Corresponding Author: Dr. Mark Ashton Smith,

Corresponding Author's Institution:

First Author: Mark Ashton Smith

Order of Authors: Mark Ashton Smith

Abstract: Moll and Tomasello's Vygotskian Intelligence Hypothesis (2007) is reviewed and critiqued, with a focus on its account of uniquely human joint attentional declarative pointing. Theoretical constructs at the core of this account are joint action, joint attention frames, perspectival representations and shared intentionality. Drawing from cognitive, developmental and comparative psychology, cognitive neuroscience and philosophy, I argue that that any account of declarative pointing needs to distinguish between shared intentionalityA (joint action based shared cogntition), and shared intentionalityR (the normatively constrained 'aboutness' or representational nature of cognition that is shared), and provide an account of both. Both are critical to understanding uniquely human cognition. Building on the Vygotskian Intelligence Hypothesis, I develop the Shared IntentionalityR Hypothesis that accommodates these two distinct, but arguably related, types of intentionality in its explanatory account. In doing so I offer a novel explanation for declarative pointing, and introduce some new conceptual distinctions and challenges to the shared cognition literature.

Suggested Reviewers:

Running Head: JOINT ATTENTIONAL DECLARATIVE POINTING

Joint Attentional Declarative Pointing:

Shared Intentionality$_A$ (Action) and Shared Intentionality$_R$ (Representation)

Dr. Mark Ashton Smith

Department of Psychology

Girne American University

Cyprus

1

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Abstract

Moll and Tomasello's Vygotskian Intelligence Hypothesis (2007) is reviewed and critiqued, with a focus on its account of uniquely human joint attentional declarative pointing. Theoretical constructs at the core of this account are joint action, joint attention frames, perspectival representations and shared intentionality. Drawing from cognitive, developmental and comparative psychology, cognitive neuroscience and philosophy, I argue that that any account of declarative pointing needs to distinguish between shared intentionality$_A$ (joint *action* based shared cogntition), and shared intentionality$_R$ (the normatively constrained 'aboutness' or *representational* nature of cognition that is shared), and provide an account of both. Both are critical to understanding uniquely human cognition. Building on the Vygotskian Intelligence Hypothesis, I develop the Shared Intentionality$_R$ Hypothesis that accommodates these two distinct, but arguably related, types of intentionality in its explanatory account. In doing so I offer a novel explanation for declarative pointing, and introduce some new conceptual distinctions and challenges to the shared cognition literature.

2

Introduction

Joint action, shared attention, joint attention frames, perspectival representations and shared intentionality are theoretical constructs that lie at the heart of prominent accounts of uniquely human cognition, particularly shared intentionality accounts developed over two decades by Michael Tomasello and his colleagues, based at the Max Plank Institute of Evolutionary Anthropology in Leibzig. In this paper I define, analyse and critique these constructs in the context of the Vygotksian Intelligence Hypothesis (Moll & Tomasello 2007), a theory that integrates these constructs in a coherent and comprehensive socio-cognitive account. Explaining joint attentional declarative pointing provides a focus for this critique. This skill is singled out because it provides a more tightly constrained focus of inquiry, enabling a more detailed conceptual explication of the constructs involved, and allowing competing accounts to be measured against each other. Joint attentional declarative pointing is also, arguably, a foundational cognitive-behavioural skill in the phylogeny and ontogeny of uniquely human cognition (Kita 2003).

Declarative Pointing

Comparative psychologists have discovered a striking behavioral difference between wild apes and humans. ''[D]espite intensive observations of the spontaneous interactions of free-ranging chimpanzees, there is no evidence that these animals …gesture with the arm and/or index finger toward other objects, animals, or events in space'' (Povinelli, Bering & Giambrone 2003, p. 41). Wild chimpanzees don't *point* and this fact holds true of wild apes generally. In over a 40 years of intensive field studies, according to Moll and Tomasello, "There has not been a single reliable documentation of any scientist in any part of the world of one ape pointing for another" (Moll & Tomasello 2007 p. 643;). By contrast, human infants from around one year of age begin to point to objects in their environment in earnest (Liszkowski et al. 2004; Povinelli, et al. 1997; Tomasello 2006).

In captivity chimpanzees, orangutans, gorillas and bonobos, without training, commonly point to unreachable food, either with their index finger or, more commonly, with all fingers extended (Leavens & Hopkins 1999; Leavens, Russell & Hopkins 2005). These are genuine communicative signals and not simply reaching behaviors because chimpanzees will not use this gesture if caretakers are not around to see them do it (Leavens, Hopkins & Thomas 2004). A review of the evidence suggests that apes in captivity use pointing only *imperatively*, to obtain food and only food (Call & Tomasello

1996; Leavens, Hopkins & Bard 2005). The recipient of the communicative act is simply understood as a 'social tool' (Bates, Camaioni & Volterra 1975) and "apes have learned that pointing gets this tool to work" (Moll & Tomasello 2007, p. 643). In striking contrast to human infants, no ape - whether wild or in captivity - has ever been observed to point for another ape or human *declaratively* – that is, "for the sake of sharing attention to some outside entity" (p. 643). In humans, both types of pointing emerge around twelve months of age (Carpenter, Nagell & Tomasello 1998; Leung & Rheingold 1981).

Thus the evidence strongly suggests that while apes and other primates can interact *dyadically* with objects or conspecifics, they cannot interact *triadically* in a referential triangle between ape, other ape/human and object or event to which they share attention or interest. And without this kind of triadic interaction other primates cannot communicate with each other about objects or events in their environments, gesturally or symbolically, in the way humans do from infancy.

Declarative pointing has been regarded as critical for the establishment of *referential triangles*. Acts of pointing can have an object as their referent. Instead of using the word 'cat' to refer to *that* cat and establish a topic of conversation we could point to it. An act of pointing, "creates a referential triangle that incorporates distant objects into the relationship between the signaller and the recipient of the gesture" (Leavens, Hopkins & Bard 2005, p. 185). Michael Tomasello has defined a 'referential triangle' as the *sharing of attention* to some "outside entity", incorporating the "child, adult, and the object or event to which they share attention" (Tomasello, 1999 p. 62). The use of pointing to establish 'referential triangles' is widely believed to be foundational for human speech acquisition (Butterworth 2003), and symbolic communication in general depends crucially on joint attention to referents. Daniel Povinelli and Michael Tomasello, along with comparative psychologists in other labs, believe that wild apes' inability to point for others and its universal presence in infants as young as one year constitutes evidence for a naturally selected, cognitive-behavioral specialization present in humans but absent in apes (Tomasello 1999; Povinelli, Bering & Giambrone 2003; Gomez, Sarriá & Tamarit 1993). Tomasello, for example, proposes that "the simple act of pointing to an object for someone else for the sole purpose of sharing attention to it is a uniquely human communicative behavior" (Tomasello 1999, p. 63).

