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No Evidence of Expectancy Effect on Visuospatial Attention in Cognitive Training with Action Video Games

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Dissertação de Mestrado

Ausência de Evidência de Efeito da Expectativa na Atenção Visuoespacial no Treinamento Cognitivo com Jogos de Ação

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Não se pode aprender nada de uma lição que não seja acompanhada por dor, já que não se pode conseguir nada sem um sacrifício. Mas quando você aguenta essa dor e a supera, as pessoas conseguem um coração forte que não perde para nada. Sim, um coração de aço.

Edward Elric – Fullmetal Alchemist Brotherhood

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Abstract

This study assessed if the expectation of cognitive improvement due action video game playing could affect visuospatial attention. All the 140 participants underwent a pre- and post-testing, or just a post-testing, of the Useful Field of View (UFoV) task in a single experimental session. Prior to the post-test, Placebo Group 1 watched a video inducing expectation of game-related effects on cognition, while Control Group 1 watched a control video, both followed by a 10-minute session of virtual reality action video game. Placebo Group 2 and Control Group 2 underwent the same procedures, except for the pre-test (i.e., Solomon four-group experimental design). Although experimental manipulation induced expectation in Placebo Group 1 compared to Control Group 1, there was no differences of performance in the UFoV task. A comparison of Placebo Group 2 and Control Group 2 assessed an expectancy effect in the absence of a pre-test, and the results showed that the manipulation did not induced expectation, which was not observed in performance as well. A comparison among all experimental conditions in the post-test evidenced a carry-over effect caused by practice and suggest that performance in placebo possibly benefited or intensified by a pre-testing. In summary, our results do not support previous investigation in the literature claiming that an expectancy effect may account for attentional gains in cognitive training studies.

Key words: Expectancy effects, Placebo effect, Visual attention, Video games, Cognitive training.

Resumo

Este estudo avaliou se a expectativa de melhoria cognitiva devido à prática de jogos de ação poderia afetar a atenção visuoespacial. Todos os 140 participantes passaram por um pré-teste e um pós-teste, ou apenas um pós-teste, da tarefa de Campo de Visão Útil (CVU) em uma única sessão experimental. Antes do pós-teste, o Grupo Placebo 1 assistiu a um vídeo que induzia expectativas de efeitos relacionados ao jogo na cognição, enquanto o Grupo Controle 1 assistiu a um vídeo controle, ambos seguidos por uma sessão de 10 minutos de jogo de vídeo game em realidade virtual. O Grupo Placebo 2 e o Grupo Controle 2 passaram pelos mesmos procedimentos, exceto pelo pré-teste (ou seja, desenho experimental de quatro grupos de Solomon). Embora a manipulação experimental tenha induzido expectativa no Grupo Placebo 1 em comparação com o Grupo Controle 1, não houve diferenças de desempenho na tarefa CVU. Uma comparação entre o Grupo Placebo 2 e o Grupo Controle 2 avaliou um efeito de expectativa na ausência de um pré-teste, e os resultados mostraram que a manipulação não induziu expectativa, o que também não foi observado no desempenho. Uma comparação entre todas as condições experimentais no pós-teste evidenciou um efeito de transferência causado pela prática e sugere que as intervenções placebo possam ser beneficiadas ou intensificadas por um pré-teste. Em resumo, nossos resultados não apoiam investigações anteriores na literatura que afirmam que o efeito de expectativa pode explicar ganhos de atenção em estudos de treinamento cognitivo.

Palavras-chave: Efeitos de expectativa; Efeito placebo; Atenção; Jogos de vídeo; Treinamento cognitivo.

Resumo Expandido

Os videogames demandam movimentos motores complexos e uma alta carga cognitiva para o processamento de informações por seus jogadores. Em particular, os videogames exigem processamento perceptual e atencional, além de exigir a criação de estratégias constantes, o que faz com que os jogadores usem constantemente o raciocínio e habilidades de tomada de decisão, entre outras funções cognitivas compiladas em revisões e metanálises ao longo da última década. A relação entre jogos de vídeo games, em especial jogos de ação, e a cognição, tem sido amplamente investigada dentro do contexto de treinamento cognitivo. No entanto, enquanto alguns estudos demonstram ganhos cognitivos devido à prática de vídeo games, outros estudos mostraram que não há ganhos cognitivos e até uma diminuição ou esgotamento de recursos atencionais. A divergência entre os resultados desses estudos tem levantado grandes discussões dentro da literatura da área. E isso tem sido relacionado a diversos problemas metodológicos, como a falta de controle sobre as expectativas dos participantes, que poderiam proporcionar efeitos placebos ou nocebos, afetando assim os resultados desses estudos. Diante disso, pesquisas tem investigado os efeitos da expectativa em intervenções de treinamento cognitivo, porém, a literatura é escassa quanto a esses efeitos em treinamentos cognitivos com jogos de ação. Pesquisas anteriores investigaram os efeitos da expectativa em treinamento cognitivo da atenção usando jogos de raciocionio. Neste estudo, investigamos se a expectativa de melhorias cognitivas decorrentes da prática de jogos de ação poderia afetar a atenção visuoespacial.

Método

Para isso, 140 participantes foram submetidos a uma sessão experimental que incluía um pré-teste e um pós-teste, ou apenas um pós-teste, da tarefa de Campo de Visão Útil (CVU). Antes do pós-teste, o Grupo Placebo 1 assistiu a um vídeo que induzia expectativas de efeitos relacionados aos jogos de ação na cognição, enquanto o Grupo Controle 1 visualizou um vídeo controle. Em seguida, ambos os grupos foram então submetidos a uma sessão de jogo de ação em realidade virtual com duração de 10 minutos, seguido do pós-teste. Os participantes do Grupo Placebo 2 e do Grupo Controle 2 passaram pelos mesmos procedimentos, exceto pelo pré-teste, seguindo assim o desenho experimental de quatro grupos de Solomon. Ao final do procedimento, todos os participantes responderam um questionário que avaliou suas expectativas sobre os efeitos da intervenção com o jogo de ação. A hipótese principal desse trabalho, é de que os participantes dos Grupos Placebos teriam um melhor desempenho no pós-teste na tarefa do CVU, comparado aos participantes do grupo controle.

Resultado e Discussão

Nossos resultados mostraram que, embora a manipulação experimental tenha induzido expectativa no Grupo Placebo 1 em comparação com o Grupo Controle 1, não houve diferenças de desempenho na tarefa do CVU. Uma comparação entre o Grupo Placebo 2 e o Grupo Controle 2 avaliou um efeito de expectativa na ausência de um pré-teste, e os resultados mostraram que a manipulação não induziu expectativa, o que também não foi observado no desempenho. Uma comparação entre todas as condições experimentais no pós-teste evidenciou um efeito de transferência causado pela prática e sugere que as intervenções placebo possam ser beneficiadas ou intensificadas por um pré-teste. Em resumo, nossos resultados não apoiam investigações anteriores na literatura que afirmam que o efeito de expectativa pode explicar ganhos de atenção em estudos de treinamento cognitivo.

Introduction

Video games demand complex motor movements, a high cognitive load, and information filtering by its players (Bavelier & Green, 2019; Bediou et al., 2018; Latham et al., 2013; Oei & Patterson, 2013; Reynaldo et al., 2021; Stanmore et al., 2017). Particularly, video games require intricate perceptual (Bediou et al., 2018; Bejjanki et al., 2014; Sajan et al., 2017) and attentional processing (Bavelier & Green, 2019; Bediou et al., 2018; Föcker et al., 2019; Green & Bavelier, 2003; Green & Bavelier, 2006a; Green & Bavelier, 2006b; Oei & Patterson, 2013), in addition to recruiting working memory (Ballesteros et al., 2017; Colzato et al., 2013; Green & Bavelier, 2006a; Green & Bavelier, 2006b; Toril et al., 2016), reasoning, and decision-making abilities (Curcio & Peracchia, 2019), among other functions compiled in reviews and meta-analyzes over the last decade (e.g., Anguera & Gazzaley, 2015; Bavelier & Green, 2019; Bediou et al., 2018; Boot et al., 2011; Dale et al., 2020; Latham et al., 2013; Stanmore et al., 2017). These findings are in line with prior research on the effects of action video games on neuroplasticity (Bavelier et al. 2012; Bavelier & Green, 2019; Colzato et al., 2013; Föcker et al., 2019; Palaus et al., 2020; Reynaldo et al., 2021; Wu et al., 2012).

Among the cognitive processes involved in video game playing, attention is a crucial skill when playing action video games. Action games are characterized by constantly changing scenarios that present visual and auditory stimuli in rapid sequences that demands fast responses for optimal performance (Bavelier & Green, 2019; Bediou et al., 2018; Green & Seitz, 2015; Green & Bavelier, 2006a; Green & Bavelier, 2006b; Oei & Patterson, 2013). Considering the very nature of such a games, research has focused on investigating how the practice of action video games influence attentional processes, and showed positive training effects on players' visual attention (Ballesteros et al., 2017; Bashiri et al., 2017; Bavelier et al., 2012; Bavelier & Green, 2019; Boot et al., 2011; Latham et al., 2013; Oei & Patterson, 2013). Of interest to this study, attentional gains associated with action video games have been observed in the Useful Field of View task (UFoV; Belchior et al., 2013; Green & Bavelier, 2006a; Green & Bavelier, 2006b; Green & Bavelier, 2003; Feng et al., 2018). The UFoV task was developed by Ball et al. (1988) to evaluate the distribution of selective attention across a wide visual field, and to assess limitations in attentional coverage in the visual space.

