The Origins of Creativity

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Abstract

The goal of this chapter is to provide an integrated evolutionary and developmental account of the emergence of distinctively-human creative capacities. Our main thesis is that childhood pretend play is a uniquely human adaptation that functions in part to enhance adult forms of creativity. We review evidence that is consistent with such an account, and contrast our proposal favorably with a number of alternatives.

1. Introduction

Most theorists assume that creativity requires ideas, behavior, or products that are both novel and valuable. Thus construed, creativity appears to be uniquely human. Indeed, it seems to be fairly rare even among humans. Given that no animals and not all humans exhibit it, it can then seem mysterious how the capacity for creativity might have evolved, and how it might emerge in the course of childhood development. However, Boden (2004) draws an important distinction between *historical* creativity (where the novelty is relative to an entire society or historical tradition) and *psychological* creativity (where the novelty is relative to a single individual). While historical creativity is rare, psychological creativity is quite widespread, and is perhaps a trait that almost all human adults possess to a significant degree.

We suggest that psychological creativity can be subdivided still further, by relativizing the value-component, too, to a single individual. The result is a distinction between what might be called "agent-relative" and "agent-neutral" forms of psychological creativity. Agent-neutral creativity is novelty of ideas, behavior, or products that are valuable in an objective or communally agreed upon sense, while not rising to the level of historical creativity. Agent-relative creativity, in contrast, would be an idea, behavior, or product that is both novel and valuable from the perspective of the agent alone. The concept of agent-relative creativity is theoretically fruitful, we suggest, in enabling us to see at least a form of creativity displayed in the behavior of some non-human animals. This can help us to see how agent-neutral and historical kinds of creativity might evolve.

It is fair to say that most of the interest in creativity on the part of philosophers has been directed toward its historical form. For of course we care especially about the sorts of creativity that result in great art, great literature, or great science. Even cognitive scientists have for the most part been interested in the factors that can transform mundane (and presumably pan-human) forms of psychological creativity into historical creativity. Hence they have focused on the extensive knowledge of historically creative people, together with the motivations, personalities, and institutional frameworks that encourage such people to flourish. However, even psychological creativity (in its agent-neutral form) is arguably uniquely human (with perhaps a few isolated exceptions that we will note in due course). Focusing on agent-relative forms of psychological creativity may enable us to see what makes it possible for historical creativity to emerge, both in phylogeny and in development. Not only is this a topic worthy of interest in its own right, but it may help us to understand the components and characteristics of uniquely human forms of psychological creativity (which in turn, of course, make historical creativity possible).

Our discussion will be organized around one widely accepted account of the structure of psychological creativity. This is the so-called "GENEPLORE" (for "generate and explore") model of creative cognition (Finke et al. 1992; Finke 1995; Ward et al. 1999). On this account, most instances of creativity can be divided into two main phases. There is a generative phase, in which novel ideas or hypotheses are created and entertained, and then there is an exploratory phase in which those ideas or hypotheses are explored, evaluated, and/or implemented. (Arguably these two phases collapse into one another in connection with some "online" forms of creativity such as jazz or dance improvisation, or in swift witty conversation. For here it seems that novel actions are undertaken immediately, coincident with the activation of the corresponding motor plans, without prior rehearsal or evaluation; see Carruthers 2011.) This enables us to separate questions about the emergence of generative capacities in infants and non-human animals, on the one hand, from questions about the development of exploratory–evaluative reasoning, on the other.

The chapter is structured as follows. In Section 2 we address the evolutionary precursors of psychological creativity. We suggest that a capacity to generate novelty can be found quite commonly in the animal kingdom, but only in ways that are either limited in scope or domain-specific. We also suggest that the exploratory component can be found in at least nascent form in some non-human animals, as well as much more robustly in earlier species of hominin. Yet non-

human animals are not (or only very rarely) creative in an agent-neutral sense. Moreover, there is very little evidence of agent-neutral creativity in the hominin line prior to the emergence of *Homo sapiens*. This leads us to ask what it is that makes human creative capacities unique. Various possible answers will be considered in Section 3. The hypothesis that we settle on, and begin to explore and evaluate in comparison with alternatives in Section 4, is that the function of pretend play in human infancy is to develop capacities for agent-neutral creativity. Finally, Section 5 examines the mechanisms through which pretense enhances creativity. We suggest that it not only encourages us to generate novelty in an unrestricted and domain-general way, but that it also exercises the abilities to suppress habitual or obvious responses and to select and hold in mind more unusual possibilities, thus enabling those ideas to be developed and evaluated.

2. Precursors of agent-neutral creativity

Most phenotypic characters evolve gradually, in small increments. Moreover, evolution often works by co-opting and re-using existing mechanisms for new functions. This is known in the literature as "exaption". We suggest that creativity does not burst suddenly onto the evolutionary scene with humans, but is exapted from mechanisms present in many animals. In the present section we consider some precursors of psychological creativity, separating our discussion into parts in accordance with the GENEPLORE model sketched in Section 1.

2.1 Precursors of generativity

The generative components of creativity are actually quite common in the animal kingdom. Consider protean forms of escape behavior, for example, which are widespread among prey animals (Driver and Humphries, 1988; Miller, 1997). A moth that detects the presence of bat ultrasound, for example, will go into a looping, tumbling, flight path that appears random (and which is certainly unpredictable to the bat; Roeder and Treat, 1961; Roeder, 1962; May, 1991). Likewise a gazelle or other prey animal fleeing from a lioness will be apt to use an unpredictable sequence of leaps and bounds and sudden changes of direction. It is likely that the cognitive mechanism underlying such protean behavior involves some sort of noisy, quasi-random, process for selecting from among a constrained set of motor instructions. (The set is constrained, of course, by the need for speed; and only motor instructions for generating motion are relevant—the gazelle won't also twitch its tail in a quasi-random manner while fleeing.) Thus animals do generate novel behavior. Further, their behavior is valuable to them, if not to anyone else.

