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The role of play in children's development: a review of the evidence

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Introduction

There is a considerable body of research which is indicative, relating children's play and aspects of their learning and development. This evidence includes work in evolutionary and developmental psychology, anthropology, neuroscience and educational studies. However, while researchers in these fields have hypothesised about how play might enhance child outcomes, much of this evidence merely establishes associations rather than firm, causal relationships. In fact, there is little or no conclusive evidence regarding possible explanatory mechanisms.

With this white paper, we set out to move the study of children's play and development forward, urging researchers to address the psychological processes involved in playful behaviour and the mechanisms by which they might enhance learning. We propose that this can be best achieved by focusing on the specific psychological characteristics of playful experiences, set out in the related white paper by Zosh et al. (2017) and the specific types of play children engage in.

Following a brief overview of the general, indicative evidence, this white paper reviews research which has been conducted in relation to the five types of play proposed by Whitebread (2012), namely physical play, play with objects, symbolic/semiotic play, pretend play and games with rules. It concludes by examining theoretical links between the five characteristics of playful experiences and the types of play reported here, and by suggesting mechanisms emerging from current research that could form the focus of future research.

The general indicative evidence of a relation between children's play, their learning and development has come from the following disciplines:

Evolutionary psychology

- Bruner (1972) argued that as more and more complex animals evolved, the length of biological immaturity increased, facilitating a related increase in learning and in the amount and the variety of different types of play - physical play (mostly 'rough-and-tumble') in mammals, 'play with objects' in primates and 'symbolic' play, including pretence, in humans. His proposed mechanisms included humans' enhanced representational abilities (language, drawing etc.) and 'flexibility of thought'.
- Pellegrini (2009), in a review of evolutionary work on play, concluded that, in animals and humans, play contexts allow individuals to focus on 'means' rather than 'ends', allowing exploratory or iterative play in which they 'exaggerate, modify, abbreviate or change the sequence of behaviours, endlessly repeat slight variations of behaviours, and so on'.

Developmental psychology

- Much of the research on play within developmental psychology has been inspired by the theoretical writings of Vygotsky (1978). During play, when it is spontaneous and child-initiated, he argued, children exercise control over their own activity, set themselves appropriate challenges, and so create their own 'zone of proximal development' within which learning is most powerfully enhanced. Karpov (2005) reviewed the work of neo-Vygotskians supporting the notion that, in play, children are required to regulate their own behavior, making it a significant factor in their development of self-regulation.

- A number of studies reviewed demonstrated children being able to perform tasks in play at significantly higher levels than in non-playful contexts (e.g. a study of 3-7-year-old children 'standing sentry' by Manuilenko, 1975).
- Tamis-LeMonda and Bornstein (1989) demonstrated that infant habituation (an established measure of speed of processing strongly related to cognitive development) predicted the amount of pretend play individuals engaged in as young children.
- Bornstein (2006) reviewed evidence of the universality of pretend play (although with cultural variations) and inter-relationships between the complexity of this type of play and children's emotional well-being.
- Whitebread (2010) reviewed a range of studies, including an observational study of 3-5-year-olds in 32 preschool settings, providing evidence that self-regulatory behaviours were most commonly observed in children during collaborative, child-initiated play.

Anthropology

- Gray (2009), in a review of anthropological studies of extant hunter-gatherer societies, reported the unfettered, playful lives of children in these cultural groups, the context in which humans evolved over tens of thousands of years until the very recent evolutionary past (c.10-12,000 BC). He argued that humans have evolved to learn through playful behaviour, and in a further study (Gray, 2012), he revealed a strong relationship between the decline of play opportunities for children in the USA over the last half century and an alarming increase in child psychopathology.

Neuroscience

- Pellis & Pellis (2009) reviewed their extensive research, spanning over 30 years, of play in simple mammals, mainly mice and rats. This consists in physical 'rough and tumble' and in play with objects. Their studies have provided evidence of impact on brain development in specific areas of the pre-frontal cortex, and of poor levels of social competence in animals deprived of these play opportunities.

Educational studies

- Diamond, Barnett, Thomas & Munro (2007) and Hyson, Copple & Jones (2007), in their reviews of the Tools of the Mind curriculum, found that children attending pre-schools using this play-based curriculum achieved higher scores on measures of executive function, skills underpinning self-regulatory abilities, than children attending regular, instruction-based pre-schools.
- Barker, Semenov, Michaelson, Provan, Snyder & Munakata (2014) showed that the amount of less-structured time in 6-7 year-olds' daily lives, including free play alone and with others, social outings, sightseeing and visiting museums & zoos, predicted their cognitive self-regulation.
- Marcon (2002), found that playful learning in pre-schools in the USA was associated with better short and long-term academic, motivational and well-being outcomes by the end of primary school.
- Sylva, Melhuish, Sammons, Siraj-Blatchford & Taggart (2004), in a cohort study of 3,000 children in the UK, showed that extended play-based pre-school experience (i.e. 3 years) was advantageous to children from disadvantaged households in relation to their academic and social development.
- Darling-Hammond & Snyder (1992), in a study of 50 'play-based kindergartens' and 50 'early learning centres' in Germany, found that by Grade 4 the children from the former were more advanced in reading, maths and social/emotional adjustment in school.

So, as we can see, there is a substantial body of research, across a number of disciplines, arguing for the importance of play in human development, and, in some cases, proposing intriguing potential mechanisms that might explain the role of play in children's cognitive, emotional and social learning. The following sections review the evidence in relation to specific types of play, and begin to set out an agenda for play research going forward, in order to examine these various hypothetical psychological processes.

Physical play

This type of play is the earliest to evolve and can be observed in most, if not all, mammals, and arguably some reptiles and amphibians. In human children it includes activity play (e.g. jumping, climbing, dancing, skipping, bike riding and ball play), fine-motor practice (e.g. sewing, colouring, cutting, junk modelling and manipulating action toys and construction toys) and what is usually referred to as 'rough-and-tumble' (play fighting with friends, siblings or caregivers).

There have been 5 significant reviews of research and theory in this area exploring evidence of causal relationships between play and aspects of development, and we have found 13 empirical papers which are sufficiently rigorous to be included in this review. The reviews are those by Bjorklund & Brown (1998) on rough-and-tumble and physical activity play, Pellegrini & Smith (1998) on physical activity play, Pellegrini & Bohn (2005) on play during school recess or playtime, Pellis & Pellis (2009) on rough-and-tumble play in simple mammals and Brussoni et al. (2015) on 'risky outdoor play'. Both in these reviews, and in the various empirical studies, results are reported related to development in cognition and academic achievement, social competence and popularity, social status and dominance, gender differences, emotional awareness and self-regulation. Studies in this area also incorporated physical games with rules, and contrasted physical play with play with objects (toys) and pretence. We found no significant studies of fine motor play.

In a significant, but purely theoretical paper, Bjorklund & Brown (1998) argued that different types of physical play could contribute to gender differences in spatial abilities, for example boys might engage in more hand-eye coordination or estimating trajectories of objects. Pellegrini & Smith (1998), in a review of the empirical evidence in the same year, concluded that there was evidence that exercise play was linked to

motor development and some tenuous evidence that exercise play may also be related to cognitive performance. In a more recent review Brussoni et al. (2015) concluded that 'the evidence suggests overall positive effects of risky outdoor play on a variety of health indicators and behaviours in children aged 3-12 years'. However, they pointed out that these conclusions were based on 'very low' to 'moderate' quality evidence.

Amongst particular studies focusing on physical activity play, Colwell & Lindsey (2005), in a study with 4-6-year-olds, focused on outcomes, in same-sex and mixed-sex play, for peer acceptance and teacher ratings of social competence. For girls, but not for boys, same-sex physical activity play was associated with these outcomes. Becker et al. (2014) used accelerometers to assess preschool children's level of physical activity and found a medium level correlation (0.46) with cognitive self-regulation, measured using the Head-Toes-Knees-Shoulders Task (HTKS) test. There was also a significant indirect effect of active play on maths and literacy scores via the HTKS test, leading to the conclusion that self-regulation mediates a relationship between active play and school achievement. However, Lehrer, Petrakos & Venkatesh (2014), in a study with 6-7-year-olds, failed to find any significant relationships between the amount of out-of-school time they engaged in active physical play and measures of school achievement, 'adaptive' behaviour and creativity.