However, although some studies demonstrate cognitive gains resulting from video game practice in terms of agility and improvement in attentional tasks and other cognitive functions (e.g., Bediou et al., 2018; Belchior et al., 2013; Boot et al., 2011; Colzato et al., 2013; Curcio & Peracchia, 2019; Föcker et al., 2019; Latham et al., 2013; Sajan et al., 2017; Stanmore et al., 2017), other studies showed no cognitive gains and even a decrease or depletion of attentional resources (Irons et al., 2011; Murphy & Spencer, 2009; Sala et al., 2018; Unsworth et al., 2015; van Ravenzwaaij et al., 2014). Additionally, issues related to experimental design and various methodological problems, such as the lack of control over participant expectations, have been highlighted in the literature. Review studies and opinion papers suggest that participants expectations on cognitive gains (i.e., placebo-like effect) influence their performance in cognitive training studies involving video games (Anguera & Gazzaley, 2015; Bavelier & Green, 2019; Bediou et al., 2018; Boot et al., 2011; Dale et al., 2020; Denkinger et al., 2021; Latham et al., 2013; Masurovsky, 2020; Stanmore et al., 2017). These reviews are being corroborated by a new avenue of research that is gathering results of trials that show evidence of expectancy effects in cognitive training on the one hand (e.g., Edwards et al., 2021; Foroughi et al., 2016; Ng et al., 2020; Parong et al., 2022; Rabipour & Davidson, 2015; Rabipour et al., 2018; Tiraboschi et al., 2019; and Ziv et al., 2022), and others that do not (Ballesteros et al., 2017; Brantley et al., 2021; Schwarz & Büchel, 2015; Tsai et al., 2018; Vodyanyk et al., 2021; Watolla et al., 2020).

The study conducted by Tiraboschi et al. (2019) was the first to investigate whether expectation regarding video game training modulates performance in visual attention tasks. The researchers conducted an experiment to assess spatial and temporal aspects of visual attention using the Useful Field of View (UFoV) and the Attentional Blink tasks, respectively. Those tasks are commonly used in the literature of video game training (e.g., Green & Bavelier, 2003, 2006a). All participants completed the UFoV and the Attentional Blink tasks before (i.e., pre-test) and after (i.e., post-test) playing a Sudoku on a tablet. Prior to the pre-test, the placebo group received written instructions that induced expectation by informing them about the benefits of video game playing. In contrast, the control group was told that they would play Sudoku during a break to recover. The results showed an overall performance increase in the UFoV task only for the placebo group, but no differences were found for the Attentional Blink task. The study was the first to show an expectation bias that was induced by a short textual instruction in a brief single video game training session, and therefore ruled out neuroplasticity-related confounding variables. In addition, Sudoku, which is often employed as a control, fits well in a placebo intervention since there are no reports of any modulation of this reasoning game in visual attention.

However, Sudoku hampers the generalization of the results since it greatly differs from action video games. These games are considered the best category for training visual attention due to their high interactivity and immersion (Bavelier & Green, 2019; Bediou et al., 2018; Dale et al., 2020; Dale & Green, 2017; Green & Bavelier, 2006a; Green & Bavelier, 2006b). Furthermore, the induction of expectation prior to the pre-test, as used in Tiraboschi et al. (2019) study, contrasts with most recent studies that investigated expectancy effect in the cognitive training literature

(Brantley et al., 2021; Edwards et al., 2021; Tsai et al., 2018; Vodyanyk et al., 2021; Watolla et al., 2020; Ziv et al., 2022). A manipulation of expectation before the pre-test hinders the establishment of a baseline, and potentially induce a nocebo effect in the pre-test. Lastly, the study did not control individual differences regarding participants' level of gaming experience (see Boot et al., 2011 and Ziv et al., 2022) and expectation on the cognitive benefits of video game practice (see Rabipour et al., 2018).

Therefore, in the present study we conducted a conceptual replication of Tiraboschi et al.'s UFoV task considering the aforementioned limitations. In addition, the expectation induction was delivered in a video format and participants played video game using a virtual reality headset. Virtual reality environment offers deeper visual and auditory immersion while minimizing distractions and unwanted noise (Bashiri et al., 2017; Bauer & Andringa, 2020; Feng et al., 2018; Wais et al., 2021; Zając-Lamparska et al., 2019). We also implemented the Solomon four-group experimental design (Braver & Braver, 1988) to control carry-over effects (e.g., practice and fatigue). Participants of the groups Placebo 1 and Control 1 underwent a pre- and post-testing, and participants of the groups Placebo 2 and Control 2 underwent just a post-testing of the UFoV task (see Method). We hypothesized that the placebo groups exposed to the experimental induction of expectation would exhibit better performance in the post-test compared to the control groups.

Method

This study was pre-registered in the Open Science Framework (OSF) platform prior to analysis of the data (osf.io/xmzrn), and was approved by the Research Ethics Committee of the University of Brasília (CAAE: 62068722.9.0000.5540). We made available as supplemental material: (1) the code of the experimental task and the stimuli set, (2) the video to induce expectation and the control video along its scripts, (3) forms and scales used in the study, (4) raw and processed data, and (5) statistical analyzes (access: osf.io/ahx7k/).

Participants

The sample size was estimated based on *a priori* power analysis using G-Power v. 3.1.9.6 (Faul et al., 2009). We considered the main comparison between groups Placebo 1 and Control 1 based on a 2 × 2 mixed-design ANOVA with Session (pre- and post-test) as the within factor, and Intervention (placebo and control) as the between factor[1]. We adopted the effect size reported by Tiraboschi et al. (2019), $\eta^2 = .086$ or Cohen's $f = .307$ (Lenhard & Lenhard, 2022). The power was set at .90, the significance level at .05, and the correlation among repeated measures at .50 (the observed correlation in the dataset was .89). The minimum sample size calculated was $n = 30$ per group.

Thus, 140 participants were recruited and randomly divided into four groups: Placebo 1 ($n = 37$, female = 23, male = 14, age = 18–29 y.o.), Control 1 ($n = 40$, female = 33, male = 6 , preferred not to respond = 1, age = 18–35 y.o.), Placebo 2 ($n = 31$, female = 19, male = 11, preferred not to respond = 1, age = 18–27 y.o.), and Control 2 ($n = 32$, female = 21, male = 11, age = 18–31 y.o.). All participants had normal or corrected-to-normal visual acuity and had no history of sensory, motor, psychiatric, or neurological disorder. The power analysis output and participants' additional data are available in the supplemental material.

[1] Although our study was conducted with four groups, the sample size of each group was calculated based on the main test of the study, which consisted of comparing the Placebo 1 and Control 1 groups, once we were running a replication of the study conducted by Tiraboschi et al. (2019).

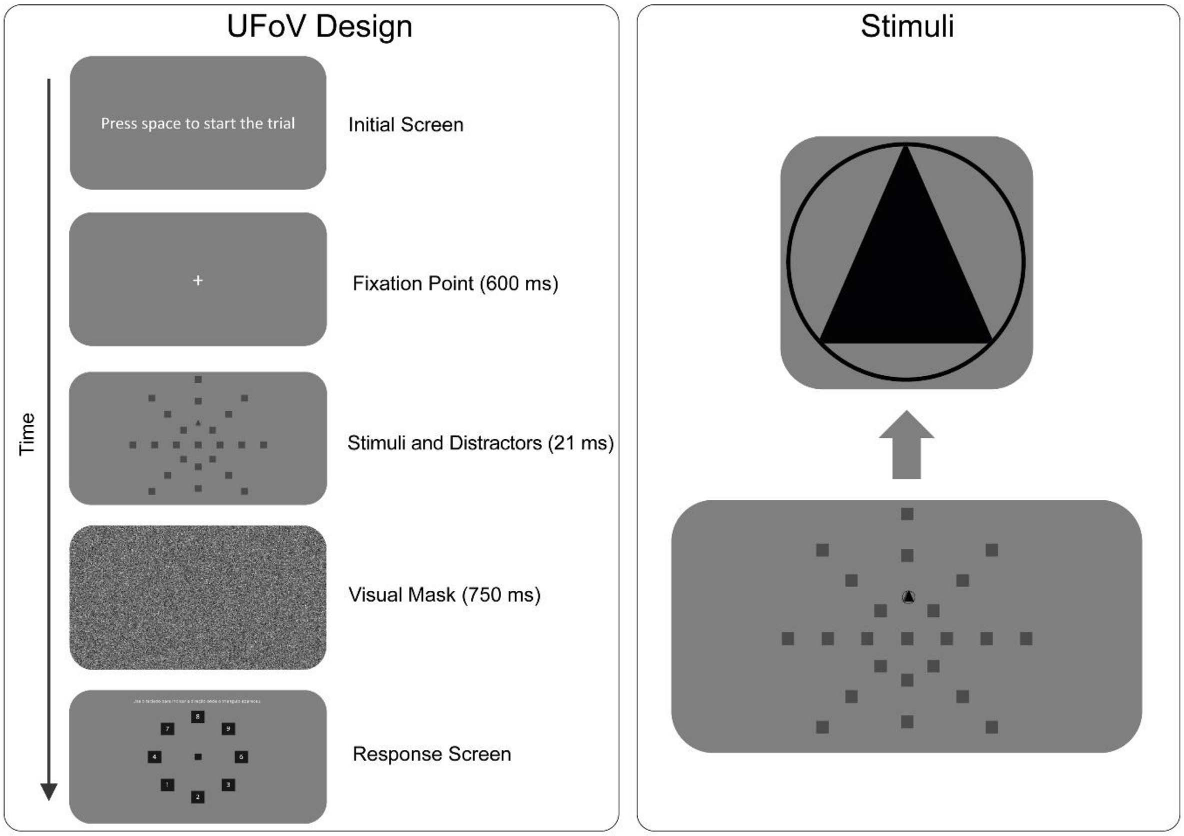
Useful Field of View Task (UFoV)

Participants were positioned 30 cm away from a 24-inch monitor (refresh rate set at 144Hz) and they had to detect the position of the target stimulus (a dark-gray filled triangle within a circle outline) amid distracting stimuli (gray filled squares). Both target and distractor encompassed 1.3º × 1.3º of visual angle (Figure 1, right).