Such behavior may not be what we have in mind when we think of creativity (not even psychological creativity). In part this may be because the behavior doesn't have the sort of agent-neutral value that people associate with creativity; but it may also be because the trigger for such behaviors is innate, and the behavior itself is limited to a single domain. It is unclear, however, that there is any significant difference between such protean behavior and swift online improvisation in jazz or dance, at least in terms of the cognitive underpinnings. Both involve stochastically selected sequences of movement, subject to a variety of contextual constraints (Carruthers 2011). And improvised movements of these latter sorts, of course, would unquestionably be described as creative. The difference between them is that the creativity of a jazz musician or dancer is valuable to others. Thus, a jazz musician or a dancer is capable of agent-neutral creativity, while a gazelle's creativity is agent-relative.

Some animal behavior can be much more readily seen as creative, because it is agent-neutral. Consider the elaborate, decorative, bower-building behavior of some species of Bower Bird. While the behavior as a whole is innately triggered, each individual bird constructs and decorates its own form of bower. It selects and arranges eye-catching materials in a way that humans can quite readily recognize as valuable, with the details of the arrangement depending partly on the happenstance of the materials that the bird finds in its immediate environment, and partly on preferences inherent in the bird's own personality. Consider also the songs of some species of bird and whale. The Australian Butcher Bird, in particular, seems to have remarkable musical talents, improvising songs from a wide repertoire of song-fragments in a way that would truly be worthy of a jazz musician (Taylor 2008a, 2008b). But while these do seem to be instances of agent-neutral creativity, they are specific to only a single domain. It is also likely that they are heavily innately channeled.

Given that domain-specific forms of the generative component of psychological creativity are widespread in the animal kingdom, it is reasonable to suppose that they might also be present in some earlier species of hominin (and also in ourselves). It seems likely that the generative capacities of earlier hominins, too, were highly constrained. For there is no evidence in the archaeological record of psychological creativity of any general sort prior to the emergence of *Homo sapiens* in Africa some 150,000 years ago. Certainly there is no evidence of creative technological innovation. On the contrary, we find complete stasis in stone tool making, with designs remaining unchanged for hundreds of thousands of years (Coolidge and Wynn 2009). Admittedly, earlier hominins might have put their generative capacities to use in specific

domains that have left no mark on the archaeological record, engaging in creative forms of song or dance, for examples. But it is plain that they did not possess the sort of domain-general creativity that is distinctive of our species. It follows, then, that some significant change must have taken place within our lineage at some point during the transition from the common ancestor of ourselves and the Neanderthals. In Section 3 we will consider some possible suggestions for what that change might have been.

2.2 Precursors of cognitive exploration

The exploratory component of psychological creativity involves a number of related capacities. One is an ability to inhibit immediate responses and to rehearse or sustain potential solutions in mind so that they can be elaborated and evaluated before a choice is made. This requires both "executive function" (to inhibit prepotent responses) and some form of controlled working memory in which the ideas in question can be explored. Evidence of both can be found in the literature on "insight learning" in comparative psychology.

Consider the Caledonian Crow who was able to solve the problem of retrieving some meat from within a cage on the first trial, after examining the experimental setup for over a minute before acting (Taylor et al., 2010). In order to solve the problem, the bird had to pull up a string to retrieve a short stick attached to the end, which could then be used to retrieve a long stick that was otherwise inaccessible behind some bars, which could then be used to retrieve the meat. The crow might have reasoned thus: "To get the meat I need to use a stick to reach it. There are two sticks available. The one on the string is too short. The one in the cage is long enough. But I need a stick to reach it. The one on the string is long enough for that. So I'll get it." Although remarkably smart, and displaying good understanding of the physical properties of sticks as well as sound judgments of distance, there is nothing here to suggest the presence of the generative component of creativity. It seems to result from a "chaining" of conditional beliefs, rather than from the sort of constrained stochasticity that is arguably the hallmark of the cognitive processes underlying psychologically creative behavior (Simonton, 2003). But undoubtedly the birds have to inhibit their initial tendency to approach the meat straight away, and they have to manipulate representations of the task setup in such a way as to work out a solution in advance of acting.

While insight learning in other animals is observed only infrequently, we know that by 400,000 years ago *Homo Heidelbergensis* made regular use of the executive and working

memory components of creative cognition when knapping finely-wrought stone tools (Coolidge and Wynn 2009). In fact we know quite a lot about the cognitive processes that are required for stone knapping. One source of evidence is provided by contemporary knappers who have acquired the skills in question and can issue us with introspective reports. But another source of evidence derives from those instances where all or most of the products of a particular tool-making episode have been discovered together in the archaeological record, and can be "retro-fitted" to provide an exact account of the sequence of blows involved in manufacture (Schlanger 1996). We know that in order to produce three-dimensional symmetries, hominins from this time must have been capable of visually rotating their image of what would happen to a stone if it were struck in a particular way, to imagine how it would then look from the other side. And we know that tool production from this era involved complex hierarchically ordered sequences of action, which required the knapper to plan several steps ahead and to inhibit prepotent or habitual strikes every so often, so as to shift to a different phase of the activity (Coolidge and Wynn 2009). These seem to be essentially the same capacities for executive control and working memory that are required for the "explore" component of psychological creativity.

2.3 Putting the components together

In addition to evidence that the two separate components described by GENEPLORE models of creativity are present in other animals, there are some examples of insight behavior among apes that suggest that both components might sometimes be at work together. These are cases where it is hard to see how the animals could arrive at their solutions by a process of chaining conditionals. It therefore seems that apes might sometimes capable of generating novel ideas and evaluating them before putting them into practice. The animals might sometimes try out in imagination actions from their repertoire in a process of unguided or quasi-random search, until they happen to hit on one that can be predicted to yield a solution.

For example, something of this sort seems like a plausible explanation for one of the findings of an experiment described by Menzel (1974). One ape, Belle, was taken alone into an enclosure and shown where some food was buried before all the apes were then released into the enclosure together. Whenever the alpha male saw Belle digging up the food, he pushed her out of the way and bit her, taking her food. Belle tried a variety of strategies to elude him, but without success. But then she used a different tack. On one occasion she walked purposefully to a location where there was no food and began to dig. After the male pushed her away and began

digging there himself, she took advantage of his absorption and traveled swiftly to the location where the food was really buried. She dug it up and was able to consume it before the male arrived. It seems possible that Belle might have hit on this idea using both of the components of agent-relative creative cognition (i.e., generation and exploration), mentally rehearsing various actions from her repertoire and considering what might happen if she were to perform them. When she hit on one that might succeed, she was able to see that this was so and put the plan into operation.