As regards rough-and-tumble play, Bjorklund & Brown (1998) suggested that it facilitates development of social cognition through the coding and decoding of social cues or signals. While, in their review of the empirical evidence in the same year, Pellegrini & Smith (1998) found minimal support for this hypothesis, more recent studies have reported evidence in its

support. Pellis & Pellis (2009), for example, reviewed a series of studies with simple mammals, mainly rats, showing that 'there is a mechanism by which experiences accrued during play fighting can improve social competence'. Similarly, Brussoni et al. (2015), in their very recent review of empirical research on 'risky outdoor play', reported studies showing relationships between rough-and-tumble play and enhanced levels of social competence. In one study, for example, moderate to large positive correlations, for popular children and for boys (but not for rejected children and girls), were found between rough-and-tumble play and higher interpersonal cognitive problem-solving scores. Colwell & Lindsey (2005) also found these kinds of differential relationships according to gender. They reported that, for boys (but not girls), same-sex rough-and-tumble play was associated with same-sex peer acceptance and teachers' ratings

of social competence. Interestingly, however, boys' rough-and-tumble play with mixed-sex peers was negatively associated with peer acceptance and teachers' ratings of social competence. Fletcher, St. George & Freeman (2012) developed a new measure of rough-and-tumble play between fathers and 3-4 year olds and investigated its relation to scores on the Strengths and Difficulties Questionnaire (SDQ). They reported negative correlations of father-child rough-and-tumble play with father reports of SDQ conduct and peer problems, with mother reports of emotional problems, and with both mother- and father-reported total problems scores. In a subsequent study, they have recently repeated this finding and also showed that this relationship is particular to rough-and-tumble, and does not arise from play with toys (St George, Fletcher & Palazzi, 2016).

Play during school recess

A final theme of research in this area has focused on play in school recess or playtime, outside in the playground, although a significant issue in this research has been whether any relationships with developmental outcomes arise from the physical activity involved or from the break from academic work and the opportunities for social interaction.

Thus, in their review of this area, Pellegrini & Bohn (2005) conclude that 'unstructured breaks from demanding cognitive tasks seem to facilitate school learning, as well as more general social competence and adjustment to school.' In support of this conclusion, they cite a number of Pellegrini's earlier studies. For example, in a study of 5-9-year-olds' playground behaviour, Pellegrini, Huberty & Jones (1995) found that children's attentiveness improved after recess, but physical activity did not seem to play an important role in this, as recess with limited opportunity for physical activity was found to have the same effect. Similarly, in a year-long study of playground games with rules (ball games, chase, and jumping or singing games) during 5-6-year-old children's first year in school, they concluded that it was the social interaction with peers during recess that was linked to school success, in terms of academic outcomes (Pellegrini, Kato, Blatchford & Baines, 2002).

Summary

The evidence base for conclusions on physical play is not extensive. In addition to the studies reviewed here, we found a further 8 studies which were mostly small scale, exploratory case studies. This adds up to little more than 20 studies, and the majority of these are with quite small samples of less than a hundred children.

- there is good evidence that physically active play provides children with exercise and the consequent health benefits;
- there seems to be reasonable evidence associating physical play of various kinds with academic progress and cognitive self-regulation, and with social competence;
- there is some evidence that, for boys, rough-and-tumble play supports the development of their social competence and emotional awareness and has possible indirect effects on academic progress;
- there is evidence that unstructured breaks from cognitive tasks improve learning and attention, though it is unclear whether physical play contributes to this effect beyond simply taking a break and, for example, talking with friends.

A range of open questions remain, some of which have been touched upon in the existing studies, which need to be addressed by future research:

- the unique contribution of physical play. It is very difficult to isolate the purely physical nature of physical play. This type of play often involves social interaction of various kinds, playing with rules, and, undoubtedly, when children are engaged in physical activity they are also often engaged in pretence;
- the mechanisms by which physical play contributes to cognitive self-regulation, attentiveness and other aspects of cognitive development;
- the interactions with gender, suggesting that what appear to be physically similar activities can have differential impacts on children depending on other aspects of their development;
- the consequences of changes in physical play as children grow up. It is notable that the vast majority of studies in this area are with quite young children and, as children grow up, physical play tends to transform into sports and games which are arguably less playful. The consequences of this, possibly accelerated by the emphasis on sports in schools, remain an entirely open question, as does the potential benefits of holding onto the playfulness of young children's physical play as they move into adolescence and adulthood.

Play with objects

This second type of play, which is also widely observed in primates, concerns children's developing explorations of the world and the objects they find within it. It also has interesting and important links to physical play – particularly in fine motor development and pretence when it involves building models of real or imaginary objects and creatures, and imagining a scenario or narrative.

Play with objects begins as soon as infants can grasp and hold on to them; early investigative behaviours include mouthing/biting, rotating while looking, rubbing/stroking, hitting and dropping. This might be described as 'sensori-motor' play when the child is exploring how objects and materials feel and behave. From around 18-24 months, toddlers begin to arrange objects, which gradually develops into sorting and classifying activities. By the age of 4 years, building, making and constructing behaviours emerge.

While there have been no systematic reviews published in this area, there has been a fair amount of empirical study. A number of key theoretical contributions also underpin the empirical work in relation to this type of play. First, it is in play with objects that it is claimed that young children start to develop their representational abilities. This suggestion was first made by Vygotsky (1978) and has been further elaborated, for example, by Stroud (1995), who argues that, once children begin to build models of real objects, their play becomes representational and serves as an introduction to symbolisation:

"...the blocks themselves become symbols for other objects, just as printed letters and words are symbols for objects and ideas."

(Stroud, 1995, p. 9)

Second, Vygotsky also argued that play of this type is particularly related to the development of thinking, reasoning and problem-solving strategies. This suggestion was particularly taken up by Bruner (1972) who argued that a primary function of play during human children's long period of immaturity was to support the development of their 'flexibility of thought'.

Object play and problem-solving

A major spur to empirical investigation of play with objects was the seminal study conducted by Bruner exploring this hypothesis with colleagues. In his study of play with objects and problem-solving (Sylva, Bruner and Genova, 1976) two groups of matched 3-5-year-olds were presented with a practical problem to solve. Beforehand, however, one group were given the opportunity to play with the objects involved, while the other group were 'taught' how to use the objects in ways which would help solve the problem. The results, perhaps surprisingly, appeared to support the hypothesis, revealing that the children who had the experience of playing beforehand with the objects were more inventive in devising strategies to solve the problem and persevered longer if their initial attempts did not work, ultimately leading to higher levels of full or partial success.

While this study was the subject of a number of methodological criticisms, it has been replicated on a number of occasions. In a study with 4-year-olds, for example, Smith & Dutton (1979) reported data showing that for some types of problem-solving, play experience and instruction can be equally effective, but for more challenging problems requiring creative and innovative approaches, play with objects appeared to be superior as a learning context, compared to instructional approaches. A study by Pellegrini and Gustafson (2005), also concerned with object play, in which observational data was collected of 3 to 5-year-olds over an entire school year, demonstrated that the amount of playful exploration, construction and tool use

in which children engaged predicted their subsequent performance on a problem-solving task very similar to that used in Bruner's original experiment.

Object play and language

A group of studies have exploited the advantages of longitudinal designs in investigating the impact of particular play experiences on language development. These studies have also commonly compared the impact of purely functional object play with that of pretence using objects. Ungerer & Sigman (1984), for example, carried out an observational longitudinal study of play with toys with infants aged 13.5 and 22 months. At the younger age, playing with objects in a conventional, functional way predicted language scores at 22 months, but at 22 months only pretend play with objects related to language. This suggests the possibility of a developmental trend in play with objects and language, where more functional forms of object play may help lay the foundations for language development, along the lines suggested by Stroud, then pretend play extends this as children enter toddlerhood. A longitudinal study by Lyytinen, Laakso, Poikkeus & Rita (1999) with 171 children aged 14, 18 and 24 months confirmed this view, showing that, when the children played alone, functional and combinatorial play with objects did not relate to language development, but pretend play with objects did.