Each trial started by pressing the spacebar on a start screen displaying the message "press space to start the trial" (i.e., self-paced trials) that triggered a white cross-shaped central fixation point that was displayed for 600 ms. Immediately afterward, the target was flashed for 21 ms at one of three possible eccentricities, at 10º, 20º, or 30º of visual angle, and at one of eight possible radial directions relative to the center of the screen, i.e., 24 possible positions for stimulus presentation. Simultaneously, 23 distractors were displayed in the remaining 23 positions. Then, a visual mask was presented for 750 ms. At the mask offset, the participant used the numerical keyboard keys 1 to 9 to indicate the direction which the target stimulus was presented. There was no time limit for response, but participants were instructed to respond as quickly as possible. When the response was given, the initial screen was presented again starting the subsequent trial. Figure 1 (left) illustrates a trial.

Figure 1

The Useful Field of View Task **(***UFoV***)**



Note. The figure illustrates one trial (left) and spatial layout of the visual stimulation with target stimuli amid distractors (right).

Participants completed 24 training trials at the beginning of the task with feedback indicating correct/incorrect responses. After the training phase, participants completed 240 trials with no feedback, consisting of 10 trials for each possible position of the stimulus. The experimental task took approximately 15 minutes. We used PsychoPy 3 v. 2022.2.4 (Peirce, 2007; Peirce et al., 2022) to present the stimuli and collect data. The code is available in the supplemental material.

Procedures and Induction of Expectation

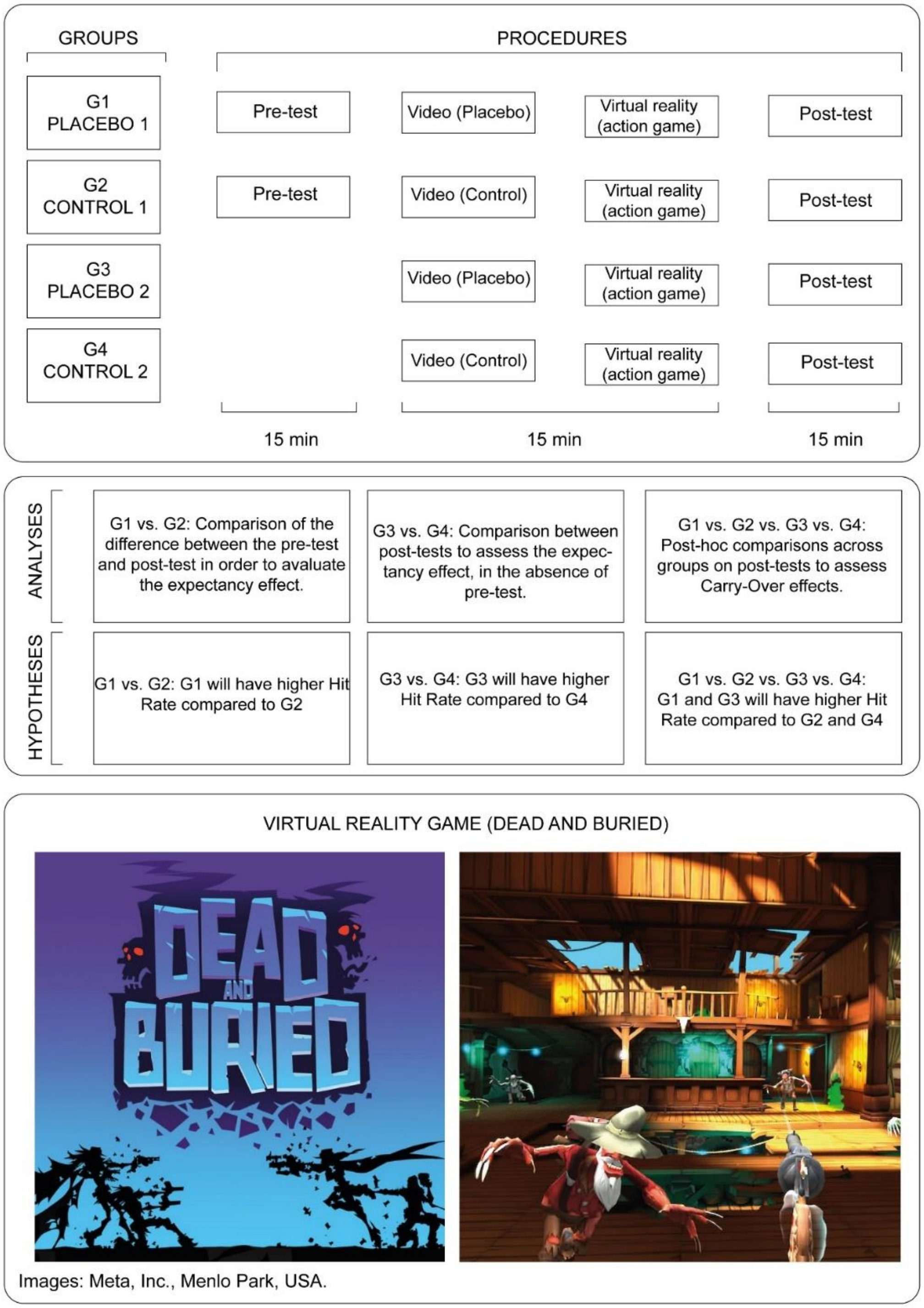
Participants were invited for a study that aimed to “evaluate visual attention in computerized tests”. The study goal and the use of video games in virtual reality were deliberately withheld to avoid a biased sample. The sample was reached by convenience using social networks and posters fixated on the campus bulletin boards. In the laboratory, the recruited participants read and signed an informed consent approved by the research ethics committee, and then underwent a visual acuity assessment test using a Snellen chart (McGraw et al., 1995). After that, they completed a health and socio-demographic form (available in the supplemental material). Subsequently, eligible participants were randomly assigned to one of the experimental groups. The experiment was single-blind and was conducted in a single session in an adapted room under constant illumination. Participants performed the UFoV task in front of a computer using a chin and forehead rest and wore ear protectors to minimize auditory distractions.

The participants of the groups’ Placebo 1 and Control 1 performed the pre-test session of the UFoV task, and participants of the groups Placebo 2 and Control 2 did not. Then, all participants watched a 1.5-minute video. Participants in the placebo groups watched a video containing instructions aimed at inducing expectations on the cognitive benefits of playing action video games in a virtual reality setup. Control groups watched a video with neutral instructions reporting that participants were going to play video game in a “brief break to prevent fatigue during the experiment while keeping attentional resources working”. The videos included narration, subtitles, and copyright-free B-roll footage related to the script. The videos were adapted for each group (e.g., mentioning or not a pre-testing session). Scripts (203–237 words) are available in the Appendix, and the complete videos can be accessed in the supplemental material at OSF.

Immediately after watching the video, all participants played the game Dead and Buried (Meta, Inc., Menlo Park, USA) using the Oculus GO 32 GB standalone virtual reality headset (Meta, Inc., Menlo Park, USA) for an average of 10 minutes (SD = 2 minutes). The game combined elements of First-Person Shooter and Beat'em up genres, in which the player control a gunslinger in a Western setting to shoot at successive waves of zombies. Each wave had a certain number of enemies to be defeated, and as each wave was completed, the game progressively increased in difficulty with stronger and faster enemies, requiring a high level of attention to detect enemies within the visual field. Figure 2 illustrates the procedure adopted for each group (top) and images of the video game played (bottom). Right after playing the video game, all participants performed the UFoV post-test.

After the post-test, participants completed two questionnaires. The first instrument inquired about participants' level of expertise in action video games (no experience–very experienced), frequency of gameplay (no frequency – high frequency), and mental states during the research (happy–sad, relaxed–anxious, and rested–fatigued) on a paper-and-pencil visual analogue scale ranging from 0 to 100, in addition to an inquiry about weekly hours dedicated to gaming scaled from 0 to 20 hours. The second questionnaire included three questions about participants' expectations regarding the trained game. Item 1 evaluated potential carry-over effects, or performance perception for groups with no pre-testing. Item 2 assessed how much participants expected their performance to be altered due to action games in virtual reality. And item 3 assessed the expectation of video game effects on people's attention. Items 1 and 2 were adapted for groups Placebo 2 and Control 2. Participants also responded in a visual analog scale ranging from 0 (strongly disagree) to 100 (highly agree). Full transcripts of the expectancy-related items are found in the Results.

Figure 2
Solomon four-group desing



Note. The top part presents the Solomon four-group experimental design adopted in the study. The central part presents the study hypotheses. The bottom part illustrates the video game used in the training session; information and a demo video are found at www.meta.com/experiences/pcvr/1198491230176054/.

The experimental session took approximately 60 minutes for groups Placebo 1 and Control 1, and 45 minutes for groups Placebo 2 and Control 2. This included an average of: 15 minutes for the UFoV application; 15 minutes for video presentation and virtual reality training; and additional 15 minutes for questionnaire and scale administration. The questionnaires, scales, stimuli, and experiment codes used in the study are available as supplemental material.

