

## Opinion

Why Do the Children  
(Pretend) Play?Angeline S. Lillard<sup>1,\*</sup>

**Pretend play appears to be an evolved behavior because it is universal and appears on a set schedule. However, no specific functions have been determined for pretend play and empirical tests for its functions in humans are elusive. Yet animal play fighting can serve as an analog, as both activities involve as-if, metacommunicative signaling and symbolism. In the rat and some other animals, adaptive functions of play fighting include assisting social behavior and emotion regulation. Research is presented suggesting that pretend play might serve similar functions for humans.**

**The Conundrum of Pretend Play**

Pretend play is a signature behavior of early childhood. Children pretend to be other people, that one object is another, and even that nonexistent things exist – all apparently with full knowledge of what the real situation is. Pretend play usually begins with object substitution at around 12–18 months of age, peaks at around 3–5 years with pretend identities and complex social situations [1,2], and ceases altogether (on average) at 11 years, although some people continue to pretend play into adulthood [3]. For example, adults sometimes pretend to be famous people going about their business. In addition, certain recreational adult behaviors (theater acting, art appreciation) have been argued to be a form of pretend play [4]. In addition to its predictable developmental schedule, pretend play is culturally universal [5–7]. Although the frequency and content of pretend play vary across cultures, its occurrence and basic schedule do not. Pretend play occurs even in settings where parents discourage it, although its schedule is slightly delayed [8,9].

These two features – a predictable developmental sequence and universality – suggest an evolved behavior. Current thinking on the evolution of play generally is that it arose independently and sporadically across the animal kingdom (it occurs in five of 30 phyla) under specific conditions and has come to serve different adaptive roles for different species [10]. If pretend play is adaptive in humans, to what ends? One possibility is that it serves (or, at a time in our evolutionary past, served) reproductive fitness directly, but an alternative is that pretend play naturally co-occurs with some other fitness-enhancing capacity, like the ability to use symbols. That is, is pretend play a human-typical adaptation or is it a byproduct of other, unique adaptations present in humans? With humans, of course, the possibility of running an experiment to test hypotheses on this point is limited. We cannot assign children randomly to a ‘no-pretend-play’ condition because pretend play arises spontaneously. We can look at what happens when there is more versus less pretend play, but such studies have yielded inconsistent results and do not address the possibility that there is a baseline level beyond which any amount of pretend play yields benefits [11].

**Natural Human Experiments Associated with Variation in Pretend Play**

Still, it is helpful to consider natural experiments where pretend play is less frequent or even absent. Lack of ‘varied, spontaneous, make-believe play’ was diagnostic for autism in the

## Trends

The study of play in both animals and humans is flourishing.

The purpose of human pretend play is not known.

By analogy to play fighting in animals, evidence is presented suggesting that pretend play might improve sensitivity to social signals and emotion regulation in humans.

<sup>1</sup>Department of Psychology, University of Virginia, PO Box 400400, Charlottesville, VA 22904-4400, USA

\*Correspondence: Lillard@virginia.edu (A.S. Lillard).

previous edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM) [12]; recently, both the diagnosis and the criteria changed somewhat, so in the DSM V lack of ‘shared symbolic play’ became a diagnostic criterion for ‘autism spectrum disorder’ (ASD) [13]. However, because ASD is a very complex disorder that manifests in myriad ways in different people it is unlikely to reveal the selective value of pretend play. For example, pretend play might be lacking in children with autism because of motivation rather than ability; one study found that many children with autism could pretend when specifically instructed to do so [14]. However, this does not mean that all non-pretending ASD children fail to pretend because they lack motivation. As research discussed later suggests, early pretending is facilitated by reading others’ social communicative cues. ASD also involves social-communicative difficulties; namely, reduced ability to interpret social signals [15]. Inability to read social signals might diminish pretend play. Alternatively, the lack of pretend play among ASD children might give rise to further social-communicative difficulties – or both, or neither. ASD is problematic as a natural experiment in revealing the functions of human pretend play.

Another human case where pretend play is infrequent is early social deprivation. A recent ‘real-world experiment’ occurred in Romania, where under the Ceausescu regime many babies were placed in institutions where they experienced very little human interaction. Eventually, after the regime fell, many of these children were adopted into families and also became participants in research on the effects of early social deprivation [16]. Unlike those adopted later, Romanian orphans adopted very young (before 6 months) show few differences from children without institutional experience. Their pretend play is an exception to this. Romanian orphans adopted to the UK before 6 months of age, compared with within-UK adoptees who did not experience severe social deprivation in infancy, showed significantly less pretend play in a structured observation at 4 years old [17]. This is an interesting finding in suggesting that absence of normal caregiver interactions very early in life – well before the appearance of pretend play – reduces the frequency of pretend play later.

