The kaleidoscope of play in a digital world

A Literature Review

Digital Futures Commission
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DIGITAL FUTURES COMMISSION
Innovating in the interests of children and young people

5RIGHTS FOUNDATION

The Digital Futures Commission

The Digital Futures Commission (DFC) is focused on putting the needs and interests of children and young people into the minds and work plans of digital innovators, business, regulators and governments. It calls for a critical examination of how children's lives are reconfigured by innovation to reimagine the digital world in value-sensitive ways that uphold rights and take practical steps to meet children's needs. This document is a snapshot of where the DFC is seeking to make an impact. As the work progresses and through the process of consultation, we imagine this report will evolve.

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Foreword

The kaleidoscope of play in a digital world brings into sharp focus how important free play is to children. As author Angela Colvert says, 'it is widely accepted that engaging in play supports children's emotional, physical and cognitive development and wellbeing'. This makes it even more extraordinary how little consideration of free play there is regarding the digital world.

The Digital Futures Commission (DFC) seeks to change that. This report builds on the DFC's *A panorama of play* and its eight qualities of play, and scours the literature for examples of free play in the digital world. There are some joyful signs: immersive spaces in which children build worlds that reflect their imagination and circumstances, sensory interactions that include movement in the real world, open-ended play in which children code their own in-game experience – and a wonderful embracing of social play, which in the digital world can infinitely extend social boundaries or find friends for the socially isolated.

Digital technology is ideally suited to create inclusive and creative environments in which to play, but there are persistent glimpses of rapacious data collection, poor safety, commercial grooming and design strategies that entrap. Pulling together the qualities and also the detractors of free play will be the work of the DFC's third and final report proposing a vision of play in a digital world, due in autumn 2021. Meanwhile, *The kaleidoscope of play* is an important milestone, reminding us that digital play is more than gaming, that children want to and do play wherever they are. So we must reconceive digital play to include the qualities of free play.

We are extremely grateful to all who contributed to the review, to the report's author Angela Colvert, to the DFC team led by Professor Sonia Livingstone OBE and the 5Rights team who tirelessly support them. But our biggest thanks go to the children who gave up their time to remind us that it is their right and desire to be free to direct and enjoy imaginative play on their own terms.

– Baroness Beeban Kidron OBE

The kaleidoscope of play in a digital world

Children will always find ways to have fun. And they don't distinguish where they play – online or offline. But do they enjoy and benefit from all the qualities of free play when they play online? This report answers this question, piecing together research from multiple disciplines to reveal whether and how children's free play can thrive in today's digital world.

The idea of the 'kaleidoscope' captures how the interaction among people, products and places shapes children's free play possibilities. Every shake of the kaleidoscope remixes these factors, generating new patterns and possibilities. As Angela Colvert shows, these new patterns and possibilities depend on eight dimensions of digital design: accessibility; ethics and privacy; adaptability (or open-ended design for flexible and generative use); hybridity; multi-sensory engagement; affective cultures; safe and positive communication; and diverse representations.

Together, these set out the key ingredients for a child rights-respecting digital world of play. But we don't live in this world yet, so the report also points out how digital policymakers, providers, professionals and the public can make greater efforts in children's best interests.

– *Professor Sonia Livingstone OBE*

Author biography: Dr Angela Colvert

Angela Colvert is a Senior Lecturer in English Education at the University of Roehampton, with particular expertise in using digital games to develop children's literacy. She has been involved in the development of award-winning educational games, including the Bafta-nominated 'Teach your Monster to Read', and completed her PhD research into alternate reality games (ARGs) in education at University College London (UCL), Institute of Education (IOE). She has created and taught courses on educational ARG design for trainee teachers at the University of Roehampton. In addition, she has run ARG design workshops for artists, publishers and educators in the UK and the US. Her current research focuses on the intersections between and the educational potential of digital gaming and immersive theatre in schools, homes and other community settings. This work has involved collaboration with various partners, including The Usborne Foundation, Punchdrunk, KIT Theatre, Coney and the UK Literacy Association.

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Summary

This report builds on the recent Digital Futures Commission (DFC) report *A panorama of play* (Cowan, 2020), which identified and explored the characteristics of free play and its importance in children's lives. This report now identifies the possibilities and challenges of children's free play in a digital world. It explores recent findings, problems and recommendations related to supporting children's play with screen-based, embedded and wearable technologies. It is grounded in a narrative review of research and explores the play experiences of children spanning the 0–17 age range: young children (aged 0–5), older children (aged 6–9), tweens (aged 10–12), teenagers (aged 13–15) and young people (aged 16–17).[1] The review draws on research from diverse fields, including Human–Computer Interaction (HCI), Humanities and the Social Sciences. The focus is on the UK, with some attention to the international context.

The report has three aims:

1. To outline possibilities for free play in the digital environment, exploring the similarities and differences with free play in general.
2. To review the breadth of multidisciplinary perspectives on free play with digital technologies and highlight areas of uncertainty, contestation and research gaps.
3. To identify the characteristics of the digital environment that enable or impede possibilities for children's free play.

The report demonstrates that a holistic approach is vital to understand free play in a digital world. It reveals how playful possibilities are shaped by a range of factors: material-functional (products), social-cultural (people) and contextual-situational (places). Using these foci, a three-part framework is presented that applies to play across digital and non-digital environments, although the report's focus is on the digital environment. These factors are analysed at micro, meso and macro levels to encompass children's (digital) experiences from the individual to the societal (see Figure 1). This new framework is entitled 'Kaleidoscope of playful possibilities' to metaphorically convey the message that the shifting and intersecting factors that constitute the digital environment can shape diverse patterns of free play. Viewing the eight qualities of free play (Cowan, 2020) through this kaleidoscope reveals how they merge and intersect with the social, material and spatial aspects of the digital environment in complex ways, presenting multiple opportunities and challenges:

- **Accessibility**
  Children's voluntary and spontaneous play in the digital environment is contingent on the accessibility of digital resources to young people in diverse circumstances. Accessibility is affected by social and economic factors as well as the materiality and functionality of products. Spatial factors also matter – not only where technology is physically situated, but also the boundaries and barriers children must negotiate to enter virtual spaces for play.

[1] The categories used in this report mirror those used by the Information Commissioner's Office (ICO) in its *Age appropriate design* (ICO, 2020a).

- **Ethics and privacy**
  Children's intrinsic motivation to play in the digital environment is best supported by age-appropriate design, respecting their evolving capacities. However, this can be undermined by commercial interests that shape the design of digital products and direct children's engagements across physical and digital contexts. In addition, the use of pervasive marketing strategies and persuasive design in the services that children use raises important ethical, privacy and child rights concerns.
- **Adaptability** (or open-ended design for flexible and generative use)
  The open-ended quality of free play is best supported by products and services that children can modify in the spur of the moment. Adaptability works when it facilitates child-led adjustments to digital functionality and structure (such as programmable devices) or supports exploration and experimentation in physical or virtual spaces (such as technology embedded in playgrounds or virtual environments that support world-building).
- **Hybridity**
  The imaginative quality of play can thrive in the digital environment if digital technology affords hybrid opportunities, enabling children to move across physical and digital settings and combine digital and non-digital resources in creative ways. Hybridity relates to the ways children choose to take up resources to meet their playful needs as they move in embodied and imaginative ways between online and offline worlds, and can be facilitated by technology in multiple ways.
- **Multi-sensory engagement**
  The stimulating quality of free play can flourish in the digital environment if multi-sensory engagement is facilitated by connected, mobile, wearable technologies and tangible interfaces that produce multiple stimuli, spanning virtual and physical contexts. However, digital interactivity can be overstimulating for some children, leading to discomfort or challenges to players' self-control.
- **Affective cultures**
  Emotional resonance is experienced in digital environments at an individual level, but also, importantly, the experience is collective, merging personal and global, transcending online and offline boundaries, generating affective cultures. Digital games and social networks can provide children with valuable opportunities to explore positive as well as negative emotions with others. However, attention must be given to how automated algorithms and networked systems curate what children can participate in and to the management of toxic cultures online.
- **Safe and positive communication**
  Children engage in social play, connecting and building relationships with others across virtual and physical spaces. In-game chat channels and social media can facilitate this. Children learn the conventions of communicating through connected play (conventions of written and spoken language, avatar gestures and use of virtual spaces). However, in these social encounters lie content, contact, conduct and contract risks that require policy and business interventions to mitigate them and strategies to promote children's resilience to benefit from participatory practices.
- **Diverse representations**
  The diversity in forms of play in global digital playgrounds can promote diverse representations of varied lived experiences, abilities and identities. Play is often

hyperlocal, reflecting children's diverse cultural heritage and subcultural interests. This can be facilitated in the digital environment. However, there is still a lack of acceptance of some social groups online, and certain forms of identity exploration and expression are marginalised or abused. Tackling the changes needed will require participatory design in policies and products and cross-sector and intergenerational collaboration with underrepresented and marginalised children.

The evidence reviewed in this report suggests that to enhance possibilities for free play in the digital environment, change needs to occur at all levels (micro, meso and macro). It also suggests that to achieve this, policymakers, academics, educators and those in industry who design products for children must develop social and cultural support and effective products and spaces for free play. Across the research in this area, many academics, designers and policymakers have highlighted calls to action relating to social-cultural, material-functional and contextual-spatial factors. These are listed in the concluding section.

The nature of free play in a digital world

What is 'free play', and why is it important? It is widely accepted that engaging in play supports children's emotional, physical and cognitive development and wellbeing. In particular, children benefit from free play, which is child-led (rather than guided by adults) and is undertaken for its own sake (rather than for instrumental purposes). Play is so vital that it has been established as a fundamental human right, defined in the United Nations Convention on the Rights of the Child (UNCRC) (1989).[2] Cowan explains that a rights-based perspective on play:

> ... highlights free play as central to children's experience of the world and their enjoyment of life. It calls on society to respect, protect and fulfil this right through creating and protecting space and time for play, consulting children on their play experiences and needs, and overcoming inequalities in children's enjoyment of their right to play. (UNCRC, 2020, p. 28)

However, only recently has this right been officially recognised by the UN as applying to the digital environment (UN Committee on the Rights of the Child, 2021).[3] To protect this right, we need to understand the nature of free play with digital technologies and the opportunities and challenges this presents. In the Digital Futures Commission (DFC) report, *A panorama of play* (Cowan, 2020), eight qualities of free play were identified: intrinsically motivated; voluntary; social; emotionally resonant; imaginative; stimulating; open-ended; and diverse in forms (Cowan, 2020). These qualities were distilled from an extensive literature review and focused on play in general, rather than focusing on the specific role of technology in children's play. These provide a valuable point of departure for this report. Although children do not *need* digital resources to play in meaningful and enjoyable ways, they now inhabit a digital world that influences and shapes their free play in myriad ways, both those that are beneficial and those that can be harmful.

So what does free play look like in a digital world? Let's begin by finding out how two girls kept themselves busy in lockdown during the coronavirus pandemic:

> It's July 2020, and Suzy (9) and Bryony (12) have been using the video-sharing app TikTok. It's designed for children who are 13 years or older, but they enjoy using it and their friends do too. Suzy has recreated some of the dances she has seen on the app and uploaded them to the platform. Her mum encourages her to keep her account set to private, but Suzy occasionally switches it to public without telling her. Suzy says that there are some 'really famous' people on TikTok who could make 'a lot of money'. This idea appeals to her. Both Bryony and Suzy talk about the 'really famous' TikTokers, and Bryony often sees dances she wants to try there. Although she sometimes worries that her own videos won't be as good, she often has a go at creating them. Posting

[2] Article 31 sets out the 'right of the child to rest, leisure, play, recreational activities, cultural life and the arts'. General Comment No. 17 foregrounds the 'need to create time and space for children to engage in spontaneous play, recreation and creativity, and to promote societal attitudes that support and encourage such activity' (UN, 2013: 3).

[3] General Comment No. 25 foregrounds the ways that children's rights apply in a digital environment.

> videos enables her to 'chat' to her friends via the comments they leave under her videos. (Adapted from Ofcom, 2020)

Suzy and Bryony's use of TikTok reflects the eight qualities of free play in several ways. For example, their play is motivated by their interest in dance, and their participation is voluntary rather than insisted on by adults. The production of videos requires imaginative engagement, and they find learning the dances stimulating and interesting. There are many different dance routines to select from on the TikTok platform, and this choice supports play that is open-ended and diverse. Being part of the TikTok community and posting videos is a social act that holds emotional resonance for the girls, meeting an important need for social engagement during lockdown. This play is beneficial because it enables Suzy and Bryony to advance their creativity, agency, social development and sense of self. However, while the learning of new dances with friends is a familiar form of play, the use of digital technology inflects and shapes this in new ways.

The digital environment is complex and can support as well as impede children's positive experiences of free play. For example, although the platform facilitates communication with friends and the broader TikTok community, it also supports and maintains business interests that may not always be aligned with the needs and rights of the child. The children enjoy communicating with others on the TikTok site and reading the comments left under their videos, but they are left to navigate the risks and opportunities associated with their activities on the platform. There is a tension between perceptions of 'staying safe' and 'participation' in global playgrounds, illustrated by the mother's instruction that her daughter keeps her account 'private' and Suzy's desire to switch it to 'public' to interact with others and gain recognition for her creative acts. While the girls are intrigued and inspired by the famous TikTokers on the platform, the impact of 'influencer culture' on children's development is not always beneficial. The commercial and globally connected context of children's play requires us to critically reflect on both the opportunities and the challenges that emerge as children play in the digital world.

Although there are many continuities with play in general, children's play is constantly changing and shifting in its nature, influenced by digital environments and new ways to integrate technology into their practices. Free play in the digital world often involves hybridity, as digital and physical domains and resources merge and intersect. Leading researchers in digital play have argued that:

> What changes in digital contexts is not so much the types of play possible, but the nature of that play. Contemporary play draws on both the digital and non-digital properties of things and in doing so moves fluidly across boundaries of time and space. (Marsh et al., 2016, p. 250)

This hybridity is not related to specific combinations of applied technologies. Instead, it can be seen to relate to the convergence of the digital and the non-digital during play (Edwards, 2013). This might include augmented and virtual reality technologies and virtual worlds where play in physical and digital settings intersect. It can also incorporate play with embedded, interactive technologies in playgrounds and community spaces or connected toys in home spaces. This hybridity is not tethered to particular technologies; rather, it is related to uptake and usage by children across a range of social and physical contexts.

Increasingly industry is looking to harness the potential of connected, networked, transmedia platforms to create branded 'metaverses'. Tim Sweeney, CEO of Epic Games, explains that such environments 'bring immersive social experiences to hundreds of millions of people and blur the boundaries between games and social networks' (2019, p. 1). David Kleeman, a leading strategist for the children's media industry, suggests that:

> Kids immediately understand the metaverse concept – a ne*arly boundless space where they'*re free to pursue their favorite brands, stories and characters in all their variations. Youth are driving the explosive growth of Roblox, currently the nearest approximation to a metaverse. The platform was already popular pre-pandemic, but Roblox has become young people's top space for everything from little kids' birthday parties to adolescents' live concerts, while they've been prevented from being with friends in person. As 'down on the corner' shifted to 'up on the server,' kids and teens 'hacked' platforms not designed for them, like Zoom and Discord, adapting them to their needs for connection and engagement. They're building their own metaverse piece by piece, solving with tech for the challenges in their lives. (2021, unpaginated)

The concept of a 'metaverse' is still emerging though, as is research on children's experiences of these practices and networked systems. As Sweeney explains, 'To get to the best possible outcome … we have to make sure that principles underlie the metaverse, rather than individual plans to grab a lot of money' (quoted in Takahashi, 2021, unpaginated). He suggests that companies will need to develop 'enlightened self-interest' that supports open cross-platform play. However, future developments must also involve companies building and sustaining ethical systems aligned with children's best interests (ICO, 2020a). This review sets out to examine the nature of free play in a digital world. It explores how free play is shaped by children's interactions and interests, product design and marketing strategies, and the global locations that span physical and virtual locations. It is only by understanding the way these factors intersect and overlap that we can set out an informed agenda for change and maintain children's right to play in a digital world.

