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The Relationships Between Video Games and Cognitive, Motor, Emotional, and Social Development Across the Lifespan: An Umbrella Review

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This umbrella review synthesizes research on the multifaceted effects of video games on cognitive, motor, socioemotional, and health-related development across the lifespan. Drawing on systematic reviews published between 2004 and 2023, this study analyzed findings from 27 reviews, encompassing 131,979 participants from 2 to 86 years old. While concerns about excessive gaming and its potential risks have dominated research and public discourse, a growing body of literature highlights the potential benefits of video gaming. The findings indicate that video games can enhance visuospatial skills, executive functioning, and problem-solving abilities, particularly when engagement is moderate and game genres involve strategic or cooperative elements. Motor benefits, especially in older adults, include improvements in balance, coordination, and reaction time, often facilitated by exergaming. Emotional and social outcomes are more complex: while cooperative and prosocial games foster emotional regulation and social bonding, excessive or escapist gaming can contribute to social withdrawal. Health-related benefits include increased physical activity through exergaming and potential stress reduction. These findings underscore the need to move beyond a binary "good or bad" framing of video games and instead consider the contextual factors that shape their impact. Future research should emphasize longitudinal designs and the mechanisms underlying gaming's diverse effects.

Public Policy Relevance Statement
Video games are often perceived through a lens of concern over addiction and negative effects, but they also offer cognitive, motor, emotional, and social benefits. This review highlights that video gaming, when practiced in moderation, can enhance skills such as problem solving, coordination, and emotional regulation. Understanding how different game types and individual factors influence these effects can help inform balanced recommendations for players, educators, and policymakers.

Keywords: video game, cognitive development, motor skills, socio-emotional development, lifespan development

Research on video games has long been dominated by concerns over problematic or excessive gaming behavior, grounded in early clinical and public debates about internet addiction (Fisher & Griffiths, 1995; Griffiths, 1999) and the potentially harmful effects of violent or immersive digital environments (Anderson & Bushman, 2001; Tisseron & Gravillon, 2008). These concerns have culminated in the inclusion of internet gaming disorder (IGD) in the fifth edition of the *Diagnostic and Statistical Manual of Mental Disorders* (American Psychiatric Association, 2013) and gaming disorder in the *International Classification of Diseases* (World Health Organization, 2019). From a clinical perspective, these developments underscore the risks associated with unregulated or excessive gaming (King & Delfabbro, 2018; Petry et al., 2014). However, they have also reinforced negative stereotypes by occasionally conflating high-frequency gaming with pathological usage (Bean et al., 2017; Ferguson & Colwell, 2020).

Concurrently, a growing body of research has begun to document the potential benefits of video gaming. Empirical studies report cognitive gains in visuospatial processing and attention (Green & Bavelier, 2003; Milani et al., 2019), as well as positive social and emotional outcomes (Adachi & Willoughby, 2013, 2017; Gentile et al., 2009; Johannes et al., 2021). Although this "good vs. bad" framing is not formally codified in a single classification system, it frequently appears in literature overviews (Barlett et al., 2009; Ferguson, 2007; Greitemeyer, 2022), reflecting ongoing polarization about whether games promote or hinder healthy development. Contemporary perspectives increasingly emphasize the plurality of potential effects (both positive and negative) mediated by individual (e.g., personality and age) and contextual (e.g., parental guidance

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and socioeconomic background) variables (Ferguson, 2007; Prot et al., 2014). This overemphasis on problematic use risks obscuring the broader picture. By focusing primarily on the minority of individuals who engage in addictive or disordered gaming, existing reviews may miss the full range of possible effects (both beneficial and nuanced negative ones) experienced by the majority of typical users. In other words, we risk missing the forest (all the possible effects of video games on the general population) for the trees (problematic and/or excessive gaming).

Yet, despite evidence of these positive or at least nonpathological outcomes, the bulk of systematic and umbrella reviews continues to focus on clinical and risk-oriented topics such as gaming disorder or addictive behaviors (Huot-Lavoie et al., 2023; King & Delfabbro, 2020; Rosendo-Rios et al., 2022; van der Neut et al., 2023). This has led to an imbalance in the literature, where a substantial need remains for integrative syntheses specifically examining beneficial or neutral video gaming effects on development. Moreover, although "excessive gaming" can sometimes lead to negative outcomes (e.g., heightened aggression and interpersonal conflict), we distinguish it here from clinically defined gaming disorder or addiction, which are covered extensively elsewhere. The present umbrella review thus aims to address the knowledge gap by concentrating exclusively on the nonaddictive aspects of gaming, that is, on how video games might influence cognitive, motor, emotional, and social development across the lifespan while still considering possible negative outcomes that do not meet clinical thresholds and without conflating high engagement with problematic usage.

Positioning Within Existing Umbrella Reviews

Several recent umbrella reviews have explored the impact of screens and digital technologies, including exergaming (i.e., video games that incorporate physical activity to promote movement and exercise), remote rehabilitation technologies, virtual reality (VR) in neurorehabilitation (i.e., immersive computer-generated environments designed to enhance motor and cognitive recovery), the effects of social media on adolescent mental health, treatments for IGDs, VR in pain management, effects of electronic screens on youth, and extended reality (XR) in education (i.e., an umbrella term encompassing VR, augmented reality [AR], and mixed reality to create interactive digital environments). These reviews provide valuable insights into the growing role of technology in health and educational contexts, though none have specifically focused on the effects of video games on cognitive, motor, emotional, and social development across the lifespan.

For instance, Reis et al. (2019) examined the efficacy of exergames in improving motor functions, such as balance, gait, and muscle strength among older adults. While promising, the interventions were criticized for methodological weaknesses. Comparisons with traditional physiotherapy revealed that exergames offered equivalent benefits, suggesting their potential as a supplementary rehabilitation tool. However, the review called for more rigorous research to validate these findings and better define exergames' role in rehabilitation. Edwards et al. (2022) evaluated post-COVID-19 remote rehabilitation technologies, such as wearable trackers and mobile apps. The findings were mixed: while mobile apps demonstrated efficacy in stroke rehabilitation, other technologies, such as web-based interventions for rheumatoid arthritis, were less effective. The review underscored the need for high-quality research to better assess these emerging technologies' impact. Voinescu et al. (2021) concentrated on the use of VR in treating neurological disorders, highlighting its potential to enhance mobility and upper limb function in patients with stroke and cerebral palsy. Despite these encouraging results, the review identified a lack of high-quality evidence and safety data, emphasizing the need for further randomized controlled trials to establish VR's efficacy and safety in neurorehabilitation.

Moreover, Valkenburg et al. (2022) provided a nuanced review of the effects of social media on adolescent mental health. Although the associations between social media use and mental health outcomes were predominantly weak or inconsistent, the review acknowledged the potential for significant negative impacts in certain contexts. This complexity illustrates the need for more refined and targeted research. Maset Sánchez et al. (2023) explored treatments for IGD, particularly the efficacy of cognitive behavioral therapy, especially when combined with pharmacological interventions. The review highlighted the growing issue of gaming addiction and called for more focused research to refine treatment approaches. In the realm of pain management, Viderman et al. (2023) documented the benefits of VR as an alternative therapy for various pain conditions. While VR holds promise, the diversity in patient responses and applications suggests the need for more personalized treatment plans to optimize outcomes. Similarly, Sanders et al. (2024) assessed the broad effects of screen use among children and adolescents, finding mixed educational outcomes and slight negative health impacts. The heterogeneity in the included studies, along with a risk of bias, urged caution in the interpretation and application of these findings. Finally, Dong et al. (2023) reviewed XR technologies' impact on education, revealing significant improvements in teaching effectiveness. The review highlighted XR's potential to enhance educational outcomes and identified trends that may shape future applications of the technology.

Furthermore, Nguyen et al. (2020) focused on interventions aimed at reducing sedentary behavior (including screen time) across various age groups, finding small but significant changes in viewing time among children and adolescents, as well as substantial reductions in occupational sitting when environmental changes (e.g., sit–stand desks) were implemented. Meanwhile, Karimov et al. (2024) presented a scoping umbrella review of serious games in science and mathematics education, highlighting potential benefits such as improved engagement and cognitive skills, yet also noting negative reports like demotivation and anxiety.

Most of these reviews center on clinical interventions, health outcomes, or specific technological tools, often prioritizing the risks or medicalization of digital practices. While informative, such a focus inadvertently reinforces a narrow, problem-oriented lens on video game use. As a result, the developmental effects of everyday, nonaddictive gaming remain largely overlooked. Although these umbrella reviews highlight the transformative potential of digital technology in health and education, they rarely examine how regular video game use (outside of clinical or intervention contexts) may influence cognitive, motor, emotional, and social development across the lifespan. This oversight underscores the need for a broader, more balanced synthesis that captures the full range of gaming's developmental impacts, both positive and nuanced.

Rationale and Objectives of the Present Review

There is thus a need to rebalance the field by exploring how typical, nonaddictive gaming behaviors influence development not only

to highlight potential benefits but also to identify more subtle or context-dependent risks that fall outside the scope of clinical diagnosis. This approach aligns with calls for more nuanced understandings of digital media use, beyond binary framings of "good" or "bad." Against this backdrop, the present umbrella review pursues three main objectives:

Objective 1: Synthesize and evaluate the existing evidence from systematic reviews on the nonpathological use of video games and its effects on cognitive, motor, emotional, and social development at different life stages (childhood, adolescence, adulthood, and seniorhood).

Objective 2: Exclude studies and reviews focusing primarily on addiction, IGD, or other problematic behaviors, thereby redressing the current imbalance in the literature and providing a more balanced view of gaming's potential.

Objective 3: Identify gaps in knowledge and methodological limitations that may guide future research, particularly regarding how individual and contextual factors shape gaming outcomes across the lifespan.

Employing an umbrella review method allows a high-level comparison and synthesis of multiple systematic reviews, thus offering an overarching perspective on trends, discrepancies, and unanswered questions in the field (Poncet et al., 2024; Sauce et al., 2022). Although some included reviews may discuss forms of "excessive gaming," our exclusion criteria (presented in the next section) are designed to omit clinically defined addiction or gaming disorder as the primary focus, thereby situating our analysis in the domain of typical to high engagement rather than pathology. By focusing explicitly on nonaddictive gaming, we aim to contribute a clear counterpoint to the clinically oriented research that dominates current discourse while recognizing the importance of responsible usage and acknowledging that excessive play can indeed pose risks. This review thus seeks to move beyond a binary "good or bad" framing of video games, instead situating them within the broader continuum of digital practices that can have both beneficial and detrimental effects, depending on users' developmental stage, individual traits, and socioenvironmental context. Our goal is indeed to offer a more complete understanding of how video games may support (or, in some cases, hinder) cognitive, motor, emotional, and social development across the human lifespan.