Joint Attention

The ability to *jointly attend* or *share attention* to something is a social cognitive skill that is both necessary and partly constitutive of declarative pointing in referential triangles. Between nine to

twelve months of age human infants begin engaging in a suite of joint-attentional skills indicating their ability to 'tune in' to the attention of adults to outside objects and events (Moore and Dunham 1995; Carpenter, Nagell & Tomasello 1998; Tomasello 1999). This includes, early on, simply registering the adult's attention and behavior towards outside entities by following an adult's gaze to objects. Subsequently, infants actively direct adult attention and behavior to objects and events using communicative gestures such as declarative pointing, but also holding up an object to show it to someone. These 'deictic'[1] gestures function in communicative referential triangles. Moreover these joint attentional skills emerge in close developmental synchrony, with 80% of infants mastering all these abilities within a four month window in one study (Carpenter et al. 1998: see Figure 1). This developmental pattern is unique to humans.
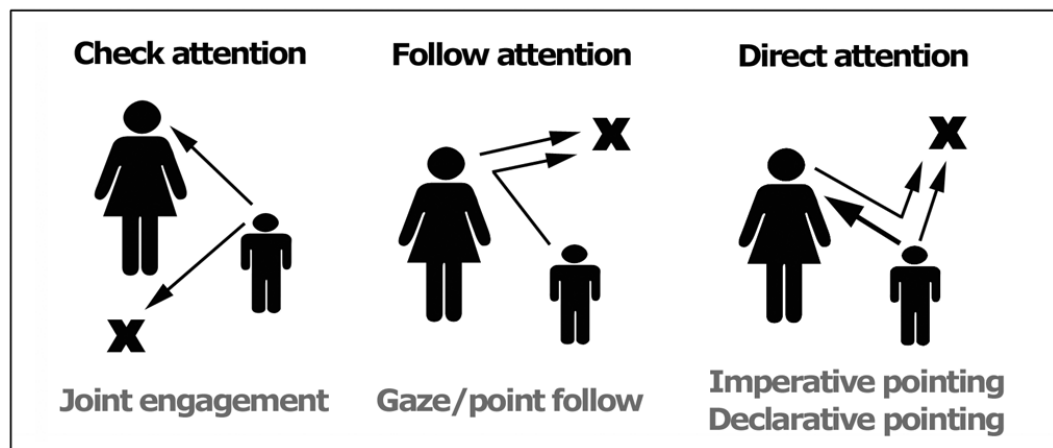

Figure 1. Types of joint attentional interaction and the sequence of their emergence in development between 9 to 12 months of age. Adapted from Carpenter, Nagell, & Tomasello 1998.

Call and Tomasello define what is required for genuine joint attention in this way:

> Joint attention is not just two individuals looking at the same thing at the same time. Joint attention requires that each of the individuals knows that the other is attending to the same thing as they are attending to; that is what makes it a joint, rather than a merely simultaneous, activity. (Call and Tomasello 2005)

Thus joint attention can be seen as a type of object directed intersubjectivity in which psychological states are mutually acknowledged and shared. While joint attention is necessary for declarative

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[1] The referent of a 'deictic' communicative act depends on the context – on who points, where and when.

pointing, this is not the case for imperative pointing – the kind of pointing observed in captive apes. Imperative pointing does not require any understanding of another individual's perceptions or mental states; it simply requires that the pointing individual understands another individual can be manipulated instrumentally to attain their goal.

Why Can't Apes Point Declaratively? The Vygotskian Intelligence Hypothesis

Given the obvious utility of declarative pointing and sharing attention in communicative referential triangles for apes and other primates ('there's monkey prey!', 'there's a leopard predator!', 'there's an unusual animal!') an obvious question presents itself: *why* can't apes and other primates communicate like this while humans do so from early infancy? This is an important question, given the critical role of declarative pointing in referential communication and symbolic language acquisition – two fundamental capabilities in human cognition. In tackling this question, we are in effect attempting to identify which factors might play a key role in the phylogeny of this cognitively fundamental socio-cognitive skill, on which so much distinctively human cognition depends.

One prominent group that directly addresses this question is Tomasello and his colleagues at the Max Planck Institute of Evolutionary Anthropology. According to these researchers, apes cannot point declaratively because declarative pointing requires two co-dependent communicative skills that they lack (Rakoczy & Tomsasello 2007; Moll & Tomasello 2007): 1. The ability to understand a cooperative *communicative intention*: that a pointing gesture of another individual is intended for their benefit – to engage their attention and interest in some outside entity. 2. The ability to participate in *joint attention frames* (JAFs) that depend on shared or 'we' intentionality, that grounds the *meaning* of the communicative intention behind the pointing, anchoring the *referent* of the pointing act. They can do neither of these things because they are both *cooperative* socio-cognitive specializations, while apes are cognitively adapted for *competitive* interactions.

According to Henrike Moll and Michael Tomasello's (2007) *Vygotskian Intelligence (VI) Hypothesis,* while the primary selective pressure for the evolution of primate cognition in general has been social competition as emphasized by the social intelligence or Machiavellian Intelligence hypotheses (Humphrey 1976; Byrne & Whiten 1988), the evolutionary driving force for uniquely human cognition has been social *cooperation* (Tomasello 2009). According to the VI Hypothesis, humans are biologically adapted for social interactions involving joint attention and *shared intentionality,* defined as "col-

laborative interactions in which participants share psychological states with one another" (Tomasello & Carpenter 2007, p. 121). Shared intentionality encompasses "joint goals, joint intentions and joint attention, and special motivations for helping and sharing with others" (p. 645). Unlike apes, humans spontaneously cooperate in their communication from early infancy – to share interest in things or to inform others. Liszkowski *et al.* (2006) demonstrated that infants readily point for adults to helpfully inform them about things that they are looking for as early as 12 months.

Data from the *object-choice task* has been used in support of the VI Hypothesis for why apes cannot point declaratively (review, Call & Tomasello 2005). In this task a human (the 'hider') hides some food in one of two containers. Then another human ('the helper') shows tilts the container to show the ape where it is. After this induction, the hider again places the food in one of the containers but now the helper uses a communicative cue to indicate the relevant container by pointing to (and in other variants, gazing at, or tapping on, or placing a marker on top of) the relevant container. The results are the same in all variants of this task: chimpanzees most often choose the container randomly, failing to understand the obvious communicative cue. Those who eventually perform well take dozens of trials to learn. Human infants, by contrast, can understand pointing gestures in an object-choice task spontaneously from as early as 14 months of age (Behne, Carpenter & Tomasello 2005).

