

Intergenerational active play: a scoping review

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This paper presents a scoping review of intergenerational active play to provide an overview of current research in HCI and related disciplines. Play has been widely perceived as a common activity among people of all ages. Physical activity and active play are essential to positive developmental outcomes, especially of those in preschool years. Intergenerational play can be beneficial to people of different generations by promoting meaningful interactions and healthy relationships. Finally, intergenerational active play shows great potential in fostering early childhood development and positive ageing for older adults. Digital technology provides opportunities for promoting intergenerational active play in new ways, such as digital games, exergames, and tangible embodied embedded interaction (TEIs). Based on the review, we present a framework for intergenerational active play which encapsulates the key concepts, challenges, and opportunities for future research and design.

CCS CONCEPTS • Human-centered computing • Human computer interaction (HCI) • Interaction design

Additional Keywords and Phrases: play, active play, intergenerational interaction, intergenerational active play, TEIs

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1 INTRODUCTION

There is a growing body of HCI research on ageing well, including addressing issues of social isolation and physical and mental health and wellbeing. The population is ageing worldwide due to declining fertility and increasing life expectancy. According to the United Nations Department of Economic and Social Affairs, over 960 million people were aged 60 or above in 2017, which was more than twice that in 1980. This number is projected to reach over 2 billion by the year 2050 [99]. Ageing population appears to provide them with more opportunities to interact with each other [44]. However, the number of collocated intergenerational families is declining due to an increase in geographically dispersed families [81]. Other causes of this trend include immigration, globalization, and the prevalence of nuclear families (i.e. grandparents and grandchildren not living together) [44, 81]. This significantly narrows the opportunities for grandparents and their grandchildren to have meaningful interactions as geographical distance is negatively correlated to contact frequency, thereby affecting intergenerational closeness [32, 44].

There is also a large area of HCI research with children, including on how to promote physical activity [22, 58] and social connection [25, 56]. Play has been widely perceived as a common activity among grandparents and their grandchildren [4, 27, 96, 34, 106]. Active play in particular is shown to provide grandparents/older adults and their grandchildren with many mutual and individual benefits by not only promoting physical activities but also creating opportunities for meaningful interactions. Regular physical activity is essential to developmental outcomes among young/preschool children [15] and healthy ageing among older adults [26, 41, 72]. However, many real-world barriers (e.g. medical complications, limited accessibility) are preventing the ageing population from achieving an adequate level of physical activity [68]. Many studies also found that only a small proportion of children aged below 5 are meeting all three guidelines concerning physical activity, sleep, and screen-based sedentary activities and there is substantially low compliance to screen time guidelines [18, 23, 85, 97].

In this paper, we examine the intersection of these two areas, in particular the opportunities for HCI researchers in supporting intergenerational active play. Very few scholarly works examine collocated intergenerational active play. There is limited knowledge of why and how grandchildren and grandparents participate in active play, and the problems they might face [4]. Most of the studies on this topic focus on screen-based approaches [1, 2, 25] despite the negative impacts of excessive screen time on young children [61] and the potential benefits of tactile control on engaging older adults in technology [25]. Therefore, more research needs to be conducted into the potential of emerging technologies, especially those that utilise tangible embodied embedded interactions (TEIs), in promoting intergenerational active play. This paper presents a framework of gaps emerging from a scoping review of relevant literature on intergenerational active play, together with design and research opportunities for HCI researchers.

2 METHODOLOGY

A literature search was conducted through Queensland University of Technology (QUT) Library and ACM Digital Library (ACM Full-text collection), using a variety of terms and their relevant variations such as ‘intergenerational play’, ‘active play’, and ‘tangible embodied and embedded interactions’. The search also included terms that define the populations being focused on for this research including ‘preschooler’, ‘grandchild*’, ‘older adult’, and ‘grandparents’ and was restricted to papers and books published between 2010 and 2022. The first author reviewed and excluded papers that were out of scope or do not satisfy the aim of this review. For example, selected papers on play, active play, and intergenerational play exhibit extensive discussions on the characteristics, existing definitions, benefits, different perspectives, and limitations surrounding these key concepts, and based on which conclusively propose a working definition. On the other hand, selected papers on intergenerational active play focus on the potentials of emerging

technologies (e.g., tangible interactive technology, augmented reality, virtual reality) on fostering physical active play and healthy interaction between older adults and preschool child(ren) or their preschool grandchild(ren). This included scoping reviews of technologies and emerging concepts as well as individual studies of experimental prototypes for facilitating intergenerational relationships and physical activity. The final review included 49 papers across several sub-topics including play, active play, intergenerational play, intergenerational active play, and tangible embodied and embedded interactions (TEIs).