Method

This umbrella review (systematic review of a systematic review) is based on the Preferred Reporting Items for Systematic Review and Meta-analysis Protocols 2015 statement (reported in Moher et al., 2015) and the tips and strategies for conducting an umbrella review by Aromataris et al. (2015), Belbasis et al. (2022), Cant et al. (2022), Choi and Kang (2022), and Bonczar et al. (2023).

Inclusion and Exclusion Criteria

The inclusion criteria were: (a) systematic review published in peer-reviewed journals; (b) studies investigating the associations between video gaming and social, emotional, motor, and cognitive development; (c) studies that included in their sample people of all development stages (children, adolescents, adults, and seniors) and without developmental disorders.

The exclusion criteria were: (a) studies in a language other than English; (b) all types of study that are not systematic reviews (original article, meta-analysis, review, poster, correspondence, oral communications, doctoral dissertations, or master's theses), (c) studies focusing solely on atypical development; (d) studies focusing exclusively on screen use, school learning, health (e.g., sleep and weight), and physical activity; and (e) systematic reviews focusing primarily or exclusively on clinical addiction, IGD, or other pathological forms of gaming. However, reviews that mention nonclinical negative outcomes (e.g., mild aggression and stress) were retained if they examined gaming use in typical populations.

There was no date range limitation applied. The last search date was March 4, 2024.

Search Strategy

A search was carried out in six databases: PubMed, PsycINFO, Web of Science, EBSCOhost, ScienceDirect, and https://ClinicalTrials.gov.

- In PubMed, the search was carried out in the search field "All fields." Search terms were: ("systematic review") AND ("video game").
- In PsycINFO, the search was carried out in the search field "Any field" and restricted to "Source: Academic publications." Search terms were the same as in PubMed.
- In Web of Science, the search was carried out in the search field "All fields." Search terms were the same as in PubMed and PsycINFO but divided into two rows and restricted to "Article" and "Review articles."
- In EBSCOhost, the search was carried out in the search field "Abstract." Search terms were the same as in PubMed and PsycINFO but divided into two rows as for Web of Science. The search was restricted to "Document types": "Academic Journals" and "Reports."
- In ScienceDirect, the search was carried out in the search field "Title, abstract or author-specified keywords" and restricted to "Article type": "Review articles" and "Research articles." Search terms were the same as in PubMed, PsycINFO, and EBSCOhost.
- In ClinicalTrials.gov, the search was carried out in "Other terms" with ("video game"). The search was restricted to "Status: Completed."

Study Selection Process

Two examiners (Rebecchi Kevin and Nguyen Chloé) autonomously scrutinized the titles and/or abstracts of the articles retrieved to spot the articles that might fulfill the criteria for inclusion. The complete article of these apparently qualified studies was evaluated separately by both reviewers. In case of any inconsistencies between the reviewers, they discuss it to resolve the issue.

Data Extraction

Using the text and spreadsheet files exported from the databases, we selected several variables: authors, year of publication, type and number of studies, number, age and sex of participants, countries, tools and platforms used to play video games, game names and

genres, objectives of the study and main findings, and stages and fields of development.

We conducted a manual examination of the reference lists of eligible articles to discover further pertinent publications. Our main focus was on assessing the effects of video games on development across the lifespan. We also noted any negative outcomes reported in these systematic reviews, provided they fell under a nonclinical context (e.g., not primarily examining addiction).

Results

Results of the Bibliographical Search

The initial search revealed 1,426 results: PubMed (109), PsycINFO (68), EBSCOhost (556), ScienceDirect (489), ClinicalTrials.gov (0), and Web of Science (204). After screening, full article review, and study selection, 27 articles were included in the review (Figure 1).

Tables 1 and 2 summarize the main elements of the 27 reviewed studies (Brilliant et al., 2019; Chen et al., 2023; Corregidor-Sánchez et al., 2020; Jiang et al., 2022; Johnson et al., 2016; Luo et al., 2022; Mansor et al., 2020; Marques et al., 2023; Mitrofan et al., 2009; Molina et al., 2014; Nuyens et al., 2019; Ogawa et al., 2016; Palaus et al., 2017; Pallavicini et al., 2018, 2021, 2022; Saleme et al., 2020; Sampalo et al., 2023; Sousa et al., 2023; Sublette & Mullan, 2012; Torres et al., 2021; Vázquez et al., 2018; Wang, 2021; Yen & Chiu, 2021; Yilmaz & Griffiths, 2023; Yoong et al., 2024; Zeng et al., 2017).

Characteristics of the Reviewed Studies

The entirety of the 27 systematic literature reviews included 131,979 participants (though three studies did not report sample sizes) from 2 to 86 years and incorporated 767 studies published between 1968 and 2023, selected from 30 databases (Academic Search Complete, Association for Computing Machinery Library, Applied Social Sciences Index and Abstracts, British Library, Child Data, Cumulative Index to Nursing and Allied Health Literature [CINAHL], Cochrane Library, Communication and Mass Media Complete, CINAHL, EBSCOhost, Embase, Elsevier Science, Education Resources Information Center, Google Scholar, Guideline National Clearinghouse, Institute of Electrical and Electronics Engineers Xplore, MEDLINE, Occupational Therapy Seeker, Physiotherapy Evidence Database, ProQuest Health Research Premium Collection, PsycINFO, PubMed, ScienceDirect, Scopus, Spanish National Research Council, SPORTDiscus, Web of Knowledge, Web of Science, Wiley InterScience, and Zetoc).

The participants of the studies came from various continents and countries, including Europe, North America, South America, Asia, Africa, and Oceania, such as Australia, Austria, Barbados, Belgium, Brazil, Canada, China, Croatia, Finland, France, Germany, Greece, Hong Kong, Hungary, India, Italy, Japan, Lebanon, Malaysia, Myanmar, Netherlands, New Zealand, Norway, Pakistan, Poland, Saudi Arabia, Singapore, South Korea, Spain, Switzerland, Taiwan, Turkey, the United Arab Emirates, the United Kingdom, and the United States.

Figure 1

Flowchart of the Bibliographical Search

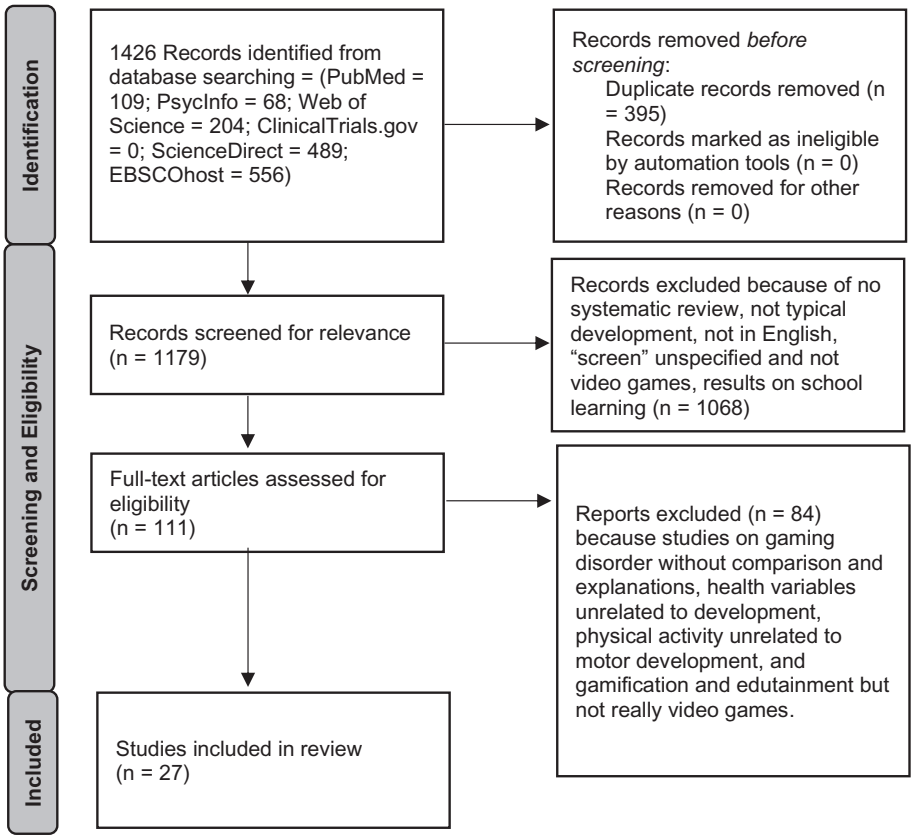

Table 1
The Main Elements of the 27 Reviewed Studies 1/2

References	Articles included, *n*	List of databases	Study start/ end dates	Types of study	Participants' countries	Review objective(s)	Main results summarized in relation to review objective
Brilliant et al. (2019)	9	PubMed and Google Scholar	2009–2018	RCT study, and MRI/fMRI analysis	N/A	To examine the effects of video games on brain structure and function.	The primary findings reveal neuroanatomical and neurophysiological changes in individuals exposed to video games, including alterations in brain morphology and neural networks involved in cognition and behavior, suggesting video game-induced neural plasticity.
Chen et al. (2023)	12	Cochrane Library, CINAHL, Embase, MEDLINE Complete, ProQuest Health Research Premium Collection, PubMed, and Web of Science	2012–2022	Randomized clinical trials	Australia, Belgium, Lebanon, Myanmar, New Zealand, Spain, Taiwan, Turkey, the United States	To review exergame training and analyze its effectiveness on physical, psychological, and cognitive outcomes in older adults residing in long-term care facilities.	The findings indicate improvements in cognitive outcomes and balance efficiency in older adults who participated in exergame interventions compared to those receiving usual care. Exergames also had a positive impact on balance compared to conventional exercise programs.
Corregidor-Sánchez et al. (2020)	14	Scopus, Cochrane, CSIC databases, Web of Science, OT Seeker, and Guideline National Clearing House	2011–2019	Randomized clinical trials	N/A	To evaluate the effectiveness of VR games in improving balance, physical performance, and reducing fall risks in older adults and patients with specific medical conditions, such as diabetes with peripheral neuropathy.	VR games demonstrated significant improvements in balance, physical performance, and a reduction in fall risks among older adults and patients with specific medical conditions.
Jiang et al. (2022)	15	Web of Science, Elsevier Science, PubMed, and Google Scholar	2012–2020	RCTs	N/A	To assess the effects of active video games (exergaming) on executive functions in seniors.	The main results show that exergaming positively affects executive functions in older adults, particularly in areas such as inhibition, cognitive flexibility, and updating.
Johnson et al. (2016)	19	EBSCOhost, (PsycINFO, MEDLINE, and CINAHL), ProQuest, ACM, IEEE Xplore, Web of Science, Scopus, ScienceDirect, and PubMed	2012–2015	Cross-sectional, quasi-experimental, and RCT	N/A	To systematically review the effectiveness of gamification in health and well-being, assessing the quality of evidence provided by the studies.	The findings demonstrate that gamification can effectively motivate and engage individuals in health and wellness behaviors, although higher-quality evidence is needed. Gamification applications can lead to positive behavioral changes and increased accessibility to health interventions.