Michael Tomasello, Josep Call and Brian Hare (Hare 2001; Tomasello, Call & Hare 2003) argue that ape foraging life, and their socio-ecologies more generally, are predominantly *competitive* and selection has favoured individuals capable of reading social cues that help them to outcompete conspecifics. Chimpanzee subjects in the object-choice task do not take pointing or gazing as an informative cue for food because primate cognition is not naturally adapted to read cooperative communicative cues. To test this hypothesis, Hare and Tomasello (2004) devised a version of the object-choice task in which a more ecologically valid *competitive* food-access relationship was established between a human and a chimpanzee. After the food was hidden in one of two containers, instead of pointing to the relevant container, the human extended her arm effortfully towards the container where the food was hidden, but not reaching it. The action closely resembled pointing except for the fact that all fingers were extended. In this competitive variation of the object-choice task, chimpanzees spontaneously performed skilfully in choosing the container with the hidden food.

In further support of the VI Hypothesis for success in the object-choice task, domesticated dogs, unlike non-human primates, are expert at spontaneously using pointing and other cooperative-

communicative cues. They do not need intense exposure to humans to exhibit this social skill (kennel-reared puppies are as skilful as puppies reared in human families), and their closest relative, the wolf, performs as poorly as apes. Thus the skill evolved during dogs' domestication (Hare et al. 2002), as revealed by the work of the geneticist Beylyaev. Beylyaev experimentally domesticated foxes, artificially selected for over 45 years on the sole criteria of low levels of fear and aggression towards humans. The foxes over successive generations became increasingly friendly towards humans, developing less robust skeletons, floppy ears, and a range of non-selected changes typically associated with the domestication of dogs and other animals. For our purposes, what is remarkable is that the experimental fox population used pointing gestures in the object-choice task at the same skill level as dog puppies and at higher levels than both chimpanzees and the non domesticated control population of foxes (Hare et al. 2005).

What were the selective pressures at work here? Accompanying domestication were changes in the adrenal cortex and the serotonergic and limbic systems - notably the amygdale - structures known to be involved in emotional reactivity (Trut 2001). It is hypothesized that the variance in *emotional reactivity* in the original stock of experimental foxes was the target of the artificial selection regime (Kagan & Snidman 2004). In the domestication of dogs, this could have allowed, in turn, for the direct selection on variance in social-cognitive skills, such as reading informative pointing cues, in contexts such as herding or hunting that required cooperation and communication with humans (Hare & Tomasello 2005; Hare 2007). According to the VI Hypothesis a similar selection on temperament in humans - through a social 'self-domestication' process - has paved the way for the evolution by natural selection of a variety of unique and powerful social-cognitive abilities for cooperative communication and shared intentionality – declarative pointing, but also symbolic communication, knowledge dissemination in cultural groups, and 'mind reading' in especially complex ways, as well as cooperative activities with joint goals such as big game hunting, food-sharing, group raiding and defence of territory, division of labour in child-rearing and group decision-making (Hermann et al. 2007; Moll & Tomasello 2007).

The Object-Choice Task: Communicative Intentions And Joint Attention Frames

According to Tomasello and his colleagues, understanding declarative pointing requires understanding *communicative intentions* (Moll & Tomasello 2007). They argue that in the competitive

version of the object-choice task chimpanzees simply perceive the goal-directedness of the reaching action and infer from this that there is something desirable in the container the action is directed towards. There is independent evidence for chimpanzee skill in this type of exploitation of social cues (Call 2004). But understanding instrumental intentions is not the same as understanding communicative intentions which, they argue, underlies successful understanding of the pointing gesture in the task:

> …to understand pointing, the subject needs to understand more than the individual goal-directed behavior. She needs to understand that by pointing towards a location, the other attempts to communicate to her where a desired object is located; that the other tries to inform her about something that is relevant for her. So the ape would need to understand something about the directedness towards itself ('this is for me!') and about the communicative intention behind the gesture in order to profit from it." (Moll & Tomasello 2007, p. 644)

On this account there is an important sense in which finding the food in the object-choice task is a cooperative *joint project* within which communicative intentions make sense: the helper's intentionally informative cue is relevant to the search task the subject is facing, and thus is incorporated into some shared comprehension of 'our project' in the game of 'I show you find'. On this account there is thus a shared intentionality – or 'we intentionality' - involved that is task or goal directed. The 'joint project' aspect of communicative intentions is elaborated in the important theoretical notion of a *joint attentional frame* (JAF) or 'common ground' of communication (Clark & Brennan 1991).

> It is … the joint attentional frame, or common communicative ground, emanating from the joint project which gives the pointing gesture its meaning in specific contexts. (Rakoczy & Tomsasello 2007 p. 120)

Rakoczy and Tomasello give the following example of a JAF:

> …if you encounter me on the street and I simply point to the side of a building, the appropriate response would be 'Huh?' But if we both know together that you are searching for your new dentist's office, then the point is immediately meaningful. (p. 120)

In this example, by virtue of the JAF the pointing has a *relevance* to the 'searching for the dentist's office' task, which – in the act of pointing – both individuals participate in together in a shared intentional way. Anyone outside *of* the JAF – the shared space of meaning - would not understand the pointing gesture. To relate this back to the notion of the referential triangle in a way that Tomasello and his colleagues do not make explicit, the JAF here anchors the *referent* of the pointing which both indi-

viduals can then triangulate on via joint attention. The referent of a pointing gesture in a referential triangle thus varies as a function of the JAF in which the pointing is grounded, and this is specific to the participants and their shared intentions. For any situation one can imagine any number of JAFs anchoring as many referents in as many referential triangles.

JAF-shared intentionality skills develop in conjunction with a developing understanding of *differences of perspective* on the *same* external entities. This uniquely human 'perspectival' cognition enables the creation of *perspectival* or *dialogic representations*, where both first and third persons' perspectives are simultaneously incorporated in a single representational format from a 'bird's eye' point of view (Tomasello et al. 2005). Perspectival representations, on this account, fundamentally transform human cognition and behavior: they regulate collaborative role-playing activities and support the creation and use of all cultural artifacts including linguistic symbols in natural languages and tools. They also mediate the comprehension and assimilation, over the generations, of the collective conventions and institutional norms that underlie a child's enculturation into adult social-institutional life, or the *collective intentionality* that constitutes a culture (Searle 1995).