3 LITERATURE REVIEW

3.1 Play

Play is universal and a fundamentally important part of human life [34]. For example, humans play to learn and master a variety of essential skills that are useful throughout their lifespans [17]. However, from an evolutionary perspective, play is not exclusively anthropogenic as it can be seen in other animal species as a way of learning about the world [17, 34]. Many researchers agree that play is complex and challenging to define as it is multifaceted, context-dependent, and involves a constellation of characteristics [17, 34, 37, 39]. Play is fun, enjoyable, pleasurable [7, 34, 39], freely-chosen, self-directed, and spontaneous [34, 39, 42]. It involves some level of active engagement [42, 86], exuberant activity [39], imagination, emotions, and metaphoric use of props and toys [102]. Play helps develop empathy through its connection with prosocial behaviour [102] and is often referred to as a vehicle for learning [7] or as a child's instinctive preparation of adulthood [39]. Grieshaber and McArdle [43], however, point out many challenges with play and provide a critique of many highly valued beliefs about play, especially the adage about "learning through play". It is argued that play in early childhood is not always fun, natural, innocent, and beneficial to all children. In fact, play can be political, involve moral issues, and can also exclude people.

Play is not just for children. Many argue that play is a mindset, and the nature and purpose of play evolves in conjunction with people's biological and psychological changes [13, 17, 34]. Toddlers play primarily to get a grasp of the fundamentals such as getting along with other people, exploring the world, and learning about themselves and their ways of doing things. As children grow older, more complex concepts and paradigms are introduced into the play process including emotions, thoughts, physical activities, friendships, and a sense of community [34]. Else [34] also identifies a potential barrier as this pattern carries into adulthood. As people grow up and become more logical and serious, they tend to prioritise more adult concerns such as housing or employment. Consequently, play seems to become viewed as somewhat frivolous. This realises major impacts adults have on children's play in the way that activities such as formal learning are deemed more worthwhile. Specifically, play is prone to social and economic changes as more and more is expected of children regarding responsibility and economic contribution, effectively reducing time spent on playful activities [13, 34]. It is also argued that adults seek new opportunities to maintain a playful mind, do new things, or take new challenges such as sports, luxury cruise, and gambling which, however, are considered not genuinely playful, yet mostly recreational and entertainment [34].

3.2 Active play

A definitive and consistent definition of active play has yet to be established, see Table 1. There is a vast variety of different terms that seem to be used interchangeably or synonymously with active play such as physical play, physical activity play, or motor play. Active play and physical activity have been used interchangeably in literature [98] and active play is frequently described as a form of physical activity [11, 75, 100]. Several authors, however, draw a distinction between different terms including motor play, gross motor/active play, and physical play that characterise children's play

development throughout their life [38, 52, 69]. This distinction can also be seen in Pellegrini and Smith’s definition of active play which describe play development during infancy, preschool years, and primary years as rhythmical stereotypes, exercise play, and rough-and-tumble play respectively [75].

Table 1: Overview of the definitions of active play

Author	Year	Definition
Swift [92]	2017	Active play is defined as “a combination of fine and gross motor activities that impacts children’s physical health and development, their social and intellectual development and develop their brains.” Active play can be individually-directed or adult-led.
Pellegrini & Smith [75]	1998	Physical activity play is defined as “a playful context combined with a dimension of physical vigour”. There are three types of physical activity play that starts to develop during different developmental stages of a child’s life including <ul style="list-style-type: none"> • Rhythmical stereotypes - in infancy (6 months): as children explore their gross motor skills. • Exercise play – in preschool years (4-5 years): gross locomotor movements in the context of play. • Rough-and-tumble in primary years (8-10 years): vigorous behaviours that may seem to be aggressive outside the context of play such as kicking, wrestling, tumbling, and grappling. Physically active play is “any physical activity where the child is doing what they want to do for their own reasons.” This type of play is different from structured physical activity in the way that the children are not closely instructed and allowed to follow their interests.
Brady et al. [11]	2008	Active play is defined as “a form of gross motor or total body movement in which young children exert energy in a freely chosen, fun, and unstructured manner.”
Truelove et al. [98]	2017	“Active play includes any activity that involves moderate to vigorous bursts of high energy. Put simply, if it raises their heart rate and makes them “huff and puff”, it’s active play. Active play can be done in lots of ways. It can be structured or unstructured. It can happen indoors or outdoors. Children can play alone or with others.”
ACT Government [3]	2019	Active free play is defined as “[...] child-organized and initiated spontaneous and voluntary activities that take place outdoors, outside of school hours and organized/adult-directed settings, and clearly require children to engage in physical activity.”
Lee et al. [63]	2015	Active free-play is “unstructured physical activity that takes place outdoors in the child’s free time [...]”
Veitch et al. [100]	2006	Physical play refers to “playful physical interaction with the world” which is vital to the development and refinement of gross-motor skills (e.g. pincer grip, throwing ball) and fine-motor skills (e.g. holding a pen) among children between birth and 12 years old.
Moyles [71]	2012	Active play is defined as “gross motor control of head, trunk and limbs in sitting, crawling, standing, running, climbing, jumping, throwing, kicking, catching and so on. It is directly concerned with promotion of physical development and necessitates the provision of adequate free-ranging space to move about in, and natural obstacles to overcome, together with simple, safe, playground equipment, mobile and fixed.”
Sheridan et al. [86]	2011	