Experimental Design and Data Analysis

The current investigation implemented a Solomon four-group experimental design for controlling carry-over effects. Thus, participants were randomly assigned to the groups Placebo 1, Control 1, Placebo 2, or Control 2 (also represented as G1–G4 in Figure 2, top). We employed a general 2 × 2 × 2 × 3 experimental design with Pre-testing (present and absent) and Intervention (placebo and control) as a between factors, and Session (pre- and post-test) and Eccentricity (10º, 20º, and 30º visual angle) as within factors. The hit rate was assessed as a measure of performance in the UFoV task. Three different analyzes were performed based on appropriate statistical analyzes for this experimental design (Braver and Braver, 1988). Despite controlling the occurrence of a pre-testing, it did not account as a factor in our main analysis in which comparisons between pre- and post-test for groups Placebo 1 and Control 1 in all eccentricities directly examined the occurrence of an expectancy effect (i.e., first analysis: Intervention [2] × Session [2] × Eccentricity [3]). Likewise, a comparison between Placebo 2 and Control 2 assessed an expectancy effect for all eccentricities while ruling out pre-test biases (i.e., second analysis: Intervention [2] × Eccentricity [3]). Finally, a comparison of the post-test for all eccentricities among all four groups evaluated a carry-over effect (i.e., third analysis: Pre-testing [2] × Intervention [2] × Eccentricity [3]). Analyzes and hypotheses are stated in Figure 2 (center). Data of individual differences obtained from the scales feed the analyzes as covariates.

The statistical analyzes were conducted using Jamovi v. 1.1.9.0 (The Jamovi Project, 2019). The significance level was set at 5%. Normality was assessed by Shapiro-Wilk test and density plots. We used Greenhouse-Geisser correction when sphericity was violated. Bonferroni adjustment and Dwass-Stell-Crichlow-Fligner test (nonparametric) were used for post-hoc multiple comparisons. All procedures implemented in the analyzes were described in the preregistration and were not altered.

Results

Subjective Perception of Expectation

Initially, we checked if the study experimentally induced expectation in the participants allocated to the placebo groups. For this purpose, participants rated their expectation using a visual analogue scale at the end of the study (as reported in the subsection "Procedures and Induction of Expectation"). The ratings were non-normally distributed for all items.

On Item 1, "I believe that my performance improved from the first session to the second session of the experiment", participants of the Placebo Group 1 had a higher score compared to Control Group 1 when we conducted a Mann-Whitney test, $U = 483$, $p = .009$, rank-biserial $r = .34$. This item assessed subjective perception of enhancement in the UFoV-task training. The Item 1 was adapted for the groups Placebo 2 and Control 2, "I believe I performed well during the test", and no rating difference was observed, $p = .315$ (Figure 3, left).

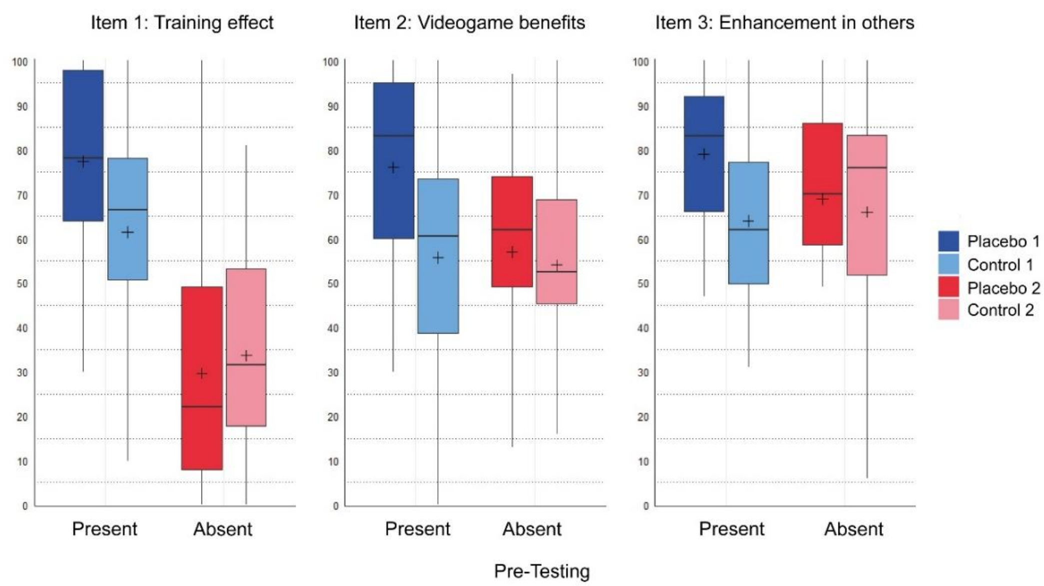
Item 2 assessed a subjective perception of expectation in the statement "I believe that my performance improved from the first to the second session due to the virtual reality game", and Placebo Group 1 presented higher rates compared to Control Group 1, $U = 407$, $p = .001$, rank-biserial $r = .45$. Likewise, the Item 2 was adapted for the groups Placebo 2 and Control 2, "I believe that my performance in the test is better when I play the virtual reality game compared to the performance when I do not", and no rating difference was observed, p = .518 (Figure 3, center).

Item 3 assessed a subjective perception of cognitive enhancement due video game in others. The statement "I believe video games improve people's attention" was presented for all groups, which were directly compared (Kruskal-Wallis), X^2 (3) = 10.45, p = .015, ε^2 = .07. Post-hoc comparisons showed that participants of the Placebo Group 1 had higher rates compared to Control Group 1 (p = .005), but no difference was observed between groups Placebo 2 and Control 2 (p = .988; Figure 3, right).

Curiously, and to sum up, an expectation on attentional gains due action video game playing was induced only in the Placebo Group 1, which was pre- and post-tested. Placebo Group 2 did not differ from its counterpart (i.e., Placebo Group 2) in all the three items that assessed an expectancy effect.

Figure 3

Rating of the participants regarding expectation on cognitive benefits of video game playing



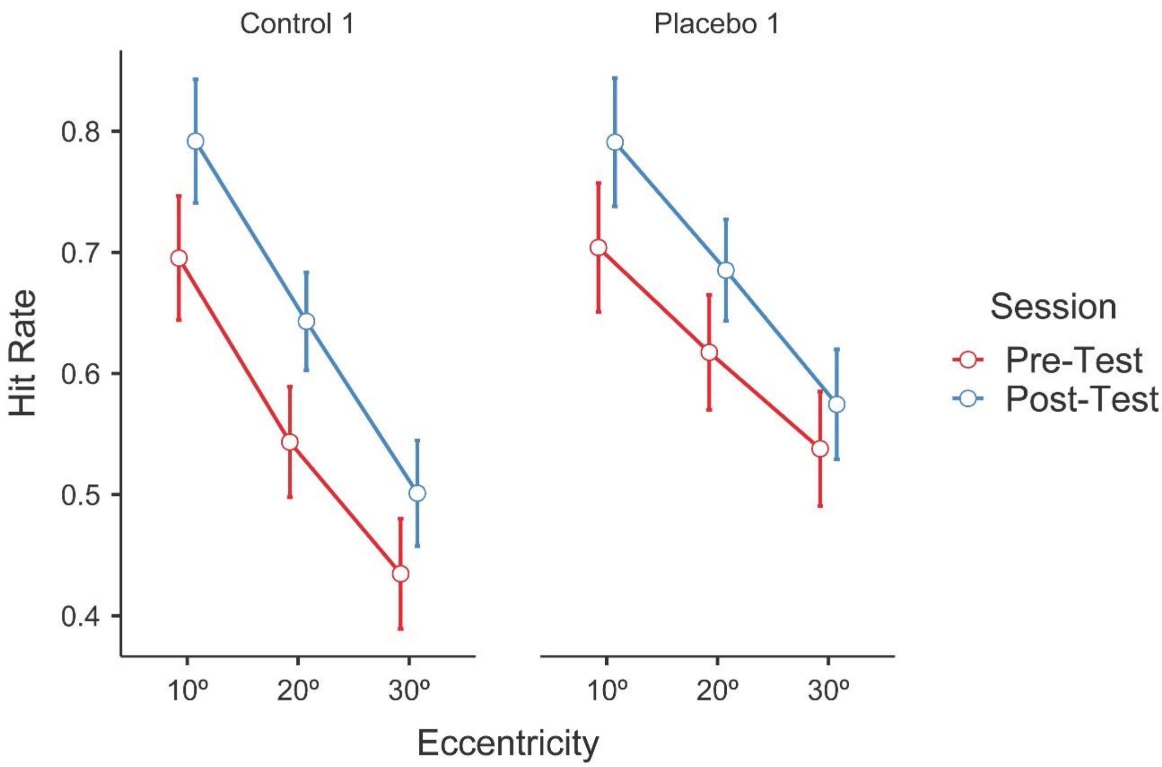
Note: Full transcript of each item is found in the text. Ratings ranged from 0 (strongly disagree) to 100 (highly agree).