For this group of children who pretend play less, are there predictable sequelae that might suggest how pretend play enhances fitness? Unfortunately, further papers from the group make no mention of a relation. This includes a paper that specifically addressed factors that are often claimed (although without convincing evidence; see [13]) to be influenced by pretend play, like theory of mind and executive function [18]. Thus, while the circumstances of the Romanian adoptees, including severely reduced early interaction, were associated with reduced levels of pretend play and also later with poorer executive function and theory of mind task performance, it is unclear whether the pretend play led to the latter, whether something else (possibly the reduced interaction) led to both, or whether differing factors led to each deficit.

In sum, human cases manifesting more and less pretend play do not shed much light on its possible function for reproductive fitness. Animal models might be a better place to look because we can experimentally manipulate animal play at least better than we can human play. Happily, the science of animal play has shown a resurgence in recent years.

### **Animal Play Fighting as an Analog of Pretend Play**

A first issue is whether nonhuman animals do anything like human pretend play. Although there are reports of animals apparently pretending with substitute objects, several of these are from human-reared primates and dolphins [19,20]. Human pretend play seems to be unique in its regularity, flexibility, and ubiquity across contexts [19,21]. However, there are two behaviors seen in some animals that could be viewed as analogs to pretend play. One, observed particularly among domestic cats and dogs, is playing with objects as if the objects were live prey [22]. Interestingly, as cats mature, the object needs to become increasingly – but never entirely – mouse-like for such play to be elicited [23]. By contrast, as children age objects can be

less like their real counterparts [24]. Because cats' predatory play behavior becomes increasingly stimulus bound with age, it is not a great analog for human pretend play.

The other possible animal analog to pretend play is a form of social locomotor play; namely, play fighting, in which one animal tries to gain advantage over another temporarily [25,26]. In play fighting players switch roles regularly and fight behaviors are typically truncated. In many species play fighting continues into adulthood, but it does not become more stimulus bound with age. Play fighting and pretend play both fit Burghardt's [27] very useful definition of play (see also [28]). In brief, Burghardt's criteria for play are that: it is not fully functional (e.g., for survival); it is voluntary and pleasurable; it differs in form or some other way from the functional expression; it is repeated; and it tends to occur under conditions of abundance, not stress. Both play fighting and pretend play fit these criteria: is there pretense in play fighting?

I maintain that play fighting can be viewed as an analog of pretend play because play fighting behaviors are issued and interpreted 'as if' they were real fighting behaviors. There are three important similarities to consider.

First, pretending involves the imposition of one reality over another, creating an 'as-if' world [29]. The degree to which pretending also requires intentional and knowing representation of the as-if world [30] is important here [19] because it is not clear that play-fighting animals are representing a real fight or understand the relation between their pretend and real fighting actions. At the least, play-fighting animals are acting as if they are having a real fight and exploring 'what it means to [have a real fight] without having to do it' ([31], see p. 67). Take a 1-year-old pretending to talk on the telephone. The degree to which a child of this age might be representing a real telephone conversation is unclear, but the child is clearly representing scripted actions while enacting those actions in the absence of an actual telephone. At least a rudimentary form of pretend play is occurring here, and therefore also in play fighting.

Note that humans also engage in play fighting and, furthermore, they sometimes superimpose another layer of pretending on those actions; for example, pretending they are fighting cowboys and Indians (for a discussion see [32]). I do not explore this further here because the point of considering animal play is to shed light on the functions of pretend play in humans using methods one cannot use with humans. Even if new identities are not projected on to the players, play fighting can be seen as sharing key elements with pretend play in that the behaviors engaged in resemble and represent analogous real behaviors.