The Vygotskian Intelligence Account of Declarative Pointing: A Summary

According to the Vygotskian Intelligence (VI) Hypothesis, apes fail to point declaratively, and fail in the object-choice task because non human primates are cognitively adapted to competition with conspecifics and communicate accordingly - instrumentally and 'individualistically', without sharing interest or information. They do not understand the communicative intention behind the pointing in the task because they cannot establish a cooperative joint attention frame (JAF) with the experimenter to anchor the point's referent ('food in *that* bucket') in a referential triangle. To understand the relevance of the gesture to their goal of finding the food, they would have to understand that the human's pointing gesture provides information for *them* in the context of a 'shared project', which they are incapable of. Thus "they follow the point to the bucket and say, in effect, 'A bucket. So what? Now where's the food?'" (Tomasello & Carpenter 2007 p. 122).

Following this line of reasoning, we also can see how an evolved tendency to cooperate in joint action (such as foraging, or hunting), along with the motivation to do so, could have provided the scaffolding for the co-evolution of joint attention in referential triangles, JAFs and perspectival repre-

sentations – the cognitive ingredients behind our uniquely powerful human cultural cognition. Cooperative, joint action and shared intentionality would be jointly reinforcing in selection.

Challenges To The Vygotskian Intelligence Account Of Declarative Pointing

In the following sections, I will present two challenges to the VI Hypothesis as an account of declarative pointing and the ability to engage in joint attention in referential triangles.

Challenge 1: Informative Vs. Declarative Pointing

The first challenge is that, on closer scrutiny, the VI Hypothesis doesn't appear to explain *declarative* pointing, only *informative* pointing. The object-choice task has a clear 'joint project' (shared intentional) structure, in which an object is hidden and a helper enables a child to find it by pointing. Similarly for all the illustrations of JAFs in communication in the literature – for example two friends in a hardware store, looking for a bucket for cleaning purposes (Moll & Tomasello 2007, p. 644). In this kind of joint action scenario is plausible that human infants, like adults, employ a JAF and "know that the 'functioning' of a joint attentional frame is specific to those people who share it" (Moll and Tomasello 2007, p. 644). There is direct experimental evidence for this kind of 'participant-specific' understanding of JAFs in infants. In one experiment different 'shared intentional' tasks involving infant and adult (e.g. stacking rings in a tower or clearing rings away by putting them in a basket) resulted in different interpretations of the very same act of pointing, with *what* is being attended to varying as a function of the JAF (Liebal et al. 2009).

But in this same experiment, the clearest case of *declarative* pointing is found in the control condition in which an adult who has *not* participated in any joint project with the child points at a ring. In this case, Moll and Tomasello (2007) claim "because they had no shared frame with this adult, they seemed most often to interpret the new adult's point as a simple invitation to note and share attention to the toy" (p. 645). This is precisely the standard definition of *declarative* pointing, and suggests that a JAF is *not* required for declarative pointing and engagement in referential triangles, contrary to the VI Hypothesis. There is apparently a motivation simply to share interest to objects with no shared intentionality of the sort implied by a JAF. In the developmental literature a distinction is drawn between

informative pointing and declarative pointing (Liszkowski 2005). Both may have a different functional basis, and pointing in the object-choice task is more plausibly informative pointing.

Challenge 2: Assuming The Referent

The second more fundamental challenge centers on the constructs of mental state *contents* and *referents*. The VI Hypothesis, I argue, *assumes the referent* in its account of ape cognition. This shall now be explained. First, it assumes that apes are capable of *perception* in the sense we normally understand it: through a sense modality such as vision, acquiring knowledge about the existence, identity and location of independent external objects such as buckets or items of food. This is apparent when Tomasello and Carpenter caricature the ape's thinking as 'A bucket. So what? Now where's the food?' As we shall see, the VI Hypothesis also assumes that apes are capable, in the competitive social situations to which they are adapted, of understanding visual perception in others. That is, they are capable of understanding the *content* of what other individuals see, i.e. the objective *referent* of a conspecific's attentional state, which they themselves may also attend to. What they are not capable of, on this account, is recognizing that they can *share* perceptual contents, by 'triangulating' their attention, in mutual acknowledgement, on the same object. The criterion that "each of the individuals knows that the other is attending to the same thing as they are attending to" is not attained, and thus although two apes may attend to the same thing at the same time, they are not engaging in *joint* attention to that object. This set of assumptions is represented schematically in Figure 2.
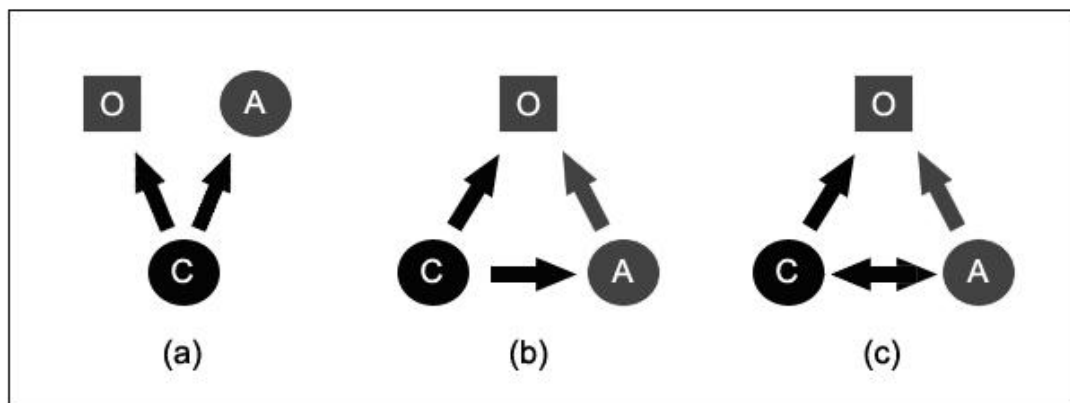

Figure 2. (a) The chimpanzee 'C' can perceive (as distinct) both a conspecific 'A' and a object 'O'; (b) the chimpanzee 'C' can understand that a conspecific 'A' can perceive (and attend to) object 'O', the *same* external entity they can themselves perceive; (c) the chimpanzee 'C' cannot, however, engage in

joint attention in a referential triangle with object 'O'.

On this account, an inability to jointly attend to objects in referential triangles is not a problem concerning the *referent* – the 'external entity' that the mental state is *about*; it is a problem of coordinating mental states to 'triangulate' on such objects. Because apes cannot establish JAFs and share intentionality through cooperative joint projects, they never developed a cognitive system to triangulate their attention on the external objects together. Humans' ability to share intentions in JAFs, on this account, solves this problem.

In the following sections I will review the evidence that backs up the VI Hypothesis assumption that the problem of joint attentional declarative pointing does not lie in the *referent* per se, but in coordinating mental states cooperatively. I will explicate how the way the data has been interpreted to this end is problematic, and propose an alternative account for declarative pointing – called the Shared Intentionality$_R$ Hypothesis – that builds on the VI Hypothesis, but does not assume the referent. Rather, it *explains* it. I will propose that the kind of joint attention required for declarative pointing originates in the kind of joint attention that plays a role in joint attention frames, and that it creates the *very possibility* of a referent in declarative pointing, ultimately facilitating the kind of declarative, propositional cognition that is distinctive in uniquely human symbolic thought and communication.