Attentional performance

We assessed an expectancy effect observing performance changes in the mean hit rate in the groups Placebo 1 and Control 1 (see Figure 4). A three-way mixed ANOVA was performed with Intervention (placebo and control) as between factor, and Session (pre- and post-test) and Eccentricity (10º, 20º, and 30º) as within factors. This is the same analysis conducted by Tiraboschi et al. (2019). The ANOVA revealed a main effect of Session, $F(1, 75) = 72.62$, $p < .001$, $\eta_p^2 = .49$, showing that hit rate was higher in the post-test. A main effect of Eccentricity was also revealed, $F(1, 101) = 139.67$, $p < .001$, $\eta_p^2 = .65$, showing that the target stimuli was better recognized at 10º than at 20º, which in turn was better recognized than at 30º (all with $p < .001$). No main effect of Intervention was found. Importantly to the study goal, the two-factor interaction Intervention × Session was nonsignificant, $F(1, 75) = 1.79$, $p = .188$, $\eta_p^2 = .02$; and the triple interaction considering the factor Eccentricity was also nonsignificant, $F(2, 139) = .41$, $p = .647$, $\eta_p^2 < .01$. Therefore, the experimental manipulation of expectation did not modulate the attentional performance. The two-factor interaction Intervention × Eccentricity was significant, $F(1, 101) = 4.68$, $p = .023$, $\eta_p^2 = .06$. However, the hit rate of the groups Placebo 1 and Control 1 did not differ when the target stimulus was presented in the same spatial distance from the fixation point, regardless of the eccentricity (all with $p \geq .076$). The two-factor interaction Eccentricity × Session was also significant, $F(2, 139) = 4.86$, $p = .011$, $\eta_p^2 = .06$, and showed an increase in the hit rate from the pre- to post-test when comparing the same eccentricity for the target stimulus presentation (all with $p < .001$). Additionally, we eliminated the factor Session by considering as response variable the hit rate difference (post-test minus pre-test) and performed the same analysis to compare groups Placebo 1 and Control 1. Again, no effect was found for Intervention nor its interaction with Eccentricity, which reinforces the non-occurrence of an expectancy effect in the present study.

Figure 4

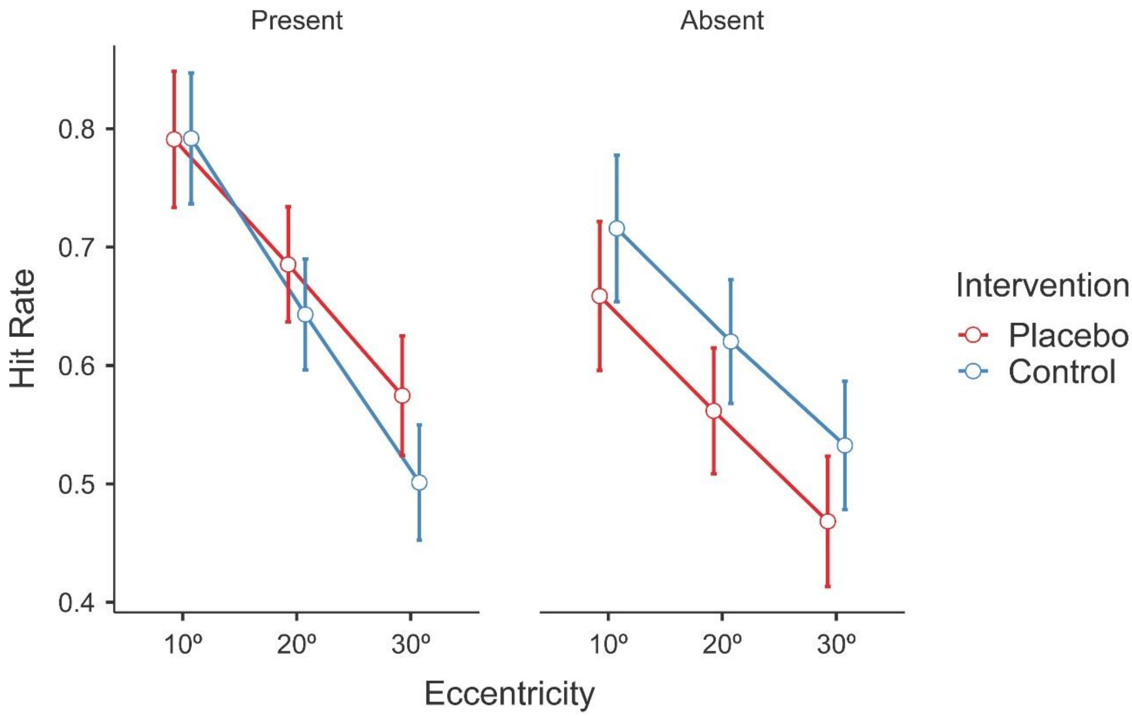
UFoV performance at each eccentricity in the pre- and post-test for the Placebo 1 and Control 1.



Note: The pre-test condition is represented in red, while the post-test is represented in blue. Bars indicate 95% confidence intervals.

A second analysis compared the mean hit rate of the groups Placebo 2 and Control 2 to assess an expectancy effect while ruling out pre-test biases (see Figure 5, right). Thus, a two-way mixed ANOVA "Intervention × Eccentricity" was carried out. Similar to the "Placebo 1 vs. Control 1" comparison, a main effect of Eccentricity was found, $F(2, 100) = 78.47$, $p < .001$, $\eta_p^2 = .56$, indicating higher hit rate for target stimuli presented at 10º, 20º, and 30º, in this order (all pairwise comparisons with $p < .001$). Importantly to the study goal, no main effect of Intervention was found, $F(1, 61) = 2.03$, $p = .159$, $\eta_p^2 = .03$. The interaction Intervention × Eccentricity was also nonsignificant. These results support our previous analysis indicating that the expectation on cognitive benefits of video game playing does not modulate visuospatial attention.

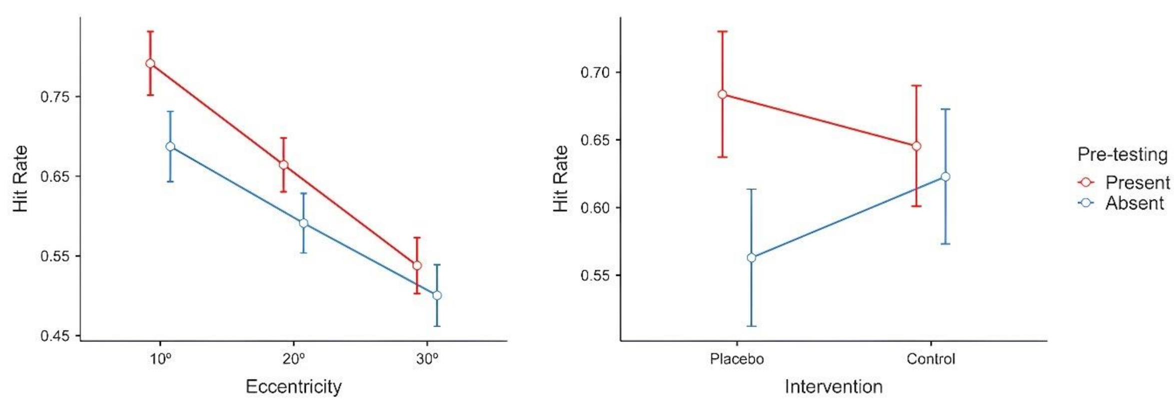
Figure 5
UFoV Performance in the post-test grouped by pre-testing conditions (present or absent).



Note: Groups Control 1 and Placebo 1 (pre-test carried out) are represented in the left half, and groups Control 2 and Placebo 2 (pre-test not carried out) are represented in the right half. Bars indicate 95% confidence intervals.

Finally, a comparison of the mean hit rate of the post-test of all experimental groups and for all eccentricities evaluated a carry-over effect (see Figure 5). A three-way mixed ANOVA was performed with Pre-testing (present and absent) and Intervention as between factor, and Eccentricity as within factor. The ANOVA revealed a main effect of Pre-testing, $F(1, 136) = 8.75$, $p = .004$, $\eta_p^2 = .06$, showing a greater hit rate in the post-test to groups that underwent a pre-test. This result sugests a carry-over effect caused by practice. No main effect of Intervention was found, $F(1,\ 136) = .20$, $p = .655$, $\eta_p^2 < .01$, supporting previous analysis that showed that the induction of expectation did not modulate spatial attention in the UFoV task. A main effect of Eccentricity was found, $F(1, 196) = 199.38$, $p < .001$, $\eta_p^2 = .59$, and pairwise comparisons output follow previous results for this factor (all with $p < .001$). The interactions "Intervention × Eccentricity", and "Pre-testing × Intervention × Eccentricity" were nonsignificant. The significant interaction Pre-testing × Eccentricity, $F(1, 196) = 4.59$, $p = .021$, $\eta_p^2 = .03$, showed that the hit rate in the post-test of the experimental groups that underwent a pre-test, when compared to groups with no pre-testing, was greater only when the target stimulus was presented at 10º (p = 010), marginally significant when presented at 20º (p = .069), and nonsignificant when presented at 30º of eccentricity (p > .999; see Figure 6, left). The interaction Pre-testing × Intervention was also significant, $F(1, 136) = 4.11$, $p = .045$, $\eta_p^2 = .03$. The only significant comparisons showed that the hit rate in the post-test of the placebo group that underwent a pre-test (i.e., Placebo Group 1) was higher than the placebo group with no pre-testing (i.e., Placebo Group 2), $p = .004$ (see Figure 6, right). Such result suggest that placebo interventions are possibly benefited or intensified by a pre-testing.

Figure 6
UFoV Performance in the post-test grouped by pre-testing conditions (present or absent).



Note: Groups Control 1 and Placebo 1 (pre-test carried out) are represented in red, and groups Control 2 and Placebo 2 (pre-test not carried out) are represented in blue. Bars indicate 95% confidence intervals.

We also ran the same analyzes considering the correct response time as the response variable. Data points that were outside the boundaries of two standard deviation units of the averaged correct response time for each participant were excluded. An expectancy effect was not observed. Complementary to the ANOVAs, we ran ANCOVAs and MANOVAs in many different combinations of response variables and covariates. The hit rate and response time were considered as response variables. The covariates were assessed in the forms that the participants responded at the end of the study regarding expectation (subjective expectancy, training effect, and enhancement in others), video game-related profile (expertise, frequency of gameplay, and weekly hours dedicated to gaming), and mental state during the experiment (happy/sad, relaxed/ anxious, and rested/fatigued). No expectancy effect was observed in any model that was implemented. These additional analyzes are not reported in the paper for the sake of brevity. All analyzes conducted, assumptions checks, post-hoc comparisons, and additional graphs are found in the supplemental material's online repository.