The second important similarity between play fighting and pretend play is that both are communicated in specific, ritualized ways so participants know clearly that they are partaking in the as-if rather than the real world; if they did not know this, real fighting behaviors would ensue. Animals have ritualized ways that they engage in play fighting, signaling conspecifics to take their behaviors as pretend [33]. For example, when rats play fight they target and nuzzle the nape of the neck, whereas in real fighting they bite the flanks and lower back [34]. Rats emit high-pitched ultrasonic signals while play fighting [35] that, at least in adult rats, appear to signal 'play' and prevent escalation into aggressive fighting [36]. Dogs and other canids signal play fighting by punctuating actions with 'play bows' [37,38]. Such signals are most common after ambiguous acts in which a rough play bite, for example, might have been misinterpreted as a real bite. In chimpanzees there is the 'play face' [39]. Human children also use ritualized cues in play fighting that enable others to read their behaviors as play [40]. Bateson referred to this signaling as 'metacommunication' and noted that play fighting 'could only occur if the participant organisms were capable to some degree of metacommunication, i.e., of exchanging signals which would carry the message, "this is play"' [41]. The degree to which animals are

self-consciously aware of this is debatable but the fact that such signals are emitted and interpreted is not.

The third important similarity between pretend play and play fighting is related to the first one but is different. It is that, for both pretend play and play fighting, what happens in the as-if situation symbolizes what is real and the players must know this at some level. This is slightly different from the metacommunicative signals just mentioned, because here the message is within the act rather than something surrounding the act. As Bateson [42] also pointed out, an animal that is engaged in play fighting must read a behavior as denoting a behavior different from the behavior it resembles: 'The playful nip denotes the bite, but it does not denote what would be denoted by the bite' ([42], see p. 180). In other words, the playful nip is a pretend bite, just as a child can pretend-talk into a pretend phone to symbolize really talking into a real phone. In this way both pretend play and play fighting behaviors are symbolic. They mean something other than what they are.

In three ways, then, pretend play and play fighting are isomorphic. Both involve an as-if world, both are communicated through ritualized signals, and in both what occurs in the expressed level (the nip or the mock talking) is symbolic of a different, unexpressed level (the bite or real talking).

As mentioned above, not all animals engage in play fighting; rather, it occurs in isolated species across the animal kingdom, suggesting it arose independently in different lineages [26] rather than emerging at some point in the animal tree and then remaining genetically encoded (and phenotypically expressed) in later animals in that tree. Given its spotty appearance in the animal kingdom, what purposes might play fighting serve (if any) and might some of those purposes also be served in humans by pretend play? For some species empirical tests have shown that play fighting does serve specific functions, and the functions can differ by species. We are on weak ground in extrapolating from play fighting to a function for pretend play in humans, but given the possibility of parallel evolution (which has been seen in some cases for functions of animal play fighting), it could be fruitful to examine.

### Developmental Sequelae of Play Fighting in Animals

A difficulty in studying the purpose of play fighting is creating proper empirical conditions. Because play fighting requires adversaries, social isolation prevents play fighting, but it also prevents much more than that, confounding the variable of interest. With laboratory rats, one approach to partially rectify this is to house a single baby rat with an adult female rat. The adult female socializes with the baby but will not play fight. This research design is not perfect since littermates (in addition to a mother) are the norm, but the approach has revealed deficits that are attributed to lack of play fighting during the juvenile period for this species. As adults, laboratory rats who were deprived of juvenile play later mistake play fighting bids from other adults as real fighting bids [43]. In other words, they are impaired in their abilities to read social signals, like people with ASD. They also do not copulate normally, which is attributed to a failure to coordinate their bodies with others' bodies [44]. In addition, play deprivation influences the development of the medial prefrontal cortex [45], reducing long-range inhibitory circuits (for a discussion see [46]). This might be because an important feature of play fighting is truncation of behaviors: animals hold back, inhibiting the full extent of aggression. Taking turns at being dominant also involves inhibition. Perhaps play fighting exercises and strengthens the neural circuitry of inhibition, and in the absence of play fighting that circuitry fails to fully develop.

In sum, in laboratory rats lack of play fighting as juveniles leads to later impairments in reading of social signals, social coordination, and stress regulation. Similar paradigms with nonhuman primates suggest that juvenile play also improves their social skills; for example, it influences

how well adults read others' social signals [46]. Related to this, play fighting (both juvenile and adult) also appears to reinforce dominance hierarchies in both nonhuman and human primates [40,47,48].

Having argued that play fighting is an analog to pretend play in three important ways and that play fighting has specific functions at least in the laboratory rat and some other species (see also [20,28]), I next ask whether there is evidence that human pretend play might serve similar functions.

### Human Pretend Play

There is evidence suggesting that pretend play in humans involves the reading of social signals and that this might be closely tied to the development of a symbolic function. There is also some evidence that pretend play might have a role in the development of self-regulation.