There are some overlaps between the definitions of play and active play in which many agree that active play is fun, freely chosen, child-initiated, spontaneous, and voluntary [11, 62, 98]. However, it is still a topic of debate whether active play is strictly outdoor [3, 62, 100], unstructured [3, 86, 98, 100], free from adult’s control [62, 92], and only occurs outside of school hour [62] or during the child’s free time [100]. Most authors describe active play as a set of gross and fine motor skills or physical activities in general that are vital to young children’s physical, social, and cognitive development [71, 75, 86, 92, 98]. This is intimately associated with Fundamental Motor Skills (FMS) which is a “small set of score prototypical infant movement patterns and goal outcomes of upright posture, locomotion, and object-interaction [54]. This aligns with Tarlinton [93] who defines active play as: “a combination of motor skills completed in a fun or motivating way that can result in high energy exertion and supports childhood development. Active play can be participated in a variety of

contexts including structured or unstructured, solitary or social, and indoors or outdoors. Active play has been recognised as an activity that requires children to use various motor skills (gross and fine) and whole-body movements”.

3.3 Intergenerational play

Intergenerational play enables older adults and young children to have frequent, productive, and meaningful contact accompanied by a sense of reciprocity, providing opportunities for different generations to learn from each other and build healthy mutually beneficial relationships. Additionally, long-sustained intergenerational interaction can bring about enjoyment and happiness which, as a result, are viewed as a considerable benefit of involvement and become a motivation for regular attendance [90]. Existing studies have emphasised the social, psychological, physical, and cognitive benefits of intergenerational connection [24, 27, 33, 53, 60, 76]. Playful interactions between children and older adults was found to improve perceptions and attitudes of both parties towards each other [6, 24, 91], which helps address age segregation, promoting intergenerational social solidarity [2, 4, 28, 27, 90, 101, 106]. Indeed, this type of interaction can help young children to improve their perceptions and attitudes towards not only older adults but also the notion of ageing itself [36, 46, 47] and develop a greater empathy towards older people [36]. Other benefits for children include greater self-regulation capacity [36] and improved levels of literacy [5, 16, 80].