Discussion

The present study was based on the assumption that an expectancy effect in cognitive training with action games could boost visuospatial attention. We simulated a cognitive training with action games with naïve participants and we manipulated their expectation. Different information regarding the effects of a pseudo-training session with an action game in virtual reality were used for placebo and control groups. It was expected that participants in the placebo groups would perform better in the post-test evaluation of the UFoV compared to the control groups, but this was not observed in any of our analyzes. Therefore, our results do not support the findings of previous studies (e.g., Edwards et al., 2021; Foroughi et al., 2016; Ng et al., 2020; Parong et al., 2022; Rabipour & Davidson, 2015; Rabipour et al., 2018; Tiraboschi et al., 2019; Ziv et al., 2022). However, they align with investigations that did not find evidence that expectation could improve participants' performance (e.g., Ballesteros et al., 2017; Brantley et al., 2021; Schwarz & Büchel, 2015; Tsai et al., 2018; Vodyanyk et al., 2021; Watolla et al., 2020).

Our results showed that we successfully induced participants expectations in Placebo Group 1. This means that these participants had higher expectations of improving their performance after playing an action game in virtual reality compared to participants in Control Group 1 (as described in "Subjective Perception of Expectation" subsection). These results demonstrate that information given to participants can modulate their subjective perception of expectation, which was also demonstrated in the studies conducted by Edwards et al. (2021), Foroughi et al. (2016), Parong et al. (2022), Rabipour et al. (2018), Rabipour and Davidson (2015), and Ziv et al. (2022). However, our results showed no effect of this subjective perception on cognitive performance as measured by the UFoV task, contrary to the results found in Tiraboschi et al. (2019). Differences observed may be associated to differences in the experimental protocol. For example, we used a virtual reality action video game, whereas Tiraboschi et al. (2019) used a Sudoku video game. As action video games are known to enhance visual attention (e.g., Green & Bavelier, 2003), it could be that we observed a training effect on the post-test that minimized differences in expectancy effects. Should this be true, the expectancy effects of training might be mitigated by the training's inherent impact. Furthermore, the distinctive nature of virtual reality may have inadvertently signaled the study's objectives to participants, especially since Sudoku is more typically associated with casual pastime activities.

Conversely, Placebo Group 2 was not affected by the induction of expectation and showed a subjective perception of expectation very similar to Control Group 2. Manipulating participants beliefs about their expectation likely depends on concrete evidence obtained from a pre-test experience to check performance changes in the post-test. This claim is somehow supported by the results on performance of participants in the placebo groups. In general, those who were exposed to the Pre-testing condition performed better in the UFoV task than participants who did not undergo the pre-test (as shown in Figure 6, left), indicating a potential influence of the pre-test on the expectation. However, this hypothesis needs to be properly tested.

The successful manipulation of expectation in the pre-tested groups in our study can be explained by the way in which the assessment of subjective perception of expectation was conducted, which is discussed by Denkinger et al. (2021). We opted for the evaluation of a retrospective perception of the participants' expectation (i.e., at the end of the experiment), which can be influenced by both real prospective expectation ("I just played a video game and now I'm going to do well on this test!"), and by the performance they retrospectively perceived ("I did very well in that second phase, so the video game must have worked!"). In other words, participants' ratings on the expectation may be a function of performance, and it is influenced, for example, by transfer effects. Thus, groups Placebo 2 and Control 2 did not have an online parameter of their own performance in a pre-test phase, and therefore may did not believe that their performance could be modulated by the game.

Considering this relationship, Bayesian models help us understand how online experience obtained during tests can modulate retrospective or prospective subjective perception of expectations (see Denkinger et al., 2021). An example of this type of manipulation can be seen in the study conducted by Vodyanyk et al. (2021). Four experiments induced expectation effects regarding cognitive training in domains such as fluid intelligence, attention, and spatial perception. For this purpose, expectation induction was employed in the placebo groups with verbal instruction in addition to manipulation of associative learning during the cognitive tasks. Associative learning consisted of intermediary tasks that provided evidence that the training intervention was improving their cognitive abilities. Although no expectation effect was observed in performance of any task, the combination of verbal expectation induction and associative learning evidence during the experiments could potentially enhance the effects of prospective expectation.

Another important aspect to understand the results observed in the groups Placebo 2 and Control 2 refers to the adaptation items 1 and 2 of the expectation assessment questionnaires have suffered since there was no pre-test. Modifications to the items were adopted, possibly causing these items not to capture the transfer effect (item 1) and the implication of the gaming session on UFoV performance (item 2), and thus limiting comparability between the four groups. In addition, individual differences, such as different growth mindset profiles, may affect the subjective perception of expectation and consequently its effects on performance. It is recommended that future studies assess profiles regarding growth mindset to increase comparability among experimental groups or to check its effect as a covariate (see Rabipour et al. 2018, Rabipour & Davidson, 2015). Finally, our results are restricted to visuospatial attention. Other cognitive processes may be more prone to an expectation of boost on cognition, and the Solomon four-group experimental design is useful for disentangling expectancy and carry-over effects.

In summary, the results of this study do not corroborate the findings of previous research suggesting that expectation could modulate cognitive performance. Although the induction of expectation was successful in participants of Placebo Group 1, no improvement of performance in the UFoV task was observed. The results of the Placebo Group 2 suggest that the experience (i.e., pre-testing) may influence the subjective perception of expectation. It is recommended that further research delve into the relationship between subjective perception of expectation and participants' performance. For this purpose, researchers may implement procedures like associative learning combined with verbal instructions, biased samples (as utilized by Foroughi et al., 2016), and tasks assessing different mental functions. Furthermore, individual differences, such as growth mindset profiles, may help better understand how expectation affects cognitive performance.

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Appendix A – Instructions and Access to instructional videos (Portuguese Version)

Roteiro das instruções para o vídeo do grupo Controle 1

“Muitas pesquisas têm sido realizadas visando investigar os diferentes tipos de atenção. Essas pesquisas têm se mostrado importantes, pois possibilitam uma melhor compreensão sobre as capacidades atencionais dos indivíduos. Além disso, uma maior compreensão sobre o funcionamento da atenção possibilita que sejam criados testes psicológicos que poderão ser utilizados em contextos clínicos para a identificação de déficits cognitivos, como a avaliação de pessoas com o Transtorno de Déficit de Atenção e Hiperatividade (TDAH), demência ou que possam ter sofrido algum acidente, como um Acidente Vascular Cerebral (AVC). A atenção recruta diferentes vias sensorias, como a audição, tato, paladar, olfato e visão. Além disso, a atenção pode receber diferentes classificações a depender de como ela é utilizada, como no caso da atenção sustentada, que diz respeito a capacidade dos indivíduos de manterem a atenção por longos períodos de tempo, ou a atenção seletiva, que se refere a capacidade dos indivíduos de selecionarem alguns estímulos no ambiente e ignorarem outros. Testes de atenção geralmente estão associados a tarefas longas e que exigem muito esforço cognitivo dos participantes. Para evitar uma fadiga durante o teste, você irá agora fazer uma breve pausa de alguns minutos. Para que você mantenha seus recursos atencionais em funcionamento durante esse intervalo, você irá jogar um jogo em realidade virtual. Em seguida, você irá realizar uma segunda etapa do teste de atenção. Vamos lá?”. Palavras: 226/ Caracteres (com espaço): 1499 / Link para o vídeo: https://osf.io/njmzb

Roteiro das instruções para o vídeo do grupo Placebo 1

“Você sabia que os jogos de videogame, além de divertidos, podem melhorar suas habilidades atencionais? Esse tem sido um tema de ampla investigação dentro da Psicologia, onde diversos pesquisadores estão investigando os efeitos dos jogos na cognição humana. Muitas pesquisas têm apontado para um aprimoramento de diversas habilidades cognitivas em pessoas que jogam videogame, comparado a pessoas que não jogam videogame. Essas pesquisas têm mostrado que os jogos podem melhorar a atenção, memória, raciocínio lógico e as capacidades perceptivas dos jogadores. Não só isso, o uso de realidade virtual pode apresentar efeitos ainda mais benéficos, comparado a jogos de celular, computadores ou de videogames no geral. Visando investigar a aplicabilidade dos efeitos benéficos dos jogos, pesquisadores tem investigado também sobre a possibilidade de utilizar jogos de videogame para tratar casos clínicos, como no caso de pessoas com algum tipo de lesão cerebral ou deficiência. Assim, pessoas com a doença de Alzheimer, Parkinson, demências diversas ou com algum tipo de lesão, como no caso de pessoas que sofreram um acidente vascular cerebral (AVC), poderiam se beneficiar com tratamentos que se utilizam de jogos de videogame. Considerando esses achados na literatura médica e científica, você irá agora jogar um jogo utilizando óculos de realidade virtual. Pesquisas anteriores têm demonstrado que, jogar jogos como esse por alguns minutos, faz você pensar mais rápido e ficar mais atento. Em seguida, você irá refazer os testes computadorizados para avaliar sua atenção.”. Palavras: 237 / Caracteres (com espaço): 1559 / Link para o vídeo: https://osf.io/ceud7