While examples like this are suggestive, we really have no solid evidence that both the generative and exploratory components of creativity are ever employed together by members of other species. Even in connection with the fine stone tools made by members of closely related species—*Homo Heidelbergensis* and the *Neanderthals*—it is by no means clear that ideas needed to be generated *creatively* prior to their development, transformation, and evaluation in working memory. For experienced knappers have extensive knowledge of the properties of their materials, and of the sequences that are necessary to achieve their goals. They may therefore be capable of discerning the affordances provided by a particular stage in tool making without having to generate and rehearse alternative actions in a creative way. While members of these species were remarkably smart on many different levels, it is by no means clear that they were capable of even agent-relative forms of GENEPLORE creativity.

Moreover, even if forms of psychological creativity are sometimes present in other species, what we know for sure is that they are only manifested in highly restricted circumstances. We don't see Bower Birds or Butcher Birds turning their creative capacities to other forms of problem-solving, for example (nor do gazelles). And up until the advent of *Homo sapiens* some 150,000 years ago we see no signs of creativity of products in the archaeological record, either (Coolidge and Wynn 2009). On the contrary, we see hundreds of thousands of years of seemingly complete technological stasis. While there may be psychological creativity of a very limited sort in non-human animals and earlier species of *Homo,* there is certainly no historical creativity. What, then, explains the remarkable creative abilities of humans? What cognitive processes enable us to take the capacities for executive function, working memory, and creative idea and behavior generation that we share with some other animals and then "boost" them and deploy them across many different types of context, in such a way that the result is so dramatically different as to seem like a qualitative and not just a quantitative difference? This is the question that we take up in Section 3.

3. What makes humans unique?

We are not here asking what makes humans unique in general, but rather what makes them uniquely creative. Since other species share (or have shared, in the case of earlier hominins) capacities for constrained generativity of the sort that are characteristic of creative cognition, while also having the necessary powers of working memory, it is natural to wonder whether human creativity results from some combination of these with some other distinctively-human capacity or capacities. At any rate, this is the hypothesis that we propose to consider.

3.1 Language

Bickerton (1995) suggests that our distinctive capacities for creative thought are a by-product of language. This is a natural enough idea, for we know that the large vocabulary and recursive grammar of natural language together provide us with an almost unlimited representational resource (even allowing for limitations in working memory). And we know that we can, at will, combine together words in novel ways—thereby entertaining novel thoughts—and that we often do so, e.g. in humor and in metaphor.

However, it is one thing to possess a recursive representational system that makes it *possible* for people to formulate thoughts that neither they, nor anyone else, has entertained before, but it is quite another thing to have a disposition to use it thus, and to use it relevantly. And we can see no way that the former could in any sense be sufficient for the latter. Moreover, it is highly implausible that language should underlie all forms of distinctively-human creativity. For there are many kinds of creativity that seem wholly unrelated to language, such as musical, kinetic, or visual creativity. And indeed, painters and other artists who suffer from aphasia may show no diminishing of artistic creativity (Mell et al. 2003; Seeley et al. 2008).

3.2 Highly developed working memory

Coolidge and Wynn (2009) argue that the distinctive adaptation separating highly creative *Homo sapiens* from the otherwise extremely successful (but uncreative) Neanderthals is an increase in working memory. They point out that the evidence from cranial anatomy suggests that the only difference between the two species that has relevance for brain function is a distinctive enlargement in posterior parietal cortex (Bruner 2008, 2010). This is an area known to be deeply implicated in human working memory function (Jonides et al., 2008). Moreover, the parietal

cortex in general is heavily involved in the control of action, and posterior parietal has recently been shown to be distinctively implicated in the *manipulative* (as opposed to short-term retentive) aspects of working memory (Koenigs et al. 2009).

These enhancements in working memory capacities probably extended a trend that had been taking place throughout hominin evolution towards increased capacities for executive function and attentional control. For it is well known that the main seat of these capacities lies in the frontal lobes, which have been significantly expanded relative to other brain areas during hominin evolution (Coolidge and Wynn 2009). And recent theories of working memory place special emphasis on attentional capacities and related executive functions in their accounts (Engle 2002; Postle 2006; D'Esposito 2007). Moreover, as we will see in Section 5, these capacities are vital for sustaining creativity. But sustaining is one thing, generating is another.

These changes in executive function and working memory would no doubt have greatly enhanced the "explore" component described by GENEPLORE models of creativity. They would have led to an increased capacity to rehearse and evaluate potential ideas and actions in advance of accepting or implementing them. But it is very doubtful whether they are sufficient by themselves to explain the emergence of domain-general forms of psychological creativity of the sort that humans distinctively exhibit. This remains true even if we suppose that sophisticated language capacities were already in place among the common ancestors of ourselves and the Neanderthals, thereby conferring on them an enhanced capacity for generating and entertaining novel thoughts across all domains. For again, it is one thing to be *capable* of generating novelty in a domain-general manner, and quite another thing to be *disposed* to do so regularly and in relevant ways. Put differently, it is one thing to possess capacities that *enable* creative cognition (such as language and a powerful form of working memory). It is another thing to put those capacities to use. The disposition to do so has not yet been explained.

3.3 Cultural construction

It might be suggested that the disposition to be creative could be a culturally constructed one. Perhaps it depends upon cultural frameworks that reward creativity and that consequently instill in people the explicit goal of being creative. In support of this suggestion it might be said that it can explain the gap of more than 100,000 years between the first emergence of *Homo sapiens* in Africa and the so-called "cultural explosion" of creative products that didn't begin until after 50,000 years ago. For it may be that the latter didn't depend upon any new biological adaptation,

but rather on some suitable set of cultural practices and expectations.