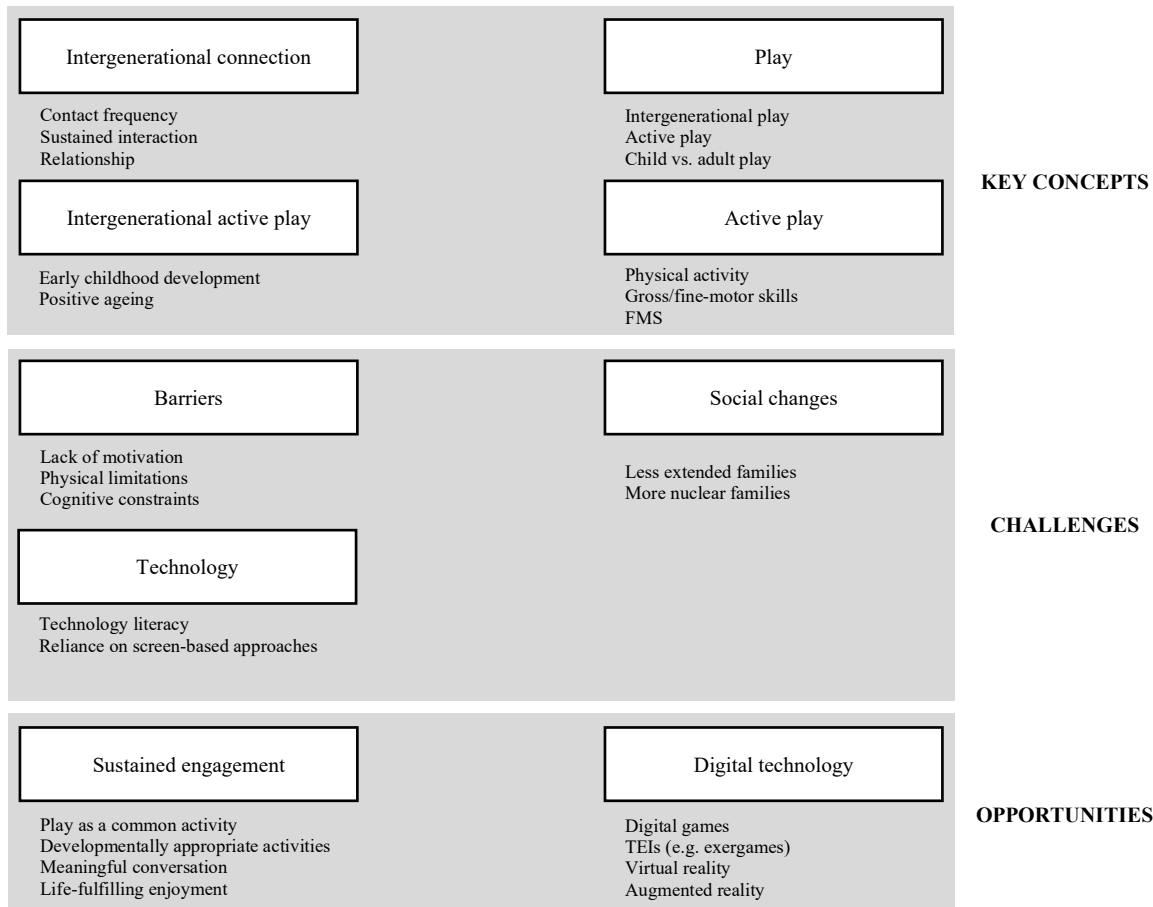
Regarding older adults, health and cognitive benefits of intergenerational interaction are well-documented; some of which include improved physical activity [14], reduced stress for people with dementia [40], improved mood [20], and freedom of movement [5]. Intergenerational interaction is also known to provide older adults with a sense of generativity and the joy of sharing their wisdom with the younger generation, which adds meaning and purpose to their life [24, 27, 33] from a life span perspective [35, 70]. Continuity of interaction with people of different generations is of even greater importance for older adults residing in aged care facilities or nursing homes as comorbidity and frailty associated with longevity among this group can pose significant challenges for sustained interaction with the external community [24]. Intergenerational play can be facilitated by intergenerational programs such as Play Matters experiences [77], which offer many benefits such as connectedness, reduced sense of loneliness, and enhanced self-esteem [55, 76, 78, 83, 88]. Despite the development of and a community appetite for intergenerational programs in Australia, they are still in their infancy [16, 55, 79].

3.4 Intergenerational active play

Active play has been found to be a common interaction between older adults and their grandchildren [4, 27, 96]. Research has highlighted the role of intergenerational active play in promoting health and wellbeing for both groups at a physical, psychological, social, and spiritual level [96]. For older adults, active play can improve cognitive function, mental health, and lower physical health decline [14, 48, 60, 96]. However, multiple studies found that only a small proportion of Canadian and Australian children in their early years are meeting all three guidelines outlined in the 24-Hour Movement Guidelines [18, 23, 97]. These guidelines provide recommendations to promote regular physical activity and reduction of screen-based sedentary activities among preschoolers [23]. It is recommended that preschoolers engage in at least 180 minutes of physical activity, less than an hour of screen-based activity, and between 10 to 13 hours of quality sleep per day. Low adherence to physical activity guidelines can also be seen in older adults as highlighted by Jefferis et al. [51], who examined the prevalence of older adults' adherence to UK physical activity guidelines (150 minutes of moderate intensity activity and/or 75 minutes of vigorous intensity activity per week) [73]. Older adults are subject to many real-world barriers such as medical complications and limited accessibility to exercise facilities that are preventing them from effectively engaging in physical activity [68]. Wootten et al. [104] argue that physical activity program providers need to