#### Reading Social Signals and the Symbolic Function

First, human pretend play arises in social contexts (especially parent–child interactions in middle-class American culture) and requires proper interpretation of social signals [49]. Parents pretend in front of very young children [50] and children who do not correctly interpret their parents' pretend behavior as pretend could become confused about the real world – mistaking bananas for telephones, for example. Addressing this problem, when mothers pretend in front of their children they emit specific behaviors (strong eye contact, mistimed movements, a smile just after the pretend behavior, and so on) that children use as signals to the fact that play has ensued. This has been shown in the USA [51–55] and Japan; in Japan, researchers also found that mothers' pretend behaviors predicted toddlers' understanding of a stranger's pretense 6 months later [56]. Like animals' and children's play-fighting signals, mothers' pretend play signs seem to communicate to infants not to take their actions literally.

The specific behaviors involved (strong eye contact, a smile 'about' a just-completed altered action) suggest that early pretend play is about achieving joint attention [57] and communicating about abstraction – about pretend behaviors that symbolize their real counterparts. We saw that rats that do not have the opportunity to play as juveniles are impaired in their reading of social signals as adults. We lack good case studies of this issue with humans; the Romanian adoptees study might shed light on this as it found deficits in pretend play at 4 years of age and in theory of mind at 11 years, but there are no published reports of whether one can trace these deficits across individual trajectories. Still, one possibility is that pretend play sensitizes human children to social signals, which subsequently improves social interaction and understanding. This relation is modeled in Figure 1. Early pretense with parents would lead to attention to social signals, which would then boost theory of mind or social understanding [58]. Theory of mind predicts social competence [59].

However, recent research does not support this more obvious path. It does not appear to be the case that early pretense comprehension (enabled by sensitivity to social signals) advances social understanding. A study of 58 children tested at 2.5 years old on pretend comprehension



Trends in Cognitive Sciences

Figure 1. A First Model of How Pretend Play Might Improve Social Understanding.

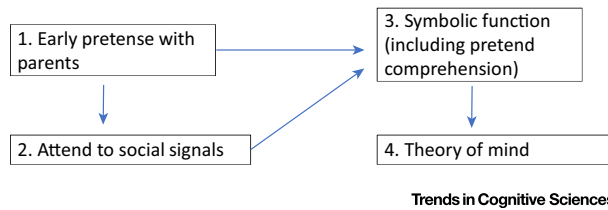


Figure 2. A Better Model of a Role for Pretend Play in Improving Social Understanding.

and at ages 4 and 5 years on theory of mind revealed that pretend comprehension had very little predictive power [60]. Instead, this study found that a symbolic component underlying pretending itself, language, and specific symbol understanding tasks at 2.5 and 3 years of age predicted social understanding at ages 4 and 5 years. Furthermore, statistical analyses suggested that the reason pretend comprehension was not strongly predictive of theory of mind was that the symbolic tasks absorbed the variance and what was key about pretense comprehension for later theory of mind was the symbolic component; namely, learning that reality can exist at two levels: the nip and the bite, the banana and the telephone, the false belief and the reality. This path is illustrated in Figure 2. Early pretend play with parents is postulated to increase sensitivity to social signals, since this is needed to understand that the parents' acts are pretend ones. This sensitivity then helps to develop the symbolic function rather than directly advancing theory of mind. Yet this sensitivity alone would not develop the symbolic function; rather, it is the sensitivity in concert with the fact that the parent is presenting reality at two levels to the child, where one level serves as a symbol for the other. Thus both parental pretend and the child's sensitivity to social signals are postulated to undergird the symbolic function (which is also used in language and the interpretation of other symbols). The study just mentioned suggests that this symbolic understanding serves to assist social understanding in humans.

There might be continuity, then, with pretend play and play fighting: In both cases, meta-communication is key and fundamental. In humans this ties into a symbolic capacity that is not well developed in other species [61], but a common root is reading social signals indicating that a behavior is to be interpreted at other than at-face value. In humans it is interesting to note that learning-disabled children are particularly poor at distinguishing play and real fighting [62] because they fail to discriminate the cues to play fighting. They also suffer social difficulties [63].