However, it seems unlikely that the disposition to create is entirely culturally constructed. For one thing, there is reason to think that the cultural explosion is illusory, an impression created by an over-emphasis on Europe in archaeological research, combined with the fact that high population densities are necessary for cultural innovations to be transmitted reliably enough to show up in the archaeological record (McBreaty and Brooks 2000; Shennan 2000, 2001; Henrich 2004). Also, while the kinds and degree of exhibited creativity vary from culture to culture (Lubart 1990), people in every culture display significant amounts of creativity. Metaphor, poetry, dance, music, myths, body adornment, and narratives are among the creative endeavors that appear cross-culturally and are universal among humans (Pinker 2003).

3.4 Convergent and divergent thinking

Gabora and Kaufman (2010) argue that what is distinctively human is the capacity for both divergent and convergent thinking. Divergent thinking is associated with defocused attention, which involves more intuitive thought. Out-of-left-field generation of ideas comes about via divergent thinking. Convergent thinking is more rigorous and analytical, and is associated with focused attention. Consideration and fine-tuning of ideas are part of convergent thinking. Gabora and Kaufman suggest that divergent and convergent thinking can function independently depending on context. They can also work together in the case of creativity, where divergent thinking maps on to the generation of ideas described in GENEPLORE, and convergent thinking maps on to exploration.

We think this view is largely right. We aim to offer an explanation of how divergent and convergent thinking become a habitual paired process as they do in the case of creativity (first divergent, followed by the refinements of convergent). And again, we also wish to explain the *propensity* of humans to deploy these abilities for creative thought.

3.5 Is creativity adaptive?

With the exception of Gabora and Kaufman (2010), each of the proposals considered briefly above seems to assume that distinctively-human creative capacities aren't a biological adaptation. For it isn't plausible to claim that either language or enhanced working memory evolved specifically to make us more creative. (In contrast, social constructivists who believe in cultural evolution might be able to claim that creativity is a *cultural* adaptation.)

Our own proposal is to link creativity to another distinctively-human tendency, the disposition to engage in pretend play. While the young of many other species engage in rough-and-tumble play, and also in the playful execution of species-characteristic adult behaviors (especially running and hunting), none engages in *pretend* or *symbolic* play in natural circumstances. In contrast, pretend play is a human universal, occurring in all typical infants. Moreover, it emerges spontaneously, without encouragement or teaching. Since the pretend play of children is sometimes, itself, creative in nature, it is natural to wonder whether the adaptive function of pretense might be to be encourage and enhance adult forms of creativity. This is the hypothesis that we propose to explore, beginning in Section 4. But since our proposal is that pretense is an adaptation for creativity, it presupposes that creativity itself is adaptive. This question will be addressed briefly here.

It is surely very plausible that incremental increases in creativity would bring in their train increases in fitness. For it seems quite likely that creative individuals would be better able to solve problems and overcome obstacles, and would thus be more effective in seeking sustenance, securing mates, providing for young, and avoiding danger. And indeed, there is evidence that creative hypothesis generation plays a vital role among hunter–gatherers who are tracking prey (Liebenberg 1990; Carruthers 2002). Of course it might be objected that other animals get along just fine without evolving domain-general creative capacities. But this is easily explained if, as we have suggested, enhancements in creativity depend upon increases in executive function and working memory. It may be that the latter had to evolve first, before increases in creativity would even be possible, let alone adaptive.

Miller (1999) suggests, in contrast, that creativity of an agent-neutral sort is not adaptive for survival, but has rather been sexually selected. He states: “The most dramatic examples of human culture, such as ritual, music, art, ideology, and language-play, seem like energetically expensive wastes of time, to someone thinking in terms of the survival of the fittest. From the viewpoint of indicator theory, that sort of wasteful display is exactly what we would expect from traits shaped for reproductive competition.” Miller proposes that since creativity is an indicator of intelligence and youthful vigor, and is expensive to produce, creative displays (such as music, dance, witty conversation, and body adornment) that seem *prima facie* less than apt to help us survive are actually fitness advertisements. One cannot easily fake creative ability, so one’s advertisement of creativity is an honest indicator that one is reproductively fit.

In fact it may be that both accounts are true. If one sees creative cultural endeavors as one

manifestation of a cognitive process of constrained generativity and exploration that underlies much everyday problem-solving as well as scientific creativity (as we do), then music, say, is less clearly an expensive waste of time. Rather, it is an exercise of an ability that is quite useful in many situations. And it may be that such endeavors are sexually attractive, in part, because of this. But we don't need to settle this issue here. For all of these accounts agree that creativity is an adaptation. They disagree only about the adaptive pressures that produced it.

4. Why do children pretend?

Why do nearly all children, cross-culturally, engage in pretend play? The question is ambiguous, since it can be interpreted in either a proximal (motivational) or distal (evolutionary or functional) sense. The answer to the proximal question is, we believe, quite obvious. Children pretend because they enjoy it. More specifically, we think that young children begin with a disposition to find pretend play intrinsically rewarding (Picciuto 2009). The mere act of entertaining a suppositional representation is pleasurable for its own sake, leading children to begin exploring pretend scenarios. When they do so, they are likely to discover additional rewards, since by representing themselves as engaged in some desirable or admired activity their emotional systems will respond with positive affect (in the manner outlined by Damasio, 1994), despite the fact that they know full well that the actions in question aren't real (Carruthers 2006). As a result, the disposition to engage in pretend play will be further reinforced.

It is the distal question that interests us here. What is the evolutionary and/or developmental *function* of pretend play, if any? We will consider a number of possible answers.

4.1 Functionless pretense

Two prominent theorists in the first half of the 20th century denied that pretense has any function. They suggested that, essentially, children pretend for lack of anything better to do. Maria Montessori considered pretense a waste of a child's developmental time (Lillard 2005, 187). She concluded from the fact that children prefer to use a real object rather than a substitute (e.g., that they prefer cutting with a real knife rather than a pretend knife) that instances of pretense occur because children are not able (or permitted) to perform real actions. Likewise, Piaget (1962) regarded pretense as a stage that would be cast aside as children develop logic and rationality.