Does An Ape Understand That Another Individual Can See What They Themselves Can See?

The experimental evidence for ape understanding of seeing is found in a set of studies (Hare et al. 2000; Hare, Call & Tomasello 2001; Call 2001) in which a subordinate (S) and a dominant (D) chimpanzee were placed in competition over food items that were placed either in full view of both of them, or sometimes behind a physical barrier such that S could see the food but not D (Figure 3). In this setting S flexibly pursued the food that was concealed from D, suggesting S knows what D can and cannot see. In another set of experiments, there were two barriers and the food was placed behind one of them, out of view of D. In the control condition both D and S watched the food hiding process while in the experimental condition only S watched. S pursued the food more often in the experimental condition, suggesting that S knows what D has or has not seen in the immediate past. Moreover, if D is switched for another D (2) after watching the hiding process, S pursues the food more than when there is no switch, suggesting S knows who (D1 or D2) knows what.
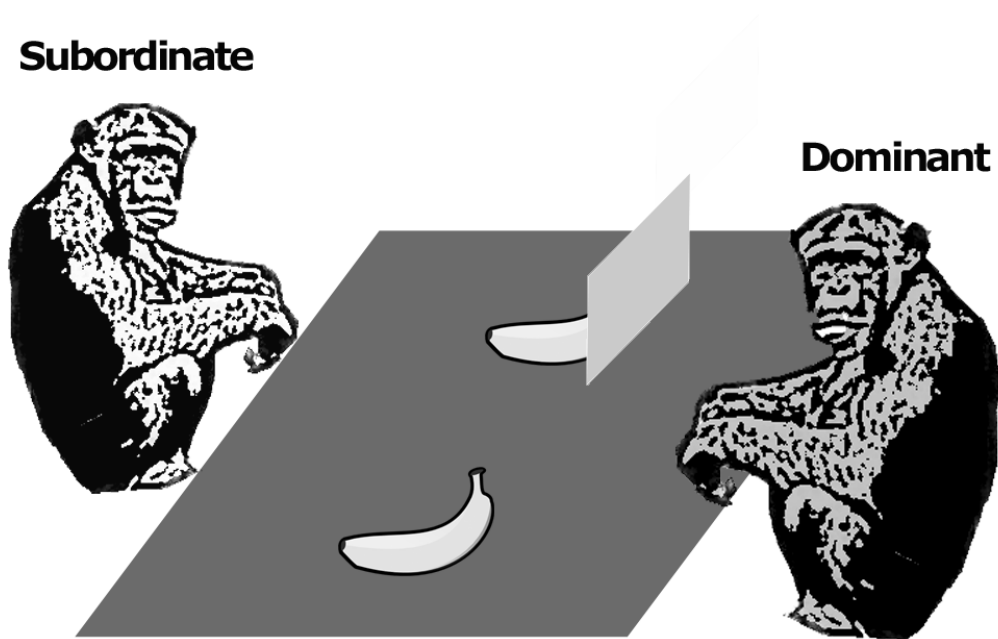
Figure 3. Experimental set up in the 'seeing-knowing'

food competition experiments (adapted from Hare, Call & Tomasello 2000)

To help clarify the 'mind reading' abilities that Tomasello and colleagues attribute to apes based on these experiments, I will make use of a number of theoretical distinctions made by Richard Byrne in his analysis of how acts of deception may be interpreted in Hamadryas baboons (Byrne 2007). In his field work Hans Kummer (1968) observed the behavior of a female baboon who carefully positioned herself over a 20 minute period such that she could groom a subordinate male without her harem leader being able to see what she was doing. Under normal circumstances, this subordinate male would have been forbidden to interact with her. Byrne identified three distinct interpretations of this behavior as illustrated in Figure 4. In the most richly psychological (or 'intentional' in Byrne's terminology) – *level (a)* - the female is thinking about her harem leader's *false belief* that there is no other baboon behind the rock. A less richly psychological interpretation – *level (b)* - is that the female is thinking about what the harem leader *sees* – about the *content* of his perception that does not include the subordinate. At *level (c)* the female may simply be aware of her harem leader's geometric *position* and know that

from that position she is safe in her grooming activity. A skill like geometric gaze following may be employed without any understanding of the harem leader's mental states.
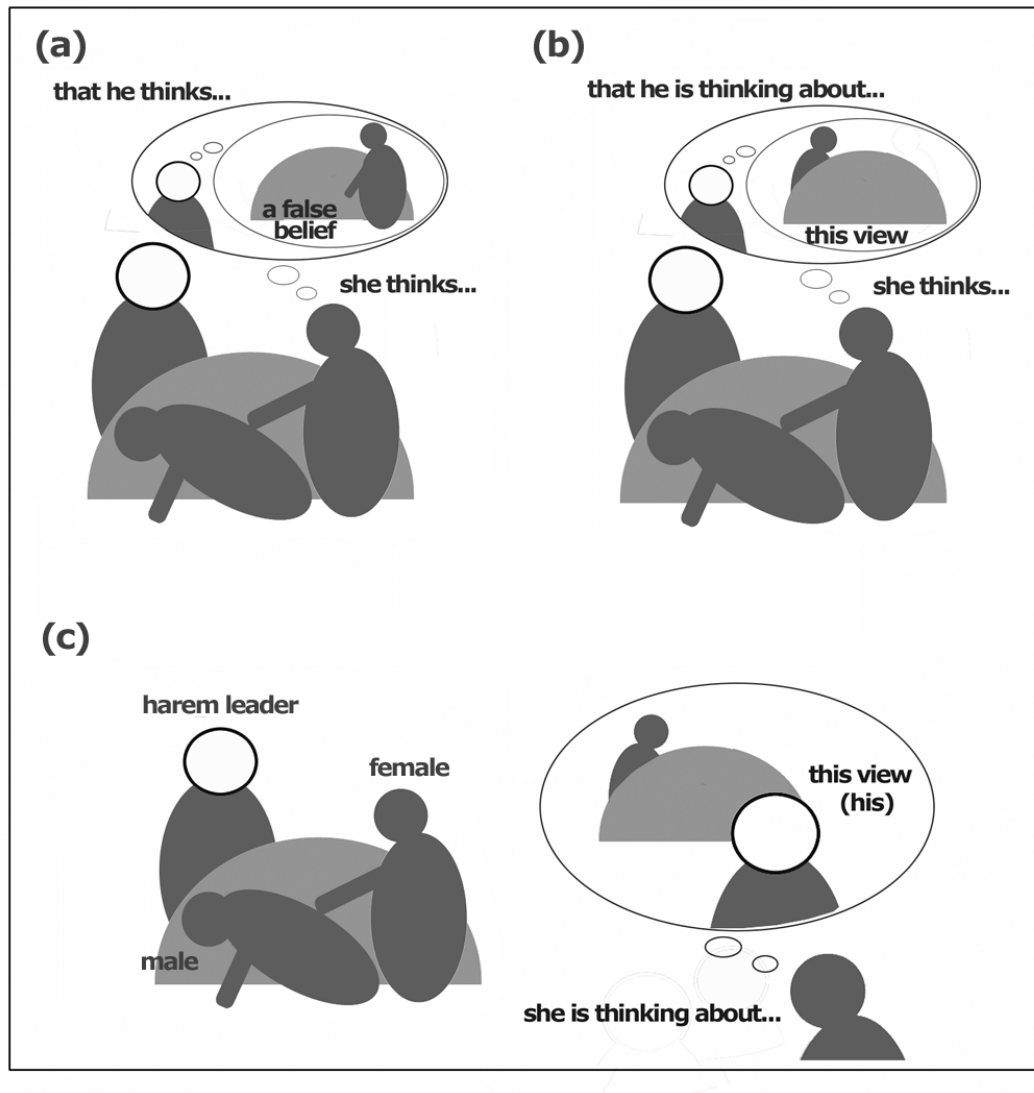