### Self-regulation

A second, nonexclusive commonality between children's pretend play and the play fighting of animals concerns self-regulation, including emotion regulation. As with animal play fighting, in pretend play there is a need to inhibit the real, as hypothesized by Vygotsky [64]. Just as the rat must inhibit the real bite; the human child must inhibit really biting into a play cookie. This practice might assist with the development of self-control. In humans pretend play seems to develop emotion regulation, when children replay difficult events as if to establish control over them [1]. An analog in rats and marmoset monkeys might be the regulation of stress hormones during play fighting [65]. The quantity of juvenile social play shapes marmoset HPA development [66]. Related to this, as noted above, neurons in the medial prefrontal cortex – implicated in executive function – are influenced by play in juvenile rats [67].

However, in humans the evidence for play serving a self-regulatory function is not conclusive. Anecdotally, one thinks one sees it. A child who had a traumatic visit to the allergist might 'play out' the scenario repeatedly with a younger sibling or a doll, having the latter undergo the treatment while the child plays the part of doctor or nurse. Children appear to do this to get a



feeling of mastery or control over a difficult situation [68], but seeing it occasionally differs from witnessing it regularly in empirical paradigms.

In the early 1980s, two experiments appeared to show that children used pretend play to reduce emotional stress [69,70], but some issues in the methods left open other interpretations [11] and two attempts to replicate the study in my laboratory have failed (although our efforts continue). In these studies children watched a video in which a beloved dog appeared about to drown; physiological stress measures were taken before and after the film, the children then engaged in play with toys (including figures from the film clip), colored, or were read to, and then stress was remeasured. Pretend play did not reduce stress relative to the other activities. Recently other researchers have looked at whether pretend play is related to executive functions, which are prefrontal processes involved in emotion regulation [71]. In one study preschoolers' ability to state that a pretense is different from reality was strongly related to performance on 'conflict executive function' tasks, in which one has to inhibit one response while executing another [72]. Specifically, the first type of task involved stating that although an experimenter was pretending something was a hammer, it was really a pencil. The second type of task involved, for example, executing behaviors when ordered to do so by a bear puppet, but not when ordered to do so by a dragon puppet. Importantly, the relation found between executive function and pretending held even when a task that was similar to the pretend-reality task but involved appearance and reality was entered in an earlier step in a regression analysis. This suggests that something about pretend specifically, rather than mere analogy across tasks, underpinned the relation. Another pretend task in this study examined whether children used a body part or an imaginary object when asked to pretend four actions, like brushing their teeth. A general finding in the literature is that, as children get older, they are more likely to use an imaginary toothbrush than to use their finger as a toothbrush (for example), although see [73]. The study found a smaller but significant relation between this task and the ability to delay getting a smaller prize in favor of getting a larger prize later. This first study, then, suggested some relation between pretend play and executive function.

The second study used an intervention design to see whether asking children to pretend to be someone else improved their performance on a conflict executive function scale [74]. In other words, does taking on someone else's identity, creating a psychological distance between the self and one's actions, lead to greater self-regulation? The results here were less clear because, although baseline executive function was collected, it was not controlled for in the analyses. However, the authors concluded that the result supported the Vygotskian hypothesis that pretend play serves executive control. Thus, there are some suggestions that pretend play might serve a self-regulatory function in humans, like play fighting serves in animals, but the case cannot yet be made with strong confidence.

There are alternative possible functions as well: for example, although empirical evidence is wanting (see [13]) some argue that pretend play is an adaptation for creativity [75–77]; discussion of this is outside the scope of this Opinion article.

### Concluding Remarks

I have argued that play fighting in animals is an analog for pretend play in humans in that both involve an as-if world, reading signals that indicate this as-if status, and understanding that behaviors and objects in the as-if world stand for or are symbolic of behaviors and objects in the real world. Because of this isomorphism, we might look to some functions of animal play fighting as indicating possible functions of pretend play as a potential case of parallel evolution. Using the rat as one possible example (among many), I presented some evidence that pretend play in humans might serve two functions that have been shown empirically to result from juvenile play fighting in some animals: sensitivity to social signals enabling symbolic

### Outstanding Questions

Does pretend play increase people's sensitivity to social signals?

Is there a sensitive period when social interaction is required in order for pretend play to emerge later?

What are the neural signatures of symbolic thought, pretend play, and play fighting?

Does pretend play assist emotion regulation in children?

Why do most people stop engaging in pretend play around age 11?

interpretation of behavior and emotion regulation. Many questions remain, including whether these truly are main functions of human pretend play, whether there are other functions, and why people typically stop pretend play when they are about 11 years old.