Few theorists today would be likely to consider a child who fails to pretend as unusually

competent and fulfilled. Most think that pretense at least co-occurs with, and more likely helps develop, some cognitive faculty—that children pretend for an important developmental reason. It is well known that the pretense of autistic children is extremely limited, and it is natural to think that there is some connection between the absence of pretense behavior and the other impairments seen in autism. Moreover, given that play interventions can actually improve executive function, emotion regulation, and divergent thinking in typically developing children (Fisher 1992; Galyer and Evans 2001; Moore and Russ 2009) as well as improving behavior, social cognition, and language in developmentally disabled and autistic children (Greenspan 1992), it seems likely that pretense has a causal role in optimal development.

4.2 Social schemata

A more recent suggestion is that the function of pretense is to help children practice social schemata and acclimate themselves to the wider culture in which they live (Bogdan 2005). The idea is that pretense functions to enhance social functioning and familiarity with social roles and scripts. And it is true that in many cultures parents use pretend play to teach children how to behave in social situations (Haight et al. 2003). But much pretense does not involve social schemata. While the account has some plausibility for instances of pretend cooking or pretend child-care, it is much harder to map onto such paradigm cases of pretense as talking with an imaginary friend or pretending that a block of wood is a fire-truck. Taking one object for another does not necessarily involve social or cultural rehearsal. Moreover, it is far from clear how this proposal could work, even in those cases where it initially seems most plausible. For one needs to have a mental representation of a social schema in order to pretend to enact it. So how could the latter help to inculcate the former? Further, there are many instances of social pretense where it is hard to see them as an aid to cultural acclimation. A pretense that is especially outlandish and fantastical is not the easiest route for learning about cultural conformity. Pretending one is a superhero (as many children do, particularly in Western cultures), and pretending to leap tall buildings in a single bound does nothing to rehearse useful schemata for everyday social interactions—which tend not to involve leaping tall buildings.

In addition, the proportion of pretense devoted to rehearsing social schemata seems to vary from culture to culture. Irish-American children spend much less time rehearsing everyday social situations than do Chinese children in Taiwan (Haight et al. 2003); Anglo-American preschoolers do less than Korean-Americans (Farver and Shin 1997). If pretense were a

cognitive activity whose function is to inculcate cultural conformity and practice social roles, then it would be likely to function similarly across cultures. That is, children in all cultures would pretend their culture's particular schemata.

4.3 Developing mindreading

Yet another suggestion is that the function of pretend play is to facilitate the development of our so-called "mindreading" capacity. (This is the ability to attribute mental states to other people, and to explain and predict their behavior in the light of such states.) For on some accounts, mindreading is fundamentally a *simulative* capacity in which one adopts in imagination the perspective of another person and then thinks and reasons within the scope of that pretense, attributing the outcomes to the target individual (Currie and Ravenscroft 2002; Goldman 2006). So early pretense (beginning at 18 months) may be a necessary precursor for later mindreading (emerging in the third and fourth year of life). Additional support for this suggestion can be derived from the finding that pretend play is largely absent in autistic children. For everyone accepts that autism involves a deficit in mindreading (Baron-Cohen 1995; Goldman 2006). Hence it may be that it is the early failure to engage in pretend play that is responsible for later failures in mindreading tasks such as the false-belief task.

A rapidly expanding body of recent research makes this suggestion untenable, however. For it shows that children have intact mindreading capacities far earlier than the age at which they successfully pass verbal false-belief tests, and either earlier than, or coincident with, the onset of pretend play. We now know that infants in the first year of life attribute goals to other agents and form appropriate expectations in light of those goals, while at the same time drawing appropriate inferences when agents have or lack perceptual access to an event (Woodward 1998; Johnson 2000; Csibra et al. 2003; Luo and Baillargeon 2005). Moreover, we also know that infants in their second year of life (almost certainly by the age of 18 months and perhaps as early as 13 months) can identify and form appropriate expectations about the false belief of another agent, while also understanding that other people can be misled by appearances (Onishi and Baillargeon 2005; Southgate et al. 2007; Surian et al. 2007; Song et al. 2008; Scott and Baillargeon 2009; Buttelmann et al. 2009). Since infants do not begin to engage in pretense until around the age of 18 months, it is plain that the function of pretense cannot be to enable the development of mindreading. On the contrary, some aspects of mindreading, at least, are in place prior to the onset of pretend play, while others seemingly co-occur with the latter. Even infants'

understanding of the pretend behavior of other agents seems to co-occur with the onset of first-person pretending (Onishi et al., 2007).

In addition, mindreading is a capacity that is restricted to a single domain. Both pretense and creativity, however, are (at least in humans) domain-general. It seems more plausible that a domain-general behavior serves to develop a domain-general capacity, rather than a domain-specific capacity.

What, then, is the connection between the mindreading problems that are characteristic of autism and the absence of pretend play in autism, if pretense doesn't serve to facilitate mindreading? There are a number of possibilities. One is that it is pretense that depends upon mindreading, rather than vice versa. This could happen either directly (pretending requires knowing that you are pretending) or indirectly (the pleasures of pretense depend upon seeing one's own actions in a certain light). But another possibility is that both utilize similar cognitive resources, which Leslie (1987) calls "decoupling". This is the capacity to entertain and reason with a suppositional or counterfactual representation (either one's own pretense or the false belief of another). Hence it may be this common capacity that is damaged in autism.

Yet another possibility is that both pretense and mindreading happen to depend upon networks of long-range neural connections in the brain, which are known to be less prevalent in autism (Belmonte et al. 2004; Courchesne et al. 2007). For as we will see in Section 5, pretense uses executive control and attention (known to be located in the frontal lobes) to suppress interpretations arising naturally from perceptual input (located in the occipital and temporal lobes in the case of vision). Likewise the mindreading system involves a long-range network including regions of frontal, temporal, and parietal lobes (Frith and Frith, 2003; Saxe and Powell, 2006; Saxe, 2010). Hence on this account the co-occurrence of mindreading deficits with an absence of pretend play in autism wouldn't be causal. Rather, both would be products of the same underlying neurodevelopmental cause.