Methodology

This report presents a narrative review of the literature relating to free play in a digital world. The aim is to foreground indicative and salient features of the digital environment that inflect with and affect children's free play. The review for the report was constructed and evaluated in an iterative process in discussion with leading academics and industry partners at key stages of development. These included representatives from LEGO®, Dubit, Sesame Workshop and the BBC, as well as academics from the universities of Sheffield (UK), Leeds (UK), Deakin (Australia) and California (US). This panel of experts drew on expertise from Human–Computer Interaction (HCI), Social Sciences and Humanities (reflecting research and industry experience) (across the 0–17 age range) and served as a valuable steering group. They were central to validating the efficacy of the methodological approach and foregrounding the relevance and implications of the review framework that was developed. They were also able to ensure coverage of the key issues and highlight areas that could be strengthened or needed to be explored in greater depth. This development process included a range of approaches to consultation and review, including a workshop, formal meetings and written correspondence and feedback.

The literature search that underpins this report was extensive and not without challenges. First, the focus on free play required careful reading of the literature to ascertain what should be under consideration. Much of the literature cited in this report does not use the term 'free play' but has been deemed relevant as it is aligned with the definition outlined by the DFC (Cowan, 2020). In broad terms, most play with digital technologies can be categorised as free play if it is driven by the child's intrinsic motivations and supports their agency rather than being insisted on by adults for instrumental purposes, such as to further educational aims. This did not mean that articles that focused on school uses of technology were excluded, but only those that focused on children's subversive or exploratory uses of technology in classroom settings were considered relevant to the discussion. It was therefore not always possible to exclude or include literature based on the use of key terms or the authors' stated focus. Instead, to be effective, the search for relevance needed to be exploratory – searching for themes that were sometimes implicit in the literature rather than explicit.

The literature search was underpinned and informed by a rigorous process to ensure that the report reflects research across a range of disciplines. Appropriate databases were accessed to locate literature from Social Sciences, Humanities and HCI. These included wide-coverage journal search engines, such as JSTOR, alongside subject-specific databases such as the IBSS (International Bibliography of the Social Sciences), Bloomsbury Collections (Arts and Humanities) and ACM Digital Library (HCI). Careful consideration was given to the combinations of search terms used. Demographical terms (such as 'families', 'Early Years', 'children', 'young people' and 'teenagers') were combined with terms relating to specific social settings (such as 'home', 'school', 'clubs' and 'outdoor') and terms relating to specific technology uses ('gaming' and 'social media') or platforms (such as TikTok, Fortnite, Minecraft, Pokémon Go, etc.). Literature included peer-reviewed articles, conference papers and book chapters as well as reports and policy documents. Media accounts and blog posts were also drawn on where relevant, especially concerning emergent research relating to the effects of the pandemic on play. As the literature was reviewed, it became evident from early on in the

process that a framework was needed to map the coverage and foci of the literature under review. This would serve two key functions. Developing such a tool would help identify any gaps across the field of research and would help identify and map what factors were in focus within individual research projects. The rationale for, and significance of, this approach is explained in the next section.

Building a kaleidoscope: constructing a review framework

So what needs to be in focus when researching and designing digital play? Where should we begin? The digital environment is complex and ever-changing, shaped by many interrelated factors. Free play can occur in multiple physical locations such as home, school and on the streets, and increasingly, technology is part of such play. Ecological approaches to analysing and understanding play highlight the interdependent influences on children's experiences and opportunities for development (Bronfenbrenner, 1979; Plowman, 2016). These evolve over time and are rooted in social and cultural contexts. In describing the role of digital technologies in children's play, Wohlwend explains that:

> Commercial, imaginative, and social practices tangle bodies, play, and toys, moving across the immediate spaces of children's worlds and global multimedia sites and networks that distribute consumer goods over vast distances. (2020, p. 2)

This explanation captures the interrelationship across three broad categories of factors:

- people, involving social practices and bodies;
- products,[4] including artefacts (e.g., toys, apps) and networks;
- places, situating people and products within immediate spaces and global multimedia sites.

Play can therefore be conceptualised as a social and cultural activity inflected by the materials taken up (products), the contexts in which play occurs (places), and the meanings shaped by participants and their relationships (people). There are, however, layers of complexity associated with each of these areas:

> Online gaming communities are comprised of myriad stakeholders beyond the child (e.g., parents, influencers, game developers, researchers, educators), nestled within a complex web of influences (e.g., indirect and direct influences on behavior, community culture, incentive structures, policy effects, and adverse online events) that change over time. As researchers of children and media, we cannot ignore these multi-level influences on the development of children and adolescents and must ask: How can we conceptualise and operationalise online gaming using this integrative lens? (Navarro, 2020, p. 3)

[4] The term 'products' refers to artefacts, networks and systems that shape the digital environment. It is important to note, however, that at the micro level, the artefacts that shape play may include non-digital objects such as sticks or boxes that can be combined with digital technologies to shape play.

In this report, a new three-part framework is presented to acknowledge that people, products and places taken together shape possibilities for play in a digital world (see Figure 1). These have the potential to support the qualities of free play (Cowan, 2020) and, ultimately, children's agency, identity and wellbeing. These factors are interdependent as each influences the other and can be examined at multiple levels: micro, macro and meso. Micro refers to the smallest unit of analysis: experiences and interpretations (people), the design of artefacts (products) and the immediate vicinity in which play takes place (places). Meso refers to an exploration of relationships between parts: relationships and social interactions (people); networks, connectivity and transmedia (products); and social settings and local contexts (places). Macro focuses on broader social structures: private and public practices and policies (people); marketing, distribution and data systems (products); and national and global geographies (places). The framework is entitled the 'Kaleidoscope of playful possibilities.'

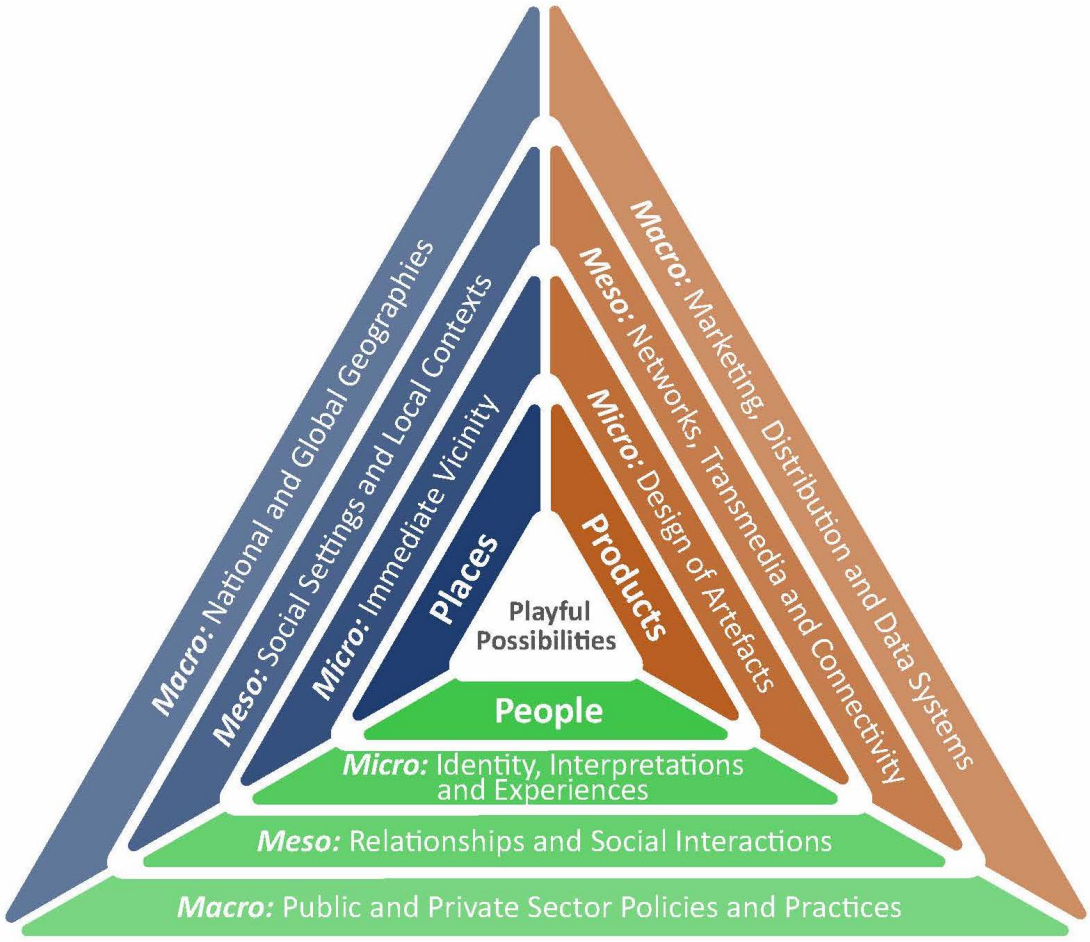

Figure 1. The kaleidoscope of playful possibilities: factors that affect free play in a digital world

Why has the metaphor of the kaleidoscope been adopted to describe this new model? Many researchers have used it to capture the transmutability of play in the digital world. Opie, a notable play historian, described 'the kaleidoscopic vitality of … the people in the playground' (1994, p. ix). Potter and Cowan, also leading researchers in this field, describe the 'kaleidoscopic variety and dynamism' of play in the 21st century' (2020, p.

249), drawing on the methodological approach of Law (2004). Faced with the challenges of researching human experience, Law asks:

> If much of the world is vague, diffuse or unspecific, slippery, emotional, ephemeral, elusive or indistinct, changes like a kaleidoscope, or doesn't really have *much of a pattern at all, then ...* how might we catch some of the realities we are currently missing? (2004, p. 2)

The kaleidoscope metaphor is useful as it suggests we need multiple perspectives on play in a digital world (Chaudron et al., 2017). Extending the metaphor in this review, we can regard each side of the three-part framework as functioning like the mirrors inside a kaleidoscope, reflecting and refracting the perspectives and practices of digital play while, in the centre, the possibilities for play shift and slide.

This three-part 'kaleidoscope' framework is unique in the way it foregrounds the *layers of complexity* inherent in the digital environment. Whilst social-cultural approaches to play have always focused on the contexts in which play occurs, this approach has historically given central importance to human experiences with resources and settings being grouped together. However, there is increasingly a shift in research towards 'post-humanist' discourses that decentre the significance of human agents and highlight the impact that technology and materials have on children's interactions (Marsh, 2017). Materiality is seen as important to the affective experiences of play and the ways opportunities for play are taken up (Burnett & Merchant, 2020). Research into spaces, physical and virtual, has also developed which foregrounds the significance of children's engagements with their environments (Pyles et al., 2019). Much literature defines the virtual as 'immaterial' in contrast to the materiality of physical locations. Kinsley, however, has argued that there is a need to re-examine conceptions of 'virtual geographies' and attend to the 'material conditions of contemporary digitally inflected spatial formations' (2014, p. 365). This model foregrounds the equal importance of attending to all social, material and spatial factors when seeking to understand how possibilities of play emerge.

The framework presented here emerged from an analysis of the literature on children's play and reflects perspectives and concerns drawn from HCI, Humanities and Social Sciences. Although these factors (relating to people, products and places) emerge across research, what has been lacking is an approach to mapping the findings and foci of such research to identify gaps in knowledge or areas that have been hitherto overlooked. Therefore, this report adopts an innovative approach to reviewing the literature by applying this framework as a lens to look at the *levels of focus* in research and *what is in view*. What is significant here, and a point of departure from other models, is that no one factor is given more significance than another: people, products and places all inflect and shape possibilities for play.

Let's begin by reviewing 'moments of play' taken from three different research papers using this framework as an analytical tool.

People

Children's play in a digital world is shaped by the social-cultural affordances of the world around them. At the micro level, interpretations and experiences of individuals (adults and children) are affected by vectors of identity such as gender, ethnicity, class, sexuality and disability. At the meso level, relationships and interactions with family, friends and educators or social media influencers all make a difference. At the macro level, broader

social and cultural practices also matter as governmental and institutional policies and practices, commercial concerns and market forces all shape play in a digital world. To understand the significance of these factors, consider how a group of children play in Autcraft. Autcraft is a semi-private server on Minecraft created for children with autism, their families, and allies. Anyone wishing to join the Autcraft community must first complete an application process to become a member:

> It is late in the evening in the summertime, and only a handful of players are online in Autcraft. One community member posts in the chat window that there will be fireworks displayed in the main hall in 10 minutes, inviting everyone to join in watching… When the show starts, everyone stands still, looking up into the black sky as the colours burst forth. Fireworks take a great deal of effort and energy to create. There is a lengthy process in which the player must find the right materials within the Minecraft world and use them to craft the different kinds of fireworks. Knowing how to make these different fireworks requires the player to ask more experienced players or look up the knowledge online (which is readily available on wikis). These fireworks shows are important to the Autcraft community members because many of them have special sensory needs and cannot attend physical-world fireworks displays. Being able to control their own fireworks allows them to partake in an activity that was before inaccessible to them. This shows that users are willing to put in tremendous effort when given the opportunity to experience a sensory experience in a comfortable way. (Ringland et al., 2017, pp. 341–2)[5]

Here we see members of the Autcraft community engaged in free play, which is imaginative, driven by personal interests and emotionally resonant. At the micro level, vectors of identity shape play in relation to the needs and individual members who gather to enjoy the spectacle of the firework show. The experience of play is collective and supported by interpersonal relationships as players develop and share knowledge about the game with each other to facilitate the production of objects in the virtual world. At a broader level, the play is framed by the cultural conventions of Autcraft, shaped by members and the company that designs the product. Equally as important as the people involved in play are how the products and spaces shape the possibilities for these social interactions. For example, the tools in Autcraft enable children to represent themselves through a range of actions and creations, allowing them to participate in play in ways that might be difficult in physical settings. The Autcraft members' area creates a safe space for play for children with autism who may experience social challenges in other settings, including bullying and social exclusion.

Products

Children's play is shaped by the material-functional affordances of the world around them. At a micro level, individual artefacts and characteristics of digital products present opportunities for, or hinder, play and 'position' and frame players' engagement. Children's play is also framed, at a meso level, within transmedia, networked systems

[5] Minecraft is a multi-player virtual world that enables players to build virtual landscapes by creating and combining virtual blocks. Ringland et al state that, in 2017, 'Autcraft had more than 6000 members with a daily average of approximately 50 players in-world at peak hours of the day' (2017: 1258). The Autcraft community is an inclusive, mixed-ability space.

that enable children to connect with others and offer multiple 'entry points' to engage with imagined worlds. At the broad macro level, technological, political and commercial rule structures shape access to products. All of these factors affect children's free play. As they engage with technology, they negotiate their agency, led by their interests and motivations. To illustrate this, let us consider how one girl plays with her PAW Patrol app:[6]

> Amy (2 years and 3 months) sits on the floor in her front room with a tablet… The narrator asks, 'Will you help the PAW Patrol save Adventure Bay?' to which Amy replies, 'Yes' as she sits next to the tablet and looks towards her toys placed in front of her in the hearth. The narrator says, 'Great, let's check out all the places where our friends need help… Swipe through the places in Adventure Bay to see where we need to lend a paw.' The app provides scaffolding and features a large hand icon moving across the screen to show that a swipe is needed. Amy swipes through the various scenarios. The app regularly provides visual and auditory instructions highlighting badges that can be earned. Amy chooses a train location on the app and a character to lead the mission. The narrator says, 'Chase is on the case!' and Amy says, 'I need to find Chase on the case. Here he is now', and fetches the Chase plastic toy from the model of the PAW Patrol HQ, which is near the tablet. In these initial moments, Amy is prompted to play with the app but gradually becomes more interested in playing with her PAW Patrol figures and begins to drive them around in a truck as the music from the app plays in the background. (Adapted from Marsh, 2017, p. 25)

When focusing on the product as an artefact, it appears that, in many ways, the features of the PAW Patrol app are developmentally appropriate in how invitations to play and navigation instructions are communicated. When considering the networked nature of Amy's play, it is apparent that it is influenced by transmedia narratives that include apps and toys that link to television shows. At a macro level, commercial factors shape how data is collected and used as Amy plays and influences the strategies that increase the 'stickiness' of the product (for example, encouraging the player to return to earn more badges). However, by focusing on the product alone, the richness and complexity of play is lost. A focus on the way people incorporate products into play is vital. In this moment of play, the product does not neatly align with Amy's interest, so she adapts her use of the technology to support her free play. The place is also significant. The home environment supports Amy to combine both digital and non-digital artefacts into her play and allowing her agency in selecting these resources herself.