### Acknowledgments

The author thanks Sergio Pellis, Jess Taggart, Dermina Vasc, and the anonymous reviewers for comments on an earlier draft. Support during preparation of the manuscript was provided by grants from the Brady Education Foundation and the Sir John Templeton Foundation.

### References

1. Piaget, J. (1962) *Play, Dreams, and Imitation in Childhood*, Norton
2. Haight, W. and Miller, P.J. (1993) *Pretending at Home: Early Development in a Sociocultural Context*, State University of New York Press
3. Smith, E.D. and Lillard, A.S. (2012) Play on: retrospective evidence for the persistence of pretend play into middle childhood. *J. Cogn. Dev.* 13, 524–549
4. Walton, K.L. (1990) *Mimesis as Make-Believe*, Harvard University Press
5. Edwards, C.P. (2000) Children's play in cross-cultural perspective: a new look at the six cultures study. *Cross Cult. Res.* 34, 318–338
6. Roopnarine, J.L. et al. (1994) *Children's Play in Diverse Cultures*, State University of New York Press
7. Singer, D. et al. (2009) Children's pastimes and play in sixteen nations: is free play declining? *Am. J. Play* 1, 283–312
8. Carlson, S.M. et al. (1998) The influence of culture on pretend play: the case of Mennonite children. *Merrill Palmer Q.* 44, 538–565
9. Gaskins, S. et al. (2007) The cultural construction of play. In *Play and Development: Evolutionary, Sociocultural, and Functional Perspectives* (Goncu, A. and Gaskins, S., eds), pp. 179–202, Erlbaum
10. Burghardt, G.M. (2005) *The Genesis of Animal Play: Testing the Limits*, MIT Press
11. Lillard, A.S. et al. (2013) The impact of pretend play on children's development: a review of the evidence. *Psychol. Bull.* 139, 1–34
12. American Psychological Association (2000) *Diagnostic and Statistical Manual of Mental Disorders: DSM-IV-TR*. (4th, text revision ed.), American Psychological Association
13. American Psychological Association (2013) *Diagnostic and Statistical Manual of Mental Disorders (DSM-5)*, American Psychiatric Publications
14. Jarrold, C. et al. (1996) Generativity deficits in pretend play in autism. *Br. J. Dev. Psychol.* 14, 275–300
15. Schultz, R.T. (2005) Developmental deficits in social perception in autism: the role of the amygdala and fusiform face area. *Int. J. Dev. Neurosci.* 23, 125–141
16. Nelson, C.A. et al. (2014) *Romania's Abandoned Children*, Harvard University Press
17. Kreppner, J.M. et al. (1999) The pretend and social role play of children exposed to early severe deprivation. *Br. J. Dev. Psychol.* 17, 319–332
18. Colvert, E. et al. (2008) Do theory of mind and executive function deficits underlie the adverse outcomes associated with profound early deprivation? Findings from the English and Romanian adoptees study. *J. Abnorm. Child Psychol.* 36, 1057–1068
19. Mitchell, R.W. (2007) Pretense in animals: the continuing relevance of children's pretense. In *Play and Development: Evolutionary, Sociocultural, and Functional Perspectives* (Goncu, A. and Gaskins, S., eds), pp. 51–76, Erlbaum
20. Mitchell, R.W. (2002) *Pretending and Imagination in Animals and Children*, Cambridge University Press
21. Suddendorf, T. and Dong, A. (2013) On the evolution of imagination and design. In *The Oxford Handbook of the Imagination* (Taylor, M., ed.), pp. 453–467, New York, Oxford