4.4 Pretense is for creativity

So far in this section we have considered a number of suggestions concerning the function of pretend play (or lack thereof), and have found each of them to be problematic to various degrees. Our own suggestion, in contrast, is that the function of pretense is to enhance creativity. Practicing pretense as a child, we suggest, makes one a more creative adult. This is an intuitive connection suggested by, among others, Vygotsky (1934/1965). There are also recent empirical

data that are consistent with it, at least.

Pretend play has been found to predict creativity four years later, and early imaginative play predicts later divergent thinking (Russ et al. 1999). Moreover, when children are given play opportunities, as opposed to repetitive copying, this boosts their subsequent creativity in unrelated domains when tested a few minutes later (Howard-Jones et al. 2002). In addition, just as our account predicts, it turns out that people with autism, who show a marked absence of pretend play in infancy, are also less creative than typical people in adulthood (as well as having well-known mindreading deficits). People with autism are less generative overall, while also producing less novelty and showing less imagination (Craig and Baron-Cohen 1999). They also do far worse at generating novel uses of an object and generating novel interpretations of a meaningless line-drawing, and there is evidence of both impaired generation of new ideas and failure to inhibit impermissible or repeated responses (Turner 1999).

None of this evidence is probative, of course. Indeed, each set of data also admits of an alternative explanation. Thus the reason why pretense abilities predict creativity some years later may be that both are manifestations of a common innate mechanism (such as Leslie's "decoupler") which varies in efficiency between people; and essentially the same explanation can be given of the deficits in creativity found in autism. If so, then it needn't be the *function* of pretense to enhance creativity; and earlier pretense might fail to have any causal impact on later creativity. Moreover, while the short-term effects of play on creativity are surely causal, they might be mediated by the well-known effects of positive mood on creative performance (Baas et al. 2008). It may be that play puts the children into a good mood (or repetitive copying puts them into a bad one), and it is the latter that then impacts their creative performance a few minutes later. However, our account does have the advantage of providing a single unifying explanation of the data, in contrast with the disparate explanations sketched here.

Gaut (2011) suggests a possible critique of the view that the function of pretense is to enhance creativity. Some animals seem to pretend. For example, kittens engage in defanged hunting and stalking behavior that is similar to, but importantly different from, the hunting and stalking behavior that occurs in the presence of actual prey. If some animals pretend, then pretense is not the uniquely human behavior that can explain uniquely human forms of creativity. However, the pretense behavior of animals is restricted to a single domain. Kittens pretend to hunt, but they don't pretend to eat, or to groom themselves, or that they can fly, or that they are dogs. If indeed animals do pretend, it is in a very different way than the variegated, domain-

general pretending that human children engage in. It is this type of domain-general pretense that would be likely to give rise to the domain-general capacity of creativity.

In addition to being consistent with and providing a unifying explanation of the evidence, our account has one crucial feature that the common-cause explanations canvassed earlier lack: it can explain why children engage in pretense in the first place. This should not be taken for granted. On the contrary, were it not so familiar, the fact that human infants begin to engage in pretend play at around 18 months would be a striking species-typical behavior, and would cry out for some sort of adaptionist explanation. For even if infants' emotional reactions to their pretend episodes can explain why they continue pretending once they have begun (Carruthers 2006), we need to explain why they ever begin in the first place. Since cultural explanations (in terms of imitation of others, for example) are highly implausible, the most reasonable suggestion is that human infants are innately disposed to begin engaging in pretense, and that they find these episodes somehow intrinsically rewarding (Picciuto 2009). If this is so, then it requires an explanation. This is what our account can provide, and it is the only one of those canvassed that can do so while being consistent with the full range of evidence.

Our account would be greatly strengthened, however, if we could specify the mechanisms through which pretend play in infancy enhances creativity in later life. (As generally happens in science, the capacity of a theory to provide a satisfying and detailed explanation of the phenomena can provide us with good reason for embracing it, even if alternative accounts are not yet ruled out.) This will require us to characterize some of the cognitive mechanisms involved in pretense, as well as the processes involved in psychological creativity, demonstrating how an innate disposition to engage in the former might lead to enhancements in the latter. This will form the topic of Section 5.

5. How pretense enhances creativity

There are a number of ways in which pretense might enhance creativity, and there are a number of cognitive factors that are common to each. We propose to discuss these in turn, drawing attention where appropriate to empirical evidence that bears on our proposal. These are not competing hypotheses, however. Rather, we believe that pretense helps develop several capacities that are required for creativity.

5.1 Pretense and generativity

A natural initial thought is that the function of pretense may be to encourage and enhance the generative component of creativity. Perhaps the initial disposition to pretend, combined with the further encouragement and rewards provided by frequent pretense, are what explain why humans generate so much more novelty than do other animals, and why they do so across a wide range of domains. One initial problem with this suggestion, however, is that many forms of pretense are, in themselves, only minimally creative. Most instances of pretense fail to be historically novel, and many won't even be psychologically new. Children frequently return to the same or similar pretend scenarios, for example, which would not seem useful for exercising the mere ability to come up with unorthodox suppositions. Moreover, children in some cultures most often pretend quotidian scenarios (Farver and Shin 1997; Haight et al. 2003).

We suggested in Section 2 that capacities for constrained stochastic selection of actions and ideas may be a preserved feature, deriving from our nonhuman animal ancestors. But we noted that other animals don't use this capacity very much, or only do so within highly restricted domains. Hence even if pretense is only sometimes creative, it can still have the function of helping to develop adults who are more creative than are non-human animals, and who are creative in a general way, not restricted to a specific sort of context or activity. Moreover, recall that it is *imaginative* play in childhood that predicts adult creativity (Russ et al. 1999). Since individual differences in creativity of play co-occur with individual differences in adult creativity, this is quite consistent with the idea that the function of childhood pretense is to produce at least pan-human levels of creativity among adults. The proposed role for pretense in encouraging widespread generativity is also consistent with the finding that people suffering from autism not only fail to engage in pretense during childhood, but also grow up to be much less creative than normal as adults.