(*table continues*)

Table 1 (*continued*)

References	Articles included, *n*	List of databases	Study start/ end dates	Types of study	Participants' countries	Review objective(s)	Main results summarized in relation to review objective
Luo et al. (2022)	18	MEDLINE, PsycINFO, SPORTDiscus, Web of Science, and CINAHL	N/A	16 cross-sectional studies and two longitudinal studies	The United States, China, Netherlands, South Korea, Sweden, Canada, Finland, Norway, Germany, Spain, and World	To evaluate the relationship between video game participation and loneliness.	The meta-analysis revealed a weak positive association between video game participation and loneliness, with mixed results across studies. Longitudinal studies showed no predictive relationship between gaming participation and loneliness over follow-up periods of 6 months–1 year.
Mansor et al. (2020)	27	PsycINFO, CINAHL, Scopus, Web of Science, and MEDLINE	1992–2018	Experimental	N/A	To examine the effects of video games on cognitive functions in older adults.	The systematic review found that certain types of video games positively impact cognitive functions in older adults, improving memory, attention, processing speed, and executive functions. Further research is needed to understand the optimal use of video games for cognitive benefits.
Marques et al. (2023)	36	PubMed and Scopus	N/A	Cross-sectional, prospective observational study	Australia, Taiwan, Germany, Italy, the United Kingdom, Switzerland, Belgium, Japan, Finland, the United States, Canada, Spain, Poland, France, Sweden, Netherlands, Hungary, Croatia, India, South Korea, Malaysia, Singapore, and the United Arab Emirates	To examine gaming motivations, particularly escapism, and its association with emotional, social, and mental health outcomes.	Escapism motivation is inversely correlated with mental health outcomes, influencing gaming habits, emotional processes, and social interactions. While linked to negative psychological effects, escapism can also positively enhance confidence, belonging, and virtual community engagement.
Mitrofan et al. (2009)	12	MEDLINE, PsycINFO, ASSIA, Embase, CINAHL, Cochrane Library, Child Data, SOSIG, British Library, Google Scholar, and Zetoc	1968–2005	Experimental studies, case–control studies, cross-sectional surveys, and qualitative studies	N/A	To examine the association between aggressive content in television and video games and aggression in children and youth with behavioral and emotional difficulties.	The review found insufficient evidence to support an association between exposure to aggressive content in television or video games and subsequent aggression in children and youth with behavioral and emotional difficulties.
Molina et al. (2014)	13	Embase, MEDLINE, PsyINFO, Cochrane database, PEDro, and ISI Web of Knowledge	N/A	Randomized clinical trials	N/A	To assess the effectiveness of interactive video games (exergames) in improving physical functions in older adults.	The effectiveness of exergames in improving physical functions among older adults remains uncertain, with mixed evidence. Positive perceptions exist, but further studies are needed to substantiate the benefits.

(*table continues*)

Table 1 (*continued*)

References	Articles included, *n*	List of databases	Study start/ end dates	Types of study	Participants' countries	Review objective(s)	Main results summarized in relation to review objective
Nuyens et al. (2019)	32	Google Scholar, ScienceDirect, PubMed, and PsycINFO	2008–2015	Experimental and quasi-experimental	N/A	To evaluate the impact of video games on cognitive processes, particularly visual perception, working memory, attentional control, and other cognitive functions.	Video game players, especially those engaged in action, FPS, and RPGs, show improvements in visual perception, working memory, and attentional control. The extent of improvements varies depending on the type of game and individual characteristics.
Ogawa et al. (2016)	7	PsycINFO, PubMed, and Web of Science	2010–2014	Randomized controlled studies and uncontrolled studies	N/A	To assess the effects of exercise-based video games (exergaming) on cognitive function and dual-task performance in older adults.	Exergaming appears to improve cognitive function and dual-task performance in older adults, although evidence is limited regarding its effect on fall rates.
Palaus et al. (2017)	116	MEDLINE and Web of Science	2010–2016	Experimental, quasi-experimental, longitudinal, cross-sectional studies, and case studies	N/A	To synthesize evidence on the neural correlates of video gaming, focusing on addiction, exposure to violence, and the state of flow during play.	The review highlighted significant variability in neural responses depending on the type of video game played. Action games were associated with increased activation in brain regions related to rapid decision making, while MMORPGs engaged areas involved in strategic planning and social interaction.
Pallavicini et al. (2018)	35	PsycINFO, Web of Science (Web of Knowledge), PubMed, and Scopus	2012–2017	Randomized, quasi-experimental controlled trial	N/A	To analyze the use of video games as training tools for well-being, focusing on cognitive and emotional aspects.	The review found evidence that video game training benefits cognitive skills (e.g., processing speed, reaction times, memory, and multitasking) and emotional regulation, particularly in young adults. Both commercial and noncommercial video games demonstrated efficacy.
Pallavicini et al. (2021)	28	PsycINFO, Web of Science, MEDLINE, IEEE Xplore, and Cochrane Library	N/A	RCT, quasi-experimental design, and cross-sectional	N/A	To describe the literature on the use of commercial video games for reducing stress and anxiety, examining outcomes related to game characteristics such as genre, platform, and playtime.	Video games, including exergames, action, action-adventure, and augmented reality games, have shown efficacy in reducing stress and anxiety across various platforms. Even brief gaming sessions demonstrated positive effects.

(*table continues*)

Table 1 (*continued*)

References	Articles included, *n*	List of databases	Study start/ end dates	Types of study	Participants' countries	Review objective(s)	Main results summarized in relation to review objective
Pallavicini et al. (2022)	24	PsycINFO, Web of Science, and MEDLINE	N/A	RCT, quantitative nonrandomized, and quantitative descriptive (cross-sectional/ correlational study and longitudinal study), mixed methods	Europe, North America, South America, Asia, Africa, and Oceania	To examine the association between video games and mental health, particularly during the COVID-19 pandemic.	Video games can have both positive and negative effects on mental health. Some games are associated with social and emotional benefits, while others are linked to depression, anxiety, and social isolation.
Saleme et al. (2020)	11	EBSCO, Ovid, ProQuest, Scopus, and Web of Science	2012–2019	RCT and nonrandomized quasi-experimental	The United States, Canada, Barbados, Belgium, the United Kingdom, and Germany	To systematically review the literature on prosocial digital gaming interventions for youth, exploring the effectiveness and measures used in these interventions.	The review highlighted the diversity in measurement approaches used to evaluate prosocial gaming interventions, limiting comparability. The results suggest encouraging effects on prosocial behaviors, though methodological limitations must be addressed.
Sampalo et al. (2023)	13	Scopus, PubMed, and Web of Science	2012–2022	Experimental, quasi-experimental, and observational studies	Germany, Netherlands, Austria, the United Kingdom, Spain, China, America, and Saudi Arabia	To explore the effects of AVGs on attentional functions in expert players, highlighting associated neurological changes.	AVGs are linked to improvements in various attentional functions, including reduced reaction times, increased concentration capacity, and better performance in tasks requiring attentional selection and division.
Sousa et al. (2023)	129	PubMed, PsycINFO, SPORTDiscus, MEDLINE, Web of Science, and Google Scholar	N/A	N/A	Asia, Europe, North America, South America, Oceania, and Africa	To evaluate the effects of AVG on postural balance control.	AVGs have a significantly positive effect on postural balance performance.
Sublette and Mullan (2012)	16	PsycINFO and MEDLINE	2005–2009	Observational studies, longitudinal studies, and experimental studies	Korea, China, Taiwan, the United States, the United Kingdom, and Canada	To evaluate the physical and psychosocial effects of online video games, focusing on massively multiplayer online games (MMORPGs).	Negative effects were primarily associated with excessive or addictive use of online video games, leading to outcomes such as aggression, social isolation, and adverse academic and professional performance.
Torres et al. (2021)	17	PsycINFO, ERIC, and ACM Library	2009–2018	Cross-sectional and experimental	The United States, England, Canada, Spain, Switzerland, the Netherlands, Pakistan, and Australia	To understand whether and how digital play technologies promote developmentally relevant behaviors in typically developing children aged 0–12 years.	The results indicate that new interactive play technologies could have a positive effect on developmentally relevant behaviors in children.

(*table continues*)

Table 1 (*continued*)

References	Articles included, *n*	List of databases	Study start/ end dates	Types of study	Participants' countries	Review objective(s)	Main results summarized in relation to review objective
Vázquez et al. (2018)	22	MEDLINE, PsycINFO, Embase, CINAHL, and the Cochrane Central Register of Controlled Trials	1992–2018	Randomized controlled trials and longitudinal studies	N/A	To assess the effectiveness of video game-based interventions for active aging, focusing on their effects on balance, cognitive function, quality of life, and other aspects of health in older adults.	Video games have shown positive effects on balance, cognitive function, quality of life, and other aspects of health in older adults.
Wang (2021)	59	Google Scholar, ScienceDirect, Wiley InterScience, and Web of Science, and Scopus	2016–2019	Experiments, surveys, and case studies	N/A	To analyze the effects of playing Pokémon Go on the physical, mental, and social health of players while examining player motivation and reasons for continuing or discontinuing gameplay.	Pokémon Go was associated with positive physical, mental, and social health effects, although these benefits were often limited to the duration of gameplay. Increased physical activity and social engagement were among the key positive outcomes.
Yen and Chiu (2021)	18	PubMed, Embase, MEDLINE, and Cochrane	2012–2020	RCT	N/A	To explore the effectiveness of VR exergames in improving cognitive function and reducing depressive symptoms in older adults.	VR exergames had moderate effects on global cognitive function and memory and significant effects on reducing depressive symptoms in older adults, especially when the intervention duration was extended.
Yilmaz and Griffiths (2023)	35	Web of Knowledge, ScienceDirect, Scopus, PsycINFO, PubMed, and EBSCO	2000–2018	Experimental studies, surveys, and case studies	South Korea, Hong Kong, Taiwan, Canada, Greece, the United States, China, Turkey, Norway, and Italy	To examine the effects of different types of games on children's social problem-solving skills.	Most studies concluded that playing both traditional and video games positively impacted children's social problem-solving skills.
Yoong et al. (2024)	11	PubMed, Scopus, Cochrane Library, CINAHL, ProQuest, and Google Scholar	2014–2023	Experimental and observational studies	The United States, Canada, the United Kingdom, Australia, Germany, Japan, and China	To assess the effectiveness of dance-based exercise video games in improving physical and cognitive health in older adults.	Dance-based exercise video games were found to improve physical health, cognitive function, and psychosocial well-being in older adults.
Zeng et al. (2017)	19	Academic Search Complete, Communication and Mass Media Complete, ERIC, PsycINFO, PubMed, SPORTDiscus, and MEDLINE	2008–2016	RCT, cohort studies, and cross-sectional studies	Singapore, Brazil, the United States, Turkey, Australia, and Taiwan	To examine the effects of video game-based rehabilitation in older patients with chronic illnesses.	Video games have shown potential as rehabilitation tools in older patients, with improvements observed in physical, psychological, and cognitive functions.