reframe their provided benefits to align with older adults’ motivators. For children, regular interactions with older adults can improve reading outcomes [80]. Intergenerational connection can result in positive youth development, including improved academic performance, decreased likelihood of drug use, and better relationships with friends and parents [74]. Intergenerational play is depicted as a transformative and meaningful experience for provoking family discussion on critical issues in a game-mediated environment [87]. However, research on grandparents-grandchildren active play is limited [4, 28]. There is limited knowledge of why and how grandchildren and grandparents participate in active play, and the problems they might face [4]. Scholars have also noted the physical benefits of intergenerational active play for children [12].

Figure 1: The intergenerational active play framework.



With the increase in average life expectancy and early-years children’s access to electronic media devices, there is growing attention on technology-augmented approaches to connecting people from different generations [19, 82, 84]. There are a plethora of scholarly works focusing on technologies and designs that help promote intergenerational play [8, 81]. Digital game [45] and tangible interactive game (e.g. exergame) [58] are only some of the most prominent examples in the broad spectrum of designs for intergenerational active play. Figure 1 demonstrates the framework of

intergenerational active play with concerns about physical activity, active play, and intergenerational aspects as well as opportunities for HCI researchers and designers. Vetere et al. [101] show that technologies can mediate intergenerational connection through play-based activities that promote story-telling, tangible exchange, and playful interactions. This aligns with Siyahhan et al. [87] who state that the affordances of technologies such as digital games or digital media devices in intergenerational interaction can be overlooked due to their possible negative impacts on children. In a more recent study, Reis et al. [81] reveal a growing body of research into the potentials and capabilities of technologies in facilitating meaningful intergenerational connections indicated by the increase in related studies in recent years. However, the technologies in most of these studies are still in their early or pilot phase, and thus considered “proof of concept” [81]. Costa and Veloso [25] argue that digital games such as Age Invaders can enhance social interactions, pro-social behaviours, and sharing of knowledge between generations. There is also a trend towards newer technologies such as Virtual Reality or Augmented Reality in intergenerational interaction design [25].

There are many studies on intergenerational active play that focus on screen-based approaches [1, 2, 25, 87, 101, 106], despite negative impacts of excessive screentime on preschool children’s health and development [61, 82]. While a typical intergenerational interaction is usually led by the older adults or grandparent, the (grand)children often become the mentor in digital play [8, 25, 81, 106]. It has been suggested that older adults can greatly benefit from tactile controls [25] or controls with familiar physical actions [2]. This is supported by Kirsnan et al. [57] who argue that familiarity with equipment is positively correlated with intergenerational engagement as it can make participants feel less distant from each other and elicit nostalgic memories. Indeed, research shows that both older adults [9] and young children [29, 105] can benefit greatly from new forms of play-based social interactions afforded by Tangible Embodied and Embedded Interactions (TEIs). Therefore, smart toys that feature a hybrid of physical and digital components would be beneficial for intergenerational active play [94]. TEIs entail physical manipulation of digital data which uses bodily interactions with physical artefacts as input [49, 105], showing their potentials in supporting active play. TEIs can be defined using the description of tangibility, embodiment, and embeddedness. Tangibility is the physical interactions that control or affect digital information [49]. Embodiment is the relationship between meaning and action in which users create, manipulate, and share meaning through engaged interactions [31]. Embeddedness refers to the phenomenon of conceptually integrating and augmenting interactions into common everyday objects [59]. However, understanding of how to effectively apply TEIs in intergenerational active play is still lacking.

The benefits of TEI-enabled exergames are well-documented [22, 21, 50, 56, 63, 64, 65, 66, 88]. Games such as MouvMat [22], Age Invaders [56], and console exergames (Nintendo Wii, Microsoft Xbox) [58, 65] provide young children and older adults with significant physical, cognitive, emotional, and social benefits through intergenerational physical activity. Group exergame activities help older adults with serious mental illness (SMI) with recovery and healthy ageing by increasing social interaction, self-efficacy, promoting physical health [30]. One of the main values of exergames is highlighted by Dobbins et al. [30] and Lund [67], who observed that older adults participate in play for their own pleasure, enjoyment, and meaning where they tend to forget about their physical limitations, the fear of losing balance, and thus the fear of falling. As a result, older adults become intrinsically motivated to take risks and face challenges such as skill mastery and willingness to increase the game difficulty [30, 67]. This is valuable as one of the challenges faced by health professionals is to find ways of motivating older adults to engage in more physical activity and maintain regular engagement throughout their lifetime [95].