5.2 Supposition

A further natural suggestion arises from the fact that pretense and creative thinking both involve forms of *supposition*. In play, children *suppose* that the banana is a telephone, or that the teddy bear is alive and likes to drink tea, and they reason and act accordingly (up to a point). Likewise in science, researchers creatively generate explanatory hypotheses or possible experiments, in each case *supposing* that the hypothesis is true or that the experiment is conducted as described, in order to evaluate those suggestions. Similarly in the arts, composers and painters might entertain imagistic representations of the consequences of certain actions, or of those actions

themselves, in such a way that one might naturally express their thoughts in the form: "*Suppose* the melody continued like *this* …" or "Suppose I painted a red oval just *there* …". Perhaps what pretense does, then, is provide practice in making suppositions and reasoning within their scope, thus supporting both the "generate" and "explore" components of GENEPLORE creativity. Indeed, some of the standard tests of an individual's creativity invite the test taker to "just suppose"—for example, to just suppose that people never had to sleep anymore. Subjects are then graded on their responses to measure their abilities for divergent thinking (Plucker and Makel 2010, 53).

It might be objected that there are forms of creativity that this model doesn't fit so easily. These include some kinds of "performance art", where creativity is displayed "on-line", as well as in spontaneous athletic, musical, and dance improvisation, and in witty conversation. The supposition-model only fits those forms of creativity where ideas are first *rehearsed* before being evaluated or put into practice. This is central to GENEPLORE forms of creativity, but as we noted earlier, there seem to be many instances in which no real distinction can be drawn between the two phases postulated by such models. As we will see in Sections 5.3 and 5.4, however, there are other ways in which pretense can enhance even on-line forms of creativity. And in any case it can be true that pretense is, in part, an adaptation to enhance GENEPLORE creativity, while also having the function of encouraging more widespread use of our generative capacities (as outlined in Section 5.1).

One piece of evidence consistent with the proposed connection between the suppositional nature of pretence and adult forms of creativity is the finding that people with autistic-spectrum dissorders (who fail to engage in pretend play in infancy and who show deficits in their creativity as adults), also have problems in entertaining and reasoning with counterfactual or suppositional thoughts more generally (Peterson and Bowler 2000; Grant et al. 2004). It may thus be that difficulties in suppositional reasoning (which are manifested initially in an absence of pretend play) are what result in the reduced creativity of people with autistic-spectrum disorders.

5.3 Bypassing the obvious

In addition, a further common factor in both pretend play and creative thought and behavior is that in each the agent has to bypass prepotent, habitual, and/or more obvious responses. In playing with a banana as if it were a telephone, for instance, a child has to bypass, and keep bypassing, the thought that it is really a banana—despite the fact that her senses will be

screaming out at her that it is. She must ignore the fact that the object is really a banana and explore what opportunities are afforded by the premise that it is a telephone—all the while conscious of the fact that it is a banana. Likewise in generating creative titles for a story, or unusual things that one might do with a brick, one has to suppress the obvious responses. And the same is true even in cases of creativity that don't fit the GENEPLORE model. In dance or jazz improvisation, for example, one has to bypass "too obvious" or habitual continuations. Perhaps this ability is part of what play enhances. Note that it is an ability that requires executive function, akin to that involved when one attempts *not* to think of a polar bear (Mitchell et al., 2007).

Moreover, Baumeister et al. (2012) discuss a study that required guitar players to count backward by 6s while playing improvised guitar solos. Such counting absorbs the resources of working memory. The guitar soloists were able to keep the beat and remain in key, even when the key changed. This suggests such abilities do not require much in the way of conscious attention. However, the creativity of soloists who were asked to count was ranked lower than those who were not asked to perform such a task. Creativity seems to require conscious attention. An exercise of executive function, such as that provided by pretense, could thus serve to enhance creative ability.

Since in both pretense and creativity one has to bypass the obvious, most salient, reality-oriented construal or response, it may be part of the function of the disposition to pretend that it should enhance such a capacity. This suggestion is consistent with the finding that creative adults are indeed better at bypassing irrelevant information, responding faster and more accurately in Stroop-like tasks (Groborz and Necka, 2003). (These are tasks in which, for example, one has to name the color of a presented word, where the word itself can be a color-word that is either congruous or incongruous with the color shown. In the incongruous case one has to ignore the irrelevant semantic content of the word in making one's response.) While we know of no evidence that the same is true of children who play more often, it at least serves to confirm that creativity does indeed involve some sort of generalized ability to bypasss unwanted or irrelevant information. Ideally what one would like, however, is evidence that children who play more often and with greater elaboration in childhood should turn out to be less sensitive to the Stroop effect as adults. For this is what our account predicts.

5.4 Selecting the non-obvious

Another factor that is common to both pretense and creativity is closely related to the above, while being almost its inverse. For in order to embark on a pretense, and in order to come up with a creative idea or behavior, one has to *not* bypass the *non*-obvious, seemingly irrelevant, possibilities. On the contrary, pretense and creativity are each only possible if there are a range of non-literal, non-obvious, non-routine, possibilities that are available for the agent to select among. (And indeed, Bristol and Viskontas (2006) cite a number of memory studies that show that creativity requires not only working memory, but decreased cognitive and cortical inhibition.) So representations of these possibilities need to be active. Note that it will do no good for them to be stored in long-term or semantic memory. For then of course one could not search for and activate any one of them in particular without already having determined its potential usefulness. But that would mean that the idea had *already* occurred to one. Nor would a more generalized query, "Give me something new", be likely to activate these representations in particular. Hence novelty, in both pretend play and adult creativity, is only possible if the agent can maintain a range of activated non-obvious representations to select between.

It may then be part of the function of pretense to foster the availability of such representations in adulthood, thereby supporting creativity. Consistent with this suggestion, it has been found that high levels of creative achievement among adults is linked with low levels of what psychologists call "latent inhibition" (Peterson et al. 2002; Carson et al. 2003). The latter is measured by giving subjects a learning task in which there are recurring but irrelevant distractor stimuli. When the task is completed, subjects are given a follow-up assignment that depends upon detection of those very same types of stimuli. Subjects high in latent inhibition find the second task difficult to solve. For having learned of the irrelevance of the stimuli, they have ceased to attend to them. Subjects low in latent inhibition, in contrast, perform significantly better on the follow-up task. Although they, too, were able to succeed on the first task, they have continued to pay attention to details that they have learned are irrelevant. What this seems to show is that creative individuals tend to pay attention to seemingly irrelevant details, and maintain a range of activated representations that aren't obviously relevant to the task in hand.