Places

Play takes place within physical as well as virtual spaces. Children play at home, in school, parks, on the streets as well as online. Digital technology connects these physical and virtual spaces, creating both local and global digital playgrounds. Some of these spaces are designed with play in mind, and others are not. From a micro perspective, research attends to the immediate vicinity of play and how those interactions take place with those who are not physically present, as well as with those materials and people who are 'in the room'. A meso focus relates to local settings, such

[6] Please refer to Marsh (2017) for a full analysis of Amy's play.

as how digital technologies might support play in outdoor environments. A macro perspective involves developing an understanding of the ways global contexts shape children's digital play experiences. This requires a focus on social and cultural factors beyond those related to economic and commercial structures.

To highlight the interconnected nature of these layers, let's examine how the Internet of Things (IoT) might support children to engage in outdoor play. Wood et al. (2019) developed a study that involved running a series of workshops with children aged between 5 and 15 in a local community centre. The centre was 'in a low economic area in the UK and … was established to provide opportunities to a community who are limited by poor average income and affected by a reduction in the provision of social services' (Wood et al., 2019, p. 4). In these workshops, children co-created new IoT designs using the BBC micro:bit.[7] The third workshop was held with 15 children aged between 8 and 15 (9 girls and 6 boys). In the following, the researchers recount an observation of Lucas and Max leading free play:

> In preparation for Workshop 3, we included a 'Fortnite dance' game. In response, two children in our Hackathon – Lucas and Max – invented and facilitated a game they called 'Outdoor dance party'. Lucas and Max wanted to demo their game, so we took the entire group outside when they returned after lunch. Taking a step back, we permitted the children to introduce and demo their game, something they did with great confidence. The two boys got everyone into four groups and gave them each a number between one and four. Lucas went on to explain their game: 'So we have a dance party, whenever I shake this a song will play. But it will come up on here the number and whoever's number gets called has to dance.' Max then began the game by announcing, 'Let the humiliation begin… I mean fun … 3 … 2 … 1 … go'. Following the countdown, Lucas shook his BBC micro:bit. The digit '3' appeared and a random song played. The other groups laughed as Group 3 awkwardly danced. Lucas shook the BBC micro:bit bit again and announced, '1'. A member of a participating group shouted 'Silliest dance … come on'. In this instance, Lucas and Max were given the opportunity to perform and act as facilitators of their game. They were particularly excited about being in charge and overseeing gameplay with both adults and children. We saw them express confidence and happiness performing in this role. (Wood et al., 2019, p. 9)

The immediate vicinity for this play, at the micro level, is the space outside the community centre where Lucas and Max have access to micro:bits and also willing players. At the meso level, the significance of the local context comes into view. The community centre is surrounded by residential housing. This space is well used by the community and is a place where people from the neighbourhood can gather to access

[7] The BBC micro:bit is a low-cost tiny programmable computer, designed to make teaching and learning programming fun. It can be programmed in a way that allows code to be dragged and dropped into graphical coding blocks that snap together to make programming logic easier to understand. They are proving ideal for outdoor play. They come with useful sensors, including motion detection, compass and Bluetooth connectivity, and can be connected to other input/output boards extending how they can be used. Importantly, they are readily available and easy to learn: one million micro:bits had been given to every Year 7 student in England and Wales, with 90% of those students reporting that it showed them anyone can code (Wood et al., 2019, p. 3).

support, resources and services. The outside space is accessible to the children and is used regularly in their everyday play. At the macro level, the national context relating to economic factors is significant. This affects where children may access technology as well as the values attributed to devices and tools. Such places shape possibilities for play in conjunction with people and products. For example, in this community setting, children play alongside adults and with children of different ages. The play is facilitated by adults but led by the children. The design of products enhances their play and supports their creativity with open-ended design principles, which they can adapt. It is significant here that these devices were not connected to networks and were not collecting data related to the children's location. Rather, these devices were programmable and within the control of the children who could shape and change the functionality to meet their playful needs.

Analysis of these three vignettes of play demonstrates that individual research papers relating to free play with digital technologies sometimes foreground the impact of people, products and places but often all of these factors are in view simultaneously. Where differences arise is the level of focus in view. In the next section, a large body of literature is reviewed to highlight the opportunities and challenges for free play with technologies.

Viewing the qualities of free play through the kaleidoscope

How can we use the 'kaleidoscope' framework to understand how people, places and products shape possibilities for free play? As the framework adopts an ecological approach to studying play, it offers the advantage of supporting a holistic and interconnected analysis. Salen and Zimmerman usefully define play broadly as 'free movement within a more rigid structure' (2004, p. 304), and explain that 'play is an expression of the system, one that takes advantage of the space of possibility created from the system's structure' (2004, p. 304). Although they are referring to games in this instance, the digital environment can be seen to open up or close down possibilities according to the configurations of people, places and products. Such possibilities can be positive or negative, and the digital environment can shape free play in ways that are beneficial and potentially harmful.

However, especially in digital environments, such ecological approaches have been criticised for emphasising balance and coherence whereas the *essence* of digital play is much more eclectic, fast-moving and multi-layered (Carrington, 2013). Burnett and Merchant call for an approach that 'celebrates complexity, embraces ambiguity, and, in doing so, challenges orderly perspectives' (Burnett and Merchant, 2016, p. 262). To achieve this, researchers in the Social Sciences increasingly draw on Deleuze and Guattari's (1987) use of the term 'assemblage' (Carrington, 2013; Carrington & Dowdall, 2013):

> While an ecological framing looks to find a contributory role for all components, an assemblage has room for tension, mismatch and ongoing reconfiguration. There is not a sense of creating and then maintaining a balanced symbiosis of parts. As a result of this heterogeneity and independence, assemblages dismantle and reassemble in different combinations as context and requirements shift. (Carrington, 2013, p. 209)

Viewing free play through the kaleidoscope framework, many patterns emerge, with different combinations and permutations of play. The components of the kaleidoscope are not fixed but shift and overlap, and can therefore be seen to align with the multi-layered and changing nature of play. This report now revisits the eight qualities of free play, as outlined in *The panorama of play* (Cowan, 2020), to consider the how these qualities are shaped by and inflect with the digital environment.

Intrinsically motivated

> **A hallmark of free play is that it is intrinsically motivated, meaning that the play happens for its own sake rather than to serve other purposes, especially instrumental ones. Because it is intrinsically satisfying, it is sustained by the interest of the player(s) themselves.** (Cowan, 2020, p. 32)

There is a large body of work related to children's play in the pre-digital era that has revealed that children's play is motivated by a broad range of psychological, social and emotional needs and interests. However, we currently lack sufficient knowledge and

understanding about children's motivations for playing with digital technologies. In recent years, to address this gap, there have been several useful UK consultations, the findings of which were summarised by the Digital Futures Commission (Mukherjee & Livingstone, 2020). In addition to these, there have been a range of research projects that have explored children's approaches to play, spanning the 0–17 age range: young children (aged 0–5), older children (aged 6–9), tweens (aged 10–12), teenagers (aged 13–15) and young people (aged 16–17).[8] These have sometimes adopted innovative methodological approaches in order to align with the developmental capacities of the young research participants.

Understanding what inspires young children to play with technologies can be particularly challenging, due to linguistic barriers, but an ethnographic study in which a researcher played alongside and with pre-schoolers in homes (Scott, 2018a) has revealed rich pictures of children's media use. Using innovative methodologies such as GoPro cameras, which record a 'child's eye' view of play, has also revealed valuable insights into young children's playful choices in addition to discussing young children's motivations for play with parents (Marsh et al., 2015). With older children, tweens and teenagers, participatory design practices have been adopted to discover what interests them and drives their decisions to play. In these studies children have been invited to create their own games and virtual worlds with and for their friends using design software (Pelletier et al., 2010), everyday technologies such as webcams and websites (Colvert, 2019), virtual reality headsets (DigiLitEY, 2018), connected toys (Yamada-Rice, 2019) and programmable mobile technologies (Wood et al., 2019). In order to understand the playful experiences and concerns of teenagers and young people, intergenerational working groups have been developed. These have supported young people to reflect on and discuss their play practices through collaborating in creative tasks with peers, academics and industry partners. In this process participants have developed a better understanding what play looks like and feels like from a range of perspectives (Salen Tekinbaş, 2020).

Olson (2010) suggests that there are developmental factors that affect children's motivations for play, and argues that playing video games serves a diverse range of needs throughout childhood. Motivations to play can differ in relation to the age of the child. For example, one study noted that competition was more motivating for 13- to 16-year-olds than for 10-year-olds, who were more motivated by challenge (Greenberg et al., 2008). However, although there are some developmental differences, there are some broad patterns that have emerged from consultations, which have revealed that children's priorities 'centre on play opportunities that afford agency and choice, imagination, sociability, safety, and a lack of adult restrictions and interference' (Mukherjee & Livingstone, 2020). Research projects, focusing on specific age groups, have revealed a range of interests relating to the experiences of young children. For example, Marsh et al. reported that parents noted a range of motivations for under-fives using apps:

> Children: (i) found them fun to use; (ii) found interactive apps particularly engaging; (iii) enjoyed learning new skills and acquiring knowledge; (iv) liked

[8] The categories used in this mirror those used by the Information Commissioner's Office (ICO) in Annex B: Age and developmental stages of the Age Appropriate Design Code (ICO, 2020b).

> apps that related to their popular cultural interests; (v) enjoyed practicing skills and achieving a sense of mastery; (vi) liked the positive feedback and rewards they received when they achieved goals; (vii) liked to play the apps that siblings and parents used; (viii) enjoying watching videos and more passive experiences when they wanted to wind down. (2015, p. 21)

Studies with older children and tweens have revealed that children value the opportunity to negotiate the rules of play with peers (Colvert, 2019), and that children are receptive to, and build on, each other's interests during play (Wood et al., 2019). This appears to be aligned with a developmental need to establish friendship and explore social dynamics outside of the family context (Salen Tekinbaş, 2020). Hartas explains that 'Peer influence peaks in mid-adolescence where young people show a heightened desire for affiliation and become increasingly sensitive to social evaluation and comparison and their consequences for peer acceptance or rejection' (2020, p. v). Teenagers' and young people's playful interactions, on social media and online gaming platforms, is therefore often motivated by a desire to shape identities, forge friendships and seek independence.

As children play with technology, digital products and systems collect vast amounts of data about children in general and their media use in particular. Such data reveal patterns related to their interests and motivations for play. Although companies often claim that they use data collected from children to enhance players' experiences by tailoring experiences to meet their needs and predict content that players will find engaging, the processing of such data can result in adverse outcomes that neither companies nor children can anticipate. Children can also manually curate and personalise content. For teenagers, personalising devices such as phones by downloading favourite apps can be very important. In one ethnography, Carrington describes one teenager's relationship with her mobile:

> Roxie makes use of the affordances of the phone, the software apps she has used to customize the device to s*uit her own needs, and the internet alongside the textual repertoires she has constructed for herself. Roxie's artefact, her iPhone®*, is clearly important to her. It affords particular engagements with the unique blend of apps she has chosen, and the contemporary features of the internet made accessible via her network. (2012: 10)

However, personalisation features for children are not always appropriate (Kucirkova , 2017). Kucirkova argues that 'the importance of children's agency in the use of technologies is well-established but it continues to be challenged with applications that automatically personalise children's content' (2019, p. 112). She highlights how few research studies focus on principles of personalisation for children aged between 2 and 12, and argues that:

> … personalisation design needs to be re-conceptualised at a fundamental level, given that adult-oriented data-based design and personalised algorithms are based on assumptions about the user that do not apply to the young child, such as for example informed consent or established preferences. (Kucirkova, 2019, p. 112)

There are also issues related to personalised content on social media feeds for older children, tweens, teenagers and young people, who are still in the process of

establishing preferences. UNICEF highlight this issue in their report, entitled 'The children's rights-by-design standard for data use by tech companies', suggesting that 'automated decision-making with opaque algorithms and non-transparent nudge techniques based on personal data can lead to limited diversity experiences and developmental opportunities, creating echo chambers and self-referential bubbles' (Hartung, 2020, p. 4). This limits opportunities for children to extend their interests. It may also limit opportunities to challenge and question belief systems and view and understand their motivations to play from alternative perspectives.

The broader eco-system of the environment intersects and merges with children's experiences in complex and nuanced ways. Children's motivations to play are shaped by the commercial and connected environment in which they play (Grimes, 2010, 2015). In relation to product design, games and social media platforms include features and content that are intended to increase the likelihood of children choosing to return and play over extended periods. Such practices are intended to increase the 'stickiness' of products. Offering badges and rewards for participation are not simply benign features. There are many inappropriate and harmful uses of such incentives. These are amplified in the increasing intersections between online gambling and gaming practices: loot boxes, esports tournaments and the trading of virtual items or skins (digital artefacts that change the appearance of characters or weapons) are all part of broader gaming/gambling eco-systems that span games as well as social networks (Macey & Hamari, 2018). Zendle et al. explain that:

> Loot boxes are items in video games that may be bought for real-world money, but which provide players with a randomised reward of uncertain value. When paying their money, players have no way of knowing exactly what they will receive in return for their investment. Similarities between loot boxes and gambling have led to concerns that they may provide a gateway to gambling. (2020, p. 1768)

Children are motivated to purchase these for a range of social reasons as well as to progress in the game more quickly.

Zendle et al. (2020) surveyed the 100 top-grossing games on both the Google Play store and the Apple App store, and the top 50 most-played games on the Steam store, which revealed that 58.0% of the games on the Google Play store, 59% of the iPhone games and 36% of those on the Steam store contained loot boxes; 93% of the Android games that featured loot boxes and 95% of the iPhone games that featured loot boxes were deemed suitable for children aged 12+. This is highly problematic as there is currently no requirement for companies to indicate that these games contain loot boxes, and use of this technique is not currently regulated. In a recent survey of 582 players who were engaging in gambling behaviours within gaming contexts, 27% were under 18 (Macey & Hamari, 2018), and given the prevalence of these features in games accessed and played by children, the impact is likely far-reaching (DCMS, 2019). 5Rights argues that these 'random reward features should be characterised as online gambling in law but in the meantime, these features should not be routinely offered to young people' (2020, unpaginated). However, there are fundamental regulatory challenges. Wardle explains that the rate of development in the gaming industries 'disrupt and challenge our existing thinking and legislative frameworks' (in press: unpaginated), and argues that a cross-national approach to regulation and legislation is urgently needed. She urges that we 'pay more attention to the broader systems in which these products are developed,

more attention to the processes that determine their advancement … and more attention to impact – reaching beyond questions of whether something is gambling or not' (in press: unpaginated).

