilot study, participants also filled out questionnaires designed to assess acceptance and usability

287   of several game elements. Acceptance and usability were assessed to inform design decisions for further

288   development of the game to a final version to be evaluated in a randomized controlled trial for outcome efficacy.

289

290   *Participants*

291   Candidates for the pilot study were identified and informed by their therapist. The therapists were all members of

292   the consortium consisting of ADHD specialized mental health care services. Once a potential participant was

293   identified, children and parents received information letters from the researcher, allowing them to make an

294   informed consent about voluntary participation in the pilot study. Inclusion criteria were (a) having a clinical

295   DSM-IV-TR ADHD diagnosis (all subtypes were included) set by a certified health care professional, (b) aged

296   between 8 and 12 years, (c) being stable on pharmacological and/or psychological ADHD treatment for at least

297   two months prior to baseline assessment (determined by health care professionals on the basis of medication data

298   and behavioral observation) and (d) availability of a computer workstation at home with internet and sound

299   facilities. Children were excluded if they had an estimated total IQ of 70 or lower and had a physical and/or

300   cognitive disability (i.e., deafness, blindness) that would predict great difficulties in playing the serious game

301   and would be problematic for standardized measurements.

302   In total, 66 children were referred by their therapist and informed about the studies' purposes. The final

303   sample consisted of 42 clinically referred children with a primary diagnosis of ADHD. Children's age ranged

304   from 8 to 11 years with a mean age of 9.4. Children participating in the study had average intelligence ($M = 104$;

305   $SD = 12.3$). This was tested with the Wechsler Intelligence Scale for Children III (WISC-III) short version.[30]

306   There was an absence of any neurological disorder, sensory (blindness, deafness) or motor disorder as stated by

307   the clinicians and parents. All children except for two were taking ADHD medication at study entry.

308   Comorbidity of dyslexia was present in four children.

309

310   *Procedure*

311   As part of the pilot study we decided to randomize children to one of the two conditions for playing the "Plan-it

312   Commander" prototype. Twenty children were asked to play the game for a maximum of three times per two

313   weeks (total number of play sessions M=7.41; SD=1.37) for six weeks. Twenty-two children were asked trying

314   to play the game about eight times per two weeks (total number of play sessions M=17.16; SD=4.75) for six

315   weeks. However, as there appeared to be no significant differences (p > .05) among children's and parent's

316   satisfaction scores between the two groups we decided to present the results of the total group of children.

317   Children played the game at home for eight weeks, divided into four periods of two weeks, with a free choice in

318   playing one of the preferred minigames during the last two weeks. Every two weeks a different minigame was

319   unlocked in predefined order. Children had their own password and ID to log on from their home. Children were

320   asked to play the game for a minimum of 30 minutes and a maximum of 45 minutes each time. Two children

321   were lost to follow-up and one child dropped out because of acute psychiatric problems. Ethical approval was

322   obtained from the Committee of Medical Ethics for Mental Health Care in Utrecht. Written informed consent

323   was obtained from both parents. Questionnaires were developed especially for this study to assess expectations

324   and satisfaction. Parents filled out questionnaires measuring expectations at baseline (pre-test measurement; see

325   Appendix 1) and satisfaction at follow-up (post-test measurement; see Appendix 2). Children filled out a

326 questionnaire at follow-up to assess their satisfaction with the prototype "Plan-It Commander" game (see

327 Appendix 3).

328

329 *Pre-test parent expectations*

330 Parents rated their expectations about the game in different domains during pre-test measurement (Table 3).

331 Ratings were collected on questionnaires specifically designed for this study (Appendix 1-3). Questionnaires

332 were filled out at study location on a laptop. Questions included, "How much improvement do you expect with

333 regard to the time management skills of your child?" Parents rated their answers on a 10-point Likert scale in

334 which 1 = "none" and 10 = "a lot". Scores from 6 to 10 were combined and interpreted as a positive response. As

335 shown in Table 3, parents had overall high expectations of the game, except where it concerned learning

336 prosocial behavior and reducing ADHD core symptoms. This might be explained by the fact that parents feel

337 prosocial behavior is hard to target in a game. Learning prosocial behavior through a game requires multiplayer

338 options and a different game structure than proposed in this first prototype.[31] For these reasons, a social

339 community aspect was integrated in the final version of the game. Furthermore, the game was not focused on

340 diminishing ADHD core symptoms but on improving behavioral skills. Therefore, lower expectation scores

341 regarding this topic reflect a realistic insight into the capabilities of this game intervention.

342

343   Table 3 around here.

344

345 *Post-test parent satisfaction*

346 At post-test measurement parents answered four additional questions on a 10-point Likert scale (1 = "not at all"

347 and 10 = "totally") concerning parental perceptions about the burden of playing the "Plan-It Commander" game

348 on the child and family. Mean scores ranged from 2.5 to 4.3, indicating that most parents did not feel offering

349 such game intervention was troubling for the family. Furthermore, results demonstrated that parents were overall

350 positive about the game. Their average overall satisfaction with the game was 6.7 (SD = 1.4; on a scale from 1 to

351 10). In addition, a majority of the parents (88%) reported they would recommend the game to other parents. All

352 parents (100%) indicated (on a yes/no question) they would like access to the game once further developed.

353 These findings assured us that our current approach was acceptable for parents and helped us in deciding on how

354 and to which degree children should be exposed to the game.