22. Hall, S.L. and Bradshaw, J.W. (1998) The influence of hunger on object play by adult domestic cats. *Appl. Anim. Behav. Sci.* 58, 143–150
23. Baerends-van Roon, J. and Baerends, G.P. (1979) *The Morphogenesis of the Behaviour of the Domestic Cat, with a Special Emphasis on the Development of Prey-Catching*, North-Holland Publishing Company
24. Hopkins, E.J. et al. (2016) The development of substitute object pretense: the differential importance of form and function. *J. Cogn. Dev.* 17, 197–220
25. Aldis, O. (1975) *Play Fighting*, Academic Press, (New York)
26. Pellis, S.M. et al. (2015) Modeling play: distinguishing between origins and current functions. *Adapt. Behav.* 23, 331–339
27. Burghardt, G.M. (2011) Defining and recognizing play. In *Oxford Handbook of the Development of Play* (Pellegrini, A., ed.), pp. 9–18, New York, Oxford
28. Mitchell, R.W. (1990) A theory of play. In *Interpretation and Explanation in the Study of Animal Behavior* (Bekoff, M. and Jamieson, D., eds), Westview Press, (Oxford)
29. Lillard, A.S. (2011) Mother-child fantasy play. In *Oxford Handbook of the Development of Play* (Pellegrini, A., ed.), pp. 284–295, New York, Oxford
30. Lillard, A.S. (2015) The development of play. In *Handbook of Child Psychology and Developmental Science: Cognitive Processes* (Liben, L.S. and Mueller, U., eds), pp. 425–468, New York, Wiley-Blackwell
31. Fein, G.G. and Moorin, E.R. (1985) Confusion, substitution, and mastery: pretend play during the second year of life. In *Children's Language* (Vol. 5) (Keith, E.N., ed.), In pp. 61–76, Lawrence Erlbaum Associates, Inc.
32. Power, T.G. (2000) *Play and Exploration in Children and Animals*, Lawrence Erlbaum
33. Palagi, E. et al. (2015) Rough-and-tumble play as a window on animal communication. *Biol. Rev.* 91, 311–327
34. Pellis, S.M. and Pellis, V.C. (2009) *The Playful Brain: Venturing to the Limits of Neuroscience*, Oneworld, (Oxford)
35. Panksepp, J. and Burgdorf, J. (2003) "Laughing" rats and the evolutionary antecedents of human joy? *Physiol. Behav.* 79, 533–547
36. Kisko, T.M. et al. (2015) From play to aggression: high-frequency 50-kHz ultrasonic vocalizations as play and appeasement signals in rats. *Curr. Top. Behav. Neurosci.* 30, 91–108
37. Bekoff, M. (1995) Play signals as punctuation: the structure of social play in canids. *Behaviour* 132, 419–429
38. Bekoff, M. (1977) Social communication in canids: evidence for the evolution of a stereotyped mammalian display. *Science* 197, 1097–1099
39. Eibl-Eibesfeldt, I. (1989) *Human Ethology*, Aldine de Gruyter, (New York)
40. Smith, P.K. et al. (1997) Play fighting and real fighting. In *New Aspects of Human Ethology* (Schmitt, A., ed.), pp. 47–64, New York, Plenum Press
41. Mitchell, R.W. (2017) Mteacommunication. In *Encyclopedia of Animal Cognition and Behavior* (Vonk, J. and Shackelford, T., eds), Springer, (New York)
42. Bateson, G.A. (1972) A theory of play and fantasy. In *Steps to an Ecology of Mind* (Bateson, G.A., ed.), pp. 177–193, New York, Chandler
43. Einon, D.F. and Potegal, M. (1991) Enhanced defense in adult rats deprived of playfighting experience as juveniles. *Aggress. Behav.* 17, 27–40