An earlier observational study by Pellegrini (1980) with 5 to 6-year-olds also showed a similar pattern, with the amount of construction play children engaged in being significantly correlated with their pre-reading, language and writing abilities, but not as strongly as their pretend play. In contrast, however, a small longitudinal study by Hanline, Milton & Phelps (2010), with just 29 children over three years between the ages of 5 and 8 years, found no significant relationship between children's block building abilities and their mathematics scores, but a significant relationship with reading scores. More recently, Whitebread, Jameson &

Basilio (2015) report two studies exploring the impact of object play on children's writing. In these studies, 6-7-year-old children were given the opportunity to play with a 'story sack' containing dolls and objects related to a particular story, and 5 to 10-year-olds undertook a construction task with LEGO® bricks as preparation for various genres of writing. The results in both studies showed that the children wrote with greater engagement and enthusiasm, and higher levels of creativity, after play with objects experiences (in which there was also, however, a clear pretence element) than when they did not have this opportunity.

Play with objects, math and spatial abilities

Studies of play with objects and development in mathematical abilities, in contrast to Hanline et al.'s result, have also shown positive results. In a small longitudinal study with 24 children over a 2 year period, from the ages of 5 to 7 years, Pellegrini (1992) reported that object play in recess significantly predicted their first-grade school achievement, even when controlling for kindergarten achievement, and particularly in maths. Nath & Szücs (2014), in a study with 7-year-olds, have also recently reported a positive relationship between abilities on a LEGO construction task and children's mathematics performance (although, as this is a correlation, no causal relationship can be imputed). This is, however, one of a very few studies investigating the mechanisms by which play with objects might impact upon development. Their analysis showed that the relationship between construction and maths abilities was mediated by visuo-spatial memory.

Yet other studies have shown relationships between children's puzzle play from 2 to 4 years of age and their spatial ability at 4 years old (Levine, Ratliff, Huttenlocher & Cannon, 2012), play with objects and self-regulatory abilities among 4-year-olds (St George, Fletcher & Palazzi, 2016), and 3 to 5-year-olds' perceptions of tasks with objects as playful and their level of involvement and emotional well-being (Howard & Mcinnes, 2013).

Once again, a range of open questions remain. Some have been touched upon in the existing studies, but all need further investigation:

- the nature of the psychological mechanisms through which play with objects might influence development; does this type of play have an impact by enhancing enjoyment and engagement, or through its support for representational abilities, or visuo-spatial memory, or self-regulation, or all of these?

- to what extent can Pellegrini's advice from 25 years ago, that 'observers might attend more closely to what children actually say and do during object play' (Pellegrini, 1992, pp. 571-2), help us to understand any potential mechanisms, or any potential benefits?
- will any type of play with objects suffice, or is a range of different activities required? Is a problem-solving element essential? How vital is it that a pretence element should be encouraged?
- is there, as some studies have suggested, a developmental progression of types of object play of which we need to aware?

Summary

- theoretical arguments have been developed, and have been supported by some empirical studies, linking play with objects with the development of representational abilities, reasoning and problem-solving strategies;
- a range of studies have provided reasonable evidence of links between play with objects with the development of language, maths and spatial skills;
- however, while some points have been established, some results are contradictory, and the usual range of methodological limitations of small or purely correlational studies are present. It is also the case that, overwhelmingly, studies of play with objects have been with young children under the age of 7 years.

Symbolic play

We now come to types of play which are engaged in only by humans, mainly because they rely on our incomparable symbolic representational abilities. The first of the types, which we are referring to as symbolic play, concerns play with the various symbolic representational systems we use to make and communicate meaning. For this reason, an alternative name for this type of play might be 'semiotic' play.

This type of play emerges in children from around the age of 12 months when they first begin to intentionally use sounds to convey meaning (although it could be argued that they play with sounds, in babbling, much earlier and also with gestures, which are used to convey meaning during the first year of life). Progressively during early childhood, these aspects are an important element within children's play and learning when they begin to master a range of 'symbolic' systems, including spoken language, various visual media, mark making/writing, number, music and so on.

Theoretically, therefore, it might be presumed that this type of play would support their developing technical abilities to express their ideas, feelings and experiences through these various media. However, while there is a general presumption that this is the case, with the exception of language and literacy, there is a dearth of rigorous scientific studies examining the impact of symbolic play on development. As a consequence, there appear to be no overall systematic reviews in this area.

Given that the studies in this area each address one specific symbolic system, this section is divided into separate reviews relating to the different media.

Symbolic play and language

We begin with play with language and its impact on early literacy, as this is the most researched area and the only one which has merited a significant review, namely that by Christie & Roskos (2006). Much of this review relates to the role of pretence in language and literacy development, to which we return in the next section. However, they also review a significant body of evidence relating play with language to early phonological awareness, a key predictor of early literacy abilities. They cite, for example:

- evidence that infants and toddlers frequently play with the sounds of language, including repeating strings of words containing related sounds, exploring both rhyme and alliteration (Weir, 1976, pp. 610-611)
- findings that children's knowledge of nursery rhymes and the frequency that they engage in word play were both strong predictors of children's phonological awareness (Fernandez-Fein & Baker, 1997).
- the many research-based strategies for promoting phonological awareness in preschool and kindergarten use playful activities such as singing songs, reciting nursery rhymes, reading books that play with the sounds of language, and game-like activities (e.g., Adams, Foorman, Lundberg, & Beeler, 1998).

More recent studies have confirmed that children do indeed play with language, but these have been generally qualitative, small-scale observational studies – see for example, Alcock, Cullen & St George's (2008) study in three early childhood education centres in Australia, and Varga's (2000) study of 4 to 5 year-old children's playful use of language at one nursery school in Canada, within which she reports that:

"Language play, a common children's activity, includes diverse behaviors such as joke telling, using metaphors, and repeating sounds as in chants, rhymes, and nonsense verse."

(Varga, 2000, p. 142).

In a very recent study, Burrell & Beard (2016) have also reported a qualitative analysis to show that 9-11-year old children play with language in writing as well as in speech. Three empirical studies have been carried out, however, that do appear to provide evidence to support a link specifically between language play and literacy development more generally. Ely & McCabe (1994), in a small-scale study involving just 20 children aged 5-6, did show a statistically significant correlation between frequency of language play and scores on the Riddle explication task (r = .48), a test of the ability to understand some subtle nuances of language and metalinguistic awareness. Ravid & Geiger (2009) demonstrated that an intervention based on linguistic humour and some forms of language play significantly enhanced 9-10-year old children's awareness of the morphology or structure of words. Finally, Read, James & Weaver (2017) have very recently reported a study showing that 3-5-year old children's abilities in four specific types of language play were significantly correlated to their teacher-reported verbal skills. However, each of these studies has its limitations arising from the lack of comparison groups or the inability of correlations to establish the direction of causality.

Musical play

Despite their accepted prevalence in the activities of young children, the role of other forms of symbolic or semiotic play in development have been even more sparsely researched. In relation to musical play, for example, it is a common observation that children sing, dance and delight in exploring and making sounds of all kinds, with their own bodies and with all kinds of objects. There is also a significant body of theory suggesting influence on development arising from these activities. Trevarthen (see Malloch & Trevarthen, 2009), for example, has demonstrated the 'musicality' of early infant-mother interactions and argued for the importance of the infant's innate response to rhythm and sounds in establishing early communicative abilities.

Yet there have been only a handful of studies attempting to investigate any impact of musical play on development and, as with the studies on language play, each have their methodological limitations. Kirschner & Tomasello (2010) showed that the prosocial behaviour (helping each other and co-operating) of a group of 5-6-year old children who took part in a musical play activity improved to a significantly greater extent than that of a group who took part in non-musical play. Similarly, Putkinen, Tervaniemi & Huotilainen (2013) showed that children who experienced higher levels of informal musical activities in the home appeared more sensitive to subtle changes in sounds, which could be indicative of more advanced auditory development, and showed a reduced activation in response to the appearance of novel sounds, suggesting they were less surprised and distracted by these unusual sounds than children from less musical homes. A common problem of both of these studies, however, is that they failed to clearly distinguish musical play from other forms of musical

activity. More recently, Zachariou & Whitebread (2015) have shown in an observational study of 6-year-old children that engagement in musical play allowed self-regulatory behaviours to emerge. However, it is not clearly established that the musical play activities, as such, promoted self-regulation, or merely allowed the children to use abilities they already possessed.