Other communications relating to marketing (adverts and in-app purchases) are designed to influence children's motivations to purchase items. These can create an impediment to free play and disrupt children's experiences. Studies reveal that pre-school children's creative uses of apps are improved when adverts, such as pop-ups, banner adverts or in-app purchases are limited (Marsh et al., 2015, 2018). An investigation into the impact of in-game advertising on 9- and 12-year-old children's experiences of mobile games revealed that:

> … children's engagement with in-game advertising takes the form of a struggle and that children both resist and resign themselves to the advertising strategies. Advertising brings about negative experiences of deception, enforcement and confrontation, and interrupts moments of enjoyment, achievement, and immersion during gameplay. These results suggest that playing advertising-based free-to-play mobile games is a demanding environment for children. (Martínez, 2017, p. 848)

In-game advertising is more likely to impact on the experiences of children from lower socio-economic backgrounds, as 'children from families with lower income are more likely to use freemium products and are less likely to pay for apps' (Marsh et al., 2015, p. 42). Some have argued that:

> Children are uniquely vulnerable to the persuasive effects of advertising because of immature critical thinking skills and impulse inhibition. School-aged children and teenagers may be able to recognise advertising but often are not able to resist it when it is embedded within trusted social networks, encouraged by celebrity influencers, or delivered next to personalised content. (Radesky et al., 2020, p. 1)

The impact of influencer culture on children's motivations to purchase products is currently under-researched. Children are increasingly participating in content creation and some have become 'influencers' with significant numbers of followers watching and commenting on their posts. Ofcom report that 'there has been a rise in interest among children with the "vlogger next door": While high-profile YouTube stars remain popular, children are now increasingly drawn to influencers who are often local to their area, or who have a particular shared interest – known as "micro" or "nano" influencers' (Ofcom, 2019, p. 2). In addition to this, the impact of managing the role of 'child influencer' on children's wellbeing is not yet understood.

De Veirman et al. (2019, p. 13) suggest that four areas require further investigation: 'first, insights into influencers' content strategies and how they perceive their role in children's consumer socialization. Second, the impact of influencer marketing on children. Third, how to empower children to deal with influencer marketing, and fourth protecting children from influencer marketing through guidelines and regulations' (2019, p. 13). They also suggest that while most research has focused on YouTube, studies should also focus on popular platforms such as TikTok.

A 'child-centred' approach to understanding children's motivations to play is not sufficient, as commercial interests exert significant influence over the design and

operation of the digital products that children use for fun. Spatial factors also influence children's motivations to engage in free play.

- **At the micro level,** products can provide valuable opportunities for children to tailor and personalise devices and games to meet their needs and interests, although the extent to which the parameters of personalisation are aligned with or extend children's needs requires further exploration.
- **At the meso level,** online networks and virtual spaces support children to connect with others and develop their interests, but the social impact of influencer culture is an area that requires further study.
- **At the macro level,** from time to time industry and design practices manipulate children's playful motivations for commercial gain. New forms of pervasive marketing are being developed, not all of which are respectful of children's developing capacities. For example, practices relating to the design of loot boxes and advertising need regulation to ensure that they are always in the best interests of the child (ICO, 2020a, p. 24).[9]

Voluntary

> **Free play is initiated by the player(s), entered into willingly and cannot be imposed or insisted upon. It has a spontaneous quality and cannot be totally planned for, though others may inspire or invite it. It is self-chosen, self-directed, and includes the freedom to quit.** (Cowan, 2020, p. 32)

The extent to which technology use is spontaneously integrated into play is, in part at least, linked to children's access to the spaces and materials that support such engagement. Many children in the UK have access to a wide range of technologies at home and elsewhere.[10] A recent UK study undertaken with a sample 2400 of parents of children in the UK revealed that the majority of children have access to standard televisions (82%), smart TVs (77%), tablets (94%), smartphones (84%), laptops (72%) and games consoles (78%) (Marsh et al., 2020, p. 35). However, access to technology is limited for some social groups due to a range of social and economic factors. Gender, age and race all impact on access to technology. Marsh et al. noted that 'older children are more likely than younger ones to own a phone. Gender differences are most pronounced in relation to the ownership of games consoles, with boys more likely to own PlayStation and XBox consoles' (2020, p.33). In addition to understanding how ownership is affected by social factors, Marsh et al. also argue that it is important to understand the places where children gain access, noting that 'there were differences in relation to Black, Asian and Minority Ethnic (BAME) and White families in that children from BAME families were more likely to have access to some devices outside of the

[9] In the UK, the Information Commissioner's Office (ICO) issued a statutory code of practice that came into force on 2 September 2020, with a 12-month transition period (2 September 2021), the Age Appropriate Design Code (also known as the Children's Code). After this date, organisations providing online services likely to be accessed by children in the UK must ensure that they are consistent with children's best interests and developing capacities. This will apply to all online services, such as apps, online games and web and social media sites, likely to be accessed by children (ICO, 2020a).

[10] However, access to these was not always in home spaces, and included grandparents' houses. For a European report into the digital literacy practices of young children, see (Sefton-Green et al, 2015).

home' (Marsh et al., 2020, p.36). There were also differences related to socioeconomic status in that middle- and upper-class families were more likely to own iPads than working class families, who were more likely to own cheaper devices (Marsh, 2020). A UNICEF report on surveys revealed that people living with disabilities in developed countries 'are half as likely to have a computer at home as someone without a disability, even less likely to have internet access – and even less likely to go online when they do' (2017, p. 34). While these surveys did not look specifically at children, they point to the need to understand the barriers to access (UNICEF, 2017). Without access, children cannot enter willingly into play with technologies or integrate it spontaneously into play.

Despite the 24/7 presence of smartphones for some children, adults still play an important role in defining the rules of use and the boundaries within which children can engage in play, in both digital and physical domains. For example, in educational settings teachers can both constrain and support children's free play with technology through classroom arrangements (Arnott, 2016) or through imposing restrictions on where children can move within virtual spaces (Burnett & Merchant, 2014) or by determining the time and duration of children's play with technologies (Sakr & Oscar, 2020; Sakr, 2020). Similarly, in home settings parents impose time restrictions on playful technology use, and the location and storage of technology has an impact on how freely available it is for children (Ito et al., 2010). Adult perceptions of inclusive play (Sobel et al., 2015) and the perceived risks of playing with digital technologies (Livingstone & Blum-Ross, 2020) can inform decisions to limit or direct children's access. Similarly, beliefs about the intrinsic value of free play exert an influence. For example, the instrumentalisation of play for educational reasons shapes (and can limit) opportunities for free play. Reflecting on the experience of designing a virtual world to support literacy learning, and the integration of this into teacher's classroom practice, Merchant notes that:

> If the [virtual world] planning team imagined active learners engaged in playful discovery, the teachers who eventually introduced the virtual world into classrooms were governed by other stories of learning, were constrained by institutional norms and routines, and obliged to adopt narrower definitions of literacy… In a similar way, children's access to the virtual world was subject to institutional routines, and delimited by the availability of hardware. (2010, pp. 142–3)

Social norms, and narrow views on the relationship between play and learning, can thereby be seen to impact on opportunities for free play in school. However, playful practices can emerge when teachers collaborate with children to explore gaming principles in the classroom (Beavis et al, 2017). Further, arts-based practices such as participatory theatre in school settings can also open up new possibilities for play (Burnett et al, 2020).

Research also demonstrates that giving freedom of movement in classroom spaces enables children to cluster around tablets and negotiate playful interactions (Arnott, 2016; Burnett et al, 2017), often with many hands controlling play on touchscreens (Wohlwend, 2015). Arnott investigated how the 'ecological factors in early childhood playrooms contributed to children's social experiences during their digital play' (2016, p. 274), and observed the children when they voluntarily decided to use the digital resources in the classroom. She observed that children's 'agency was often constrained or moulded by the child's position in relation to the technology as well as their role within

[social] clusters' (2016, p. 280) as they gathered around devices. In observing children's collaborative play with a digital puppetry app, Wohlwend noted that 'many hands all busy dragging, resizing, and animating puppet characters, and many voices making sound effects, narrating, directing, and objecting – appears aimless, chaotic, and in sharp contrast to the orderly matching activities in prevalent letter and word recognition apps that dominate early childhood educational software' (2015, p. 154). However, she suggests that such engagements support rich storytelling practices. If broad conceptualisations of learning are adopted, related to exploratory free play, digital technologies can provide a range of educational opportunities led by the interests of the child. In reflecting on the role of technologies in Early Years settings, Scott draws on the work of Bodrova and Leong (2010), and suggests that:

> ... with increasing pressure for formal pedagogies in early childhood classrooms, certain essential forms of play are becoming neglected, particularly solo and peer fantasy play ... rather than restricting play, digital devices and texts may provide young children with precisely the opportunities for free (uninterrupted) peer fantasy play that are increasingly missing in other realms of their lives. (Scott, 2018b, p. 244)

To make technology accessible and inclusive for all players, research into play and disabilities often explores assistive technologies. However, there is a growing impetus toward the social model of disability in which technology is seen as a tool with which to shape inclusive environments, systems and communities (Sobel et al., 2015). When access is denied or flawed, it is at that stage that disability is created (Ellcessor, 2016; Ginsburg and Rapp, 2013). Therefore, poorly designed places and products can create contexts in which children experience a range of disabilities. Titchkosky argues that 'While we all have bodies – bodies that we act, sense, feel, or move in and through – only some bodies, only some of the time and only in some places, are understood as disabled ones' (2011, p. 4). Ringland suggests that three factors need to be in focus when designing opportunities for play in online environments – physical, liminal and virtual:

> The physical space includes computer hardware and the environment in which players access the computer (e.g., bedroom, home office, computer lab in the library). The liminal space includes the installation and configuration of the software, as well as user authentication. Finally, the virtual space includes the various social media. (2019, unpaginated)

Digital artefacts with multi-function uses, multi-device compatibility and personalisation features are all factors that influence players' abilities to participate in free play. In relation to Autcraft, Ringland explains that these intersect and support 'children and parents [to] negotiate and decide where to spend their resources to create access to [the virtual world] while balancing other priorities in the family – including rules about how much time a child can spend on the computer, how much money a family can afford to spend on access to the game, and the needs of other family members' (2019, unpaginated). She explains that 'this becomes more than a simple question of access to game play, but a negotiation over the shared environment and individual values to gain access to the Autcraft community' (2019, unpaginated).

While interactions across networks and the ability to use a range of devices to access content is helpful, the level of support offered to members is significant. Although this

can take the form of free-to-access member forums, some must be paid for, and can be prohibitively expensive for some families. There are numerous social barriers to developing opportunities for inclusive play for neurodiverse children. Sobel et al. explain that:

> ... the advocacy, training, intentionality, collaboration, and other efforts necessary to enable active, equal participation of all children, often coupled with ableism on macro-, meso-, and micro-levels, prevent children from participating in inclusive environments. Specifically, inclusive education typically requires more support and a greater level of collaboration among teachers and parents. (2015, p. 39)

Once children are able to access technology and play with it freely, their use of games and platforms might be described as 'voluntary', but the associated sharing of data, often integral to the process of play, may not be. The 'digital traces' (Cochoy et al., 2020) collected and analysed by companies and researchers add a layer of complexity to the notion of children having the 'the freedom to quit' from play. As children play with technologies, they participate in a data economy (Zuboff, 2019) in which they trade and exchange data with corporations relating to their interests and location, or even when they go to bed at night. Cochoy et al. explain that this is particularly true of free services and games. In these:

> Consumers do not pay with money, but, instead, they pay by providing the personal data that they share (often unknowingly) with the system. This data is generated by the digital traces that consumers leave on the systems while chatting, browsing websites, and shopping, and is used to create marketing knowledge and direct action. Digital double-sided markets are thus inherently duplicitous; they show a friendly 'social face' outwards to the consumer, and a 'controlling face' to the companies that use their data services. Both faces are closely inter-dependent. (2020, p. 3)

Indeed, some communications during play, and features of products, are designed to nudge children towards sharing information in ways that are not necessarily in their best interests. The ICO usefully summarises the potential uses of such techniques:

> The deployment of nudge techniques in the design of online services can encourage users, including children, to provide an online service with more personal data than they would otherwise volunteer. Similarly, it can lead users, particularly children, to select less privacy-enhancing choices when personalising their privacy settings. (2020a, pp. 73–4)

The extent to which these design features affect children's actions requires further research and investigation. However, it is clear that such persuasive techniques can have significant implications for children and raise urgent ethical questions for society as a whole (Kidron et al., 2018). Communication about why data is collected and for what purposes must be transparent and accessible to the youngest users, and to parents, carers and educators who share technology with children. Recital 38 of the GDPR states that: 'Children merit specific protection with regard to their personal data, as they may be less aware of the risks, consequences and safeguards concerned and their rights in relation to the processing of personal data processing of personal data.' However, research suggests that although children have the right to know how their data is used, explanations and processes are still complex (Milkaite & Lievens, 2020), since

'managing and controlling social media data involve social and technical challenges that can be difficult for young people to negotiate' (Pangrazio & Selwyn, 2018: p.8). This suggests that we need 'collective and centralized approaches to data privacy' (Pangrazio & Selwyn, 2018: p.8). The Age Appropriate Design Code (AADC) in the UK requires all companies to address these issues, and should prompt and support companies to develop more transparent approaches to communicating the ways data is collected and used.

The same excessive collection and usage of data that could interfere with children's intrinsic motivation to play also interferes with the voluntary quality of free play. Linked to the pervasive data collection and processing is children's privacy threatened by connected toys and household smart devices. There have been some high-profile cases that revealed the extent to which companies have access to a broad range of data about children. McReynolds et al. explain that 'VTech, a company that produces tablets for children, was found to have been storing the personal data of 5 million parents and over 200,000 children (including pictures and chat logs) when it was hacked, making it possible to fully identify and locate the children' (2017, p. 5197), and 'ToyTalk drew additional attention for a privacy policy that appeared to allow the company wide latitude with the use of children's recordings' (2017, p. 5198). These are not the only cases. The ICO explains that:

> Connected toys and devices raise particular issues because their scope for collecting and processing personal data, via functions such as cameras and microphones, is considerable. They are often used by multiple people of different ages, and by very young children without adult supervision. Delivering transparency via a physical rather than a screen-based product can also be a particular challenge. (2020a, p. 77)

Voluntary play with digital technologies is inextricably linked with issues of access. Inequalities of access intersect social economic factors, product design and distribution systems, as well as places, or contexts in which the technology is deployed.

- **At the micro level,** vectors of identity such as social class, gender and ethnicity all impact on the ownership of devices and games, and where children are able to access technology. In order to select and combine digital resources, children need to be able to reach it in the moment of play. Accessibility is therefore affected by whether it is 'at hand', in their immediate physical or virtual vicinity. The materiality and functionality of devices, such as whether they have tangible interfaces, can also influence the take-up of digital resources and the ease with which they can be integrated into play.
- **At the meso level,** views about the value of play with technologies (such as those held by parents or educators) can curtail or open up opportunities for access. Spatial factors also inflect with issues of voluntary play in relation to how accessible technology is in home, school and community settings. Sometimes, the networked and connected nature of technology can lead to barriers to entry for some children and their parents.
- **At the macro level**, education policies that adopt narrow conceptualisations of learning can limit the ease with which free play can be integrated into classroom settings. In relation to product design, voluntary play that is 'entered into willingly'

and includes the 'freedom to quit' are concepts that are problematic when applied to the way data is gathered and stored by companies, as these imply informed consent and control over information, which is not always the case (particularly with the youngest children). Voluntary play is thereby complicated by lack of transparency in relation to commercial intent.