Note. MRI = magnetic resonance imaging; fMRI = functional magnetic resonance imaging; RCT = randomized controlled trial; N/A = not available; CINAHL = Cumulative Index to Nursing and Allied Health Literature; CSIC = Spanish National Research Council; OT = Occupational Therapy; VR = virtual reality; ACM = Association for Computing Machinery; IEEE = Institute of Electrical and Electronics Engineers; ASSIA = Applied Social Sciences Index and Abstracts; SOSIG = Social Science Information Gateway; PEDro = Physiotherapy Evidence Database; ISI = International Scientific Indexing; FPS = first-person shooter; RPG = role-playing game; MMORPG = massively multiplayer online role-playing game; AVG = active video gaming; ERIC = Education Resources Information Center.

Table 2
The Main Elements of the 27 Reviewed Studies 2/2

References	Development area	Developmental stages	Game types and names	Game platform(s)	Sample size	Ages (min, max, *SD*, average)	Sex
Brilliant et al. (2019)	Cognitive	Adolescence, adulthood, and seniorhood	Strategy, 3D adventures, puzzle, rhythm dance, FPS games: original Super Mario 64 and DS version, Call of Duty, Tetris, Professor Layton, Dance Dance Revolution, and Space Fortress	N/A	393	$M = 43.67$; $SD = 15.63$	N/A
Chen et al. (2023)	Cognitive and motor	Seniorhood	Wii Fit, memory exercises, VR games (e.g., virtual smash, and one ball roll), cognitive training games (e.g., Jenga, Star Wars Battlefront), and Your Shape Fitness	Wii, PlayStation, Kinect, and Xbox 360	482	Adults ≥65 years old	More women (60%–79%) than men
Corregidor-Sánchez et al. (2020)	Motor	Seniorhood	Dance Dance Revolution, Wii Sport, StepMania, Yoga, and so on.	Wii, PlayStation, Kinect, and Xbox 360	673	Over age 60	N/A
Jiang et al. (2022)	Cognitive	Seniorhood	N/A	Nintendo Wii, Kinect sport, and computer	650	60.4–86.0 years	Mainly men
Johnson et al. (2016)	Cognitive and emotional	Childhood, adolescence, and adulthood	N/A	Website, smartphone, Wii console, and Wii Fit	1,457	Young teenagers and adults	Mainly women
Luo et al. (2022)	Emotional and social	Childhood and adulthood	Happy farm, World of Warcraft, Pokémon Go, and EverQuest II	Computer and mobiles	20,372	N/A	Males represented 74.24% of the total number of participants ($n = 15,124$), females represented 25.59% of the total number of participants ($n = 5,214$), and 0.17% ($n = 34$) of participants did not declare any gender information
Mansor et al. (2020)	Cognitive	Seniorhood	Dance Dance Revolution, Pac Man, Donkey Kong, Tetris, Super Mario, Kinect Sports, Rise of nations, and so on.	Computer, Wii, and Xbox	1,126	60 years and older	N/A
Marques et al. (2023)	Emotional and social	Childhood, adolescence, adulthood, and seniorhood	MMORPG, MMO, leisure and sports, and electronics	N/A	40,514	Four groups: (a) Children (0–12 years), (b) Teenagers (12–18 years), (c) Adults (18–65 years), and (d) seniors (over 65 years)	Predominantly male (72.2%), with women, representing only 23.7% of the total number of study participants, while others (4.1%) were unable to access the data or identified themselves as a different gender

(*table continues*)

Table 2 (*continued*)

References	Development area	Developmental stages	Game types and names	Game platform(s)	Sample size	Ages (min, max, *SD*, average)	Sex
Mitrofan et al. (2009)	Emotional and social	Childhood and adolescence	N/A	Game consoles, computers, the internet, and mobile phones	1,423	Between 2 and 19 years depending on the study	N/A
Molina et al. (2014)	Motor	Seniorhood	Dance video game with pad and Wii Fit	Nintendo Wii and console	487	Adults aged 60 and over	N/A
Nuyens et al. (2019)	Cognitive	Adolescence and adulthood	Action, RPG, FPS, and RTS	N/A	1,960	N/A	N/A
Ogawa et al. (2016)	Cognitive	Seniorhood	Exercise video games (exergaming): Wii Sport, Wii Balanced Board, Dance Dance Revolution, Kinect (Sudoku and Tai Chi), and Nintendo Wii Fit games	Nintendo Wii and Kinect	210	Adults aged 60 and over	N/A
Palaus et al. (2017)	Cognitive and social	Adolescence and adulthood	Action, FPS, MMORPG, Sport, RPG, Strategy, and so on.	Game consoles, personal computers, and mobile devices	382	Participants were generally aged between 18 and 35, but some study groups included teenagers or older adults	N/A
Pallavicini et al. (2018)	Cognitive and emotional	Adulthood	Unreal tournament 3, Tetris, Call of Duty, Half Life, Super Mario 64, Mario Kart, Roller Coaster Tycoon III, Fruit Ninja, Medal of Honor, Need for speed, and so on.	Xbox, DS, Smartphone, Computer, Wii U, Gamecube, and so on.	The mean number of participants included in the emerged studies was 54.4 (cognition: $M = 56.1$; emotion: $M = 42.8$), ranging between 5 and 209	Average age of 24.2	N/A
Pallavicini et al. (2021)	Cognitive and emotional	Adulthood and seniorhood	Casual video games, Exergames, Action games Role-playing games, action-adventure games, sports games, racing games, augmented reality games	PC, console, smartphone, mobile console, and VR	The number of participants ranged from 27 to 337 in RCT studies and from 1 to 40 in quasi-experimental studies. The two cross-sectional/ correlational studies included 3,915 and 133 participants	N/A	N/A
Pallavicini et al. (2022)	Cognitive, emotional, and social	Adolescence and adulthood	N/A	N/A	33,964	N/A	N/A
Saleme et al. (2020)	Social	Childhood and adolescence	N/A	N/A	2,303	Between 7 and 17 years old	N/A
Sampalo et al. (2023)	Cognitive	Adulthood	AVG	N/A	517	Between 18 and 45 years of age, with many participants in the 22–23 age group	N/A

(*table continues*)

Table 2 (*continued*)

References	Development area	Developmental stages	Game types and names	Game platform(s)	Sample size	Ages (min, max, *SD*, average)	Sex
Sousa et al. (2023)	Motor	Adulthood and seniorhood	N/A	Computer, Nintendo Wii, Wii U, Microsoft Xbox Kinect, integrated AVG-specific equipment (such as a stationary bike or a dancing mat)	6,407	$M_{age} = 55.1$, range = 3–99 years, $SD = 22.6$)	N/A
Sublette and Mullan (2012)	Emotional and social	Adolescence, adulthood, and seniorhood	MMORPGs: World of Warcraft, EverQuest, Asheron's Call, and so on	Computers	14,640	From 11 to 68 years old	N/A
Torres et al. (2021)	Cognitive	Childhood and adolescence	N/A	Kinect, computer, and apps	341	3–14 years old	N/A
Vázquez et al. (2018)	Cognitive and motor	Seniorhood	Breakout, Galaxian, Frogger, Kaboom, Ms. Pacman, Pengo, Qix, Tetris, Smart Harmony, Mario and Sonic on Olympic Games, and Xbox Kinect Adventures games	PC, Xbox, and Wii	1,224	Over 60	N/A
Wang (2021)	Motor, emotional, and social	Childhood, adolescence, and adulthood	Pokémon Go	Mobile	N/A	N/A	N/A
Yen and Chiu (2021)	Cognitive and emotional	Seniorhood	Commercial or self-developed VR games with exercise (i.e., biking, dancing, kayak paddling, or boxing)	Commercial game systems (i.e., Nintendo Wii, or Xbox Kinect)	1,023	Over 60	N/A
Yilmaz and Griffiths (2023)	Cognitive	Childhood and adolescence	Professor Sudoku, Giok the Alien, Alien Rescue, World of Warcraft, Weather Forecast Game, Zoo U, Crystal Island game, Sim City, and so on.	Computer, game console, and mobile phone	870	School-age children and adolescents	N/A
Yoong et al. (2024)	Cognitive and motor	Seniorhood	Dance Dance Revolution, Just Dance, Wii Fit, Dance Central, Mario Kart, and other specific games developed for research	Wii, Kinect, PlayStation Move, Oculus Rift, HTC Vive, and mobiles	200	The average age of participants ranged from around 60 to 80 years.	Studies included both men and women
Zeng et al. (2017)	Cognitive, motor, and emotional	Seniorhood	Physical exercise games, balance games, cognitive games, exergaming games (Soccer Heading, Ski Slalom, Ski Jump, Table Tilt, Penguin Slide, Balance Bubble, Bowling)	Nintendo Wii, PlayStation EyeToy, and Xbox Kinect	361	The average age of participants ranged from around 60 to 72 years.	Studies included both men and women

Note. min = minimum; max = maximum; 3D = three dimensions; FPS = first-person shooter; DS = dual screen; N/A = not available; VR = virtual reality; MMORPG = massively multiplayer online role-playing game; MMO = massively multiplayer online; RPG = role-playing game; RTS = real-time strategy games; PC = personal computer; RCT = randomized controlled trial; AVG = action video gaming; HTC Vive = high tech computer.

The studies cover a diverse range of research methodologies including randomized controlled trial study, magnetic resonance imaging/functional magnetic resonance imaging analysis, experimental and quasi-experimental designs, case–control studies, prospective observational studies, cross-sectional and correlational studies, observational studies, cohort studies, longitudinal studies, uncontrolled studies, various qualitative studies, and mixed methods approaches.

The selected studies focus on a broad spectrum of video game genres, including but not limited to strategy games, three dimensions (3D) adventures, puzzles, rhythm and dance games, first-person shooter (FPS), massively multiplayer online games, leisure and sports games, electronic games, action games, role-playing games (RPG), real-time strategy games, casual games, and AR video games.

