

Effects of Action Video Game Play on Cognitive Skills: A Meta-Analysis



This meta-analysis report is part of a bigger project in the seminar "Topics in Cognitive Psychology: Psychological Interventions Using Digital Technologies" at the University of Graz.

The advice to: “play action video games to enhance certain aspects of our cognitive function”, sounds strange? The results of this meta-analysis will assess the truth behind this advice.

METAANALYSIS

focus of the study:

Efficacy of action video games to enhance certain aspects of cognitive function.

target group:

healthy adults

average effect-size:

cross-sectional meta-analysis: significant medium effect ($g = 0.64$)

intervention meta-analysis: significant small effect ($g = 0.30$)

SHORT REVIEW

Introduction

Playing video games get more and more popular. Accompanying this rise in popularity in the population, researchers are currently interested in examining which video game behaviour is associated with enhancement in cognitive function. This meta-analysis specifically looks at action video games. Action video games in this meta-analysis are classified as first- and third-person shooters. Bediou et al. are looking at both cross-sectional and intervention studies that examined the enhancement of cognitive abilities due to action video games. This analysis was computed with nine different outcome measures which measure cognitive ability objectively.

- Perception
- Bottom-up attention
- Top-down attention
- Inhibition
- Task-switching/multitasking
- verbal cognition
- visual spatial cognition
- problem solving

This meta-analysis follows up the research done by Bediou et al. (2018). He and his colleagues conducted the analysis on articles from 2000 to 2015. Since then, there have been many additional articles on that topic and this meta-analysis also uses newer and better statistical methods.

What is this study about?

This meta-analysis discusses the interest in action video games and their potential impact on cognitive skills. It emphasizes that action video games are of particular interest due to their unique gameplay elements and their potential to improve perceptual, attentional, and cognitive abilities. The existing literature suggests positive associations between action video game play and higher cognitive performance ($g = 0.55$; Bediou et al., 2018). Previous Meta-analyses have found that frequent players of action video games outperform infrequent players in various cognitive skills, particularly in perception, attention, and spatial cognition (e.g. Bediou et al., 2018, Hilgrad et al., 2019).

However, the intervention studies in this area are limited and have smaller sample sizes, which poses some challenges in interpreting the findings. The meta-analysis also acknowledges methodological variations and potential publication bias in the field, calling for an updated meta-analysis incorporating recent research. Overall, further investigation through meta-analyses is needed to better understand the relationship between action video game play and cognitive skills.

To sum it up the cross-sectional meta-analysis explored if action video game play is associated with greater levels of cognitive task performance. The intervention meta-analysis analysed if action video game play enhances the cognitive task performance.

What does this study find?

The meta-analysis found that individuals who engage in action video game play (AVGP) have superior cognitive skills compared to those who engage less in video game play. The cross-sectional analysis showed a positive relationship between AVGP and cognitive skills, with medium to large effects observed in perceptual, top-down attentional, spatial, and multitasking domains. The intervention analysis supported the idea that playing action video games improves cognitive skills outside of the game context, with medium effects observed in top-down attention and multitasking.

Both analyses revealed substantial heterogeneity among the effect sizes, indicating a wide range of possible outcomes. The duration of training was found to be a significant moderator, with longer interventions leading to stronger effects. However, the effects of training duration may vary across cognitive domains, suggesting that some brain functions are more plastic than others.

The meta-analysis also addressed expectation effects and found that group differences were observed regardless of whether participants were recruited overtly or covertly. There were numerically stronger effects observed when overt recruitment was used compared to covert recruitment, but this did not reach statistical significance. Manipulating expectations to enhance cognitive benefits may require significant effort.

Publication bias was assessed, and significant funnel plot asymmetry was found in the cross-sectional studies, suggesting the presence of bias. The 3-parameter selection model provided a bias-corrected estimate and indicated a positive relationship between AVGP and cognitive performance after adjustment for publication bias. However, no significant publication bias was detected in the intervention studies.

It's important to note that publication bias detection and adjustment methods have limitations, and the presence of heterogeneity can affect their reliability. Sensitivity analyses were conducted to account for these issues, and a range of estimates with confidence intervals were considered instead of relying on a single adjusted effect size estimate.

How does the Digital Psychology teaching Lab evaluate this study?

The Digital Psychology teaching Lab evaluates this study based on the following five questions, which are based on the MAGIC-criteria:

Magnitude – How big is the effect?

In the cross-sectional meta-analysis action video game play shows significant large effect ($g = 0.64$) on cognitive domain. In the intervention meta-analysis significant small effects ($g = 0.30$) of action video gameplay training on cognitive skills were shown. No moderator had a significant effect on the effect-sizes. These effects are comparable with the effects of prior meta-analysis (Bediou et al., 2018).

Articulation – How specific is it?

The effect sizes are presented for each subdomain of cognitive abilities. Additionally, the effect sizes of different moderators are also split into subdomains, this allows for better exploration and better explanation of the effects. These detailed effect size analysis shows that the largest effects of action videos are on the perceptual ($g = 0.71$), top-down ($g = 0.63$), multitasking ($g = 0.86$) and spatial domain ($g = 0.67$) in the cross-sectional meta-analysis. In the intervention meta-analysis only the top-down attention ($g = 0.52$) subdomain showed significant improvements. Looking at the moderators more in detail, there are stronger effect sizes for accuracy than speed.

Generality – How generally does it apply?

The reported positive effect of action video games on cognitive abilities are even though many computed moderators' analysis robust. The implications for the results are only applicable for young healthy adults.

Interestingness

The results are highly interesting because action videos elements could be applied to designing cognitive task. This could possibly improve the transfer effects of cognitive task. But further research needs to be done to identify and isolate the cognitive relevant elements of action video games.

Credibility

The data for the meta-analysis is openly available at <https://osf.io/at36x/>. The authors applied many different analysis techniques and used the PRISMA guidelines for conducting and reporting systematic reviews and meta-analyses.

Conclusion for teaching practice

This meta-analysis further proves that the action video games can improve cognitive abilities of young healthy adults. But there are still mixed feelings about action video games, especially shooter games. On the one hand action video games are significantly related to gaming addiction (Ohno, 2022) and violent video games enhance state hostility and decrease positive affective state (Saleem et al, 2012). But on the other hand, people who prefer shooters tend to have greater emotional stability compared to other gaming preferences (Johnson & Gardner, 2010) and as this meta-analysis proves have positive affect on cognitive skills.

In my opinion there needs to be more research on a small target game-type like this meta-analysis tried to do. But social factors like friend group and being able to play online with friends still needs to be considered!

Overall action video games are a great resource and elements of those games should be extensively researched to improve education and learning methods.

Study example

The study from Libertus et al. (2017) aims to examine whether engaging in action video games can enhance mathematical skills. The study was conducted with university students (18-35) who were randomly assigned to either a video game training group (Unreal Tournament 2004) or a control group (The Sims 2). Both groups engaged in 40 hours of training and their improvements in cognitive skills were evaluated after 25 and after 40 hours of training. The cognitive skills were evaluated on mathematical abilities, attention control, verbal abilities, and fluid reasoning.

The results of the study revealed that the participants in the video game training group showed significant improvements in their advanced mathematical abilities compared to the control group. But there were no significant training related improvements regarding basic mathematical computations and attention control. Additionally, there were no differences between the groups in their verbal abilities or fluid reasoning.

The findings suggest that engaging in action video games can have a positive impact on mathematical abilities in adults. The study highlights the potential cognitive benefits of action video game training and its relevance to mathematical performance.

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