Play drawing and writing

The final aspect of symbolic or semiotic play to be significantly theorised and researched concerns children's drawing. Like language and musical play, play with mark-making and drawing is ubiquitous in the behaviour of children across cultures, and is widely accepted as an important way in which children, even before they are literate, record their experiences and express their ideas. Vygotsky (1986) himself pointed out the very close links between early drawing and writing which is very commonly observed in young children's mark-making. However, research in this area has largely confined itself to understanding the developmental processes that lead to children drawing as they do. Thomas & Silk (1990) and Cox (1992), for example, pioneered work of this kind. Ring (2010) documents very persuasively the role of drawing as a tool for children to make meaning from their experiences and their worlds, and argues passionately and persuasively for the importance of continuous provision for playful drawing in early years educational settings. In our increasingly visual world, this would seem to be an eminently sound proposition. However, no studies appear to have been carried out that unambiguously demonstrate an impact on development of children's play with drawing or any other kind of visual representational media.

Summary

- it seems reasonable to hypothesise that play with symbolic systems will help develop those systems; however, this is a relatively neglected and weak area of play research as regards the impact of play on children's development;
- there is reasonably good evidence that language play enhances children's language development in a variety of ways; this is important, as there is reasonably good evidence that language development has relations with other important skills and outcomes, including self-regulation (Vallatton & Ayoub, 2011) and school achievement (Hoff, E, 2013);
- there is some evidence that musical play might be significant in relation to the development of communication skills, and there is some evidence that it is related to higher cognitive functioning, and can be used for self-regulation (Winsler, Ducenne & Koury, 2011).

A range of open questions remain, some of which have been touched upon in the existing studies. These will need to be addressed by future research:

- the extent to which play with symbolic systems, other than language, enhances children's abilities in using those systems to develop and communicate their ideas and understandings;
- the nature of the psychological mechanisms through which play with symbolic or semiotic systems might influence significant aspects of development more generally, including higher cognitive functioning, abstract thought and self-regulatory abilities;
- is play of this type most valuable in the early stages of development, or is there advantage in encouraging play with language, music, drawing etc. through middle childhood and beyond?

Pretend play

Pretend play is the type of play which has been researched most extensively. In a recent review paper, Lillard, Lerner, Hopkins, Dore, Smith & Palmquist (2013) identified and critiqued 154 studies of pretend play relations with children's learning and development in various areas. The authors conclude that:

- pretend play is one way of developing children's reasoning skills, but there are other ways of achieving the same result that are just as effective;
- pretend play may be a way of developing children's social skills and awareness of others' minds ('Theory of Mind') but the evidence is mixed or unsatisfactory;
- pretend play could be crucial to the development of language, narrative skills and emotion regulation, but the evidence is very limited and more research is needed;
- There is little to no evidence that pretend play helps to develop children's creativity, intelligence, problem-solving, or self-regulation and executive functioning.

We identified 13 research studies into pretend play and learning outcomes that have been published since the Lillard et al. review. In this section, we describe these studies and assess whether they alter the conclusions drawn by Lillard and colleagues.

Learning in pretence and real contexts

One study, investigating children's ability to learn new information in pretence and real contexts, and directly addressing some of the methodological concerns expressed by Lillard et al., has been published by some of the authors involved in this original review (Hopkins, Dore & Lillard, 2015). In two tightly controlled studies using blind testers, 56 and 54 typically developing children aged 4,5-5,5 years were taught information of two types (labels and object functions) in a pretend

or real context. In each condition, they were taught a typical, atypical and novel function for two familiar objects (a screwdriver and a spoon), and the real object label and a new pretend label (a sprock and a coodle) for the object when it was used for the novel function. Intriguingly, when subsequently presented with a set of three objects, including the original objects and two others, children in the pretend condition were more likely to extend the pretend label to novel objects similar in appearance to the substitute used during the pretence episode, but children in the real condition were more likely to apply the pretend label only to the identical object used during the learning episode. The authors discuss various possible explanations for this difference in the quality of the information learnt in pretend and real contexts, and refer to Vygotsky's proposal that pretence is a ''zone of proximal development'' where children are capable of more complex thought than they would be otherwise.

Pretend play and creativity

We found three studies that addressed the relation between pretend play and creativity. Mottweiler and Taylor (2014) classified 75 4 to 5 year-old children based on the extent to which they engaged in elaborated role play, as assessed through an interview and parental questionnaire. Children were asked questions such as whether they had an imaginary friend, and if they often pretended to be someone they were not. They were also asked to perform actions with an imagined object (for example "pretend to brush your teeth with a toothbrush") to assess their current level of pretend play. As a measure of creativity, children were asked to provide endings to stories and to make drawings, both of which were rated for creativity by the experimenters. Children who engaged in more elaborate role play – particularly involving imaginary friends and pretend identities – scored significantly higher for creativity in their narratives.

Notably, in response to one of Lillard et al's criticisms of research in this area, the authors took steps in this study to control for experimenter bias, (e.g. conducting a separate analysis using scores from raters who had not collected the original data and did not know the children).

Wallace and Russ (2015) looked at how pretend play predicted the creativity of 31 privately educated girls over a four-year period, from when the girls were between 5 and 10 years old to when they were between 9 and 14 years old. Pretend play was assessed using the Affect in Play Scale, and creativity was measured with the Alternative Uses Task, where children are asked to think of different uses for common objects such as a key or a shoe. Children who were more imaginative and organised in their pretend play at the start of the study scored higher on the Alternative Uses Task four years later.

Both of the above studies suggest that pretend play and creativity are related, but they do not provide any evidence that pretence causes increases in children's

creativity. The only study found in this area to take a more experimental approach is that by Hoffmann and Russ (2016), who conducted an intervention study with a sample of 50 5 to 8-year-old girls. In groups of four the children took part in a play session twice a week for three weeks, and were asked to tell stories using the toys provided. A control group played with beads, puzzles and colouring books. Creativity was assessed within two weeks of the intervention ending, using a story book test and the Alternative Uses Task. For children in the intervention group, the level of organisation and imagination in pretend play (measured using the Affect in Play Scale) improved substantially over the course of the study compared to the control group. However, there were no significant improvements in either creativity measure in the intervention group compared to the control group. When the authors only included children who were scored low on the Affect in Play Scale at the start of the study, however, there was a significant improvement in creativity on the Alternative Uses Task for the intervention group compared to control. This is tentative evidence that pretend play might lead to improvements in creativity for children (or at least

girls) who are less advanced in their play skills than their peers, but the fact that the result is based on a sub-sample and only one outcome measure out of two means it should be treated with caution. Overall, these studies do not affect the conclusions of Lillard et al., suggesting that pretend play may be related to children's creativity, but there is little evidence that it improves children's creativity.

Pretence and executive functions

We also found four studies looking at pretend play and executive function outcomes. Pierucci, O'Brien, McInnis, Gilpin and Barber (2014) measured children's fantasy orientation, which is the extent to which children engage in fantastical pretence such as being a wizard or flying, rather than non-fantastical pretence such as being a fireman. Fantasy orientation was assessed through interviews and teacher and parent reports, and children's executive function measured using a variety of tests. They found correlations between specific types of fantasy orientation and specific executive function measures. Thus, while children's fantasy-related thoughts correlated with their ability to shift attention and their beliefs in fantastical entities or imaginary friends correlated with their inhibitory control, children who reported more favourite fantasy-related toys and games had lower scores for inhibitory control and working memory. Children's reported proclivity to pretend to be someone or something other than themselves also did not correlate with any executive function measures. At the same time, in a study of 104 4-year-old children, Carlson, White, and Davis-Unger (2014) found that understanding the distinction between pretence and reality, and engaging in more pretend behaviours, were both correlated with aspects of children's executive functioning.

In order to explore whether such a relationship between fantasy orientation and executive functioning is causal in nature, Thibodeau, Gilpin, Brown, & Meyer (2016) divided 110 children between 3 and 5 years

old into three different groups. Over a five-week period, children in the 'fantastical play' group were given regular sessions where imaginative fantastical play was supported and encouraged, children in the non-imaginative play group were supported to play with objects, balls, and games that involved minimal imaginative elements, and children in the control group engaged in normal classroom activities.

Results showed that children in the fantastical play group increased in their working memory scores over the course of the intervention, whereas children in the other two groups did not. Furthermore, the children who were most fantastical and highly engaged in the play were the ones who showed most improvement.