The selected studies encompassed a diverse range of games, including Super Mario 64, Call of Duty, Tetris, Professor Layton, Dance Dance Revolution, Space Fortress, Wii Fit, various VR games such as Virtual Smash and One Ball Roll, Jenga, Star Wars Battlefront, Your Shape Fitness, StepMania, Kinect Sports, Rise of Nations, Pac-Man, Donkey Kong, Unreal Tournament 3, Half Life, Mario Kart, Roller Coaster Tycoon III, Fruit Ninja, Medal of Honor, Need for Speed, Pokémon Go, World of Warcraft, EverQuest II, Kinect Adventures, Professor Sudoku, Giok the Alien, Alien Rescue, Weather Forecast Game, Zoo U, Crystal Island, Just Dance, and Dance Central.

Among the selected studies, various tools and platforms were utilized, including Nintendo Wii, PlayStation, Kinect, Xbox360, Kinect Sport, computer, smartphone and mobile phone, Wii Fit, dual screen, Wii U, Gamecube, Xbox, nonspecified game consoles, Oculus Rift, high tech computer Vive, and PlayStation EyeToy.

Among the 27 studies, 18 studies are about cognitive development and video games (Brilliant et al., 2019; Chen et al., 2023; Jiang et al., 2022; Johnson et al., 2016; Mansor et al., 2020; Nuyens et al., 2019; Ogawa et al., 2016; Palaus et al., 2017; Pallavicini et al., 2018, 2021, 2022; Sampalo et al., 2023; Torres et al., 2021; Vázquez et al., 2018; Yen & Chiu, 2021; Yilmaz & Griffiths, 2023; Yoong et al., 2024; Zeng et al., 2017), eight studies are about motor development and video games (Chen et al., 2023; Corregidor-Sánchez et al., 2020; Molina et al., 2014; Sousa et al., 2023; Vázquez et al., 2018; Wang, 2021; Yoong et al., 2024; Zeng et al., 2017), 11 studies are about emotional development and video games (Johnson et al., 2016; Luo et al., 2022; Marques et al., 2023; Mitrofan et al., 2009; Pallavicini et al., 2018, 2021, 2022; Sublette & Mullan, 2012; Wang, 2021; Yen & Chiu, 2021; Zeng et al., 2017), and 10 studies are about social development and video games (Luo et al., 2022; Marques et al., 2023; Mitrofan et al., 2009; Palaus et al., 2017; Pallavicini et al., 2022; Saleme et al., 2020; Sublette & Mullan, 2012; Torres et al., 2021; Wang, 2021; Yilmaz & Griffiths, 2023).

Among the 27 articles, eight are about childhood (Johnson et al., 2016; Luo et al., 2022; Marques et al., 2023; Mitrofan et al., 2009; Saleme et al., 2020; Torres et al., 2021; Wang, 2021; Yilmaz & Griffiths, 2023), 12 are about adolescence (Brilliant et al., 2019; Johnson et al., 2016; Marques et al., 2023; Mitrofan et al., 2009; Nuyens et al., 2019; Palaus et al., 2017; Pallavicini et al., 2022; Saleme et al., 2020; Sublette & Mullan, 2012; Torres et al., 2021; Wang, 2021; Yilmaz & Griffiths, 2023), 13 are about adulthood (Brilliant et al., 2019; Johnson et al., 2016; Luo et al., 2022; Marques et al., 2023; Nuyens et al., 2019; Palaus et al., 2017; Pallavicini et al., 2018, 2021, 2022; Sampalo et al., 2023; Sousa et al., 2023; Sublette & Mullan, 2012; Wang, 2021), and 15 are about seniorhood (Brilliant et al., 2019; Chen et al., 2023; Corregidor-Sánchez et al., 2020; Jiang et al., 2022; Mansor et al., 2020; Marques et al., 2023; Molina et al., 2014; Ogawa et al., 2016; Pallavicini et al., 2021; Sousa et al., 2023; Sublette & Mullan, 2012; Vázquez et al., 2018; Yen & Chiu, 2021; Yoong et al., 2024; Zeng et al., 2017).

Effects of Video Games

Cognitive Effects

Childhood. Research focusing on children primarily underscores improvements in problem solving and attentional control when playing cognitively demanding games. Yilmaz and Griffiths (2023) examined puzzle- and simulation-oriented titles (e.g., Professor Sudoku and Alien Rescue), finding modest yet consistent enhancements in executive functioning and social problem solving among school-aged children. These improvements were particularly evident when games incorporated cooperative tasks or strategic planning. Although information on usage patterns (e.g., frequency or duration) was limited, most interventions appeared to involve short, recurring sessions that facilitated sustained engagement without overwhelming children's cognitive capacities. Certain studies in Yilmaz and Griffiths (2023) also included adolescents, suggesting that transitions from childhood to adolescence may further amplify benefits, particularly if gameplay complexity and session lengths increase over time.

Adolescence. Several systematic reviews investigated how video gaming influences adolescent cognition across various genres, including action, FPS, RPG, and massively multiplayer online role-playing game (MMORPG). Nuyens et al. (2019) observed that adolescents who regularly engaged in action or FPS titles demonstrated more robust visual perception, working memory, and attentional control. Palaus et al. (2017), which included adolescent samples alongside adults, highlighted how fast-paced genres were associated with increased efficiency in rapid decision making, whereas MMORPGs and RPGs fostered strategic thinking and social-cognitive skills. Yilmaz and Griffiths (2023) reinforced these findings in adolescent cohorts, noting that problem solving and cooperative gameplay mechanisms prompted gains in higher-order cognition. Session lengths varied markedly among studies, ranging from brief daily engagements to longer weekly sessions; yet, the data consistently pointed to a dose–response pattern in which moderate but recurrent play facilitated significant cognitive advantages.

Adulthood. Cognitive enhancements related to video gaming persisted into early and middle adulthood. Action-oriented genres, including FPS and real-time strategy games, frequently emerged as catalysts for improved visuospatial processing, attentional control, and rapid decision making (Nuyens et al., 2019; Sampalo et al., 2023). Palaus et al. (2017) underscored genre-specific neural activation in adult gamers, suggesting that the selective demands of different game types (e.g., puzzle, RPG, and action) might drive distinct patterns of cognitive adaptation. Brilliant et al. (2019), who surveyed broad age ranges from adolescence through older adulthood, reported that relatively short gaming sessions (often 30–60 min several times a week) were sufficient to induce neural plasticity, although individual baseline skills and motivational factors could

moderate these outcomes. Collectively, these reviews indicate that while adults may benefit from both short, focused intervals of gameplay and more extended sessions, the cognitive gains are consistently tied to gameplay variety, sustained engagement, and alignment with the player's existing skill level.

Seniorhood. Older adults represent the most extensively studied cohort in the context of exergames (video games requiring physical activity) yet reviews also highlight the role of classic arcade, puzzle, and VR-based experiences in stimulating cognitive functioning. Chen et al. (2023) and Jiang et al. (2022) found that exergaming protocols (e.g., Wii Fit and Kinect-based programs) delivered several times per week produced significant gains in executive functions such as inhibition, cognitive flexibility, and updating. Mansor et al. (2020), Ogawa et al. (2016), and Vázquez et al. (2018) likewise reported improvements in memory, attention, and processing speed, particularly when sessions spanned at least 6–8 weeks. Yen and Chiu (2021) extended these findings to immersive VR exergames, noting moderate yet noteworthy advances in global cognition when older adults participated regularly in dance-based or sports-themed virtual environments. Zeng et al. (2017) and Yoong et al. (2024) both emphasized the importance of tailoring game intensity and session duration to seniors' physical constraints, as well as ensuring adequate support (e.g., supervision and interface usability). Taken together, these reviews confirm that sustained, physically active gameplay can enhance key cognitive domains in seniors, supporting an "active aging" framework that integrates mental engagement with mild-to-moderate physical exercise.

Socioemotional Effects

Childhood. Research on the socioemotional impact of video games on children frequently highlights positive outcomes linked to problem solving and cooperative play. Yilmaz and Griffiths (2023) observed that both traditional and digital games contributed to improved social problem-solving abilities among school-aged participants. Although various game genres were represented (e.g., puzzle games and strategy simulations), the most consistent benefits emerged when children engaged in collaborative or narrative-driven titles requiring shared goal setting. Saleme et al. (2020), focusing on prosocial digital games, similarly reported encouraging effects on children's prosocial behaviors but noted that diverse measurement approaches limited direct comparisons across studies. Wang (2021) further illustrated that playing Pokémon Go could enhance children's social engagement, albeit transiently, as benefits often declined once the novelty diminished. Marques et al. (2023) included younger cohorts in their exploration of escapism motives, suggesting that while a sense of belonging and emotional relief may arise from immersive gaming experiences, the potential for social withdrawal remains if usage becomes excessive.

Adolescence. Several systematic reviews address adolescents' socioemotional outcomes, often through the lens of social interaction, stress, or mental health. Yilmaz and Griffiths (2023) noted that problem solving and cooperative play can enhance interpersonal competencies in adolescents, echoing the positive findings reported for children. However, some studies in this age group underscored the role of competitive or immersive environments in eliciting either prosocial or antisocial behaviors (Saleme et al., 2020). Sublette and Mullan (2012), while focusing on the negative effects of excessive or addictive gaming, found that adolescents were particularly prone to social isolation and aggression when MMORPGs were used to replace offline social activities. Conversely, Marques et al. (2023) noted that escapism-driven adolescents may experience heightened virtual community engagement and self-confidence, provided that gaming sessions do not overshadow real-world socialization. Luo et al. (2022), analyzing gaming participation and loneliness, indicated a weak positive association in younger groups, but longitudinal data did not establish a strong predictive link between gaming and persistent loneliness.

Adulthood. Adult populations frequently exhibit a complex interplay of both positive and negative socioemotional outcomes. Luo et al. (2022) reported that adult gamers displayed only marginal relationships between gaming frequency and loneliness, suggesting that gameplay itself may not be a robust predictor of social disconnect. By contrast, Pallavicini et al. (2018) and (2021) emphasized the potential of commercial video games to foster emotional regulation, reduce stress, and alleviate anxiety when sessions were moderate in length and games were matched to the players' interests (e.g., action-adventure and exergames). Marques et al. (2023) found that escapism as a motivational factor could either enhance social connectedness (especially within online communities) or exacerbate mental health vulnerabilities if gaming served chiefly as an avoidant strategy. Sublette and Mullan (2012), focusing on adult MMORPG users, concluded that negative social consequences were strongly tied to excessive time investment, overshadowing other life commitments. Wang (2021), who included adult Pokémon Go players, noted positive effects on social interaction in community-based events, although these benefits waned when gameplay motivation declined.