Roteiro das instruções para o vídeo do grupo Controle 2

“Muitas pesquisas têm sido realizadas visando investigar os diferentes tipos de atenção. Essas pesquisas têm se mostrado importantes, pois possibilitam uma melhor compreensão sobre as capacidades atencionais dos indivíduos. Além disso, uma maior compreensão sobre o funcionamento da atenção possibilita que sejam criados testes psicológicos que poderão ser utilizados em contextos clínicos para a identificação de déficits cognitivos, como a avaliação de pessoas com o Transtorno de Déficit de Atenção e Hiperatividade (TDAH), demência ou que possam ter sofrido algum acidente, como um Acidente Vascular Cerebral (AVC). A atenção recruta diferentes vias sensorias, como a audição, tato, paladar, olfato e visão. Além disso, a atenção pode receber diferentes classificações a depender de como ela é utilizada, como no caso da atenção sustentada, que diz respeito a capacidade dos indivíduos de manterem a atenção por longos períodos de tempo, ou a atenção seletiva, que se refere a capacidade dos indivíduos de selecionarem alguns estímulos no ambiente e ignorarem outros. Para que vocês comecem a utilizar seus recursos atencionais, você irá jogar um jogo em realidade virtual. Em seguida, você irá realizar um teste de atenção. Vamos lá?”. Palavras: 203 / Caracteres (com espaço): 1356 / Link para o vídeo: https://osf.io/sg46h

Roteiro das instruções para o vídeo do grupo Placebo 2

“Você sabia que os jogos de videogame, além de divertidos, podem melhorar suas habilidades atencionais? Esse tem sido um tema de ampla investigação dentro da Psicologia, onde diversos pesquisadores estão investigando os efeitos dos jogos na cognição humana. Muitas pesquisas têm apontado para um aprimoramento de diversas habilidades cognitivas em pessoas que jogam videogame, comparado a pessoas que não jogam videogame. Essas pesquisas têm mostrado que os jogos podem melhorar a atenção, memória, raciocínio lógico e as capacidades perceptivas dos jogadores. Não só isso, o uso de realidade virtual pode apresentar efeitos ainda mais benéficos, comparado a jogos de celular, computadores ou de videogames no geral. Visando investigar a aplicabilidade dos efeitos benéficos dos jogos, pesquisadores tem investigado também sobre a possibilidade de utilizar jogos de videogame para tratar casos clínicos, como no caso de pessoas com algum tipo de lesão cerebral ou deficiência. Assim, pessoas com a doença de Alzheimer, Parkinson, demências diversas ou com algum tipo de lesão, como no caso de pessoas que sofreram um acidente vascular cerebral (AVC), poderiam se beneficiar de tratamentos que utilizam de jogos de videogame. Considerando esses achados na literatura médica e científica, você irá agora jogar um jogo utilizando óculos de realidade virtual. Pesquisas anteriores têm demonstrado que, jogar jogos como esse por alguns minutos, faz você pensar mais rápido e ficar mais atento. Em seguida, você irá fazer os testes computadorizados para avaliar sua atenção.”. Palavras: 235 / Caracteres (com espaço): 1557 / Link para o vídeo: https://osf.io/jna9w

Appendix B – Instructions and Access to instructional videos (English Version)

Script of instructions for the Control 1 group video

"Much research have been carried out aiming to investigate the different types of attention. These studies have been shown to be important, as they enable a better understanding of individuals' attentional capacities. In addition, a greater understanding of how attention works makes it possible to create psychological tests that can be used in clinical contexts to identify cognitive deficits, such as the evaluation of people with Attention Deficit Hyperactivity Disorder (ADHD), dementia or who may have suffered an accident, such as a Cerebral Vascular Accident (CVA). Attention recruits different sensory pathways, such as hearing, touch, taste, smell, and sight. In addition, attention can receive different classifications depending on how it is used, as in the case of sustained attention, which concerns the ability of individuals to maintain attention for long periods of time, or selective attention, which refers to ability of individuals to select some stimuli in the environment and ignore others. Attention tests are usually associated with long tasks that require a lot of cognitive effort from the participants. To avoid fatigue during the test, you will now take a short break of a few minutes. In order for you to keep your attentional resources working during this break, you will play a game in virtual reality. You will then perform a second step of the attention test. Let's go?". Words: 226 / Characters (with space): 1499 / Link to the video: https://osf.io/njmzb

Script of instructions for the Placebo 1 group video

"Did you know that video games, in addition to being fun, can improve your attention skills? This has been a subject of wide investigation within Psychology, where several researchers are investigating the effects of games on human cognition. Many studies have pointed to an improvement in several cognitive abilities in people who play video games, compared to people who do not play video games. These researches have shown that games can improve players' attention, memory, logical reasoning and perceptual abilities. Not only that, but the use of virtual reality can also have even more beneficial effects compared to mobile games, computers or video games in general. Aiming to investigate the applicability of the beneficial effects of games, researchers have also investigated the possibility of using video games to treat clinical cases, as in the case of people with some type of brain injury or disability. Thus, people with Alzheimer's disease, Parkinson's disease, various dementias or with some type of injury, as in the case of people who have suffered a stroke, could benefit from treatments that use video games. Considering these findings in the medical and scientific literature, you will now play a game using virtual reality glasses. Previous research has shown that playing games like this for a few minutes makes you think faster and become more attentive. You will then retake computerized tests to assess your attention.”. Words: 237 / Characters (with space): 1559 / Link to the video: https://osf.io/ceud7

Script of instructions for the Control 2 group video

“Much research have been carried out aiming to investigate the different types of attention. These studies have been shown to be important, as they enable a better understanding of individuals' attentional capacities. In addition, a greater understanding of how attention works makes it possible to create psychological tests that can be used in clinical contexts to identify cognitive deficits, such as the evaluation of people with Attention Deficit Hyperactivity Disorder (ADHD), dementia or who may have suffered an accident, such as a Cerebral Vascular Accident (CVA). Attention recruits different sensory pathways, such as hearing, touch, taste, smell, and sight. In addition, attention can receive different classifications depending on how it is used, as in the case of sustained attention, which concerns the ability of individuals to maintain attention for long periods of time, or selective attention, which refers to ability of individuals to select some stimuli in the environment and ignore others. In order for you to start using your attentional resources, you will play a game in virtual reality. Then you will perform an attention test. Let's go?”. Words: 203 / Characters (with space): 1356 / Link to the video: https://osf.io/sg46h

Script of instructions for the Placebo 2 group video

“Did you know that video games, in addition to being fun, can improve your attention skills? This has been a subject of wide investigation within Psychology, where several researchers are investigating the effects of games on human cognition. Many studies have pointed to an improvement in several cognitive abilities in people who play video games, compared to people who do not play video games. These researches have shown that games can improve players' attention, memory, logical reasoning and perceptual abilities. Not only that, the use of virtual reality can have even more beneficial effects compared to mobile games, computers or video games in general. Aiming to investigate the applicability of the beneficial effects of games, researchers have also investigated the possibility of using video games to treat clinical cases, as in the case of people with some type of brain injury or disability. Thus, people with

Alzheimer's disease, Parkinson's, various dementias or with some type of injury, as in the case of people who have suffered a stroke, could benefit from treatments that use video games. Considering these findings in the medical and scientific literature, you will now play a game using virtual reality glasses. Previous research has shown that playing games like this for a few minutes makes you think faster and become more attentive. You will then take computerized tests to assess your attention.”. Words: 235 / Characters (with space): 1557 / Link to the video: https://osf.io/jna9w

Appendix C – Written Informed Consents (WICs)

Termo de Consentimento Livre e Esclarecido (TCLE)

Você está sendo convidado a participar de uma pesquisa sobre a avaliação da atenção visual em testes computadorizados. Essa pesquisa tem como objetivo avaliar como sua capacidade de atenção pode sofrer alterações em tarefas computadorizadas que avaliam diferentes aspectos da atenção visual. Caso opte por participar, você contribuirá para ampliarmos os conhecimentos sobre processos da atenção visual e a construção do ensino em nossa universidade.

Os requisitos para que você participe desta pesquisa são: (1) ter boa acuidade visual, (2) ter acima de 18 anos. Ao aceitar fazer parte deste experimento, você será convidado a realizar tarefas para avaliar sua atenção. O procedimento experimental será realizado Laboratório Integrado de Pós-Graduação e Pesquisa Experimental em Psicologia com Humanos (LIPSI), da Universidade de Brasília (UnB), em um computador, sob as orientações dos pesquisadores. Nessas tarefas você terá que detectar e identificar alvos que aparecerão rapidamente na tela do computador.

Esta pesquisa inclui riscos mínimos ao participante, como fadiga mental equivalente à fadiga ocasionada por uma tarefa de leitura simples. Sua participação é voluntária, podendo ser interrompida em qualquer tempo sem quaisquer penalidades e é garantido o sigilo dos dados pessoais. Estima-se 1 hora para a participação desta pesquisa.

O responsável por essa pesquisa é Edimilson dos Santos Gonçalves, estudante de mestrado pelo programa de Programa de Pós-Graduação em Ciências do Comportamento (PPG-CdC) da Universidade de Brasília (UnB), sob a orientação do Dr. Rui de Moraes Junior, professor do Departamento de Processos Psicológicos Básicos da Universidade de Brasília (PPB/UnB) e coordenador do Grupo de Pesquisa em Percepção Visual da UnB. Caso tenha qualquer dúvida em relação ao andamento da pesquisa, você pode entrar em contato através dos e-mails: [redacted] ou [redacted].

Os procedimentos adotados nesta pesquisa obedecem aos Critérios da Ética em Pesquisa com Seres Humanos conforme Resolução Nº 510, de 7 de abril de 2016 do Conselho Nacional de Saúde e este projeto foi revisado e aprovado pelo Comitê de Ética em Pesquisa em Ciências Humanas e Sociais (CEP/CHS) da Universidade de Brasília pelo CAAE 62068722.9.0000.5540. As informações com relação à assinatura do TCLE ou aos direitos do participante da pesquisa podem ser obtidas por meio do e-mail do CEP/CHS: cep_chs@unb.br ou pelo telefone: (61) 3107 1592. Nenhum dos procedimentos usados oferece riscos à sua dignidade.