One might think that having one's mind filled with irrelevant ideas would be maladaptive. And indeed, in some circumstances, and taken to extremes, it is. For example, there is an extensive literature documenting low levels of latent inhibition in people suffering from schizophrenia (Baruch et al., 1988a, 1988b; Lubow and Gevirtz, 1995). Carson et al. (2003) posit that one difference between the two groups, however, is that people in psychotic states, or prone

to psychotic states, tend to be of lower general intelligence than creative controls. They find that creativity requires low inhibition specifically in combination with high general intelligence. They also point out that schizophrenia is associated with deficits of working memory. One needs both the ability to summon ideas that are seemingly irrelevant, and the working memory to select and explore a valuable one. Moreover, one might think that there is a big difference between someone for whom there are a range of activated representations *available* to be selected and entertained, and someone for whom such representations are *actually* entertained on a regular basis. It seems that normal creative individuals might be in the first situation, whereas people suffering from psychotic states are in the second.

Consistent with these ideas is the finding that creativity can be enhanced by the conscious intention to be creative (Baumeister et al. 2007). It can also be primed by a symbol of insight, such as a lightbulb illuminating (Slepeian et al. 2009). It seems that ordinary individuals, while normally ignoring active representations that aren't immediately relevant, can adopt the strategy of paying attention to and entertaining such representations when they have the goal of being creative. Arguably what one does in such circumstances is to "think playfully" beyond the age at which one any longer engages in pretend play as such. People suffering from schizophrenia, in contrast, may be unable to prevent themselves from entertaining bizarre or irrelevant representations.

5.5 Exploring and evaluating

In addition to requiring both bypassing more obvious responses and openness to non-obvious ones, in both play and creativity there is also an element of evaluation and development. These are, of course, crucial to the "explore" component of GENEPLORE models of creativity. For example, a scientist who thinks of a novel hypothesis must initially evaluate its consistency with the evidence and coherence with things that she already believes. She then needs to consider ways to test the hypothesis, how those experiments should be designed, and so on. The path from initial idea to final evaluation may take many years of hard work. Likewise a painter who has a novel idea for a painting has to undertake an initial evaluation of the idea before considering the many different ways in which the idea could be implemented, what paints to use, what size canvas would work best, and so forth.

Similarly, it is not the case that simply any non-obvious or non-habitual response will do in a pretense—some are better than others. For example, objects used in pretend play generally at

least suggest a perceptual resemblance to an imagined object. And while scenarios can get increasingly elaborate with age, there still seem to be both inappropriate and appropriate additions to pretend episodes. When pretense becomes social, it requires an openness to surprise additions made by others, yet it seems that even in social pretense it isn't the case that simply anything goes. So there seems to be an initial evaluation taking place at the outset of a pretend episode, just as there is at the outset of a creative episode in adulthood.

Moreover, pretense, like creativity, often involves a capacity for sustained focus while working within the scope of an initial supposition. Pretending generally takes time, as well as involving a number of intermediate stages. Hence during that time the child needs to keep in mind the relevant pretend suppositions, and needs to maintain her focus while the pretense is acted out. It may thus be part of the function of pretense to enhance people's capacity to focus on an idea or activity while it is being explored, evaluated, or implemented. While there is little hard data involving controlled experiments to support this claim, it is in fact one of the central tenets of the "Tools of the Mind" educational program (Bodrova and Leong, 2006). This is based on the ideas of Vygotsky, who believed that pretend play enhances both creativity and executive function. It is claimed that participation in structured forms of pretend play in preschool enhances children's executive function abilities during their later school years, and especially that it enhances their abilities to keep focused on a task. This is just what our analysis would predict.

The capacity for persistent focus on a task is of much more general value, however, playing an important part in many aspects of characteristically-human life, both creative and uncreative. So even if the capacities for sustained focus are required in both pretense and creativity, and even if the former contributes materially to the latter, it may be the case that pretense helps develop other abilities in addition to creativity. It may be an adaptation for enhancing goal-directed and executively controlled behavior, as well.

5.6 Pulling together the strands

A number of the ideas canvassed above are supported by the main conclusions of Christoff et al. (2007), as well as Bristol and Viskontas (2006). They find that a kind of defocused attention combined with cognitive control is especially distinctive of creative thought, combining together aspects of focused problem solving (cognitive control) with unguided thinking (or "mind-wandering"). This is surely consistent the main components of our earlier task-analysis of

creative cognition. To be creative one has to allow oneself to attend more widely and be open to alternative ideas or behaviors, but at the same time one has to bypass more obvious ideas and behavior and maintain focus while alternative possibilities are explored and evaluated. Since the same would appear to be true of pretend play, this is quite consistent with the claim that the latter is an adaptation designed to enhance the former.

We have to concede that the evidential base for our claim is presently somewhat slim, and much of it only supports, at best, a *correlation* between pretense and creativity. But the evidence is at least consistent with the proposal that enhancing creativity is what pretend play is *for*. Moreover, recall that the species-specificity of pretend play behavior cries out for explanation. Our hypothesis gains considerable plausibility, in our view, from its capacity to provide such an explanation. For it is the only proposal among those canvassed that does so.

6 Conclusion

We have argued that pretend play in children is an adaptation whose function is, at least partly, to enhance creativity in adults. There is evidence that some animals exhibit a limited and domain-specific creative ability, which may have been exapted by humans—in whom creativity seems to be an adaptation. We suggest that a primary reason that typical human infants universally engage in pretend play is to develop the capacities that encourage and allow for creative thought. This is a more plausible account of the function of pretense than theories that suggest that pretend play develops mindreading capacities or more sophisticated social schemata. By encouraging the development of several different common capacities (such as generativity, supposing, bypassing the obvious, and selection of the valuable but less obvious) childhood pretense paves the way for creativity in adulthood.

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