Seniorhood. Research on older adults' socioemotional outcomes emphasizes the role of gaming in mitigating feelings of isolation and enhancing emotional well-being, often through exergames or interactive VR. Pallavicini et al. (2021) identified reductions in stress and anxiety for seniors who engaged in short but consistent gaming sessions, including VR-based exergames, casual action titles, and puzzle games. Yen and Chiu (2021), although primarily focused on cognitive improvements in older adults, reported significant decreases in depressive symptoms, highlighting the socioemotional dimension of active VR interventions. Marques et al. (2023), whose participants ranged up to seniors over 65, observed that escapism-driven motivation in older adults often manifested as a constructive outlet for stress relief and social engagement, particularly in multiplayer virtual environments. Sublette and Mullan (2012) also included senior gamers in their broader sample; although negative outcomes (e.g., social isolation and aggression) were less prevalent among older players, excessive or addictive patterns still introduced risks to mental health and social cohesion.

Motor Effects

Childhood. Few systematic reviews have specifically examined motor or physical outcomes in children, although Wang (2021) provided some relevant insights through studies of Pokémon Go. The review indicated that children who engaged in Pokémon Go exhibited an increase in physical activity levels, including walking distance and daily step counts, suggesting that mobile AR games can positively affect basic motor behaviors. However, these benefits often diminished as the novelty wore off, highlighting the importance of sustained engagement to reinforce long-term motor or fitness gains in younger populations.

Adolescence. Research exploring motor effects among adolescents is also limited. Wang (2021) briefly included adolescent players of Pokémon Go, reporting similar short-term improvements in physical activity as observed in children. Palaus et al. (2017), which encompassed participants aged 18–35 but also included some teenage samples, suggested that certain sports-oriented or action-based titles could promote rapid coordination and motor responses. However, direct evaluations of adolescents' motor performance were sparse. Overall, these findings hint that physically interactive or movement-based games may enhance motor functions for adolescents; yet, further investigation is needed to confirm and measure these potential benefits.

Adulthood. Several reviews considered adult participants in broader samples assessing exergaming or active video gaming. Sousa et al. (2023) reported positive effects on postural balance in a wide age range ($M_{age} = 55.1$ years), indicating that active video games can encourage improved body stability and motor coordination, at least in the short term. Similarly, Wang (2021) noted that adult Pokémon Go players experienced notable increases in daily steps and social walking events, although consistent engagement was necessary for sustaining these benefits. While Palaus et al. (2017) primarily addressed neurological correlates of gaming, their inclusion of sports and action titles implies potential gains in hand–eye coordination and reaction times for adults. The overall evidence suggests that moderate, regular participation in active or movement-based video games may confer meaningful improvements in motor proficiency among adult populations.

Seniorhood. Studies of older adults overwhelmingly focus on exergames, VR games, and interactive rehabilitation tools. Chen et al. (2023) and Corregidor-Sánchez et al. (2020) both reported significant enhancements in balance and physical performance when older adults engaged in VR-based or Wii Fit-style interventions, particularly compared to standard care or conventional exercise programs. Molina et al. (2014) highlighted mixed evidence regarding exergames for physical functioning, indicating that while some older participants perceived benefits in strength or balance, robust longitudinal data remained scarce. Sousa et al. (2023), with a subset of senior participants, found positive outcomes for postural balance, aligning with Zeng et al. (2017), which documented improvements in physical and psychological domains among older patients with chronic conditions. Taken together, these reviews affirm that active, game-based interventions can support motor function, gait, and equilibrium in seniors, especially when sessions are regular and adapted to individuals' physical capabilities.

Health and Well-Being

Childhood. Several reviews highlight the potential benefits of interactive digital games for children's health and development. Torres et al. (2021), focusing on digital play technologies in children aged 0–12, found that these tools can positively influence developmentally relevant behaviors, including physical engagement and social interaction. Johnson et al. (2016), although examining gamification and wellness across broader age ranges, noted that child-focused applications have been effective in increasing motivation and accessibility for health interventions when age-appropriate strategies are employed (e.g., short, engaging tasks, and playful incentives). Wang (2021), in a review of Pokémon Go, similarly reported that children who engaged with AR games experienced transient increases in physical activity and social participation, although these gains often diminished once initial novelty or external reinforcement declined.

Adolescence. Teen-focused interventions likewise reflect a mix of physical, mental, and social benefits deriving from gamified or exergaming activities. Johnson et al. (2016) indicated that adolescents typically respond well to interactive health interventions that incorporate competition, achievement badges, or social-sharing features, suggesting that digital platforms may help sustain engagement with health-promoting behaviors. Wang (2021) included adolescent players of Pokémon Go, demonstrating that location-based gaming can temporarily boost daily step counts and encourage peer-based play. However, Torres et al. (2021), examining a broader child and adolescent cohort, underscored the necessity of context-specific design (particularly the importance of tailored difficulty levels, appealing narratives, and cooperative elements) to translate short-term engagement into meaningful, longer-term health, or developmental outcomes.

Adulthood. Research on adult populations frequently underscores the positive influence of gamified health interventions and mobile exergames. Johnson et al. (2016) highlighted a range of studies showing that well-structured gamification elements (e.g., points and leaderboards) can produce modest yet consistent improvements in physical activity and self-management of health goals, especially when individuals receive timely feedback and social support. Wang (2021) reported that adult Pokémon Go users often participated in community-based walking events, leading to a temporary upswing in physical activity and social engagement. Although these benefits were often limited to the period of active gameplay, the reviews point to the promise of digital gaming interventions in bridging gaps between traditional health care resources and everyday lifestyles.

Seniorhood. The majority of reviews on older adults center on exergames and structured video game interventions aimed at maintaining or improving health and well-being. Vázquez et al. (2018) demonstrated that active gaming protocols benefited older adults by enhancing quality of life, balance, and cognitive function, encapsulating a broader "active aging" framework. Yoong et al. (2024) similarly found that dance-based exergames not only promoted physical and cognitive health but also fostered psychosocial well-being, including reduced stress and a greater sense of community. Zeng et al. (2017), focusing on individuals with chronic illnesses, outlined improvements in physical, psychological, and rehabilitative outcomes tied to active video game participation. These studies collectively suggest that regular, well-designed video game programs can enable seniors to sustain higher levels of independence and life satisfaction by facilitating gentle physical exercise, mental engagement, and social interaction.

Discussion

The findings presented in this umbrella review underscore the need to shift beyond a predominantly clinical or risk-focused narrative around video games. While previous research has rightly drawn attention to the dangers of pathological gaming (King & Delfabbro, 2018; Petry et al., 2014), the studies synthesized here reveal a more nuanced picture: video gaming can indeed carry risks (such as social withdrawal and increased aggression in cases of excessive use), but it also holds significant potential to foster cognitive, motor, socioemotional, and health benefits. This realization challenges binary depictions of games as simply "good" or "bad," suggesting instead that

their ultimate impact depends on complex interactions among individual traits, game genres, and broader contextual factors (Ferguson, 2007; Prot et al., 2014).

A compelling pattern that emerges from the results is the convergence of evidence indicating that cognitively engaging or physically active video games can enhance attention, executive functions, and motor coordination across different age groups. However, it is equally evident that no single gaming modality or schedule will suit all individuals. Outcomes vary considerably based on factors such as developmental stage, baseline ability, and personal motivation. These findings underscore how individual differences (including age, personality, socioeconomic background, and technological familiarity) can mediate or moderate gaming outcomes (Mansor et al., 2020; Nuyens et al., 2019).

Socioemotional outcomes present particular complexities. On the one hand, prosocial and cooperative gaming contexts foster positive interpersonal skills, emotional regulation, and broader social engagement (Saleme et al., 2020; Yilmaz & Griffiths, 2023). On the other hand, when gaming becomes a vehicle for escapism or an outlet for unaddressed stressors, it can intensify loneliness or social isolation (Marques et al., 2023). These differences highlight the importance of contextual elements, such as the motivation to play, the presence of a supportive community, and the balance of online versus offline activities.

A growing body of literature demonstrates that exergames, VR-based programs, and mobile gaming interventions can serve as valuable adjuncts for both physical and psychological well-being (Chen et al., 2023; Johnson et al., 2016; Zeng et al., 2017). Notably, these benefits extend across the lifespan, from children's enhanced physical activity with Pokémon Go (Wang, 2021) to older adults' improved balance and cognitive performance in VR or dance-based exergames (Yoong et al., 2024). Importantly, these interventions do not occur in a vacuum. Successful outcomes often depend on their integration into existing support networks (schools, health care settings, community centers, or family routines) where guidance, monitoring, and social reinforcement can amplify positive results while mitigating overuse.

This review shows that while video games carry recognized risks and remain subject to misuse, they can also act as important levers for positive developmental, cognitive, socioemotional, and health outcomes. The challenge, therefore, lies in discerning how best to optimize video gaming experiences (e.g., through thoughtful design, age-appropriate content, and responsible usage guidelines) so that diverse populations might benefit without exacerbating vulnerabilities.

Limitations

This umbrella review brings to light several limitations that must be acknowledged when interpreting the findings. First, there is a notable shortage of longitudinal studies in the current body of research. Most of the included studies are interventional, offering insights into short-term effects but failing to capture the long-term consequences of video game exposure. This limitation complicates our understanding of the enduring impacts of video games on cognitive, motor, socioemotional, and health outcomes.

Second, existing systematic reviews do not consistently integrate all relevant data concerning the characteristics of the analyzed studies. This lack of comprehensiveness may lead to overgeneralizations or conclusions that do not adequately account for the diversity and complexity of the primary research. For instance, variations in study design, participant demographics, and game types are often underreported, potentially skewing the interpretation of the results.

Third, this review deliberately excluded meta-analyses, which limits the ability to assess effect sizes, a key metric for evaluating the clinical significance of video game impacts. The absence of effect size data may hinder the precision with which we can quantify and understand the magnitude of video game effects, leaving an important gap in the evaluation of their overall significance.

Moreover, the effects of video games are highly context dependent, varying widely based on factors such as game genre, session duration, and frequency of play. This heterogeneity in outcomes underscores the need for a more nuanced approach when assessing the potential benefits and risks associated with video game use. Without considering these contextual variables, it is difficult to draw firm conclusions about the generalized impacts of video games across different populations.

Finally, while many studies report positive outcomes, there is also evidence of mixed or negative effects, particularly regarding the risks of social isolation, addiction, and mental health issues associated with excessive gaming. These conflicting findings highlight the complexity of the topic and the need for continued research to identify the conditions under which video games are beneficial versus detrimental.

Addressing these limitations is essential for advancing future research in this area. It will enable the development of more precise and evidence-based recommendations that take into account the full scope of video game effects, both positive and negative, across diverse contexts and populations.

Perspectives

In light of the findings and limitations highlighted in this umbrella review, several important research directions and recommendations emerge to guide future studies in this field. First, the scarcity of longitudinal research represents a critical gap in the literature. While many studies examine the short-term effects of video games, long-term impacts remain largely unexplored. Conducting well-designed longitudinal studies would offer valuable insights into the enduring effects of video game exposure on cognitive, motor, socioemotional, and health-related development across different stages of life. These studies would allow for a deeper understanding of how video games influence developmental trajectories over time, particularly regarding potential lasting benefits or risks.