There were no significant changes in the other executive function measures (attention shifting and inhibitory control). This study addressed many of the methodological concerns raised by Lillard et al., so can be considered good evidence of a relationship between fantasy-oriented pretend play and working memory development, but not other aspects of executive functioning.

However, in an experimental study by White and Carlson (2016), children were asked to use different strategies to complete an executive function task based on attention switching. Five-year-olds who were encouraged to distance themselves from the task by pretending to be an imaginary character who was very good at the task (e.g. Batman), and children who were asked to think of themselves in the third-person while completing the task, both performed significantly

better than children in the control condition. However, this was not the case with 3-year-olds. These results add to earlier research by Singer (1961) and the study mentioned earlier by Manuilenko (1975), both discussed by Lillard et al., suggesting that pretence may be a strategy that children can apply to improve performance on certain executive function tasks. It could also be the case that whether such strategies are effective (and perhaps which are effective) changes with the age of the child.

Overall, the recent research on pretend play and executive functioning suggests some changes to the conclusions of Lillard et al. There is now evidence of a potential causal relationship between fantasy-oriented pretence and working memory development, and further indication that pretence may be a strategy that can be applied in executive function tasks. Both these hypotheses, however, need to be further examined in future research.

Pretend play and language

Conner, Kelly-Vance, Ryalls & Friehe (2014) reported the one study we found relating pretend play to language development. This involved 10 2 year-olds with whom they developed an intervention which included components of reading, modeling, and positive reinforcement of language and play. The children were read a story and played with a matching toy set. Five of the children received the play intervention, and five were used as a comparison. All the children were assessed using the Play in Early Childhood Evaluation System, the Preschool Language Scale and a Vocabulary Assessment. The results showed that children who received the intervention increased pretend play, comprehension and expressive communication skills more than the comparison group. Given the extremely small sample (with only 3 out of the 5 children in the play group contributing to the group improvement) this study adds little to the Lillard et al. conclusion that play is associated with language development, but no clear causal measure has been determined. As most previous studies in the

area have been conducted with 3-5 year-olds, this study's main contribution is to suggest that pretend play interventions are feasible with, and may have an impact upon, children as young as 2 years of age.

Pretence and emotion regulation

We found one study on emotion regulation. Gilpin, Brown and Pierucci (2015) measured the emotion regulation skills and fantasy orientation of 103 5-year-old children using checklists and questionnaires, and found that the two measures were correlated. This finding slightly expands the previous correlational finding of Shields and Cicchetti (1997), discussed by Lillard et al., in that it shows that there is a specific correlation with fantasy orientation in addition to pretence behaviour in general. However, this does not change Lillard et al.'s main conclusion, that whether pretend play helps develop emotion regulation is still very much an open question.

Pretence and social development

In one very recent study in Hong Kong, Fung & Cheng (2017) have reported evidence related to pretend play and social development. 60 5-year-old pre-schoolers with matched home pretend play time period were randomly assigned to pretend or non-pretend play groups to take part in a one-month play training. Children's pre- and post-training social competences were assessed, using the Peer Interactive Play Rating Scales, by two assistant teachers who did not take part in the play training. Results revealed a trend that girls who participated in the pretend play training tended to be less disruptive during peer interactions after the training than those who participated in non-pretend play, while boys benefited equally from the two play activities. This study is interesting in that it separated out the pretence element from general play, and that it showed a moderating effect of gender, which suggests further study. The authors argue that, due to their experimental design, their study goes some way to addressing the Lillard et al. conclusion that play may not be a primary source of social competence development.

Qu, Shen, Chee & Chen, (2015) conducted the one study we found relating to Theory of Mind (ToM). They randomly assigned 71 5-year-old kindergartners in Singapore to three groups: free play, socio-dramatic play or socio-dramatic play + ToM coaching. Each condition included four weekly sessions of 45 minutes. Before and after the training, children's ToM, language and executive functioning were measured. The results showed that socio-dramatic play positively predicted children's gains in ToM, and that teachers' ToM-related guidance during socio-dramatic play and children's pretest executive functioning positively predicted this effect of socio-dramatic play on children's ToM. This study would seem to provide some evidence, contrary to the conclusion of Lillard et al., that socio-dramatic play, a sophisticated form of pretence, might impact on ToM development. This is a potentially interesting route for further research, picking up on Bodrova, Germeroth & Leong's (2013) reminder of Vygotsky's distinction between immature and mature forms of play, particularly in relation to pretence.

Pretence and motivation
Finally, Sawyer (2017) investigated the impact of pretence on motivation. They allocated 38 preschool children to either a pretend play or non-play condition and gave them a fishing task. The two conditions differed only in how the task was initially framed by the experimenter, which was either as a chance for the child to pretend to be a fisherman, or as a challenge to the child to catch fish for sticker rewards. During the activity, the children in the pretend play condition demonstrated more types of self-directed speech associated with higher persistence on-task. These results indicate that framing an activity as pretence may increase children's motivation. However, the study did have a small sample and the experimenter was not blind to the test condition for each child, meaning experimenter-bias could have affected the results.

Summary
Here follows a revised version of the list provided at the beginning of the pretend play section in this review:

- pretend play is one way of developing children's reasoning skills, but there are other ways of achieving the same result that are just as effective;
- pretend play may be a way of developing children's social skills and awareness of others' minds ('Theory of mind'). Most of the evidence is mixed or unsatisfactory, but there is good evidence from one recent study that pretend play may have an impact on social development;
- pretend play could be crucial to the development of language, narrative skills and emotion regulation, but the evidence is very limited and more research is needed;
- there are differences in the quality of learning and applications of learning when children learn in pretence versus non-pretence contexts;
- there is some good new evidence that pretend play – and particularly fantasy-oriented pretence – may relate to learning-to-learn skills such as executive function and self-regulation;
- There is very tentative evidence for a link between pretence and motivation.

Once again, a range of open questions remain, some of which have been touched upon in the existing studies, which need to be addressed by future research:

- How does pretence change the learning experience of children? Is it primarily a motivator, or does it affect learning in other ways?
- What are the implications of findings about pretence and development for cultures where pretend play is discouraged and does not occur frequently?
- How are pretence and counterfactual reasoning related?

Games with rules

Young children are strongly motivated by the need to make sense of their world and, as part of this, they are very interested in rules. From a very young age children begin to enjoy games with rules, and to invent their own. These include physical games such as chasing games, hide-and-seek, throwing and catching etc. As children mature, electronic and computer games, and the whole variety of sporting activities emerge. In young children, a considerable proportion of the time and energy spent playing games is devoted to establishing, agreeing, modifying and reminding one another about the rules. As well as helping children to develop their understandings about rules, the main developmental contribution of playing games derives from their essentially social nature. While playing games with their friends, siblings and parents, it has been argued that young children are learning a range of social skills related to sharing, taking turns, understanding others' perspectives and so on.

Due to the current level of interest in computer games, there have been a number of systematic reviews of the research in this area. For the purposes of this brief review, it is probably simplest to quote the abstract from the latest of these authored by Boyle, Hainey, Connolly, Gray, Earp, Ott, … & Pereira, J. (2016):

'Continuing interest in digital games indicated that it would be useful to update Connolly et al.'s (2012) systematic literature review of empirical evidence about the positive impacts and outcomes of games. Since a large number of papers was identified in the period from 2009 to 2014, the current review focused on 143 papers that provided higher quality evidence about the positive outcomes of games. Connolly et al.'s multidimensional analysis of games and their outcomes provided a useful framework for organising the varied research in this

area. The most frequently occurring outcome reported for games for learning was knowledge acquisition, while entertainment games addressed a broader range of affective, behaviour change, perceptual and cognitive and physiological outcomes. Games for learning were found across varied topics with STEM subjects and health the most popular. Future research on digital games would benefit from a systematic programme of experimental work, examining in detail which game features are most effective in promoting engagement and supporting learning.'

There appear, however, to be no existing systematic reviews of empirical research on non-computer games with rules or board games and child outcomes. Hassinger-Das et al. (2017) consider how games can scaffold children's learning in a similar way to an adult, foster curiosity and require the inhibition of reality. They give examples from research with digital games, playground games, board and card games. DeVries (2006) has reviewed Piaget's seminal contribution to the analysis of children's games, particularly his analysis of stages in their play with marbles, and his proposals concerning their contribution to social and moral development. She also reviews her subsequent analyses, based on observations of children playing 'Guess-which-hand-the-penny-is-in' and 'Tic-Tac-Toe' suggesting that the former supports children's ability to take the perspective of another, and the latter to be flexible in their use of strategies. She concludes by arguing that, in broad agreement with Piaget's view, playing games with rules supports aspects of children's social-moral and intellectual development.