Figure 4. Three interpretations of the same observation of a female hamadryas baboon deceiving her harem leader. (From Byrne 2007)

After examining hundreds of field study records of deception among numerous species of primates, Byrne and Whiten (1992) concluded that only twenty or so records suggested that knowledge or beliefs of other individuals was being taken into account (*level (a)* or *level (b)* understanding) in an intelligent, strategic way - where an explanation in terms of hard-wired or learned simple geometrical cue use was highly implausible. These acts of deception were all from the *great ape* taxon. The food

competition experiments of Hare and colleagues described above also suggest at least a *level (b)* cognitive ability in apes: an understanding of what a competing conspecific *perceives*. Thus, given *this* taxonomy of primate social intelligence there is convergent evidence from both field studies and experimental laboratories for ape understanding of others' mental states at perceptual *level (b)*.

Mental State Assumptions In Byrne's Taxonomy

Until the Hare and colleagues' (2000, 2001) food competition studies there was little experimental evidence in support of the view that apes could understand *anything* about other conspecifics' mental states, whether intentions, perceptions, beliefs or emotions (Tomasello & Call 1997; Povinelli, Bering & Giambrone 2000). By the late 1990s, both the Tomasello and Povinelli labs – among the very few labs that studied ape cognition experimentally – there was a consensus for a sharp dichotomy in primate cognition: Humans are able to understand and predict the behavior of others in terms the attribution of psychological states, a capability that has been termed 'theory of mind' (Premack & Woodruff 1978), while nonhuman primates simply read observable *behavior*, detecting antecedent-consequent patterns, but not understanding the underlying mental states that cause the behavior. This disjunction is apparent in Byrne's distinction between 'theory of mind' involving *levels (a)* and *(b)* and the non-psychological behavior-reading *level (c)*.

The view that apes were stuck at *level (c)* was challenged, experimentally, by Brian Hare and colleagues' food competition experiments described above. In their 2003 review paper *Chimpanzees understand psychological states – the question is which ones and to what extent,* Tomasello, Call and Hare concluded that "we feel safe in asserting that chimpanzees can understand some psychological states in others… With regard to visual perception, we propose that by monitoring the gaze direction of others (mostly head direction), chimpanzees know what others see" (2003, p. 154) and that "chimpanzees actually know something about the content of what others see and, at least in some situations, how this governs their behavior" (p. 155). This set of experiments provides the background for 'assuming the referent' in the VI Hypothesis for joint attention and declarative pointing, discussed above.

Intentionality$_R$

An implication of these authors' claim that apes can know or comprehend the *content* of a conspecific's or their own visual experience is that apes can understand or think about the *representa-*

tional nature of mental states, or more broadly the *intentionality* of mental states in the philosophical sense (Brentano 1874; Searle 1983, Caplin 2002) I shall call this *intentionality$_R$* (for '*R*epresentation') to distinguish it from the conventional meaning of *intention* as relating to goal directed action that features centrally in the VI Hypothesis qua *shared intentionality* which I shall call *intentionality$_A$* (for 'Action').

Intentionality$_R$ derives from the Latin verb *intendere*, which means being *directed towards* (in the sense of pointing towards or attending to) some goal or thing. Intentionality$_R$ in its modern, philosophical sense is the capacity of minds to be about, to represent, or to stand for, things, properties and states of affairs (Jacob 2003). Every perception, belief, intention or desire, on this account, has an 'intentional$_R$ object' that it is *about* - the perceived, believed, and the wanted. The intentional$_R$ object constitutes the normatively constraining *truth conditions* for propositional, predicative cognition. The *normative* dimension of intentional$_R$ cognition entails a goodness-of-fit criterion - between the representing mental state and the world. Searle (1983) characterizes two opposite 'directions of fit' between intentional mental states and the external world they are about. It is the function of a perception or a belief to match a *fact* (the fact the mental state is *true* or *false* of): here there is a *mind-to-world* direction of fit. It is the function of a desire or intention, on the other hand, to represent a non-actual – but potential - state of affairs that may be brought into accordance with the content of the mental state: here there is a *world-to-mind* direction of fit. This normative property underscores the *objectivity* of an object as an *external*, mind-independent entity – something that exists independently from the way it is represented, but which governs the accuracy or truth of the content of the mental state, its *success* or *failure.*

When Tomasello, Call and Hare argue that chimpanzees understand both the 'content' of another individual's perceptions and that this content may govern their behavior in the food competition task, they are drawing on this traditional conception of the *mental*: that it is characterized by intentionality$_R$. The objective presence of the food item in this task is assumed to be normatively constraining in the seeing-knowing understanding of the subordinate (S) chimpanzee. S understands not only the content (i.e objective target) of the dominant D's act of seeing when a food item is within D's visual field, but also the fact that D *fails* to see the food item that S *successfully* sees when it is hidden from D's line of sight by a barrier. In the former case S understands that there is *one* external object - public and objective - that is perceived by *both* S and D; in the latter case S understands that

17

there is an external object that is *not* perceived by D. It is a grasp of this objective-normative aspect of perception – on this account - that enables S to strategically choose the non-contended food and outwit D.