Second, further exploration into the underlying mechanisms driving video games' developmental effects is necessary. Neuroscientific and psychological studies could shed light on the specific neural and cognitive processes that underlie the observed changes in behavior and brain structure. By identifying these mechanisms, future research could inform the development of more targeted video game interventions, enhancing their effectiveness in improving cognitive, motor, and emotional functions.

Third, the role of moderating and mediating factors in the effects of video games warrants closer examination. Individual differences, such as age, gender, socioeconomic status, and neurocognitive profiles, may significantly influence how individuals respond to video games. Research exploring how these factors moderate the effects of gameplay could help tailor interventions to specific populations. Moreover, studying the mediatory processes (such as social,

emotional, or cognitive mechanisms) through which video games exert their influence could provide a more comprehensive understanding of their impact on development.

Finally, translating research findings into actionable recommendations for health professionals, educators, policymakers, and families is essential. The nuanced insights from this review suggest that video games hold both potential benefits and risks. Health professionals and educators should be equipped with evidence-based strategies to harness the positive effects of video games while mitigating potential harms, particularly in vulnerable populations. Policymakers could use this knowledge to inform guidelines on video game use, promoting balanced approaches that optimize developmental outcomes while minimizing the risks of excessive use.

In conclusion, while significant progress has been made in understanding the effects of video games on development, numerous questions remain unanswered. Future research should aim to address these gaps by focusing on longitudinal, mechanistic, and context-specific studies that provide more nuanced and robust evidence. By doing so, it will be possible to offer clearer guidance on how video games can be leveraged for positive developmental, health, and educational outcomes across the lifespan.

References

Adachi, P. J. C., & Willoughby, T. (2017). The link between playing video games and positive youth outcomes. *Child Development Perspectives*, *11*(3), 202–206. https://doi.org/10.1111/cdep.12232

Adachi, P. J. C., & Willoughby, T. (2013). More than just fun and games: The longitudinal relationships between strategic video games, self-reported problem solving skills, and academic grades. *Journal of Youth and Adolescence*, *42*(7), 1041–1052. https://doi.org/10.1007/s10964-013-9913-9

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). https://doi.org/10.1176/appi.books.9780890425596

Anderson, C. A., & Bushman, B. J. (2001). Effects of violent video games on aggressive behavior, aggressive cognition, aggressive affect, physiological arousal, and prosocial behavior: A meta-analytic review of the scientific literature. *Psychological Science*, *12*(5), 353–359. https://doi.org/10.1111/1467-9280.00366

Aromataris, E., Fernandez, R., Godfrey, C. M., Holly, C., Khalil, H., & Tungpunkom, P. (2015). Summarizing systematic reviews: Methodological development, conduct and reporting of an umbrella review approach. *International Journal of Evidence-Based Healthcare*, *13*(3), 132–140. https://doi.org/10.1097/xeb.0000000000000055

Barlett, C. P., Anderson, C. A., & Swing, E. L. (2009). Video game effects—Confirmed, suspected, and speculative. *Simulation & Gaming*, *40*(3), 377–403. https://doi.org/10.1177/1046878108327539

Bean, A. M., Nielsen, R. K., Van Rooij, A. J., & Ferguson, C. J. (2017). Video game addiction: The push to pathologize video games. *Professional Psychology: Research and Practice*, *48*(5), 378–389. https://doi.org/10.1037/pro0000150

Belbasis, L., Bellou, V., & Ioannidis, J. P. A. (2022). Conducting umbrella reviews. *BMJ Medicine*, *1*(1), Article e000071. https://doi.org/10.1136/bmjmed-2021-000071

Bonczar, M., Ostrowski, P., D'Antoni, A. V., Tubbs, R. S., Iwanaga, J., Ghosh, S. K., Klejbor, I., Kuniewicz, M., Walocha, J., Moryś, J., & Koziej, M. (2023). How to write an umbrella review? A step-by-step tutorial with tips and tricks. *Folia Morphologica*, *82*(1), 1–6. https://doi.org/10.5603/fm.a2022.0104

Brilliant, T. D., Nouchi, R., & Kawashima, R. (2019). Does video gaming have impacts on the brain: Evidence from a systematic review. *Brain Sciences*, *9*(10), Article 251. https://doi.org/10.3390/brainsci9100251

Cant, R., Ryan, C., & Kelly, M. A. (2022). A nine-step pathway to conduct an umbrella review of literature. *Nurse Author & Editor*, *32*(2), 31–34. https://doi.org/10.1111/nae2.12039

Chen, P.-J., Hsu, H.-F., Chen, K.-M., & Belcastro, F. (2023). VR exergame interventions among older adults living in long-term care facilities: A systematic review with meta-analysis. *Annals of Physical and Rehabilitation Medicine*, *66*(3), Article 101702. https://doi.org/10.1016/j.rehab.2022.101702

Choi, G. J., & Kang, H. (2022). The umbrella review: A useful strategy in the rain of evidence. *The Korean Journal of Pain*, *35*(2), 127–128. https://doi.org/10.3344/kjp.2022.35.2.127

Corregidor-Sánchez, A. I., Segura-Fragoso, A., Rodríguez-Hernández, M., Criado-Alvarez, J. J., González-Gonzalez, J., & Polonio-López, B. (2020). Can exergames contribute to improving walking capacity in older adults? A systematic review and meta-analysis. *Maturitas*, *132*, 40–48. https://doi.org/10.1016/j.maturitas.2019.12.006

Dong, W., Zhou, M., Zhou, M., Jiang, B., & Lu, J. (2023). An overview of applications and trends in the use of extended reality for teaching effectiveness: An umbrella review based on 20 meta-analysis studies. *The Electronic Library/Electronic Library*, *41*(5), 557–577. https://doi.org/10.1108/el-11-2022-0257

Edwards, D., Williams, J., Carrier, J., & Davies, J. (2022). Technologies used to facilitate remote rehabilitation of adults with deconditioning, musculoskeletal conditions, stroke, or traumatic brain injury: An umbrella review. *JBI Evidence Synthesis*, *20*(8), 1927–1968. https://doi.org/10.11124/jbies-21-00241

Ferguson, C. J. (2007). Evidence for publication bias in video game violence effects literature: A meta-analytic review. *Aggression and Violent Behavior*, *12*(4), 470–482. https://doi.org/10.1016/j.avb.2007.01.001

Ferguson, C. J., & Colwell, J. (2020). Lack of consensus among scholars on the issue of video game "addiction". *Psychology of Popular Media*, *9*(3), 359–366. https://doi.org/10.1037/ppm0000243

Fisher, S., & Griffiths, M. (1995). Current trends in slot machine gambling: Research and policy issues. *Journal of Gambling Studies*, *11*(3), 239–247. https://doi.org/10.1007/bf02104791

Gentile, D. A., Anderson, C. A., Yukawa, S., Ihori, N., Saleem, M., Ming, L. K., Shibuya, A., Liau, A. K., Khoo, A., Bushman, B. J., Rowell Huesmann, L., & Sakamoto, A. (2009). The effects of prosocial video games on prosocial behaviors: International evidence from correlational, longitudinal, and experimental studies. *Personality & Social Psychology Bulletin*, *35*(6), 752–763. https://doi.org/10.1177/0146167209333045

Green, C. S., & Bavelier, D. (2003). Action video game modifies visual selective attention. *Nature*, *423*(6939), 534–537. https://doi.org/10.1038/nature01647

Greitemeyer, T. (2022). The dark and bright side of video game consumption: Effects of violent and prosocial video games. *Current Opinion in Psychology*, *46*, Article 101326. https://doi.org/10.1016/j.copsyc.2022.101326

Griffiths, M. D. (1999). Internet addiction: Fact or fiction? *The Psychologist*, *12*(5), 246–250. https://www.researchgate.net/publication/232557569_Internet_Addiction_Fact_or_Fiction

Huot-Lavoie, M., Gabriel-Courval, M., Béchard, L., Corbeil, O., Brodeur, S., Massé, C., Fournier, É., Essiambre, A. M., Anderson, E., Cayouette, A., Giroux, I., Khazaal, Y., Demers, M. F., & Roy, M. A. (2023). Gaming disorder and psychotic disorders: A scoping review. *Psychopathology*, *56*(4), 315–323. https://doi.org/10.1159/000527143

Jiang, J., Guo, W., & Wang, B. (2022). Effects of exergaming on executive function of older adults: A systematic review and meta-analysis. *PeerJ*, *10*, Article e13194. https://doi.org/10.7717/peerj.13194

Johannes, N., Vuorre, M., & Przybylski, A. K. (2021). Video game play is positively correlated with well-being. *Royal Society Open Science*, *8*(2), Article 202049. https://doi.org/10.1098/rsos.202049

Johnson, D., Deterding, S., Kuhn, K.-A., Staneva, A., Stoyanov, S., & Hides, L. (2016). Gamification for health and wellbeing: A systematic review of

the literature. *Internet Interventions*, *6*, 89–106. https://doi.org/10.1016/j.invent.2016.10.002

Karimov, A., Saarela, M., & Kärkkäinen, T. (2024). Serious games in science and mathematics education: A scoping umbrella review. *International Journal of Serious Games*, *11*(4), 3–20. https://doi.org/10.17083/ijsg.v11i3.765

King, D. L., & Delfabbro, P. H. (2018). The concept of "harm" in Internet gaming disorder. *Journal of Behavioral Addictions*, *7*(3), 562–564. https://doi.org/10.1556/2006.7.2018.24

King, D. L., & Delfabbro, P. H. (2020). Video game addiction. In C. A. Essau & P. H. Delfabbro (Eds.), *Adolescent addiction: Epidemiology, assessment, and treatment* (2nd ed., pp. 185–213). Elsevier Academic Press. https://doi.org/10.1016/b978-0-12-818626-8.00007-4

Luo, Y., Moosbrugger, M., Smith, D. M., France, T. J., Ma, J., & Xiao, J. (2022). Is increased video game participation associated with reduced sense of loneliness? A systematic review and meta-analysis. *Frontiers in Public Health*, *10*, Article 898338. https://doi.org/10.3389/fpubh.2022.898338

Mansor, N. S., Chow, C. M., & Halaki, M. (2020). Cognitive effects of video games in older adults and their moderators: A systematic review with meta-analysis and meta-regression. *Aging & Mental Health*, *24*(6), 841–856. https://doi.org/10.1080/13607863.2019.1574710

Marques, L. M., Uchida, P. M., Aguiar, F. O., Kadri, G., Santos, R. I. M., & Barbosa, S. P. (2023). Escaping through virtual gaming—what is the association with emotional, social, and mental health? A systematic review. *Frontiers in Psychiatry*, *14*, Article 1257685. https://doi.org/10.3389/fpsyt.2023.1257685