Games and socio-cultural development

Two other largely theoretical papers are worth mentioning. Oren (2008) outlines the way board games can be used in child psychotherapy and gives examples of how they facilitate children's shifting perspectives as part of the therapeutic process. Hromek & Roffey (2009), similarly, discuss the use of games during "circle time" in social and emotional learning approaches in schools. They review the theoretical and practical literature on the use of games to facilitate social and emotional learning and argue that games are a powerful way of developing social and emotional learning in children. These articles, however, epitomise a reasonably extensive literature in these applied areas, in that the evidence cited is largely anecdotal, based on case studies, or of an inferential nature, based on theory.

Playground games and social skills

The very small number of reasonably rigorous empirical studies of games with rules have focused on children's playground or out-of-school games and on board games involving numbers. In the first category, Pellegrini, Kato, Blatchford & Baines (2002), observed 77 6-7-year-old children's playground games for one school year in two inner-city schools. They concluded that facility with games (ball games, chase, and jumping or singing games), particularly for boys, was related to social competence with their peers and adjustment to very early schooling (as assessed by self-report and teacher ratings). Regression analyses showed that game facility predicted unique and significant variance in children's end-of-year social competence (measured by teacher rating scales and peer nominations of popularity), beyond that predicted by beginning-of-year social competence and in end-of-year adjustment. This suggests that games with a strong social element – such as most playground games – could help children develop their social networks and a sense of belonging in the school environment.

In a second study in this area, however, Lehrer, Petrakos & Venkatesh (2014) investigated whether time spent in unstructured play outside of school predicted 6-7-year-old children's creativity, cognitive, social, or emotional outcomes in school, but largely produced negative results. In particular, as regards games with rules, they found no significant correlations between the amount of time children spent engaged in 'board games and puzzles' and any of their outcome measures.

Board games and numbers

The research on board games involving numbers principally derives from two experimental studies by Siegler & Ramani (2008) and Ramani & Siegler (2008) with 4-5-year-old children from low-income households. In the first study 36 children were randomly assigned to an experimental group who played a board game that used numbers to move around the board, and a control group that used colours. After four 15-minute sessions over a two-week period, only the children in the experimental group showed significant improvement on a number line investigation task. In the second study, using the same procedure but with a larger sample of 125 children, and more extensive testing, they showed that playing the number board game resulted in substantial improvements on four different tasks assessing number knowledge and that this improvement remained strongly apparent 9 weeks later. In a subsequent survey of 145 4 to 5-year-old children children's game playing, also reported in Ramani & Siegler (2008), they found that children who played board games in more contexts had significantly more number knowledge than other children. Analysis also showed that children who reported playing Chutes and Ladders had significantly higher numerical knowledge than those who did not.

In a more recent study with 88 3-5-year-olds, Cheung & McBride (2016) looked at parents playing games with their children and investigated the effects of training parents in strategy-use during game playing, to see if this would have an effect on the learning of their children. Specifically they investigated improvements in rote counting, numerical identification, mathematics interest and addition. After a 4-week intervention, with two 15-minute sessions per week, children in the 'Game with parent training' group improved on all four outcome measures while children in the 'Game without parent training' group improved on numerical identification and mathematics interest. Therefore, there is evidence that board games involving numbers appear to help children's number-based skills, and may lead to children having a greater interest in mathematics, perhaps because they have experienced it and its applications in a fun, relaxed context.

Games and spatial skills

Two recent studies have begun to investigate neuroscientific aspects of game playing. Wan, Nakatani, Ueno, Asamizuya, Cheng & Tanaka (2011) carried out an interesting study identifying which areas of the brain are activated when expert adult players make choices about the 'next best move' in the board game Shogi. However, this study tells us nothing about development. Newman, Hansen & Gutierrez (2016), on the other hand, in a study with 8-year-olds, investigated the effects of playing two different games (Block building or Scrabble) on spatial ability, with pre and post-tests involving a computerised mental rotation test with reaction time as the outcome measure, and fMRI scans. Not surprisingly, only the block play group showed significant training effects on the mental rotation test and increased activation in brain regions associated with spatial processing. However, what this tells us about the specific effects of playing games with rules is not clear.

Games: an untapped field of study

Overall, then, while there has been much theoretical speculation regarding the social, moral and intellectual benefits of playing games with rules, the evidence base, apart from that relating to computer games, comes down to a handful of studies. The key theoretical point about games with rules, that their essentially social nature supports children's social and moral development, has been supported, for boys at least, by one study. As regards intellectual benefits, there are 3 or 4 studies supporting some gains, over a short period of time, for aspects of numeracy. There is a considerable body of research regarding the impacts of computer games, which we have not covered in this brief review. However, in their recent review of this field, Boyle et al (2016) express disappointment that games designed to promote learning are mostly concerned with knowledge transmission and the strongest evidence for impact on more fundamental learning skills arise inadvertently from entertainment games. A few studies have begun to investigate which elements within computer games (e.g. competition versus co-operation) have most influence on their impact, but little of substance has yet to emerge from this. No studies of non-computer games have undertaken this kind of analysis.

Clearly the study of games with rules, particularly those not involving a computer, is very much in its infancy. At the moment the field is enjoying something of a resurgence due to the popularity of computer games, but there are no studies, as far as we are aware, of the differential effects of playing the same games on or off-screen. A vast range of un-addressed and un-answered questions therefore remain. Principal amongst these, that would be most productive in relation to the general field of play and learning, would be the analysis of which game features influence any impact on social, emotional of cognitive outcomes. It may be simply that the social aspects of games increase motivation and engagement and thus increase any potential developmental outcomes. Or, the social interaction in a game playing context might be beneficial to broader aspects of social competence. The problem-solving element in some games, with the inevitably iterative patterns of behaviour therefore induced, might support the development of mental strategy development and metacognitive review, which in turn enhances creative thinking. As with the entire field of play research, there is much to discover.

Summary

- board games (particularly those with numbers and linear number sequences) lead to improvements in numeracy/mathematics ability;
- physical games with rules help children (and especially boys) adapt to formal schooling;
- games with rules may act as a proxy for an adult scaffolding and guiding children's learning, while also giving the child freedom and choice in their activity.

- Most studies of games with rules and learning explore knowledge transmission – i.e. how games support children's acquisition of knowledge in specific domains (mathematics, chemistry etc). There is little research looking at games with rules and more fundamental learning to learn skills like executive functioning and self-regulation.
- Games with rules have been advocated as tools for therapeutic use, but there is very little rigorous research with large samples exploring their therapeutic value.
- It is unclear whether and how different types of games with rules – specifically solo versus social games and board games versus computer games – affect children's development and learning in different ways.

Closing thoughts

When and how is play more effective than other contexts for learning? As outlined in the previous sections, there is evidence, among other things, that:

- physical play is linked to motor development, and some tentative evidence that it is linked to social development;
- unstructured breaks from cognitive tasks improve learning and attention, though it is unclear whether play leads to greater improvements in learning than simply taking a break and, for example, talking with friends;
- block play leads to improvements in spatial processing/mental rotation;
- construction play relates to language development, and this relationship may be strongest in infancy, with pretend play becoming more important for language as children enter toddlerhood;
- word-play and word-games relate to language development;
- pretend play relates to language development, and particularly narrative skills;
- pretend play – and particularly fantasy-oriented pretence – may relate to learning-to-learn skills such as executive function and self-regulation.
- board games (particularly those with numbers and linear number sequences) lead to improvements in numeracy/mathematics ability;
- physical games with rules help children (and especially boys) adapt to formal schooling.

The majority of these findings relate to learning outcomes in specific domains, such as motor development or spatial processing, rather than domain general learning-to-learn skills. The one exception is recent evidence suggesting a role for fantasy-oriented pretence in executive function and self-regulation, but overall it is clear that more research into how play may help develop domain-general learning skills is needed. Also, to make stronger conclusions about the importance of learning through play, we need to look at studies comparing play to other learning contexts. Not many such studies have been conducted, but the results from those that do exist suggest how the five characteristics of playful experiences set out in the Zosh et al. (2017) white paper may facilitate learning through play. These suggested relationships between the research on the five types of play and development, and the five characteristics, are described on the following pages.