Stimulating

> **Distinct from the imaginative quality of play, though often going hand in hand with imagination, we here capture the idea that children seek and engage with activities they find stimulating, absorbing, and facilitating of new ideas and new possibilities.** (Cowan, 2020, p. 32)

What children find stimulating will differ from individual to individual, but there are some developmental factors to consider. Stephen and Plowman suggest that 'an interactive toy which produces sounds and lights may be an opportunity for playful exploration for a one-year-old child but is unlikely to be part of the play of a four-year old for whom engaging in play in a virtual world may be equally inappropriate' (2014, p. 7). Tangible user interfaces (TUIs) that support children's use of physical objects to engage with a task (rather than using a mouse or a screen) can be engaging (Zaman et al, 2012) Shaer and Hornecker explain that these are 'implemented using a variety of technologies and materials, [which] computationally augment physical objects by coupling them to digital data' (2010, p. 2). Embedding digital interactivity in this way enables children's play with physical toys to be supported, extended and enhanced by the contingent feedback and other learning supports that can be provided by technology (Revelle, 2013, p. 33). Mascheroni and Holloway explain the potential functionality of these devices:

> Not only does the child see, touch, feel, speak to and listen to an Internet connected toy, the toy as a connected object can also track, see, speak and address them. The interaction between t*he child and the toy is,* therefore, reconfigured as a bidirectional, multidimensional, multi-sensory experience that involves auditory, visual, haptic and kinetic communication. (2019, p. 5)

Because of their tactile nature and ease of manipulation, tangible user interfaces appeal to a broad range of players. Shaer and Hornecker suggest that this is because 'they draw upon the human urge to be active and creative with one's hands, and can provide a means to interact with computational applications in ways that leverage users' knowledge and skills of interaction with the everyday, non-digital, world' (2010, p. 2).

Such multi-sensory engagement during play can also be experienced as children use virtual reality (VR) headsets. Although these primarily stimulate visual senses, research has revealed that this can also trigger children's other senses too, as they explore their physical environment. During observations of children using VR headsets to explore Google Earth, Yamada-Rice observed that:

> Several children showed a desire to taste the virtual planet Earth. This caused children to walk around the physical environment (in which they were using the VR device) with their tongue out, something that was confusing for their parents watching on. The newness of the technology and the perceived separation of the user's sensory experience to the parent sat outside the

> immersive virtual environment seemed to exemplify that the way in which adults and children interact with spaces and materials are fundamentally different from one another. (2018, p. 533)

It is important to recognise the way that children understand and experience the world in this exploratory way. For some children with sensory processing differences, the physical environment can bring overstimulation of the senses, leading to discomfort and impeding play. Although sensory needs can sometimes be difficult to accommodate in the physical world, in describing children's play in the virtual worlds in Minecraft, Ringland et al. explain that neurodiverse children, such as those with autism, can exert control over their environments:

> If a child is highly sensitive to sound at a particular moment, they can easily adjust the volume of the world or turn it off altogether. Similarly, if the child becomes over stimulated by images, they may darken the screen, as was the case for the children digging holes in the mines to turn the screen black [in Minecraft]. (2017, p. 6)

The design of products often means that functionality and settings can be adjusted to meet a range of sensory needs.

In addition to enhancing multi-sensory experiences, technology can also support children's physical interactions with spaces and places. For example, whole-body movement interfaces for young children can support play that is stimulating and exciting. Revelle suggests that 'between the ages of 3 and 5, children typically progress from engaging in simple gross motor events like running or standing on one foot to more complex activities requiring much greater balance and coordination, like riding a scooter or skating. During this time, children are described as having a "high motor drive", meaning that they enjoy engaging in gross motor activity like jumping' (2013, p. 35). Gaming controllers, such as those associated with the Nintendo Wii, are also popular with older children and can support family play as:

> They reduce differences in physical ability and computer dexterity. The new control systems are now designed for directed movement by the whole body, offering a range of levels of physical strength and styles of play in a format that can foster inter-generational users to compete on equal terms. (Chambers, 2012, p. 73)

Such design features can thereby facilitate play within mixed age groups and increase accessibility and ease of use (Shinkle, 2008).

As connected toys, virtual worlds and VR headsets stimulate children's play, so, too, the design of online networks can also influence the actions of children. The internet 'as well as offering an abundance of "sneaky thrills" contributes to "the expanded possibilities of the self"' (Goldsmith & Wall, 2019, p. 15). Some argue that teenagers may be more prone to 'sensation-seeking … with finite resources of self-regulation and impulse control' (Goldsmith & Wall, 2019, p. 15). These developmental factors may contribute to teenagers engaging in risky or transgressive actions online. For a minority this can lead to a 'digital drift' (Goldsmith & Brewer, 2015) into cyber-delinquency. Some researchers have suggested that there are seductive qualities related to the design of online systems that 'exert an appeal to some young people to proceed from gaming and other online activities to hacking' (Goldsmith & Wall, 2019, p.4). Xu, Hu and Zhang explain

that 'Computer hackers start out not as delinquents or as social outcasts but often as talented students, curious, exploratory, respected, and, most important, fascinated by computers' (2013, p. 64). Given that some young people find these activities appealing and stimulating, 'there is a growing and urgent need to promote positive and legal alternatives for channelling young talent toward legitimate careers in the tech sector before they are lured into the area of cybercriminality' (Livingstone et al., 2017, p. 61).

Notably, the 'stimulating' quality of free play, is experienced differently by individual children, but can be augmented and extended through innovative uses and designs of games, devices and spaces. New technologies, such as those associated with TUIs and gaming genres that encourage whole-body interaction, require an understanding of the ways that stimulating play is distributed across places, products and people.

- **At the micro level,** technology can stimulate and support children's multi-sensory engagements with the world through the use of lights, sound and TUIs in ways that children find accessible and enjoyable. For neurodiverse children technologies can support them to adapt virtual environments to meet their sensory needs. Such spaces can thereby provide valuable spaces for play children for whom face-to-face situations and social events can feel overwhelming, due to sensory processing differences.
- **At the meso level,** exploratory activities online can be exciting and provide opportunities for children to engage in exciting play together. However, they can also pose risks for some teenagers and young people who, in seeking out 'sneaky thrills', may be tempted to engage in risky or criminal behaviour.
- **At the macro level,** there is a need for theories of child development to inform the design of age-appropriate games and products. The seductive qualities of online systems also require further investigation, particularly in relation to the experiences of teenagers and young people who are drawn to the expanded possibilities on offer.

Open-ended structure

> **Players not only choose to play, they also choose what and how to play, with choices generally made in-the-moment as play unfolds. Although free from external rules, free play can be orderly, even rule-governed, with the players developing an internal structure negotiated and open to adaptation through the play itself.** (Cowan, 2020, p. 32)

Children can find boundless potential for play in found objects such as sticks and boxes as well as designed toys (Vygotsky, 2004). Programmable technologies with open-ended rather than goal-orientated uses can help children integrate digital technologies into their free play (DeValk et al., 2013; Marsh et al., 2018). This type of play can be supported by products that have been developed with improvisation as a central design feature. De Valk et al. explain that:

> Open-ended play with interactive objects provides children with the freedom to construct their own rules, goals and meaning. Instead of games with strict rules, open-ended play designs offer interaction opportunities as a trigger for creating personalized games. The process of developing these designs differs from designs with predefined use. (2013, p. 92)

Giving children opportunities to design content, functions and rules means that they can better play in ways that align with their needs and interests. Stephen and Plowman suggest that:

> There is potential for digital resources to move away from the current reliance on defined and closed game designs to more open-ended and flexible uses that respond to children's changing interests and relate to authentic experiences which they want to reproduce in play. (2014, p. 9)

Those products that actively support children's ability to adapt features and content can support free play in several ways. For example, programming during play can be a form of self-expression and creativity. Some children use mods, cheat codes and hacks or manually edit game files when adapting games. They may also invent alternative in-game goals and alternative ways to play a game with other players (Gee & Hayes, 2012).[11] Common reasons for children's modifications of digital games include: to make the game easier, change its appearance, or add more content to it (Kahila et al., 2020).[12] A recent study undertaken with 5- to 15-year-olds investigated how portable, programmable devices (BBC micro:bits) could be used to support groups of children to engage in collaborative outdoor play (Wood et al., 2019). It found that introducing these programmable devices 'provides accessible starting points for play which enables children to change the gameplay to fit their changing moods, which are often fluid and whimsical, an approach that arguably aligns with how children enjoy open-ended play' (Wood et al., 2019, p. 11). Other research has also explored the educational potential of modding presented by specially designed adaptable games that invite or even provoke children into modifying content. Kynigos & Yiannoutsou suggest that 'by hacking a pedagogically engineered half-baked game in order to improve or change it, children [can be prompted to] challenge the values, the mechanics and the rules of a fully functioning, but faulty, or inappropriate game' (2018, p. 1). Leading game theorists Gee and Hayes (2012 p. 131) suggest that:

> … making game design [a] core game mechanic, facilitating modding, and encouraging robust design communities to develop around the game, are, we believe, particularly good for fostering skills with technology, design, systems thinking, and sociotechnical engineering (i.e., thinking about and creating good interactions between people and technology).

Research suggests that, while engaging in open-ended play with technology, they develop useful and valuable skills, both in relation to technical capabilities and their critical engagement with the values that underpin designed systems. They are also supported to participate creatively in player communities that centre round their favourite games.

Physical spaces can also be designed to support this open-ended play. Playgrounds and streets have always offered children material resources that can be creatively integrated into games. In this, features of the landscape such as benches, signs and trees become

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[11] It is perhaps worth noting here that there are some commercial issues related to how modders, who generate content for games, are positioned within the broader commercial context and marketplace. While fan-driven modifications are often central to the success of products and games, this work is often unpaid while generating income for companies.

[12] To see a discussion about 'modding culture' among adults, see Sotamaa (2010).

highly significant, even mythologised, as children draw on their cultural understandings of the world. Potter and Cowan have observed that children often draw on their understanding of popular culture and digital media use in the playground. In this, they can be observed 'swinging between local and global contexts of play, re-working and re-combining them in a matter of moments' (2020, p. 250). In recent years there has been an increase in research that explores the potential of technologies to transform outdoor play (Back et al., 2018; Jones et al., 2018). Technologies can be embedded in playgrounds (Back et al., 2016), supporting augmented reality experiences (Ferraz et al., 2017) and pervasive play with tangible objects (Soute et al., 2009). Although some research explores how technology related to the Internet of Toys (IoToys) might support outdoor play (Wood et al., 2019), this area is still underexplored. Wood et al. observed that even relatively simple embodied interactions with technology could lead to a range of physical interactions with the local environment:

> During our Hackathon two children took a BBC micro:bit they had programmed with our pancake flipping code and ran around outside: hopping, skipping and jumping together. Every time they jumped, the pancake flipped. We have seen similar effects with both step and fall counters, with children challenging each other to get the highest number by running around and jumping. (2019, p. xx)

As well as mobile technology, embedded technologies in urban environments and local community spaces can support open-ended play opportunities for children (Castro Seixas, 2021). One such study investigated how play installations in between residential housing supported children's free play, observing that:

> Local children learn to know the installations over time. They take time in exploring them, and they appropriate them into their everyday play activities. This means that installations close to home need not necessarily be easy to use or have obvious interfaces; in fact, exploring their functions offers interesting play opportunities in itself. However, together with their role in the overall environment, they must be conductive of recurring play sessions. An open-ended play design approach is conductive of this, as it opens up for installations to be continuously re-appropriated into new play patterns. (Back et al., 2018, p. 156)

The adaptability of the digital environment impacts the open-ended quality of free play. Opportunities for open-ended play are enhanced by: responsive social practices (which support children to experience agency and choice), materials (which can be modified at the level of functionality in the flow of children's play) and digitally augmented places (which support exploration).

- **At the micro level,** children can benefit from opportunities to program devices in order to meet their playful needs and interests. Sandbox games, which support experimentation and world-building, can also be beneficial to children's experiences of free play. However, such opportunities are not yet sufficiently available to children across diverse circumstances.
- **At the meso level,** digital technologies can be embedded in community spaces such as playgrounds to support and extend children's open-ended exploration of these spaces. Similarly, local contexts can be transformed with mobile devices that use augmented reality technologies to overlay digital images onto those of the physical

environment. Such uses of technology have been shown to support children's outdoor play.

- **At the macro level,** private and public sector policies and practices need to support multi-platform engagement and facilitate the children's production practices.

Imaginative

> **Free play escapes the immediate 'here and now'. As an experience, it marks a separation from day-to-day life, often achieved through all-absorbing make-believe and imagined realities. This includes the inventive use of the material, spatial and embodied resources to hand, transforming meanings through creative interpretation and improvisation.** (Cowan, 2020, p. 32)

Play with digital technologies provides myriad opportunities for imaginative play. For example, 'virtual worlds promote a range of types of play from the more restricted rule-bound play involved in games constructed by the site producers through to imaginative play, which can involve fantasy and sociodramatic play' (Marsh, 2010, p. 30). For example,

> Club Penguin™ promotes fantasy play through the provision of costumes that enable children to adopt a range of imaginary personas, such as pirates and mermaids. The producers also develop narratives that run across specific time-scales and which invite children into narrative-related play… Children reported … dressing in fantasy costumes in order to engage in these narratives… As in children's sociodramatic play in the offline world, children reported adopting a range of adult roles in the virtual worlds and sometimes drew on adult-focused cultural scripts in this play. (Marsh, 2010, pp. 30–1)

In these environments, children can manipulate the digital resources and maintain a presence in the virtual, whether they are in the same physical location as other players or not. This ability to change the play space can give the sense of being inside the imagined world: 'in giving players micro-control over an element or elements in a virtual world, [they] create an effect where the player feels that his or her body has extended into and is intimately involved with the virtual world' (Gee, 2009, p. 70). Research with older children demonstrates that building within virtual worlds such as Minecraft gives children the opportunity to shape their play spaces in collaboration with others. In an after-school club, Bailey observed children creating songs that wove across physical and virtual spaces as they built a Minecraft world together. He explained, 'The resources drawn upon by the children, their performances and their in-game creations did not exist in isolation – they were networked and dependent on each other in a number of complex ways' (Bailey, 2016, p. 70). He suggests that 'in this hybrid space, the game was not just the unfolding of events on-screen, rather it occurred between and across the virtual and the physical spaces' (Bailey, 2016, p. 70). Tweens and teenagers also develop and design imagined worlds through their engagements with online multi-player games such as Fortnite (Navarro, 2020) and virtual worlds such as 'Poptropica, Whyville, Roblox, Minecraft, and Habbo Hotel, have been popular digital spaces that attract millions of youth to socialize and develop friendships using creative and imaginative play' (Du et al., 2021, p. 1). In addition to qualitative methods for researching such imaginative play, fine-grained quantitative approaches are needed to deepen our

understanding of the social factors that shape children's engagements (Mavoa et al, 2018).

Transmedia content can also support children's free play by offering multiple 'entry points' into imagined worlds (Jenkins, 2006a; Herr-Stephenson et al, 2013). With children's imagination, a range of products in commercial franchises and publicly funded content can deepen children's engagements with storylines and characters. These may include adverts, films, books, video games and toys. Wohlwend explains that:

> Children's transmedia sites are dense webs of consumer and imaginative practices, commercial products and playful desires, and embodied and digitised practices. Blurred practices of playing and paying on transmedia websites entangle children, popular toys, apps, avatars, and game mechanics as co-actants in assemblages in these contemporary play worlds. (2020, p. 391)

Although linked to commercial products and official brands, transmedia networks can also be generated and sustained by children's creative and participatory practices online and by their appropriation of characters and ideas. Children regularly integrate and transform narratives, characters and themes from computer games in their offline play (Giddings, 2014; Marsh, 2014). However, opportunities for adaption and imaginative transformations of meanings can be limited by product designs and broader commercial strategies. Wohlwend argues that 'children are underestimated when the productive potential for remaking is designed out of toys and products' (2020, p. 11), and highlights the commercial drivers behind such decisions:

> When toymakers create a brand persona, they invite children to interact through emotional attachment with a character, not a product… Manufacturers seek to protect the value of their brand persona from dilution from remaking and imitations that proliferate as toys become popular, with toys and websites designed to limit tinkering and remaking. However, if a toy is an invitation to play, it is also inherently an invitation to improvise on the authorised meanings of objects, characters, and imaginaries. (Wohlwend, 2020, p. 11)

Often directed by commercial interests, design features of apps can also adversely affect opportunities for young children's imaginative free play, particularly in relation to the ways they facilitate creative acts. These have been identified by Marsh et al. (2015) and include lack of clarity relating to the purpose of features, the app containing too many aims or distracting features such as too many pop-ups.