4 DISCUSSION

The aim of this review is to gain a better understanding of intergenerational active play and provide an overview of the technology landscape for facilitating intergenerational play. This review has identified several approaches to improve active engagement in physical activity and foster meaningful intergenerational relationships, gamification and tangible interactive technologies being the most prominent. While there are a few commercially available products such as Wii games or Moto Tiles, the majority of technologies such as MouvMat proposed in the literature have not progressed beyond the pilot phase.

There is also an increasingly large focus on games as a way of fostering interaction. This is supported by Reis et al. [81] who state that gamification is a fun and effective way to maintain participants' interests and improve efficacy. Active play is a common activity among young children and older adults serve as a vehicle for intergenerational interaction. This can be enriched by tangible interactive technologies which are proved to be an effective tool to sustain engagement essential for people of different generations to form meaningful relationships. This review results in numerous implications for health professionals and designers. It is revealed that older adults become intrinsically motivated to engage in more physical activity when they participate in playful interaction with others for the life fulfilling enjoyment and pleasure of it, which is incredibly valuable for health professionals [30, 67, 95].

Designing for both young children and older adults within the context of intergenerational play seems to be a tremendously challenging task due to many generational differences in technology acceptance and literacy [2]. Indeed, designing for these vulnerable populations warrants attention to children's developmental changes to produce age-appropriate design features [17, 103]. Castella [17] highlights several key considerations when designing for young children, one of which suggests that it is important to be aware of their existing knowledge and skills and that they are continually learning new experiences and growing physically, emotionally, cognitively, and socially. Wang et al. [103] state that physical and cognitive changes related to advanced age such as decline in sensory-motor control or central nervous system need to be considered when designing playful products for older adults. Researchers also agree that older adults and children are heterogeneous and disparate populations regarding cultural backgrounds, digital proficiency, or attitudes towards technology, demanding a design process that addresses these differences on a per-case basis [10, 17, 103]. Therefore, it is recommended that play technologies need to focus on flexibility, modularity, tangible interaction, construction, and immediate feedback in order to encourage people of any age to maintain active engagement in physical activity [67].

5 FUTURE WORK

The Intergenerational Active Play Framework proposed in this scoping review serves as a foundation for future researchers to formulate a more comprehensive, yet definitive definition of intergenerational active play. The framework can be used by educators and program facilitators to establish more effective intergenerational programs that are equally engaging and beneficial for both young children and older adults. Further research is needed to gain a better understanding of individual and generational differences among young children and older adults regarding motivations, perceived benefits, physical and mental capabilities, digital literacy, and attitude towards technology in collocated intergenerational active play. For our future work, we intend to explore further into this area to inform the design of new TEIs using emerging technologies that mitigate reliance on digital games or screen-based approaches in facilitating intergenerational play and ensure sustained engagement and equal participation for both generations. We will also expand on recommendations from the research on designing for intergenerational play such as adaptive control system, multimodal interaction, or use of spatial environment to contribute to a set of guiding principles for designing new TEIs.

6 CONCLUSION

This paper has provided a scoping review of intergenerational active play. Despite the extensive research into play and active play, there is a need to gain an understanding of the nature of intergenerational active play and people's motivations and barriers to active engagement as well as its huge potential for promoting physical activity and intergenerational social relationships which are greatly beneficial for people of different generations. The review shows a predominant focus on screen-based or digital approach to fostering intergenerational active play, which fails to fully utilise the potential of tactile controls or TEIs in boosting the level of engagement and accessibility between young children and older adults when participating in game-based playful activities. Although there is growing attention on technologies that aim to support intergenerational interaction in the context of play, most of these technologies are still under trial or considered "proof-of-concept". It has been suggested that designs for intergenerational active play need to take into account generational and individual differences in terms of physical ability, cognitive function, and technological literacy. This review suggests that intergenerational active play is more than merely bringing people of different ages together and keeping them occupied as it involves connecting two generations that are developmentally distant, both physically and mentally within the highly complex construct of play. Rather, intergenerational active play calls for high-quality activities that are universally attractive and developmentally appropriate. Therefore, it is important for researchers to acknowledge the potential of the gamification of tangible interactive technologies to bring about a hybrid of digital and physical components which is mutual beneficial for different generations.

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