355

356 *Post-test child satisfaction*

357 We also asked the children who played the game to rate their game satisfaction in different areas (see Table 4).

358 Ratings on 7 questions were collected on a paper-and-pencil questionnaire specifically designed for this study

359 (see Appendix 3). Colours and smileys were used to highlight the different answer categories on a 5-point Likert

360 scale (1 = "not at all" and 5 = "very"). Table 3 shows the number (%) of children who gave a positive opinion

361 (i.e., a combination of the two highest scores) on the satisfaction questionnaire. While only, 44% of the children

362 indicated they were motivated to play the game, 67% of the children indicated they had learned from the game

363 and 77% were positive about making the game available for other children with ADHD. A social community,

364 several side missions and special features were added to the "Plan-It Commander" prototype making it more

365 attractive and thereby more motivating and challenging for children. This is relevant as motivation is thought to

366 be an important mediator for changing behavior.[6, 31-33]

367

368   Table 4 around here.

369

370 *Qualitative user-experience*

371 At post-test measurement, both parents and children answered open question concerning changes to the game.

372 They provide useful suggestions and recommendations for improvements, such as requests by children for more

373 characters, travel to different planets and other characters in the game world. Some parents indicated the game

374 could be more challenging for their child, especially if they already had broad gaming experience. These

375 important responses and feedback were very supportive in finalizing the full game.

376

377 **Summary and future perspectives**

378   In this article we outlined important aspects of developing a serious game to impact daily life

379 functioning of children with ADHD. We described how developing a serious game is a collaborative project

380 between various experts and users and how that process was carried out in this project. We outlined the

381 theoretical basis for het game as a therapeutic intervention and described how the theory was implemented in

382 various game components. This was followed by a description of the minigames and structural components of

383 the game in which game components were embodied. The information we provided supports the need in the

384 literature on serious games to provide detailed descriptions on the game themselves, theories that guide them and

385 the components of the game intended to change behaviors that lead to intended positive outcomes. The

13

386 information provided is also valuable as a description of a method and approach that represents a significant

387 effort to move beyond serious games aimed at improving neurocognitive functioning, but functioning in

388 important domains of daily life for children with ADHD. The description of our development process was

389 supplemented by a presentation of results for parents and child acceptability and usability ratings of a prototype

390 of the game. We discussed the findings in light of their implications for game development.

391   Overall, the usability findings indicated positive acceptance of this game intervention by children with

392 ADHD and their parents. These preliminary results, based on a prototype version of the final game, directed

393 further development of the game by including several aspects children proposed themselves (e.g, travel to other

394 planets, more characters, special features). Parent's feedback also helped us in making well-informed decisions

395 about children's play frequency. The advantage of our survey questionnaire approach compared to a more

396 qualitative approach such as a focus group is that the opinions from larger groups of people can be summarized

397 in standardized way through ratings. A drawback to this approach is that we may have lost the opportunity to

398 gain some important opinions and feedback from participants due to the structured format of the questions and

399 responses. We did however also include open-ended questions, which allowed participants to provide their

400 feedback in a less structured approach.

401   Both parents and children were quite satisfied with the first prototype and indicated they would

402 recommend the game to other parents of children with ADHD. As parents' high expectations might have

403 influenced their ratings, further research should try to control for these expectations by including teacher ratings,

404 blinded measures and more objective measures such as neuropsychological tasks. In the current study, only two

405 children did not use medication as their treatment as usual. It may well be that medication use is a necessary

406 condition for optimal learning from the current intervention. Future research could examine the effects of this

407 game in a non-medicated sample to further explore the necessity of medication as treatment as usual. With

408 regard to development, it should be considered to extend the game or to create an add-on with different learning

409 goals relevant for different age groups. Games could be made more individualized by creating the option to

410 choose learning modules to suit individual developmental trajectories. This project has created a platform from

411 which future goals could be implemented.

412   Although these first results regarding expectations and satisfaction are promising, a randomized clinical

413 trial is necessary in order to test the effectiveness of this serious game. As serious games become more popular

414 within mental health care, more research is needed on the implementation of such e-mental health interventions

415 into the primary process of care. This game format presents an alternative to traditional behavioral interventions

416 currently available for children with ADHD that are often presented in school settings by therapists, making

417 them time consuming, costly and less accessible compared to digital tools.[34-36]

418 In sum, the description of the approach and process used in developing Plan-It Commander along with

419 the usability findings that led back into the development process provide an example for developing serious

420 games for similar target groups and outcomes. The findings have implications for defining and describing the

421 complex processes of designing and developing serious games that involve collaborations between diverse

422 stakeholders groups that include structured input from target users and family members.

423

432 **Author Disclosure Statement**

433 **Financial**

434 • Helga van Oers and Annik Willems are paid employees from Janssen Pharmaceuticals.

435 • Rens van Slagmaat is a paid employee from RANJ serious games.

436 • Kim Bul has been paid by Janssen Pharmaceuticals for consultancy and lectures (fees were paid to the

437 institution).

438 • Athanasios Maras has been paid by Janssen Pharmaceuticals for consultancy. Athanasios Maras has

439 been a consultant to/member of advisory board of/and/or speaker for Janssen Pharmaceuticals, Eli Lilly,

440 Eurocept and Neurim Pharmaceuticals, in the past 2 years and is not an employee or a stock shareholder

441 of any of these companies. He has no other financial or material support, including expert testimony,

442 patents, and royalties.

443 • Pamela Kato has been paid by Janssen Pharmaceuticals for consultancy.

444 • Marina Danckaerts has received personal fees from Shire and Neurotech solutions outside the submitted

445 work. She has no other financial or material support, including expert testimony, patents, and royalties.

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Nonfinancial

- Kim Bul has not been paid by Janssen Pharmaceuticals to perform the pilot study.

- Saskia Van der Oord has been involved in the development, implementation, and trialing of Braingame Brian, an executive functioning game training for children with ADHD, and Zelf Plannen, a cognitive behavioral planning intervention for adolescents with ADHD. She has no financial interests in either of these interventions.

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