Augmented reality (AR) and virtual reality (VR) technologies can support children's affective engagement with a narrative world (Yamada-Rice, 2021). Research undertaken by the DigiLitEY project demonstrated how non-digital and digital resources could be combined creatively to support children's imaginative play in Early Years classrooms. In one example they explain that:

> The children watched a professional puppet show based on the Moomin stories and then created their own illuminated shoebox puppet theatres, writing play scripts to be used with these. The children also created their own clay models of the characters. These were imported into the Qlone app so that they became 3D digital models. This allowed the models to be 3D printed and

> also taken into the VR app Google Tilt Brush. The children then donned a VR headset and use the app to create a VR version of the Moomin valley. (2018 p. 3)

This research suggests that VR and AR technologies can be used to support rich and meaningful opportunities for play and learning that make good use of the affordances of the technology, support productive as well as consumptive practices and build on children's experiences of technology use outside the classroom (DigiLitEY, 2018).

In relation to connected devices, research affirms that some digital 'talking toys' can support children's imaginative play, but suggests that the dialogue of these devices requires development to support such engagement better. McReynolds et al. interviewed children and parents about their interactions with connected toys, and discovered that 'children quickly learn the repetitive loops of the toys and desire richer, more flexible interactions – interactions that many may already be exposed to through interactions with platforms like Siri and Google Now' (2017, p. 5198). In this study, parents reported that their children often interact with smart devices (such as Amazon Echo) in a similar ways to smart toys. This led McReynolds et al. to argue that:

> Policymakers should be aware that all of these connected devices may share similar issues when children interact with them, including privacy concerns and the appropriateness of content. For instance, while [some connected toys] are designed to have child-safe answers, not all toys or devices may be designed to take the same precautions. (2017, p. 9)

This has implications for companies adhering to the Children's Code, which applies to all digital products that are likely to be accessed by children (ICO, 2020a). At present, although children can play with connected devices, such as smart home hubs, these are not all designed with children's safety in mind.

Technology can also support children's imaginative engagement with local settings and outdoor play (Back et al., 2018; Jones et al., 2018). For example, wearable and connected technologies can encourage children to investigate their environment and invent new games (Dylan et al., 2020). AR experiences, such as those supported by Pokémon Go, can encourage children to engage with outdoor environments in new ways and can facilitate family play (Sobel et al., 2017). However, such fun can also expose children to safety risks (Serino et al., 2016). Embedded technologies in playgrounds can also present invitations to play, and there are 'opportunities for the use of interactive technology as a way to present more versatile play options in otherwise impoverished places' (Back et al., 2016, p. 37). Back et al. argue that developing interactive installations in community spaces could benefit children's play for several reasons. One of these is that they might support children's play as they pass by the installations on the way to and from school. They suggest that 'since the children's time for outdoor play seems to be largely under adult control, it may be very important to design for this very fleeting form of play engagement' (2018, p. 156). In relation to children's imaginative engagement with the physical environment, children also bring their prior experiences of digital games and social media to bear as they invent games in everyday spaces (Giddings, 2014). For example, research has revealed the complex ways that children's experiences of media can shape their interactions in playgrounds, as they physically enact video games or engage in clapping games that they learned from YouTube (Burn & Richards, 2014; Willett et al., 2013).

Research demonstrates the value of giving children access to spaces, physical and digital, where they can use their imagination to engage in creative and playful production practices (Willett et al, 2008). For example, makerspaces can provide a range of digital resources to support free play. Makerspaces are physical spaces that provide access to a range of digital and non-digital resources. They are often 'comprised of participants of different ages and levels of experience who work with varied media, but a commonality is that these spaces all involve making: developing an idea and constructing it into some physical or digital form' (Sheridan et al., 2014, p. 507). In these spaces, design is not experienced as an individual process; rather, the emphasis is on collaboration and sharing. These can support intergenerational collaborations in which play is child-led, but facilitated and supported by adults (Blum-Ross et al., 2020; Colvert, in press). Some studies have begun to explore the intersection between gameplay and making, and have used gaming structures to frame community production practices (Colvert, in press; Rushton & King, 2020), and demonstrate that this approach can support children to engage with technologies in new ways.

Such intergenerational play can scaffold young children's imaginative uses of technologies. However, it is equally important for older children and teenagers. Ito et al. (2010, p. 7) explain that 'adults are important coparticipants in youth new media practices. One of the important outcomes of youth participation in many online practices is that they have an opportunity to interact with adults who are outside of their usual circle of family and school-based adult relationships'. These interactions for older children and teenagers often occur in 'affinity spaces' created online when people with similar interests form a supportive community to share knowledge and skills (Gee, 2018; Jenkins, 2006b; Sefton-Green, 2011). In relation to intergenerational play, further consideration also needs be given to the 'emergent strategy of participatory learning that involves parents and children interacting together with and through digital media' (Clark, 2011).Livingstone and Blum-Ross argue that 'there is more work to be done to understand whether and how parents act as media mentors, brokers, co-learners, resource providers and more so as to help children develop the interests and values that may undergird their later pursuits' (2019, p. 70).

There are many ways that technologies are integrated into children's imaginative play, including the use of virtual worlds, transmedia content, connected toys, AR apps and embedded technologies in outdoor spaces. The commonality across such technology applications lies in the hybridity of how children combine digital and non-digital resources across physical and virtual environments.

- **At the micro level,** imaginative play with digital technology supports children to inhabit and build imagined worlds across physical and virtual spaces. Children's engagement with video games and social media also influences and shapes their use of physical spaces such as playgrounds, and supports them to invent new games with friends.
- **At the meso level,** transmedia networks can provide a range of stimuli and ways into narrative worlds. Children of all ages can benefit from non-commercial spaces, both physical (such as makerspaces) and digital (online affinity spaces), where they can develop ideas with others in a safe and supportive environment. However, children's access to makerspaces is currently limited in the UK.

- **At the macro level,** data collection, marketing strategies, including commercial nudges, pay to play and restricted user journeys and/or advertisements can impose constraints on the extent to which products can be creatively adapted to protect brand presence.

Resonance

> **Free play is often associated with pleasure and joy. However, it can feature a wide range of emotions and can deal with serious themes. It can be emotionally 'affective' or satisfying to children in multiple ways, resonating with their inner lives and helping them to make sense of the world.** (Cowan, 2020, p. 32)

A large body of work suggests that play is essential for children's emotional health and wellbeing. However, Osgood explains that although play 'is often framed as an intuitive means of fulfilling social, emotional and physical needs, ... the darker sides of play and playfulness can remain neglected and undertheorised' (2017, p 119). In order to understand how and why play with technologies holds emotional resonance for children, then, it is important to focus on not only the joyful and positive emotions but also those that may be more unsettling for adults (Osgood, 2017). Through play, children make sense of events in the world, and during the COVID-19 pandemic, researchers began to notice children adapting their play incorporating their experiences of the restrictions. Cowan noted that:

> ... play started to include references to the virus (for instance, 'corona tag' and building LEGO® hospitals). Some play seemed to be adapting to restrictions (such as 'shadow tag' to avoid touching). While many children had to stay home, some played online with faraway friends and family (for instance, 'hide and seek' through video calls). (2021, unpaginated)

To date, there has been surprisingly little attention paid 'to the question of how interactive digital systems could be used to improve the wellbeing of individuals and groups' (Jeon, 2017, p. 477). Indeed, 'despite the substantial body of research that underlines the benefits of play to assist children to make sense of what is happening to them in "dark" times, there is much less known about the sorts of games that could be designed to facilitate such play' (Osgood et al., 2017, p. 111). An interesting example of research that has sought to address this gap includes a project investigating how game design could provide opportunities for children to express emotions about illness and provide information to support them during their stay in hospital. The research particularly focused on developing game designs that could cross physical and digital platforms and facilitate open-ended child-directed play (Yamada-Rice, 2017).

Children can experience a range of emotions when playing computer games, some positive and some negative. Cunningham et al. summarise the various factors that might shape a player's emotional state, which include the affective aspects of presence in the virtual world, playing with others and engagement with the narrative and rules of the game:

> When a player controls an avatar that leaps through the levels of a game, they are engaging kinaesthetically and spatially, but the feeling of excitement that

> may develop from this also leads to affective involvement. Similarly, for players who enjoy the shared involvement of multiplayer combat games, an added sense of arousal comes from knowing that their success or failure has a bearing on the emotions of their human competitors. For games that develop complex narratives, as with films, designers may aim to tell a story with an emotional resonance with the player. Lastly, ludic involvement also generates arousal, as players attempt to evade losing lives or reaching a 'game over' state, which inevitably is disappointing. Hence, we can see that in fact, all types of involvement feed into the affective involvement of the player. (2020, unpaginated)

Rather than focusing solely on children's emotional responses, Anable (2018, p. xvii) suggests that games should be seen as an 'affective system' to consider 'how bodies, code, hardware, images, sounds, and sociohistorical contexts work together to give shape to feelings.' Research into the impact of VR on adult players' emotional responses suggested that it might be an ideal medium to present an emotional challenge for and also extend the understanding of emotional (and conventional) challenges in video games. Peng et al. (2020, p. 2) explain that 'emotional challenge requires players to deal with emotionally salient material or comprehend ambiguous elements by using cognitive effort rather than skill and dexterity'. For research on the potential of VR with children, see Yamada-Rice et al. (2017).

Children often develop strong emotional attachments to favourite toys, and new technologies have made it possible for toys to be responsive to children's play in innovative ways. Recent research has investigated how 'social robots' can stimulate and elicit emotional responses from children through digitally mediated social interactions. Breazeal (2003) explains that these interactions can occur at different levels relating to the characteristics and functionality of devices. She lists these factors as: socially evocative, social interface, socially receptive and sociable. Socially evocative characteristics are typical of games and toys that aim to illicit a nurturing response from children by asking them to create and look after a digital creature (such as a Tamagotchi). Breazeal explains that 'the act of "creating" these simple creatures encourages the participant to feel more invested in their creation's "lifespan". In short, the human attributes social responsiveness to the robot, but the robot's behaviour does not actually reciprocate' (2003, p. 169). If a robot has a social interface, it 'uses human-like social cues and communication modalities in order to facilitate interactions with people (i.e., to make the interactions more natural and familiar)' (2003, p. 169). If a toy is socially receptive, then 'interactions with people affect the robot's internal structure at deeper levels… People can shape the robot's behaviour through other social cues, such as using gaze direction or head pose to direct the robot's attention to a shared reference' (2003, p. 169). Lastly,

> Sociable robots are socially participative 'creatures' with their own internal goals and motivations… Such robots not only perceive human social cues, but at a deep level also model people in social and cognitive terms in order to interact with them. (Breazeal, 2003, p. 169)

Mascheroni and Holloway (2019) explain that an example of a sociable robot for children includes Anki's Cozmo Robot, which is able to 'recognise its user, read the emotions of its user and interpret the environment. In addition, it can show emotions based on the interactions with its user' (Demir et al., 2017, p. 2). Although such

connected toys collect data about children's emotions, there is often a lack of clarity about how this is used. Gathering such data about a child's emotional state raises ethical issues:

> It is, therefore, important that we understand children's interactions with social robots in terms of the embedded sociability of the robot and projected sociability from the child across different ages, genders and cultures and the other opportunities or risks that are afforded by automated social toys and the networked system they rely on. (Mascheroni & Holloway, 2019, p. 11)

These toys present new regulatory and ethical challenges as they monetise the data collected about children's behaviours and emotions in ways that are not always transparent. This datafication of children's interactions with technologies has far-reaching implications and requires further regulation and research (van Dijck, 2014). More research is also needed into children's interpretations of the features of such toys that can be experienced as funny but also 'creepy' (Yip et al., 2019).

To understand how feelings are expressed across digital and non-digital environments, some have suggested that it is useful to shift the focus away from emotion (which is embodied and individual) and instead consider how sentiments are mediated across and within online social networks. Döveling et al. (2018, p. 1) suggest that it is helpful to approach emotion 'as a cultural practice, in terms of affect, as something people do instead of have', and that 'digital affect culture(s) traverse the digital terrains and construct pockets of culture-specific communities of affective practice'. They explain that affective culture is manifest on three intersecting levels:

> 1. The micro-level illustrates the small-scale social media use for personal ends where the emotional attention is inward rather than outward and the focus is local… 2. The meso level sees groups of emotionally resonant individuals come together over a specific theme… 3. The macro-level entails globalized emotional flows negotiated collectively via various discourses and imagery. (Döveling et al., 2018, p. 3)

In outlining these levels, they highlight the 'relational, contextual, globally emergent spaces in the digital environment where affective flows construct atmospheres of emotional and cultural belonging by way of emotional resonance and alignment' (Döveling et al., 2018:1). In this, online and offline practices are connected, overlap and intertwine across local and global contexts. Such collective flows of feeling may be particularly resonant for tweens and teenagers, who often experience heightened emotional states, or for those who are experiencing issues with mental health. Although social media can be used to share positive affirmations, there are also instances of posts and communities that centre round issues and emotions associated with self-harm (Wang et al., 2017) and collective grief (Döveling et al., 2018). Procter and Hackett (2017, p. 213) suggest that 'when children, objects and places come into play with each other, intensities and emotions emerge', highlighting the interconnected and ecological features of 'affective' experiences.

We need to look beyond individual embodied experiences and consider how people, products and places form affective cultures to support children's emotional engagement with free play. Emotions are shaped and enacted collectively across distributed media and networked spaces (both online and offline).

- **At the micro level,** digital games and toys can be responsive to children's interactions across physical and virtual settings, and are also designed to elicit emotional attachments and engagement. Children's lived experiences and realities are diverse and nuanced, and what resonates with one child is linked with their social and cultural lives. Therefore further research in this area needs to involve participants across different ages, genders and cultures.
- **At the meso level,** social media supports children to share their emotions with others, and such interactions can lead to an 'affective culture' where both positive and negative emotions are collectively shaped and performed. Networked and transmedia games that span physical and digital spaces can also support children to work through emotions during 'dark times' as well as experience and share expressions of joy and pleasure.
- **At the macro level,** in the digital environment, children's feelings and responses are not only mediated by technology; they are also commodified and monetised. Given that data is collected during such play, transparency and regulation are needed to ensure that such information is processed in the best interests of the child. Further comparative studies with a global focus are needed to ensure that the cultural resonance of products is fully understood.