É importante que você finalize todas as etapas experimento; porém, se desejar interrompê-lo ou encerrá-lo, você assim poderá proceder a qualquer momento, sem qualquer prejuízo ou penalidade.

Não haverá nenhum reembolso de dinheiro, já que com a participação na pesquisa você não terá nenhum gasto. Os dados desta pesquisa serão divulgados em reuniões e publicações científicas, e as identidades dos participantes serão mantidas em absoluto sigilo. Caso ainda tenha quaisquer dúvidas sobre esta pesquisa, por favor, sinta-se à vontade para solicitar esclarecimentos depois de finalizado o experimento. Após estes esclarecimentos, solicitamos o seu consentimento de forma livre para participar desta pesquisa.

Você receberá uma cópia deste TCLE. Caso ainda tenha quaisquer dúvidas sobre esta pesquisa, por favor, sinta-se à vontade para solicitar esclarecimentos a qualquer momento. Para isso, entre em contato com os pesquisadores pelos e-mails informados neste termo.

Após estes esclarecimentos, solicitamos o seu consentimento de forma livre para participar desta pesquisa. Desde já, agradecemos sua confiança e colaboração. Tendo em vista as informações acima apresentadas, eu, de forma livre e esclarecida, manifesto meu consentimento em participar da pesquisa. Também autorizo a divulgação dos resultados obtidos, desde que preservado o sigilo da minha identidade.

Brasília, ____/____/________

Nome do participante:______________________________ Identidade: _______________________________________
Assinatura:_____________________________________

Pesquisador: ______________________________________
Edimilson dos Santos Gonçalves

Appendix D – Approval by the Research Ethics Committee

INSTITUTO DE CIÊNCIAS HUMANAS E SOCIAIS DA UNIVERSIDADE DE BRASÍLIA - UNB

Plataforma Brasil

PARECER CONSUBSTANCIADO DO CEP

DADOS DO PROJETO DE PESQUISA

Título da Pesquisa: Avaliação da Atenção Visual em Testes Computadorizados
Pesquisador: EDIMILSON DOS SANTOS GONCALVES
Área Temática:
Versão: 4
CAAE: 62068722.9.0000.5540
Instituição Proponente: Instituto de Psicologia - UNB
Patrocinador Principal: Financiamento Próprio

DADOS DO PARECER

Número do Parecer: 5.851.134

Apresentação do Projeto:
Inalterado em relação ao parecer consubstanciado emitido pelo CEP/CHS no dia 11 de novembro de 2022.

Objetivo da Pesquisa:
Inalterado em relação ao parecer consubstanciado emitido pelo CEP/CHS no dia 11 de novembro de 2022.

Avaliação dos Riscos e Benefícios:
Os pesquisadores informam na Carta de Revisão de Ética (12/1/2022) que decidiram "retirar os dados sobre diagnóstico e uso de medicação psicotrópica, coletados a partir do questionário sociodemográfico, visando evitar possíveis riscos aos participantes, como algum nível de desconforto emocional ou constrangimento. Essas alterações foram realizadas no corpo do projeto, como também no instrumento Questionário Sociodemográfico (QS)". Os pesquisadores apontam como riscos pouco prováveis que os participantes possam sentir "fadiga mental equivalente à um cansaço ocasionado por uma tarefa de leitura simples".

Comentários e Considerações sobre a Pesquisa:
Inalterado em relação ao parecer consubstanciado emitido pelo CEP/CHS no dia 11 de novembro de 2022.

Endereço: CAMPUS UNIVERSITÁRIO DARCY RIBEIRO - FACULDADE DE DIREITO - SALA BT-01/2 - Horário de
Bairro: ASA NORTE **CEP:** 70.910-900
UF: DF **Município:** BRASILIA
Telefone: (61)3107-1592 **E-mail:** cep_chs@unb.br

Considerações sobre os Termos de apresentação obrigatória:

Inalterado em relação ao parecer consubstanciado emitido pelo CEP/CHS no dia 11 de novembro de 2022.

Conclusões ou Pendências e Lista de Inadequações:

A proposta da pesquisa se apresenta de forma clara e atende às orientações do CEP-CHS. Parecer favorável a aprovação da pesquisa.

Considerações Finais a critério do CEP:

Este parecer foi elaborado baseado nos documentos abaixo relacionados:

Tipo Documento	Arquivo	Postagem	Autor	Situação
Informações Básicas do Projeto	PB_INFORMAÇÕES_BÁSICAS_DO_PROJETO_1992098.pdf	12/01/2023 12:36:19		Aceito
Outros	4_CARTA_DE_REVISAO_ETICA_V4.pdf	12/01/2023 12:35:47	EDIMILSON DOS SANTOS GONCALVES	Aceito
Outros	7_Resposta_ao_TERCEIRO_parecer_5847835.pdf	12/01/2023 12:34:58	EDIMILSON DOS SANTOS GONCALVES	Aceito
Parecer Anterior	PB_PARECER_CONSUBSTANCIADO_CEP_5847835.pdf	12/01/2023 12:33:26	EDIMILSON DOS SANTOS GONCALVES	Aceito
Cronograma	7_Cronograma.pdf	12/01/2023 12:33:13	EDIMILSON DOS SANTOS GONCALVES	Aceito
Projeto Detalhado / Brochura Investigador	0_Projeto_Efeitos_da_Expectativa_Sobre_o_Treinamento_Cognitivo_com_Jogos_de_Acao_em_Realidade_Virtual_na_Atencao_Visual.pdf	12/01/2023 12:33:02	EDIMILSON DOS SANTOS GONCALVES	Aceito
Outros	6_Instrumentos_Questionario_Sociodemografic_QS.pdf	21/11/2022 12:22:55	EDIMILSON DOS SANTOS GONCALVES	Aceito
Outros	6_Instrumentos.pdf	21/11/2022 12:22:31	EDIMILSON DOS SANTOS GONCALVES	Aceito
Outros	6_1_JUSTIFICATIVA_PARA_NAO_APRESENTACAO_DO_INSTRUMENTO_V2.pdf	19/10/2022 18:06:53	EDIMILSON DOS SANTOS GONCALVES	Aceito
Outros	Carta_Decana_Pdf.pdf	19/10/2022 18:05:17	EDIMILSON DOS SANTOS GONCALVES	Aceito

Outros	6_Instrumentos_Questionario_de_Avaliacao_sobre_a_expectativa.pdf	25/09/2022 12:49:23	EDIMILSON DOS SANTOS GONCALVES	Aceito
Outros	6_Instrumentos_Perfil_do_Participante.pdf	25/09/2022 12:48:56	EDIMILSON DOS SANTOS GONCALVES	Aceito
Outros	Lattes_Rui.pdf	17/08/2022 11:33:43	EDIMILSON DOS SANTOS GONCALVES	Aceito
Outros	Lattes_Edimilson.pdf	17/08/2022 11:33:30	EDIMILSON DOS SANTOS GONCALVES	Aceito
TCLE / Termos de Assentimento / Justificativa de Ausência	5_TCLE.pdf	13/08/2022 21:04:56	EDIMILSON DOS SANTOS GONCALVES	Aceito
Outros	3_CARTA_DE_ENCAMINHAMENTO.pdf	09/08/2022 14:55:25	EDIMILSON DOS SANTOS GONCALVES	Aceito
Folha de Rosto	1_Folha_de_Rosto_Plataforma_Brasil_Edimilson_dos_Santos_Goncalves.pdf	09/08/2022 14:51:41	EDIMILSON DOS SANTOS GONCALVES	Aceito

Situação do Parecer:
Aprovado

Necessita Apreciação da CONEP:
Não

BRASILIA, 12 de Janeiro de 2023

Assinado por:
MARCIO CAMARGO CUNHA FILHO
(Coordenador(a))

Appendix E – Funding Statements

- **August/2022 – February/2023**. Scholarship: Bolsa de Mestrado. Agency: Fundação de Apoio a Pesquisa do Distrito Federal, FAPDF. Process number: 00193.00001671/2021-74
- **March/2023 – May/2023**. Scholarship: Bolsa de Mestrado. Agency: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior, CAPES. Process number: 88887.821161/2023-00.

Appendix G – Publications During Master's

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do Nascimento Coutinho, H., dos Santos Gonçalves, E., Farias, A. V. P., & Junqueira, A. M. R. (2021). Organização do 1° Encontro Centro-Oeste dos Grupos PET (ECOPET) no Formato Virtual: Um Relato de Experiência. *Revista Eletrônica do Programa de Educação Tutorial-Três Lagoas/MS*, *3*(3), 150–165. https://doi.org/10.55028/repet-tl.v3i3.12867

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Gonçalves, E. S., Castilho, G. M. (2024) Effects of Action Video Game Engagement on Attention and Working Memory. *Psychology and Neuroscience, 0(0), 0–0.* https://doi.org/10.1037/pne0000334

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Rodrigues, C. M. L., Correa, D. R. C., Evangelista, A. Q. F., Gonçalves, E. S., Oliveira, S. E. S.Moura, C. F. (2022). A atenção, sua mensuração e o contexto militar. V. A. Gomez, S. G. Murta, D. S. Zanini, C. Faiad, S. E. S. Oliveira, & T. G. Nascimento (Eds). *Sistema de Avaliação para Seleção Profissional do Exército Brasileiro (SASPEB): Bases Teóricas e Técnicas* (pp. 45–59). Gráfica do Exército Brasileiro.

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