Given the available options (described by Byrne) for conceptualizing of the mental, the evidence from both the food competition experiments, and the object-choice tasks, naturally leads Tomasello and his colleagues to conclude that the problem with declarative pointing and joint attention in referential triangles in ape cognition does not lie in *objectivity* per se. Ape understanding of the *referent* (or 'external object') in a referential triangle is unproblematic on this view, and there are situations where an individual ape can comprehend that another individual can see the *same external thing* as they see – a objective entity that is normative for the accuracy of their perceptions. If the problem does not lie here, it is reasonable to conclude that it lies in the cooperative structure of declarative pointing, and the need for shared intentionality$_A$ based JAFs, as proposed in the VI Hypothesis.

Mirror Neurons And Embodied Simulation

But there is an alternative, evidence-based, explanation for apes' inability to point declaratively and share attention in referential triangles that also accounts for their success in competitive versions of the object-choice task and the food competition task. This explanation becomes a good candidate if a basic premise of the VI Hypothesis is challenged: that social cognition falls into two qualitatively distinct, *either-or* categories: (i) intentionality$_R$ mental state understanding on the one hand and (ii) (non-psychological) predictive behavior reading on the other.

In their theoretical interpretation of the function of the *mirror neuron* system in primates, the cognitive neuroscientists Vittorio Gallese and Maria Umiltà (2006) offer a strong critique this taxonomic dissociation in primate social cognition. Mirror neurons were first discovered in the premotor cortex of the macaque monkey (di Pellegrino et al. 1992; Gallese et al. 1996), and were subsequently found in a reciprocally connected area of the macaque posterior parietal cortex (Gallese et al. 2002). Mirror neurons discharge not only when the monkey executes a goal-related action like grasping an object but when observing *other* individuals executing similar actions (review, Rizzolatti & Craighero 2004). The activity of a class of parietal mirror neurons is modulated by a not-yet-observed subsequent act indicating the overall intention of a complex action, suggesting coding for goal directed 'motor chains' (Fogassi et al. 2005). Mirror neurons have been widely claimed to function in understanding or

anticipating goal directed action in conspecifics. An anatomical homolog of the pre-motor - posterior parietal mirror neuron system has been found in humans with shared as well as distinct functional properties (review, Rizzolatti & Craighero 2004).

Based on the data from the mirror neuron literature, Gallese and Maria Umiltà (2006) argue against a 'mind-reading' vs. 'behavior reading' cognitive dissociation, proposing the following account. Mirror neurons mediate a direct form of action understanding by means of an automatic *embodied simulation* of observed actions in the observer's own motor system. They function not only to recognize actions but also in 'understanding' – in an automatic, non-conceptual sense - the *intention* promoting the action. This is achieved by the activation of statistically related chains of motor schemata culminating in the distal goal state action (e.g. putting food in mouth), thus coding not only an observed motor act (e.g. grasping food) but those distal motor acts that would normally follow (e.g. putting food in mouth). Such a system can mediate the ascription of *goals* and an anticipation of what the agent is going to do next. Understanding intentions and goal directed behavior as embodied simulation in this way does not require "explicit thinking about the contents of someone else's mind" (p. 28), but nonetheless cannot be reduced to simple behaviour-reading of patterns of sensory input.

Gallese and Umiltà hypothesize that not only monkeys but also humans use this basic functional mechanism of embodied simulation which provides "direct access to the intentional states of others" (2006 p. 28). "In our social transactions," they observe, "we seldom engage in explicit interpretative acts. Our understanding of social situations most of the time is immediate, automatic and almost reflex-like." (p. 25).

This conceptualisation of interpersonal cognition highlights the fact that Byrne's taxonomy of mental states– a taxonomy that is consistent with Tomasello and colleagues' assumptions about what may be involved in apes' understanding of psychological states - does not exhaust all possibilities. There is another contender: automatic embodied simulation of other's actions or potential actions via the mirror neuron system. *Simulation* theories of 'mind reading' abilities like this are now fairly commonplace (review, Gallese & Goldman 1998). The embodied simulation account of goal-directed behavior is a theoretical possibility and one moreover that has good experimental support. It is underexplored in Tomasello and colleagues' work.

As reported in their comprehensive review of mirror neurons by Rizzolatti & Craighero (2004), to trigger monkey mirror neurons the executed or observed action must be *transitive* or object

directed: both the effector and object must *interact*. They do not respond to mimicked object-directed actions or to *intransitive* - non object directed actions; nor do they respond to the object alone. And the object-directed action must belong to the monkey's motor repertoire. This idea of the *transitivity* of mirror neuron coding in monkey mirror neuron systems suggest that the object of the action – for instance an item of food in a food directed action or potential action - may not be represented in monkey or ape cognition independently from the action *on* the object: the two may be cognitively represented or 'cognized' as a fused *interaction* or potential interaction. This kind of 'object-as-acted-on' mode of representation – which may be loosely called an *affordance-based* cognition in which 'action possibilities' and not objects are represented (Gibson 1979) – may be all that apes are capable of in their 'object directed' cognition, and account for why they are unable to engage in joint attention and point declaratively.

If we assume that apes have mirror neuron systems that are similar to monkey mirror neuron systems, and adopt the hypothesis that mirror neurons are the neural substrate mediating the understanding and prediction of intentional actions among conspecifics, an alternative – less richly intentional$_R$ - interpretation of the Hare and colleagues (2000, 2001) food competition experiments presents itself. Rather than inferring from the data that chimpanzees "know something about the content of what others see and, at least in some situations, how this governs their behavior" (Tomasello, Call & Hare, 2003 p. 155), it is parsimonious to assume that the subordinate (S) chimpanzee's food choices are the result of anticipating the food-directed intentional actions of the dominant (D) via embodied simulation in their own mirror neuron system, taking into account the food concealing barriers by basic geometrical positional cues of D's gaze. Studies show that neurons involved in the control eye movements respond to the sight of another monkey's eye movements as if they were mirror neurons for gaze (Shepherd et al. 2007). 'Gaze mirroring' may play a role in performance on these tasks. This embodied simulation account also accommodates the experiments in which S understands that D can *remember* where the food was just hidden and knowing *which* dominant ape knows *what* (when one dominant is replaced by another after observing the food hiding), if it is assumed that the chimpanzee's mirror neuron system interacts with its pre-frontal working memory circuitry – an assumption for which there is evidence in humans (Iacoboni et al. 1999). Under an embodied simulation interpretation, in no conditions of these experiments is it clear that an understanding of psychological contents, or the intentionality$_R$ of mental states, is required.