Social

> **Whether free play involves others or happens alone, it unfolds within a sociocultural context and requires others to sustain the play (even if those others may be imagined rather than present). This means it attends to, and may need to meet the desires and needs of others as well as one's own if the play is to continue.** (Cowan, 2020, p. 32)

Social play is central to children's development, and digital technology can play an important part in framing these interactions and shaping relationships. Online social networks give children access to their friendship groups even when they cannot be physically present with them, supporting them to engage in playful interactions with others. This is particularly important for teenagers and young people who seek spaces away from adults to forge social bonds with peers (boyd, 2010). Ito et al. (2010, p. 38) explain that teenagers are 'largely dependent on adults for providing space and new media and they possess limited opportunities to socialize with peers and romantic partners without the supervision of adults.' Therefore, social media becomes a place of independence:

> Young people who have ready access to mobile phones or the Internet, view online communication as a persistent space of peer sociability where they exercise autonomy for conversation that is private or primarily defined by friends and peers. Although in most cases they would prefer to hang out with their friends offline, the limits placed on their mobility and use of space means that this is not always possible. (Ito et al., 2010, p. 38)

During the global coronavirus pandemic, such limits on mobility and space meant that face-to-face interactions beyond the family unit were prohibited. Technology provided an essential tool for social interaction for many children during this time (Ofcom, 2020). The potential benefits of playing online to mitigate the adverse mental health effects of

social isolation was reflected in the World Health Organization's #PlayApartTogether campaign, supported by the gaming industry (Griffin, 2020), and a campaign run by the charity CALM, which involved a 'Play and Talk' weekend, both of which encouraged people to play games online with friends (CALM, 2020) The impact of such campaigns has not been investigated, but it is clear that urgent research is needed into the uses of technology to support play during the restrictions on children's social interactions and uses of play spaces caused by the pandemic (Graber et al., in press).[13]

While there has been considerable research into the characteristics of children's face-to-face friendships, less is known about the qualities of their interactions online. Many interrelated factors influence the way children forge and maintain friendships and explore their identities in online environments. Among these factors is the algorithmic ranking of friendships or popularity metrics that create artificial needs to formulate and maintain such digital relationships. However, research in this area is somewhat complicated, as 'real-world terms of "friends" and "strangers" seem to cause ambiguity when trying to understand what social relationships mean in online games' (Xu et al., 2011, p. 200). This is partly because being categorised as a 'friend' can open up a range of opportunities and options in online environments. Ito et al. (2010, p. 94) explain that: 'on social network sites, "Friends" end up serving as a part of a person's self-representation on the site as well as the foundation of access control to certain features (e.g., commenting) and content (e.g., blog posts)'. There is a complexity and fluidity inherent in banding together with others to play online games. In a study of young people's engagement with first-person shooter (FPS) games, Xu et al. observed that:

> Although Halo 3 only supports a simplistic 'friend list', social relationships in online FPS games were much richer than merely 'friends vs. strangers'. A great diversity existed in the form, closeness, interaction style, and origin of these relationships. Moreover, these relationships were never static. They were constantly created, strengthened, and removed together with the experience of gaming. To further enhance the social experience of FPS games, we need to think deeper how we may design the game mechanisms to support such a diversity of social relationships. (2011, p. 204)

This counters the narrative often reported in the media related to shooting games being anti-social and isolating. Yau and Reich (2018, p. 1) undertook a review of teenagers and young people's uses of social media. They concluded that 'while peer interactions in online spaces may be novel, the core qualities of friendships identified in research on offline spaces persist'. These included: self-disclosure, validation, companionship, instrumental support, conflict and conflict resolution (Yau & Reich, 2018). However, navigating the functional and operational implications of accepting people as friends on social media sites and in online games can occasionally result in social tension. This can present challenges for teenagers and young people. boyd explains that:

> As teens struggle to make sense of different social contexts and present themselves appropriately, one thing becomes clear: the internet has not

[13] One study entitled 'The national observatory of children's play experiences During COVID-19' brings together researchers from the UCL Institute of Education, the School of Education at the University of Sheffield and The Bartlett Centre for Advanced Spatial Analysis at UCLA to analyse the impact of the pandemic on children's play. Emergent findings and resources can be found at: https://play-observatory.com

> evolved into an idyllic zone in which people are free from the limitations of the embodied world. Teens are struggling to make sense of who they are and how they fit into society in an environment in which contexts are networked and collapsed, audiences are invisible, and anything they say or do can easily be taken out of context. (2014, p. 52)

The social conventions for online interactions differ from context to context and must be learned (Reich, 2017). Virtual worlds can become collaborative play spaces where children inhabit 'inter-related social realities' (Merchant, 2009, p. 42). Players are located physically in the same material space while also maintaining a presence in the game. These spaces are used differently by different age groups, many of whom adopt and learn social conventions associated with online play. The youngest children playing in virtual worlds have demonstrated that they understand how to make friends in such environments (Kafai, 2010; Marsh, 2010, 2011, 2013, 2014; Wohlwend & Kargin, 2013), utilising linguistic messages and greetings and by directing their avatars:

> Avatars tended to keep polite distances from each other unless users wanted to move in pairs, in which cases avatars moved closely together through the spaces… Avatars also grouped closely together when involved in group activities. The ability to navigate a complex, multimodal screen was, therefore, a primary skill required to engage in Club Penguin, in addition to the social knowledge needed in terms of when it was acceptable to cluster together in groups and when it was not appropriate to do so. (Marsh, 2011, p. 108)

Older children have also been observed generating complex, collaborative play in hybrid spaces through a combination of online and offline interaction. These interactions may serve important developmental needs for these children as they 'use the online environment to explore and develop their self-identity' (Kidron & Rudkin, 2017, p.18), and develop playful 'banter' and creative allegiances (Bailey, 2016). Teenagers and young people may refer to such experiences as 'hanging out' (Ito et al., 2010), as they combine various technologies and platforms to support such playful practices, including a range of social media, often simultaneously (Hartas, 2020).For those who are neurodivergent or experience physical disabilities in face-to-face environments, such multi-modal interactions can open new enjoyable and meaningful possibilities for play that they may find preferable to playing with other children in person (Ringland et al., 2016). Member spaces such as Autcraft, for autistic children and their families, have also been used to support children to learn about online and offline social conventions, such as social distancing, through play (Du et al., 2021). The livestreaming of game-play sessions on platforms such as Twitch is giving rise to new social practices (Consalvo, 2016) which can provide opportunities for young people to enter intergenerational play spaces and 'build audiences interested in observing, commenting, and playing alongside them [and] …transform their private play into public entertainment' (Taylor, 2018: p6). Platforms such as YouTube also provide opportunities for children to create and share content with friends and the broader YouTube community. However, there needs to be further research into 'children's and teenagers' perceptions and attitudes towards the intended audience of their storytelling efforts' (McRoberts et al, 2016) and attention paid to patterns of participation across and within different social groups (Jenkins, 2009).

While there are many instances of positive and healthy relationships being developed online, others can be damaging, for example, online grooming, sexual exploitation and

cyberbullying (Machimbarrena et al., 2018). The 'omnipresent, pervasive, and permanent nature of cyber interactions' can have adverse effects on children's mental health, requiring concerted efforts across 'support networks including parents, peers, and school personnel' to encourage victims to seek and receive the help they need (Dennehy et al., 2020, p. 1). However, industry and policymakers must also share responsibility for addressing and mitigating such harmful experiences. Communities of play are diverse, often comprising both adults and children, and not all members of online communities have children's best interests in mind. Online play poses different risks for different children and, although there is a lack of research in this area, evidence suggests that:

> Children who are most vulnerable to online harms include girls, children from poor households, children in communities with a limited understanding of different forms of sexual abuse and exploitation of children, children who are out of school, children with disabilities, children who suffer depression or mental health problems and children from marginalised groups. Unguided digital access and a lack of awareness also put children at risk. (UNICEF, 2017, pp. 26–7)

In relation to gameplay specifically, these experiences 'may be riskier for vulnerable children such as those with special educational needs insofar as they find it difficult to judge what is real or to read the intentions behind an approach by other players' (Livingstone et al., 2017, p. 90). Currently, media education programmes 'tend to take a standard approach and may not be suited to the specific needs of more vulnerable children' (Livingstone et al., 2017, p. 4).

To mitigate potential risks, the design of digital communication tools differs across age groups and often contains parental control options and moderation mechanisms managed by the companies. However, these mechanisms require further fine-tuning to accommodate the evolving capacities of children and cross-platforms interaction. For example, virtual worlds for younger children often include drop-down menus of responses as a safety feature. However, many children can and do find innovative ways of circumventing such constraints (for example, organising objects and avatars to construct textual messages on-screen). For older children, the moderation of audio communications and the live streaming of content can be difficult due to its synchronous and transient nature. Complexities also arise as teenagers playing multi-player online games often combine in-game communication tools with other platforms (Ofcom, 2020; Ettinger &Cohen, 2020), which can circumvent single-platform moderation features. Du et al. (2021) conducted a comparison of gameplay mechanics and community structures across 10 platforms for players aged 5 to 18+, and concluded that:

> Over the past two decades, VWs [virtual worlds] have advanced from text-only chat features to multimodal social interaction during gameplay. However, critical sociotechnical design challenges remain, especially in areas of age-appropriate design features that allow child and adolescent players to interact and communicate freely while keeping them safe within the gaming systems, and customizable communication parental control features that are easily visible, supportive of youth's developmental needs. (2021, p. 18)

There is clearly an ongoing tension between freedom to communicate with others and safety. Marsh observed the impact of these features on young children's play:

> When they chose to play on the safe chat servers, they lacked the ability to converse as they pleased. Even when on the open chat servers, the software used by Disney to screen out potentially predatory or dangerous language meant that their conversations were not always as full as they would have liked them to be. (2011, pp. 113–14)

No moderation process can be infallible, and many can be circumvented. Therefore, children need to be supported to manage risks online that can emerge from social interactions. It is essential that children, and those who care for them or create digital products, understand how best to manage and mitigate risks. However, a balance must be struck between giving children opportunities to navigate challenges and keeping them safe from harm. To achieve this, the role of social context in supporting children has been highlighted:

> Children can best learn to face and cope with a degree of risk in a supportive and sympathetic context that allows them to feel safe and not harshly judged if they make mistakes. Such a context should be provided both at home and in school, as well as in the digital environment itself. (Livingstone et al., 2017, p. 85)

For this reason, in addition to industry taking responsibility for developing safe spaces online, approaches to media education need to be developed. These should encourage exploratory approaches to risks, as this is likely to be more effective than prohibitive approaches (Burn & Willett, 2017). A media education approach that allows time and opportunity for active exploration of the nature and level of different situations is needed. To develop such educational approaches in the UK settings, some researchers have suggested that collaboration between the Home Office, the Department for Education and Skills and the media regulator Ofcom could be a beneficial way to develop joint policy initiatives (Burn & Willet, 2017). Education needs to 'focus on critical ability and technical competency in order to support children in becoming active agents in their own protection and safety' (Livingstone et al., 2017: p.85). Children are less likely to be anxious about risks if they feel prepared and capable of dealing with the challenges they might face (Vandoninck et al., 2014). More research is also needed to understand the prevalence, patterns and extent of cyberbullying and abuse online (Livingstone et al., 2017).

The digital environment supports social play and enables children to maintain and build relationships across physical and virtual spaces. Central to this are communicative practices that leverage multi-modal resources, such as images, sounds and the written word, which, in turn, reshape social conventions and practices.

- **At the micro level,** children use games and explore the online environment and in doing so, develop and perform their identities. Social play with others in physical environments can serve important developmental needs for children as well as fostering a sense of enjoyment.
- **At the meso level,** children often engage in complex, collaborative play in hybrid spaces through a combination of online and offline interaction. The development of networked communication tools supports such engagement. However, connected environments pose risks related to interactions that are harmful.

- **At the macro level,** joint policy initiatives need to be developed in order to create a curriculum and educational resources that support children to develop the skills needed to navigate risks online. In tandem, industry practices need to take into account the developing capacities of children and provide safe spaces to engage in social play and communication tools that are developmentally appropriate.

Diversity of forms

> **Free play encompasses the activities of children across ages, cultures and circumstances. Cultural values of childhood shape the time, spaces and resources available for free play, so it takes diverse forms according to contexts.** (Cowan, 2020, p. 32)

Online gaming networks can bring together young people from across the globe from a range of backgrounds. Gameplay is influenced by expressions of identity (Walkerdine, 2007) as children draw on their cultural capital and gameplay expertise in their interactions with others (Marsh, 2011). It is important to remember that participation in online communities is affected by the same social and economic factors that shape children's engagement. Complex power relations exist in online spaces as they do in broader society (Walkerdine, 2007). Shapiro suggests that 'As our kids grow into the macro-minded grownups of the future, they will need to do more than just recognize difference; they will need to negotiate respectful interactions' (2018, p. 14).

There is a lack of diverse cultural representations and acceptance in gaming communities of some social groups as defined by ethnicity, age, gender, class, disability or sexuality, leading to abusive practices and experiences (Salen Tekinbaş, 2020). Evidence suggests that children are seeing more hateful online content than before: 'Half of 12–15s say they have seen something hateful about a particular group of people in the last year – up from a third in 2016. Four in ten took some form of action, but the majority ignored it' (Ofcom, 2019, p. 3). In relation to gender, there has been an increase in 'girl gamers' in recent years and 'almost half of girls aged 5–15 now play games online – up from 39% in 2018' (Ofcom, 2019, p. 3). Nevertheless, free play provides valuable opportunities to shape and explore gendered identities, particularly in online environments. Wohlwend suggests that 'transmedia play is a key site where players can engage, reproduce, and revise stereotypical expectations for doing "girl" or "boy" that circulate through imaginaries of childhood within popular media' (2020, p. 5). To understand the performative nature of gendered identities, peer cultures need to be considered (Corsaro & Eder, 1990) particularly when trying to understand the ways children construct and navigate issues relating to conflict and exclusion through play (Wohlwend, 2012, Beavis & Charles, 2007). More research is also needed into the ways that gendered identities interrelate with those of race, class and disabilities (Kafai et al., 2016) and the wide-ranging 'technological, contextual and situational possibilities' which shape such interactions (Jenson et al, 2011, p. 152).

When designing products, representation of social groups and their lived experiences are an important factor in challenging stereotypes. Despite this, gender representations in commercial games still present narrow conceptualisations of femininity and masculinity, and non-binary identities are largely absent. Olson explains, 'like other media, video games can promote harmful stereotypes (e.g., game characters identified as Arabic are often terrorists; many female characters have unrealistic body

proportions)' (2010, p. 186). In a review of apps for young children, Marsh et al. revealed that 'BME parents were more likely than White parents to state that they could not find their children's favourite media shows and characters on apps, which suggests that apps available for young children are not sufficiently diverse or representative of all communities' (Marsh et al., 2018, p. 876). Chess et al., in analysing the diversity of gamers in advertisements for games, concluded that 'while the markets and players are, indeed, beginning to become more diverse, there is still a perception of a white, male gamer who is central to the industry' (2017 p. 54). A game's values can be embedded in the earliest stages of development, and this needs to be addressed by industry. However, approaches that focus exclusively on attracting marginalised players and employing a more diverse range of designers can oversimplify social/cultural barriers (Shaw, 2014). It is important not only to diversify the teams that design games, but also to research the experiences of a range of players, particularly those who are typically excluded from mainstream research (Kafai et al., 2016, p. 19). To tackle the challenges, collaborative approaches are needed that foreground children's voices, experiences and interpretations.

Improving the social impact of diverse representations in play spaces requires understanding the ways vectors of identity such as gender, race, class and disabilities intersect and inflect. Kafai et al. explain that:

> ... until recently, most intersectional work focused on representations of game characters and in-game narratives, instead of the experiences of players consuming these narratives. (2016, p. 115)

Representation does not just centre round how people are depicted on digital screens. It is also vital to consider ways children choose to represent themselves online. Strong models of representation in children's products 'promote transparency, open communication, and reflections on biases' (Sobel et al., 2015, p. 46). Less impactful are instances in which diversity is actually 'sameness' mass-produced (Orr, 2009), where it is 'decorative and superficial, a device to create product differentiation, or a difference that makes no difference' (Wohlwend, 2020, p. 8).