Joyful and actively engaging

Children who perceive an activity as play are more focused, attentive, motivated and show signs of higher well-being while on-task (Howard & McInnes, 2013; Sawyer, 2017). This suggests that perceiving an activity as play creates active engagement and joy, which leads to children being in the appropriate cognitive and emotional state to remain on-task and process information. This increased level of engagement, and the dopamine chemical reward system activated through joyful experience, is likely to underpin the efficacy of learning through play in all contexts and types of playful activity. But in addition to this, various studies show how social interaction, meaning and iteration can also be important factors in children's learning.

Socially interactive

Lehrer at al. (2014) assessed whether the activities children engaged in during their unstructured time predicted their 'adaptive skills' (as measured on the teacher-report BASC-2 measure). Children's adaptive skills were correlated with time spent in 'active physical play', but when all predictors were entered into a regression model the only one that remained significant was 'watching other children play'. While this study did not compare play to other learning contexts, it does suggest an important role for the social aspect of play in enhancing children's learning outcomes. Similarly, Pellegrini (1992) found that 5-year-old children's level of social interaction with other children during recess predicted their school achievement, whereas their level of social interaction with teachers during recess was negatively related to their school achievement.

Playing with other children, watching them and learning from them, may be one of the ways in which playful learning exerts its effect. In a recent study of children building collaboratively in a playful context to support their narrative and writing skills (reported in Whitebread, Jameson & Basilio, 2015) playfulness within the group was very significantly related to the level of socially-shared regulation, which suggests a mediating role for play in supporting effective group-work, demonstrated in many studies to have a clear positive impact on children's learning.

However, children can also learn from adults in playful contexts. While Pellegrini (1992) found that interactions with adults during recess were negatively related to school achievement, this could have been because teachers interacted more with children with behavioural problems, and/or children, who were

struggling to adapt to school, may have approached teachers for comfort or support. It would therefore be behavioural problems and difficulties adapting to school that were negatively related to school achievement, rather than interactions with teachers causing a reduction in children's school achievement.

Cheung and McBride (2016) compared children playing a number board game with parents who had been trained to use strategies to help children think about the game (assessing number magnitude, counting squares, predicting outcomes, etc.) with children playing with untrained parents and children doing mathematics problems from an exercise book. The children who played with trained parents improved on all four numeracy outcome measures. The children with non-trained parents improved on numerical identification and mathematics interest. The children with the exercise book improved on addition. Children in the control group (who did nothing different to their normal daily routine), improved on numerical identification.

These results demonstrate that playful interaction with a knowledgeable adult can be a more effective context for learning than traditional teaching approaches such as completing problems in an exercise book. We can see that learning from others – both adults and children – through social interaction explains some of the ways in which playful learning can be superior to other learning approaches. Future research could explore this further by comparing when and how children learn from other children versus adults through play. Furthermore, it seems possible that playing with others could also be detrimental to learning in some situations – for example if the play partner passes on false information or a deficient strategy. We do not

yet understand whether the positive effects of social interaction in play are predominantly the result of learning information from the play partner, or if there are other aspects of the social experience that are important, such as learning about other people or increasing one's social confidence, which could exert a positive effect even in the presence of an ignorant or misguided play partner.

Meaningful

It is interesting that in the study by Cheung and McBride (2016), the difference between the children with non-trained parents and those in the control group lay in mathematics interest. The children who simply played the number board game became more interested in mathematics, and one explanation for this result is that numbers now had more meaning for them – they had found a new context in their lives in which numbers could be applied, and that context was fun! Although the children given the traditional teaching approach of mathematics exercises outperformed the board game children on addition, their interest in mathematics did not increase. Learning about numbers from conducting abstract exercises would not have shown them any new ways of applying numbers in their lives.

Studies comparing engagement in pretend play with other learning contexts also suggest an important role for meaning-making in explaining play's effect. Dansky (1980) found that sociodramatic play led to children developing higher narrative skills than other conditions with equal adult contact, showing that social interactions with a more knowledgeable partner is not the important factor in this case. Baumer, Ferholt & Lecusay (2005) compared how pretending versus story talk influenced narrative development, and pretending led to superior outcomes.

As with the comparison of the number board game and mathematics exercises by Cheung and McBride (2016), the important element here could be the level of personal connection and the extent to which children can create meaning by integrating their learning into other aspects of their life. When pretending, a child needs to draw on their own personal experience and interests in order to generate ideas for characters and situations. Discussing a story, by contrast, can remain a relatively abstract, detached activity. Of course, it is possible that children could talk about how a story reflects their own experience, and it is unclear whether children did this, or to what extent, in the Baumer et al. (2005) study. An interesting avenue for future research would be to use experimental designs to assess the extent to which creating meaning during learning (in terms of how links are made to a child's personal experience) can explain learning outcomes.

Iterative

While the studies discussed above likely involved some level of iterative activity, it is difficult to know how much, and children may well engage in board games and pretend play without much repetition-with-variation. However, studies of play with objects demonstrate how iteration may explain some of playful learning's effects. In the study by Smith & Dutton (1979), before being asked to solve a problem (involving retrieving a marble) children were either trained in using materials, or were allowed to play with the materials. Both groups outperformed children in the control group in solving the simple problem that required two sticks to be connected. For the more complex problem, which required three sticks to be connected, both groups again outperformed children in the control group, but the play group also outperformed the trained group. Other studies using this method have found similar results (Hutt et al., 1989; Sylva, Bruner, & Genova, 1976).

What is different about the play condition compared to the training condition in such studies? The play in this case is clearly iterative, as children would have tried out different actions with the materials and different ways of connecting the sticks. In fact, it is likely that the play condition would have involved a higher level of iteration than the training condition, because children are more likely to try more alternative actions with the materials than the actions demonstrated by the adult. When tested on the simpler problem, which required connecting two sticks, both groups performed equally well. However, for the more complex problem, the play group probably had a better understanding of the range of possible actions with the sticks than children in the training condition, and so performed at a higher level. Therefore, these studies of object play demonstrate how the iterative nature of play can make it a more effective learning context for innovative problem-solving.

Two much more recent studies have provided additional support to this aspect of playful learning. In their studies of the impact of pedagogical approaches on children's exploratory play, Bonawitz, Shafto, Gweon, Goodman, Spelke & Schulz (2011) found that pre-schoolers restricted their exploration of a toy to its demonstrated function both after direct instruction to themselves and after overhearing direct instruction given to another child. By contrast, intriguingly, they explored more widely after observing direct instruction given to an adult or an adult performing an action with the toy with no instructional element. Bonawitz et al. concluded that instruction appeared to promote efficient learning, but at the cost of reducing children's exploration and their likelihood of discovering novel information. In a similar vein, Ramani (2012) reported a study in which four- and five-year-old peer dyads completed a playful, flexible and child-driven building task or a more structured, adult-driven building task. As predicted, the children in the playful condition engaged in greater positive joint communication and built more complex structures than did those in the structured condition, and these differences carried over into a subsequent joint building task. Ramani concluded that cooperative problem-solving activities that allow children greater control of the task goals and interaction, similar to play contexts, appear to promote higher levels of cooperation and more effective learning and performance in young children.

In sum, certain studies from the existing body of research into play types and child outcomes support the hypothesis that the five characteristics of playful experiences are the main factors that facilitate learning through play. However, more research is needed to confirm this hypothesis.

Finally, although there is some suggestive evidence about the role of play in supporting the development of communication skills, of abstract thought, self-regulation,and more adaptive, flexible, creative thinking, we still do not have conclusive evidence of causal relations.