The Shared Intentionality$_R$ Hypothesis

Developing this line of reasoning, we may propose that apes are incapable of pointing declaratively and sharing attention in referential triangles *not* because they are incapable of cooperative communicative interactions - although this is an important starting point in the overall story of uniquely human cognition. Rather it is because these cognitive skills require an understanding of the intentionality$_R$ of mental states. Jointly attending to something requires that the normatively regulating, objective intentional$_R$ object of another person's perception is conceptualized independently from the goal directed action *on* that target. And it requires not only an understanding of another individual's *psychological* states or contents, but an understanding of an objective world of objects, places, times and events, out there in 'public' and shared by different individuals. It requires an understanding of *objectivity* - of the mind-independent world itself.

Intentional$_R$ cognition, associated closely with what has traditionally been called *semantic* declarative memory systems, is, arguably, uniquely human. A qualitatively distinct intentional$_R$ representational format may have evolved in the uniquely human lineage over the past five million years, giving rise for the first time in primate cognition to a shared public world of independently existing objects and their properties, the targets of joint attention and shared intentionality, and normatively regulating the 'goodness of fit' or accuracy of human-unique intentions, perceptions, beliefs, desires and emotions. Moreover, this kind of intentional$_R$ cognition may be another way of characterizing what is involved in declarative pointing and the joint attention associated with it. This account may thus be called the *Shared Intentionality$_R$ Hypothesis* or *SI$_R$ Hypothesis*.

According to the SI$_R$ Hypothesis, *shared intentionality$_A$*, in Tomasello and colleagues' joint action sense, may have evolved first in the context of a socio-ecological shift from individualistic competition to group based cooperativity due to selection against aggressive 'emotional reactivity', as proposed by the VI Hypothesis (see also, Tomasello 2009). We can in addition speculate that this evolutionary shift in primate cognition and behavior may be closely linked to modifications of the ape *mirror neuron system* – a system known to play a social-cognitive role in goal directed action. *Informative* pointing, joint attention frames and perspectival representations would have evolved at this stage, allowing for shared cognition in a *joint action* sense, as proposed by the VI Hypothesis. Communication (whether gestural or vocal), and any understanding of *communicative intentions* that may underpin it,

would have been limited to instrumental communication, sometimes in the facilitation of joint action. It would not have been declarative, propositional (i.e. truth-value bearing) communication. This characterises the *shared intentionality$_A$* stage of Hominin evolution. At a subsequent *shared intentionality$_R$* stage, the *objects* of goal directed, joint-attentional actions would have been cognitively dissociated from the actions themselves. The way this may have happened is unclear, and providing a detailed hypothesis for this is not the aim of this paper. It may have involved an additional dissociation of emotional-motivational mechanisms linking joint motivated actions to objects (analogous to the 'toning down' of emotional reactivity in interpersonal relations reviewed above). Or it may have involved the recruitment of working memory and hierarchical motor-planning circuitry (Byrne & Russon, 1998) providing a representational format for flexible, predicative cognition. However it happened, it would have involved a transition from *action* based joint attention frames to joint-attention in referential triangles – through declarative pointing or symbolic language. Ultimately it would enable (1) predicative, combinatorial (symbolic) thought about a shared, public and external world; (2) communication using propositional ('truth/falsehood' bearing) declarative and discursive language, and (3) sophisticated theory-like ascriptions of perceptions, beliefs and desires in theory of mind.

Tomasello, in his conception of uniquely human cognition, stresses the significance of shared intentionality that allows for the creation of artifacts and social practices:

> After they understand others as intentional agents like themselves, a whole new world of inter-subjectively shared reality begins to open up. It is a world populated by material and symbolic artifacts and social practices that members of their culture, both past and present, have created for the use of others. (Tomasello 1999, p. 91)

The claim of this paper is that intersubjective *artifacts* are continous with intersubjective *objects* and *events* per se. The first instances of declarative pointing, on SI$_R$ Hypothesis, are indicative of an infants early participation in a shared objective world that can be thought *about* : a public world that we can think about predicatively and symbolically, as having properties independent from our actions on it, and a world that is normatively constraining – in an epistemic sense - on thought and behaviour.

Conclusion

While this SI$_R$ Hypothesis for the evolution of human cultural and symbolic cognition is no more than a sketch, it is sufficiently detailed to contribute the concept of intentionality$_R$ to the debate, and attempt to address what are arguably explanatory shortcomings of the VI Hypothesis.

The following points may be considered in addition as supportive of the SI_R Hypothesis:

1. The VI Hypothesis does not explain joint attention of the type seen in *declarative* pointing - only *informative* pointing. It does not account for the important distinction between these types of pointing. The SI_R Hypothesis attempts to address this problem.

2. There is already evidence for the existence of cooperative joint interactions of the shared intentionality$_A$ variety in apes (Hare et al. 2007; Tanner & Byrne 2010). It is arguably present in well-documented chimpanzee hunting (Boesch 2002). This implies that shared intentionality$_A$ is not unique to humans, as claimed by the VI Hypothesis. The SI_R Hypothesis accommodates ape-competence in joint attention frames and shared intentionality$_A$, as a precursor to uniquely human shared intentionality$_R$ and the cultural cognition it enables.

3. In phylogeny the evolution of shared intentionality$_R$ is likely to have involved the mirror neuron system. Human mirror neurons, in contrast to monkey mirror neurons, *do* respond to intransitive, non-object directed actions (Rizzolatti & Craighero 2004), suggesting that human action 'mirroring' does not incorporate the goal objects into the actions themselves in a single representational format. An investigation of great ape mirror neuron systems – for which there is little data - will be relevant to this line of reasoning.

4. Povinelli has reviewed the evidence for whether chimpanzee understanding of the physical world is mediated by an understanding of basic concepts such as gravity, force, mass and shape, that are robustly in place by three years of age in human infants. The results converged on a finding analogous to those typically found for an apes' understanding of its social-psychological world: While they can understanding and learn about observable properties of objects, they "appear to have little or no understanding that these observable regularities can be accounted for, or explained, in terms of unobservable causal forces" (Povinelli & Bering 2002, p. 118). The *Reinterpretation Hypothesis* proposed by Povinelli and his colleagues' states that in the uniquely human lineage a new representational system was stamped onto the old so that the observable world of 'perceptual invariants' readily detectable by the sensory systems was 'reinterpreted' as being governed by abstract causal forces (review, Povinelli & Bering 2002). Causal forces (gravity, mass) as well an objects view-point independent shape, are paradigmatic intrinsic properties of objects *qua* objects, independent from the ways we interact with them. The Reinterpretation Hypothesis in this respect is consistent with the SI_R Hypothesis and its notion of shared intentionality$_R$. The VI Hypothesis, which focuses on social cognition, has less

to say about how the physical world is perceived or thought about. It may be argued that the SI_R Hypothesis suggests a framework for the mutual accommodation of the VI Hypothesis and the Reinterpretation Hypothesis, indicating how – with an evolutionary basis in joint action and shared attention - the two accounts of uniquely human cognition may be integrated.

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