Participatory design practices, which include children as an integral part of the process, can ensure that their knowledge, experiences and concerns inform designs (Yamada-Rice, 2019). Examples include the co-design of computer games (Pelletier et al., 2010); digital stories (Kucirkova, 2019); connected toys (Yamada-Rice, 2019); alternate reality games (Colvert, 2019) and programmable mobile devices (Wood et al., 2019). Research has also highlighted the benefits of engaging neurodiverse children in co-design (Benton et al., 2014; Fails et al., 2013). Sobel et al. explain that 'by trying to understand the needs of children with different abilities, we can apply their strengths to see how to support them in the design process while also empowering them' (Sobel et al., 2015, p. 47). However, careful consideration is needed to understand how partnerships between adults and children are structured and facilitated, to direct focus, research methodologies and analysis and promote their agency (Yip et al., 2017). Some commercial platforms support players to generate and adapt their own content by way of ensuring that children's identities are woven into imagined worlds. For example, in the virtual world Whyville, virtual parts of avatars are all designed and sold by other Whyvillians. However, Kafai notes that given this, 'One might imagine that with over 30,000 face parts for avatars, there would be no lack of diversity, but even virtual worlds are not the color-blind utopia' (Kafai, 2010, p. 19).

Salen Tekinbaş highlights the urgent need to find effective ways to 'mitigate systemic bias, hate, and harassment in-game communities to ensure all youth have equitable access to safe, fair, diverse, and inclusive online play communities' (2020, p. 3). However, she also foregrounds the complexity of the issue:

> Online aggression, hate, harassment, prejudice, and disruptive player behavior – what we refer to in this report as online toxicity – has its root causes not in individual players or games, but in a system of interconnections, interactions, policies, patterns, and power dynamics. This system involves many stakeholders with different values and priorities who influence the system in various, interrelated ways. (Salen Tekinbaş, 2020, p. 5)

A lack of understanding of how social values and economic factors shape children's uses and access to technology can adversely affect design practices. To understand how best to support children's play, global contexts need to be in focus, particularly in relation to intercultural differences. For example, Mascheroni et al. (2019) explain that, while several studies in HRI have dealt with intercultural differences (see, for example, Bartneck et al., 2007; Li et al., 2010), cross-cultural comparative studies are still rare in research on child–robot interaction (see, for example, Kanngiesser et al., 2015; Shahid et al., 2014). Marsh et al. highlight that 'most childhood research assumes Western notions of childhood as laid down by the United Nations (UNCRC) as vulnerable, fragile and in need of protection. African childhoods are rarely conceptualised or investigated' (2020, p. 174). This has implications for all children, as in a world where children are playing in global playgrounds, these diverse values and cultural practices need to be built into designs of products, systems and content (Esser et al, 2019). This will require large-scale comparative studies as well as international collaborative projects which focus on 'games as culture' (Perrotta et al, 2020). In addition to this, communication between academic researchers and developers needs to be improved to support better research–production partnerships (Passarelli et al., 2020).

Digital technologies do not yet fully support playful activities across ages, cultures and circumstances. Many social groups are excluded or subject to abuse when playing online.

- **At the micro level,** there are still limitations in the range of lived experiences represented in digital games and online environments. Products need to extend the range of representations available to support children's play, beyond surface visual changes, and facilitate and support the engagement of a diverse range of players.
- **At the meso level,** participatory design practices can offer opportunities to learn from children and create products that reflect their identities. However, there is still a lack of acceptance of some social groups online. This needs to be actively addressed by supporting children to develop the skills and knowledge needed to engage in diverse global playgrounds as well as the development of effective community moderation practices.
- **At the macro level,** the cultural values of childhood that inform the design of games are, in many instances, still too narrow and need to represent the diversity of children's experiences better. Intercultural studies are still few and far between, particularly in relation to child–robot interactions. It is still the case that Western cultural values are the focus of much research. Industry practices also need to be developed in ways that incentivise pro-social behaviour online.

Enhancing possibilities for free play in a digital world

What has this report revealed about the possibilities for play in the digital world? What are the similarities and differences between free play in general and free play in the digital environment?

The eight qualities of free play in general (Cowan, 2020) were viewed through the kaleidoscope framework in this report. This process highlighted that although all of the qualities of free play can be experienced by children across physical and virtual spaces, the qualities merge and intersect with the digital environment in complex ways. Cowan's report (2020) previously highlighted that play practices do not need technology to be part of the picture to be valuable to children. However, the pervasive nature of technology in everyday life changes the nature of play for many children. This report began with an analysis of two girls using the TikTok app to learn and share dances, highlighting the opportunities and challenges that the digital presents in the moment. Then, in revisiting each of the qualities of free play, these overlapping issues were explored in further detail throughout the review of research. This report has demonstrated that it is helpful to view free play in the digital environment from an ecological perspective to explore such play's multi-layered and hybrid nature.

What uncertainties, contestations and gaps exist across the research in this area? The application of the kaleidoscope framework to research across the fields of HCI, Humanities and Social Sciences helped to map what is in view in research (relating to people, products and places) and the levels of focus in research (micro, meso and macro). This revealed that there are significant gaps across research, particularly at the macro level, in relation to: the impact of governmental and industry policies and practices on children's experiences of play (people); the emergence and effect of new marketing and distribution methods (products); and a lack of cross-cultural research on the international factors that shape play with the IoToys and in online global playgrounds (places).

Eight ingredients for a child rights-respecting digital world of play

What is working well? What needs to change? There are many positive and productive aspects of the digital environment, but there are also many areas that need further development. The core characteristics of the digital environment that impact on the qualities of free play and that require further consideration and improvement are:

- **Accessibility**
  Children's voluntary and spontaneous play in the digital environment is contingent on the accessibility of digital resources to young people in diverse circumstances. Accessibility is affected by social and economic factors as well as the materiality and functionality of products. Spatial factors also matter – not only where technology is physically situated, but also the boundaries and barriers children must negotiate to enter virtual spaces for play.

- **Ethics and privacy**
  Children's intrinsic motivation to play in the digital environment is best supported by age-appropriate design, respecting their evolving capacities. However, this can be undermined by commercial interests that shape the design of digital products and direct children's engagements across physical and digital contexts. In addition, the use of pervasive marketing strategies and persuasive design in the services that children use raises important ethical, privacy and child rights concerns.
- **Adaptability** (or open-ended design for flexible and generative use)
  The open-ended quality of free play is best supported by products and services that children can modify in the spur of the moment. Adaptability works when it facilitates child-led adjustments to digital functionality and structure (such as programmable devices) or supports exploration and experimentation in physical or virtual spaces (such as technology embedded in playgrounds or virtual environments that support world-building).
- **Hybridity**
  The imaginative quality of play can thrive in the digital environment if digital technology affords hybrid opportunities, enabling children to move across physical and digital settings and combine digital and non-digital resources in creative ways. Hybridity relates to the ways children choose to take up resources to meet their playful needs as they move in embodied and imaginative ways between online and offline worlds, and can be facilitated by technology in multiple ways.
- **Multi-sensory engagement**
  The stimulating quality of free play can flourish in the digital environment if multi-sensory engagement is facilitated by connected, mobile, wearable technologies and tangible interfaces that produce multiple stimuli, spanning virtual and physical contexts. However, digital interactivity can be overstimulating for some children, leading to discomfort or challenges to players' self-control.
- **Affective cultures**
  Emotional resonance is experienced in digital environments at an individual level, but also, importantly, the experience is collective, merging personal and global, transcending online and offline boundaries, generating affective cultures. Digital games and social networks can provide children with valuable opportunities to explore positive as well as negative emotions with others. However, attention must be given to how automated algorithms and networked systems curate what children can participate in and to the management of toxic cultures online.
- **Safe and positive communication**
  Children engage in social play, connecting and building relationships with others across virtual and physical spaces. In-game chat channels and social media can facilitate this. Children learn the conventions of communicating through connected play (conventions of written and spoken language, avatar gestures and use of virtual spaces). However, in these social encounters lie content, contact, conduct and contract risks that require policy and business interventions to mitigate them and strategies to promote children's resilience to benefit from participatory practices.
- **Diverse representations**
  The diversity in forms of play in global digital playgrounds can promote diverse representations of varied lived experiences, abilities and identities. Play is often

hyperlocal, reflecting children's diverse cultural heritage and subcultural interests. This can be facilitated in the digital environment. However, there is still a lack of acceptance of some social groups online, and certain forms of identity exploration and expression are marginalised or abused. Tackling the changes needed will require participatory design in policies and products and cross-sector and intergenerational collaboration with underrepresented and marginalised children.

How can we enhance play possibilities in a digital world?

The evidence reviewed in this report suggests that to enhance possibilities for free play in the digital environment, change needs to occur at all levels (micro, meso and macro). It also suggests that in order to achieve this, policymakers, academics, educators and those in industry who design products for children must all work to develop social and cultural support, as well as effective products and spaces for free play. While it is beyond the scope of this report to attribute tasks to private or public sector agents of change, several issues have emerged that require collective action. Across the research reviewed in this report, many academics, designers and policymakers have highlighted areas that need to be addressed. These calls to action are collated in the following sections relating to social-cultural, material-functional and contextual-spatial factors.

a) Address the social-cultural factors

There are many social and cultural factors that shape free play. To improve experiences of free play in digital environments children need to be supported to navigate risks and stay safe. In addition, their developing identities must be respected and valued in online communities, and their active participation in opportunities for free play need to be scaffolded and facilitated. Salen Tekinbaş explains that:

> If our goal is to mitigate hate and harassment, reduce disruptive player behavior, encourage prosocial behavior, and produce safe, fun, and socially resilient online game communities, we must redesign the system by paying attention not only to its individual components (policy, player behavior, parental attitudes, business models, etc.) but also to the relationships between its parts. (Salen Tekinbaş, 2020, p.6)

This review has revealed a number of areas that need to be addressed in order to improve opportunities for free play:

Focus of action	People
Identity, interpretations and experiences	• Incentivise pro-social behaviours online (Salen Tekinbaş, 2020) • Continue to develop innovative research methodologies to investigate children's diverse experiences of play with technologies (Kafai et al., 2016; Marsh, 2019) • Establish opportunities to develop media content that reflect diverse national and global cultures, created by a diverse range of people (facilitated by public service providers and private companies) (Kafai et al., 2016; Kleeman, 2021)

Relationships and social interactions	• Provide opportunities for children to engage in moderated online communities (Du et al., 2021) • Develop a media education approach that supports children to experience agency when managing risks (Burn & Willett, 2017; Livingstone et al., 2017) • Develop models of mentorship and codes of conduct that support peer-to-peer support and civic engagement in online communities (Salen Tekinbaş, 2020)
Public and private sector policies and practices	• Develop intergenerational working groups so that children's experiences and concerns can inform legislation and industry developments (Salen Tekinbaş, 2020) • Support academics, educators and industry to work together to develop design principles (such as those associated with age-related design) (Revelle, 2013) • Academics need to communicate relevant research findings to industry in ways that are effective and actionable (Passerelli et al., 2020)

b) Address the material-functional factors

To improve the design of products, communications between industry and families need to be transparent and easy to understand, and regulation needs to be developed in line with new features of online games and services. Children should be actively supported to adapt products to meet their needs, and companies should design for improvisation to support free play. All products should be designed with children's interests and development in mind. Edwards explains that:

> When young children access and use consumer products and move seamlessly in and out of digital media environments … they are directly participating in the digital-consumerist context, such that their play is characterised by the possibilities enabled by the convergence between various products, digital media, and digital technologies across a continuum of digital to non-digital experiences. (2014, p. 224)

To develop opportunities for play in the digital world, the research suggests the following actions to be taken in relation to developing material-functional aspects of the digital environment:

Focus of action	Products
Design of artefacts	• Avoid overloading children with marketing messages during play (Marsh et al., 2015; Martínez, 2017; Radesky et al., 2020) • Design for improvisation by providing opportunities for children to modify games to suit their interests and needs (DeValk et al., 2013; Stephen & Plowman, 2014) • Eliminate 'dark patterns' such as nudges to share data that are not in the best interests of the child (Kidron et al., 2018) • Design products which are informed by research into child development and are respectful of children's evolving capacities (Kidron & Rudkin, 2017; Revelle, 2013)

Networks, transmedia and connectivity	• Provide multiple entry points for transmedia play and continue to explore the potential of the 'metaverse' in relation to children's play and creative production practices (Kleeman, 2021; Wohlwend, 2020) • Develop a range of communication tools in virtual worlds that can be adapted and adopted in line with children's needs (Du et al., 2021) • Develop systems of moderation that support older and more experienced players to support others in virtual worlds (Salen Tekinbaş, 2020) • Ensure that personalised algorithms are aligned with the interests and needs of young children (Hartung, 2020; Kurcikova, 2019) • Develop age-appropriate and inclusive online 'neighbourhoods' for children that are respectful of children's developing capacities and provide safe spaces to play within bounded. (Kleeman, 2021; Ringland et al., 2016; Sobel et al., 2015) • Create transmedia content that is representative of diverse experiences and cultures that actively support children to explore and question stereotypes and bias (Kafai et al., 2016; Sobel et al., 2015)
Marketing, distribution and data systems	• Develop transparent communication policies and practices that can be understood by the youngest children (Milkaite & Lievens, 2020) • Ensure regulation is updated to account for new developments in commercial structures (e.g., loot boxes in games) (Macey & Hamari, 2018; Wardle, in press; Zendle et al., 2020) • Investigate the impact of influencer marketing on children, both from the perspective of consumer practices and on the wellbeing of young content creators (de Vierman et al., 2019) • Establish fair access to public service content and experiences, whether via promotion or algorithm (Kleeman, 2021)

c) Address the contextual-spatial factors

To improve places, to better support free play, spaces should provide access to digital and non-digital resources that support hybrid play. Positive intergenerational interactions should be facilitated to develop opportunities for play across and within physical and virtual domains. Children need accessible spaces that support inclusive approaches to play. Gee et al. stress that

> … the potential value of an interdisciplinary approach to understanding gameplay and learning among families, an approach that de-centers the individual child and the digital features of video games and refocuses our attention on relationships among gaming and other practices in the home and beyond, as well as on the relationships among people that are reflected in and reconstituted through gaming. This approach is particularly relevant as digital gameplay becomes increasingly dispersed across various technologies, activities, and settings. (2017, p. 479)

To develop opportunities for play in the digital world, the research calls for the following actions need to be taken in relation to contextual-situational factors:

Focus of action	Places
Immediate vicinity	• Provide community access to resources and environments that support children to combine physical and digital resources during play, e.g., makerspaces (Blum-Ross et al., 2020; Sheridan et al., 2014) • Further explore the potential of virtual reality, wearable technologies and connected toys (Mascheroni and Holloway, 2019; Yamada-Rice et al., 2017) • Further explore the potential of the Internet of Toys to support children to play with their local settings through active design practices (Wood et al., 2019) • Facilitate freedom of movement and autonomy when selecting and playing with technology in educational settings (Arnott, 2016) • Ensure that smart home devices, which children have easy access to, are designed with their safety, wellbeing and privacy rights in mind (McReynolds et al, 2020)
Social settings and local contexts	• Further explore the potential of mobile devices and games to support outdoor play (Back et al., 2018; Jones et al., 2018) • Engage in community co-design of local spaces in which technologies can be embedded to support play and facilitate access to public spaces for play, beyond bounded areas such as playgrounds (Back et al., 2018; Castro Seixas, 2021)
National and global geographies	• Undertake global comparative studies to develop a nuanced understanding of cultural differences between media use (Marsh et al., 2020; Mascheroni et al., 2017) • Investigate the potential of new opportunities for gameplay in collaborative international studies. (DigiLitEY, 2018) • Develop age-appropriate regulations and safety measures relating to geo-tracking data and other surveillance technologies (van Dijck, 2014) • Adopt a cross-national approach to legislation relating to gambling in games for children (Wardle, in press)

This literature review has shown that digital technologies have great potential to afford children playful opportunities that support their creativity, their exercise of agency and their social and mental development. However, more careful consideration of the interplay among social-cultural, material-functional and situational-contextual factors that shape free play in the digital environment is required to design, develop and oversee digital products and services that children use in their play. Given the current state of play in the digital world, with its potentials and pitfalls, this report envisions a harmonised future, in which careful thought is given to mixing and matching components of these factors in crafting and overseeing children's digital play possibilities.

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