It is still largely an open question as to whether children are more playful if they have more enhanced abilities in these other aspects of development, or if these other developments depend upon the sophistication and maturity of children's play.
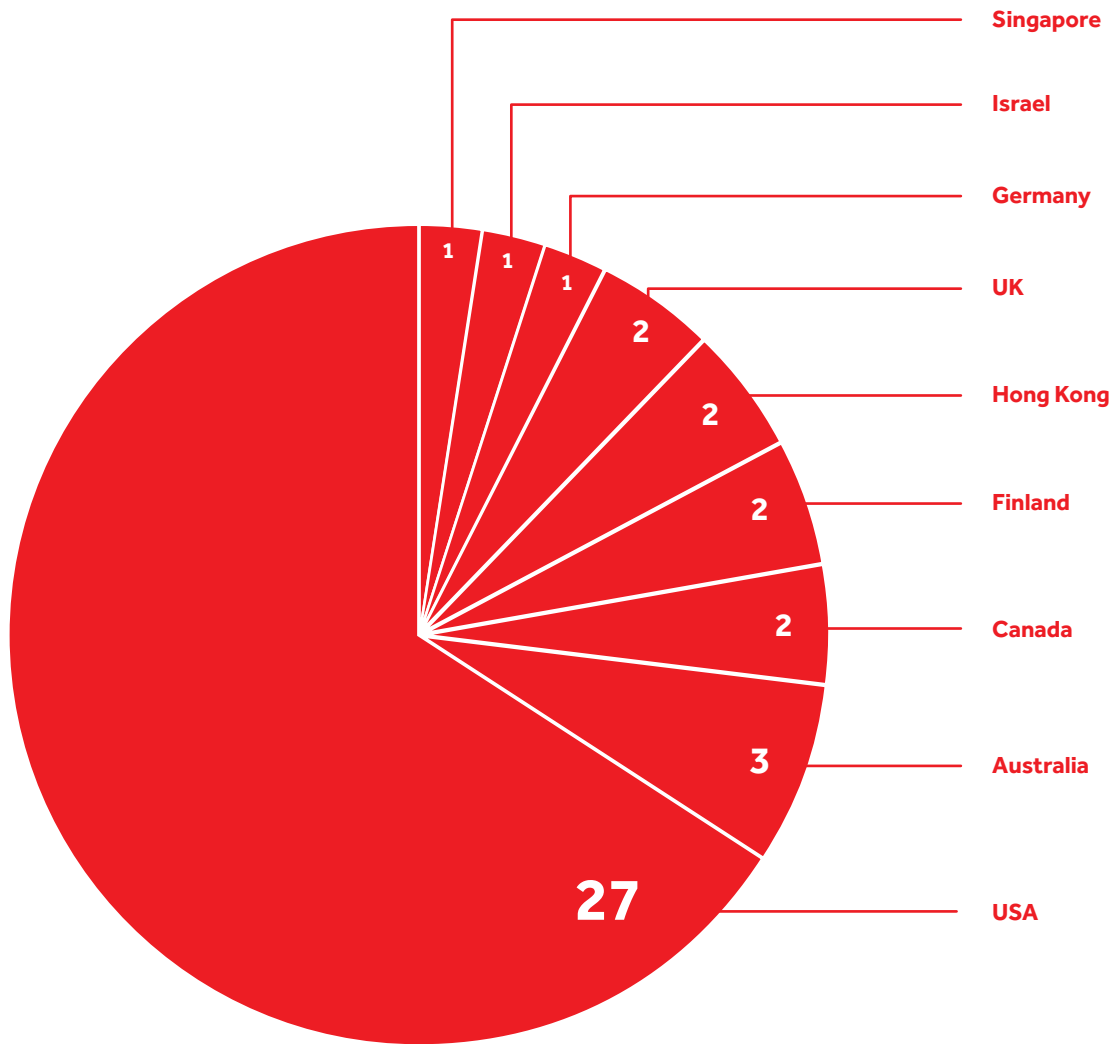
What we know:

- Perceiving an activity as play seems to lead to higher levels of joy and active engagement.
- Social interaction during play is sometimes linked to improved learning outcomes.
- Pretending may lead to improved outcomes because children make more meaningful links to their own knowledge and experience.
- Iterative play may lead to more creative, innovative ways of thinking and problem-solving.

What we don't know:

- What is the relative contribution of joy and active engagement to learning through play? Are they both required for learning to occur?
- What is it about social interaction that can improve learning outcomes? Is it the knowledge transmitted by the play partner, increases in confidence and communication skills, or something else?
- Does pretence make children create meaningful links to their own experience, compared to other learning contexts and other types of play?
- How much effect does meaning have on learning during play? Is there a large or small difference in learning if children can link material to their own experience?
- Under what conditions, if any, are the characteristics detrimental to learning? Particularly for social interaction, it seems logical that playing with an ignorant or misguided partner could lead to reduced or maladaptive learning.

Geographic Distribution of play research reviewed in this report:

Singapore — 1

Israel — 1

Germany — 1

UK — 2

Hong Kong — 2

Finland — 2

Canada — 2

Australia — 3

USA — 27

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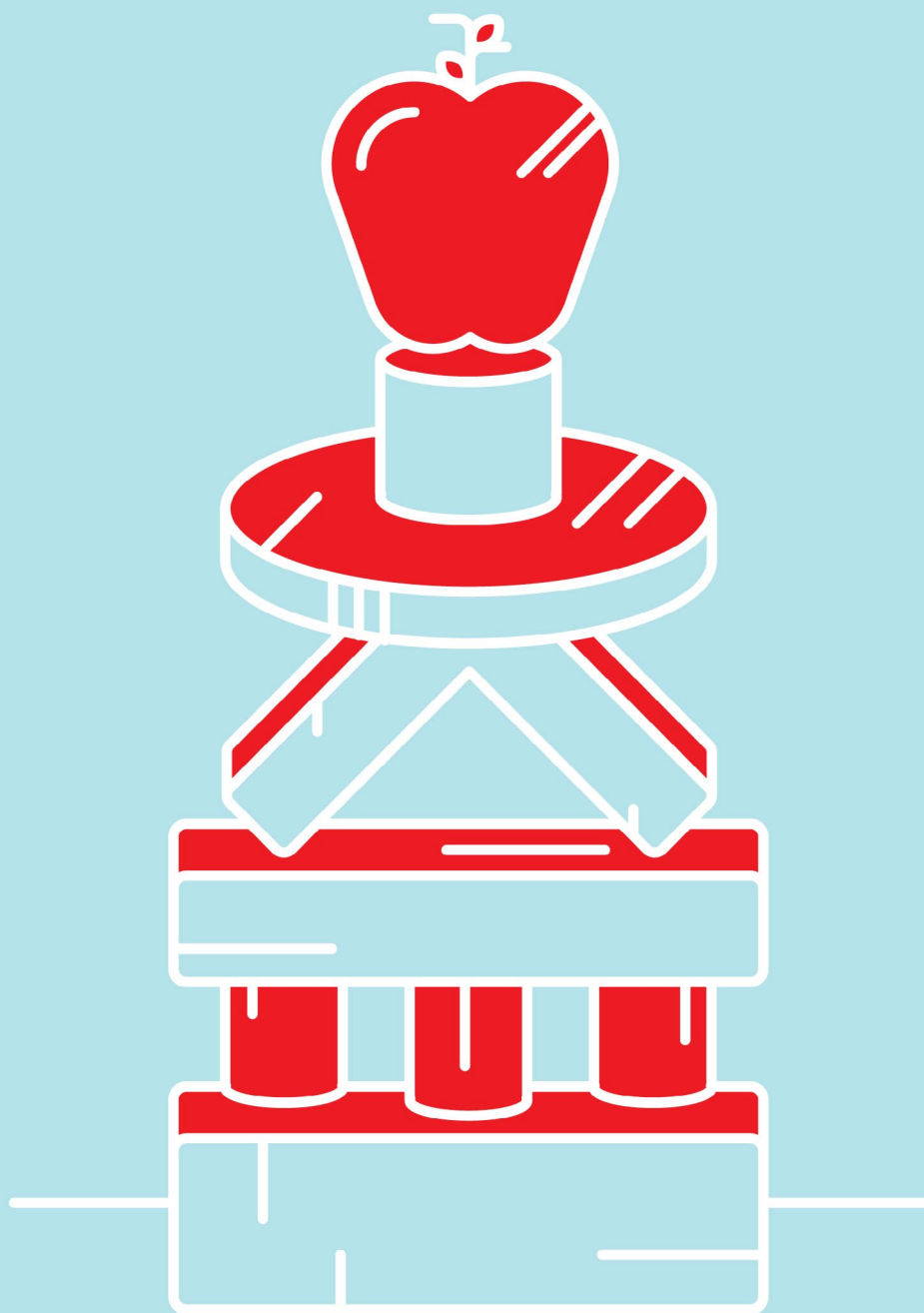
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