44. Pellis, S.M. and Pellis, V.C. (2007) Rough-and-tumble play and the development of the social brain. *Curr. Dir. Psychol. Sci.* 16, 95–98
45. Bell, H.C. *et al.* (2010) Juvenile peer play experience and the development of the orbitofrontal and medial prefrontal cortices. *Behav. Brain Res.* 207, 7–13
46. Himmler, S.M. *et al.* (2016) Play, variation in play and the development of socially competent rats. *Behaviour* 153, 1103–1137
47. Palagi, E. (2011) Playing at every age: modalities and potential functions in non-human primates. In *Oxford Handbook of the Development of Play* (Pellegrini, A.D., ed.), pp. 70–82, New York, Oxford
48. Smilansky, S. (1968) *The Effects of Sociodramatic Play on Disadvantaged Preschool Children*, Wiley, (New York)
49. Lillard, A.S. (2006) Guided participation: how mothers structure and children's understanding of pretend play. In *Play and Development: Evolutionary, Sociocultural, and Functional Perspectives* (Goncu, A. and Gaskins, S., eds), Erlbaum, (Mahwah, NJ)
50. Kavanaugh, R.D. *et al.* (1983) Mothers' use of fantasy speech to young children. *J. Child Lang.* 10, 45–55
51. Nishida, T. and Lillard, A.S. (2007) The informative value of emotional expressions: social referencing in mother–infant pretense. *Dev. Sci.* 10, 205–212
52. (a). Ma, L. and Lillard, A.S. (2006) Where is the real cheese? Young children's ability to discriminate between real and pretend acts. *Child Dev.* 77, 1762–1777;  
(b). Ma, L. and Lillard, A.S. (2017) The evolutionary significance of pretend play: two-year-olds' interpretation of behavioral cues. *Learn. Behav.* <http://dx.doi.org/10.3758/s13420-017-0285-y>
53. Lillard, A.S. and Witherington, D. (2004) Mothers' behavior modifications during pretense snacks and their possible signal value for toddlers. *Dev. Psychol.* 40, 95–113
54. Lillard, A.S. *et al.* (2007) Signs of pretense across age and scenario. *Infancy* 11, 1–30
55. Nakamichi, N. (2015) Maternal behavior modifications during pretense and their long-term effects on toddlers' understanding of pretense. *J. Cogn. Dev.* 16, 541–558
56. Goncu, A. (1993) Development of intersubjectivity in the social pretend play of preschool children. *Hum. Dev.* 36, 185–198
57. Lillard, A.S. (2001) Pretend play as Twin Earth. *Dev. Rev.* 21, 1–33
58. Wellman, H.M. (2014) *Making Minds: How Theory of Mind Develops*, Oxford, (New York)
59. Lillard, A.S. and Kavanaugh, R.D. (2014) The contribution of symbolic skills to the development of an explicit theory of mind. *Child Dev.* 85, 1535–1551
60. Deacon, T.W. (1997) *The symbolic species: the co-evolution of language and the brain*, WW Norton, (New York)
61. Nabuzoka, D. and Smith, P.K. (1999) Distinguishing serious and playful fighting by children with learning disabilities and nondisabled children. *J. Child Psychol. Psychiatry* 40, 883–890
62. Rose, C.A. and Monda-Amaya, L.E. (2012) Bullying and victimization among students with disabilities: effective strategies for classroom teachers. *Interv. Sch. Clin.* 48, 99–107
63. Vygotsky, L.S. (1967) Play and its role in the mental development of the child. *Soviet Psychol.* 5, 6–18
64. Pellis, S.M. and Pellis, V.C. (2016) Play and cognition: the final frontier. In *Animal Cognition: Principles, Evolution, and Development* (Olmstead, M., ed.), pp. 201–230, New York, Nova Science Publishers
65. Mustoe, A.C. *et al.* (2014) Gestational cortisol and social play shape development of marmosets' HPA functioning and behavioral responses to stressors. *Dev. Psychobiol.* 56, 1229–1243
66. Pellis, S.M. and Pellis, V.C. (2017) What is play fighting and what is it good for? *Learn. Behav.* 1–12
67. Clark, C.D. (2003) *In sickness and in play: children coping with chronic illness*, New Brunswick NJ, (Rutgers University Press)
68. Barnett, L. (1984) Research note: young children's resolution of distress through play. *J. Child Psychol. Psychiatry* 25, 477–483
69. Barnett, L. and Storm, B. (1981) Play, pleasure, and pain: the reduction of anxiety through play. *Leis. Sci.* 4, 161–175
70. Müller, U. and Kerns, K. (2015) The development of executive function. In *Handbook of Child Psychology and Developmental Science: Cognitive Processes* (Liben, L.S. and Mueller, U., eds), pp. 571–623, New York, Wiley-Blackwell
71. Carlson, S.M. *et al.* (2014) Evidence for a relations between executive function and pretense representation in preschool children. *Cogn. Dev.* 29, 1–16
72. Mitchell, R.W. and Clark, H. (2015) Experimenter's pantomimes influence children's use of body part as object and imaginary object pantomimes: a replication. *J. Cogn. Dev.* 16, 703–718
73. White, R.E. and Carlson, S.M. (2015) What would Batman do? Self-distancing improves executive function in young children. *Dev. Sci.* 19, 419–426
74. Picciuto, E. and Carruthers, P. (2014) The origins of creativity. In *The Philosophy of Creativity* (Paul, E.S. and Kaufman, S.B., eds), pp. 199–223, New York, Oxford
75. Root-Bernstein, M.M. (2013) The creation of imaginary worlds. In *The Oxford Handbook of the Imagination* (Taylor, M., ed.), pp. 417–437, New York, Oxford
76. Mottweiler, C.M. and Taylor, M. (2014) Elaborated role play and creativity in preschool children. *Psychol. Aesthet. Creat. Arts* 8, 277–286