Maset Sánchez, S., Schoeps, K., Valero Moreno, S., & Postigo Zegarra, S. (2023). How effective are psychological treatments for internet gaming disorder? An umbrella review. *Revista de Psicología Clínica Con Niños Y Adolescentes*, *10*(1), 84–90. https://doi.org/10.21134/rpcna.2023.10.1.5

Milani, L., Grumi, S., & Di Blasio, P. (2019). Positive effects of videogame use on visuospatial competencies: The impact of visualization style in preadolescents and adolescents. *Frontiers in Psychology*, *10*, Article 1226. https://doi.org/10.3389/fpsyg.2019.01226

Mitrofan, O., Paul, M., & Spencer, N. (2009). Is aggression in children with behavioural and emotional difficulties associated with television viewing and video game playing? A systematic review. *Child: Care, Health and Development*, *35*(1), 5–15. https://doi.org/10.1111/j.1365-2214.2008.00912.x

Moher, D., Shamseer, L., Clarke, M., Ghersi, D., Liberati, A., Petticrew, M., Shekelle, P., & Stewart, L. A. (2015). Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. *Systematic Reviews*, *4*(1), 1–9. https://doi.org/10.1186/2046-4053-4-1

Molina, K., Ricci, N., de Moraes, S., & Perracini, M. (2014). Virtual reality using games for improving physical functioning in older adults: A systematic review. *Journal of NeuroEngineering and Rehabilitation*, *11*(1), Article 156. https://doi.org/10.1186/1743-0003-11-156

Nguyen, P., Le, L. K.-D., Nguyen, D., Gao, L., Dunstan, D. W., & Moodie, M. (2020). The effectiveness of sedentary behaviour interventions on sitting time and screen time in children and adults: An umbrella review of systematic reviews. *International Journal of Behavioral Nutrition and Physical Activity*, *17*(1), 1–11. https://doi.org/10.1186/s12966-020-01009-3

Nuyens, F. M., Kuss, D. J., Lopez-Fernandez, O., & Griffiths, M. D. (2019). The empirical analysis of non-problematic video gaming and cognitive skills: A systematic review. *International Journal of Mental Health and Addiction*, *17*(2), 389–414. https://doi.org/10.1007/s11469-018-9946-0

Ogawa, E. F., You, T., & Leveille, S. G. (2016). Potential benefits of exergaming for cognition and dual-task function in older adults: A systematic review. *Journal of Aging and Physical Activity*, *24*(2), 332–336. https://doi.org/10.1123/japa.2014-0267

Palaus, M., Marron, E. M., Viejo-Sobera, R., & Redolar-Ripoll, D. (2017). Neural basis of video gaming: A systematic review. *Frontiers in Human Neuroscience*, *11*, Article 248. https://doi.org/10.3389/fnhum.2017.00248

Pallavicini, F., Ferrari, A., & Mantovani, F. (2018). Video games for well-being: A systematic review on the application of computer games for cognitive and emotional training in the adult population. *Frontiers in Psychology*, *9*, Article 2127. https://doi.org/10.3389/fpsyg.2018.02127

Pallavicini, F., Pepe, A., & Mantovani, F. (2021). Commercial off-the-shelves video games for reducing stress and anxiety: A PRISMA systematic review. *JMIR Mental Health*, *8*(8), Article e28150. https://doi.org/10.2196/28150

Pallavicini, F., Pepe, A., & Mantovani, F. (2022). The effects of playing video games on stress, anxiety, depression, loneliness, and gaming disorder during the early stages of the COVID-19 pandemic: PRISMA systematic review. *Cyberpsychology, Behavior, and Social Networking*, *25*(6), 334–354. https://doi.org/10.1089/cyber.2021.0252

Petry, N. M., Rehbein, F., Gentile, D. A., Lemmens, J. S., Rumpf, H.-J., Mößle, T., Bischof, G., Tao, R., Fung, D. S. S., Borges, G., Auriacombe, M., González Ibáñez, A., Tam, P., & O'Brien, C. P. (2014). An international consensus for assessing internet gaming disorder using the new DSM-5 approach. *Addiction*, *109*(9), 1399–1406. https://doi.org/10.1111/add.12457

Poncet, L., Saïd, M., Yang, S., Müller-Riemenschneider, F., Berticat, C., Raymond, M., Barkat-Defradas, M., Charles, M. A., & Bernard, J. Y. (2024). Associations between screen viewing at 2 and 3.5 years and drawing ability at 3.5 years among children from the French nationwide Elfe birth cohort. *Scientific Reports*, *14*(1), Article 348. https://doi.org/10.1038/s41598-023-50767-0

Prot, S., Anderson, C. A., Gentile, D. A., Brown, S. C., & Swing, E. L. (2014). The positive and negative effects of video game play. In A. B. Jordan & D. Romer (Eds.), *Media and the well-being of children and adolescents* (pp. 109–128).

Reis, E. M., Postolache, G., Teixeira, L., Arriaga, P., Lima, M. L., & Postolache, O. (2019). Exergames for motor rehabilitation in older adults: An umbrella review. *Physical Therapy Reviews*, *24*(3-4), 84–99. https://doi.org/10.1080/10833196.2019.1639012

Rosendo-Rios, V., Trott, S., & Shukla, P. (2022). Systematic literature review online gaming addiction among children and young adults: A framework and research agenda. *Addictive Behaviors*, *129*, Article 107238. https://doi.org/10.1016/j.addbeh.2022.107238

Saleme, P., Pang, B., Dietrich, T., & Parkinson, J. (2020). Prosocial digital games for youth: A systematic review of interventions. *Computers in Human Behavior Reports*, *2*, Article 100039. https://doi.org/10.1016/j.chbr.2020.100039

Sampalo, M., Lázaro, E., & Luna, P.-M. (2023). Action video gaming and attention in young adults: A systematic review. *Journal of Attention Disorders*, *27*(5), 530–538. https://doi.org/10.1177/10870547231153878

Sanders, T., Noetel, M., Parker, P., Del Pozo Cruz, B., Biddle, S., Ronto, R., Hulteen, R., Parker, R., Thomas, G., De Cocker, K., Salmon, J., Hesketh, K., Weeks, N., Arnott, H., Devine, E., Vasconcellos, R., Pagano, R., Sherson, J., Conigrave, J., & Lonsdale, C. (2024). An umbrella review of the benefits and risks associated with youths' interactions with electronic screens. *Nature Human Behaviour*, *8*(1), 82–99. https://doi.org/10.1038/s41562-023-01712-8

Sauce, B., Liebherr, M., Judd, N., & Klingberg, T. (2022). The impact of digital media on children's intelligence while controlling for genetic differences in cognition and socioeconomic background. *Scientific Reports*, *12*(1), Article 7720. https://doi.org/10.1038/s41598-022-11341-2

Sousa, C. V., Lee, K., Alon, D., Sternad, D., & Lu, A. S. (2023). A systematic review and meta-analysis of the effect of active video games on postural balance. *Archives of Physical Medicine and Rehabilitation*, *104*(4), 631–644. https://doi.org/10.1016/j.apmr.2023.01.002

Sublette, V. A., & Mullan, B. (2012). Consequences of play: A systematic review of the effects of online gaming. *International Journal of Mental Health and Addiction*, *10*(1), 3–23. https://doi.org/10.1007/s11469-010-9304-3

Tisseron, S., & Gravillon, I. (2008). *Qui a peur des jeux video?* [Who's afraid of video games?]. Albin Michel.

Torres, P. E., Ulrich, P. I. N., Cucuiat, V., Cukurova, M., Fercovic De la Presa, M. C., Luckin, R., Carr, A., Dylan, T., Durrant, A., Vines, J., & Lawson, S. (2021). A systematic review of physical–digital play technology and developmentally relevant child behaviour. *International Journal of Child-Computer Interaction*, *30*, Article 100323. https://doi.org/10.1016/j.ijcci.2021.100323

Valkenburg, P. M., Meier, A., & Beyens, I. (2022). Social media use and its impact on adolescent mental health: An umbrella review of the evidence. *Current Opinion in Psychology*, *44*(44), 58–68. https://doi.org/10.1016/j.copsyc.2021.08.017

van der Neut, D., Peeters, M., Boniel-Nissim, M., Klanšček, H. J., Oja, L., & van den Eijnden, R. (2023). A cross-national comparison of problematic gaming behavior and well-being in adolescents. *Journal of Behavioral Addictions*, *12*(2), 448–457. https://doi.org/10.1556/2006.2023.00010

Vázquez, F. L., Otero, P., García-Casal, J. A., Blanco, V., Torres, Á. J., & Arrojo, M. (2018). Efficacy of video game-based interventions for active aging. A systematic literature review and meta-analysis. *PLoS ONE*, *13*(12), Article e0208192. https://doi.org/10.1371/journal.pone.0208192

Viderman, D., Tapinova, K., Dossov, M., Seitenov, S., & Abdildin, Y. G. (2023). Virtual reality for pain management: An umbrella review. *Frontiers in Medicine*, *10*, Article 1203670. https://doi.org/10.3389/fmed.2023.1203670

Voinescu, A., Sui, J., & Stanton Fraser, D. (2021). Virtual reality in neurorehabilitation: An umbrella review of meta-analyses. *Journal of Clinical Medicine*, *10*(7), Article 1478. https://doi.org/10.3390/jcm10071478

Wang, A. (2021). Systematic literature review on health effects of playing pokémon go. *Entertainment Computing*, *38*, Article 100411. https://doi.org/10.1016/j.entcom.2021.100411

World Health Organization. (2019). *ICD-11: International classification of diseases 11th revision*. Organisation Mondiale de la Santé.

Yen, H.-Y., & Chiu, H.-L. (2021). Virtual reality exergames for improving older adults' cognition and depression: A systematic review and meta-analysis of randomized control trials. *Journal of the American Medical Directors Association*, *22*(5), 995–1002. https://doi.org/10.1016/j.jamda.2021.03.009

Yilmaz, E., & Griffiths, M. D. (2023). Children's social problem-solving skills in playing videogames and traditional games: A systematic review. *Education and Information Technologies*, *28*(9), 11679–11712. https://doi.org/10.1007/s10639-023-11663-2

Yoong, S. Q., Wu, V. X., & Jiang, Y. (2024). Experiences of older adults participating in dance exergames: A systematic review and meta-synthesis. *International Journal of Nursing Studies*, *152*, Article 104696. https://doi.org/10.1016/j.ijnurstu.2024.104696

Zeng, N., Pope, Z., Lee, J. E., & Gao, Z. (2017). A systematic review of active video games on rehabilitative outcomes among older patients. *Journal of Sport and Health Science*, *6*(1), 33–43. https://doi.org/10.1016/j.jshs.2016.12.002

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