From thought to language to thought: Towards a dialectical picture of the development of thinking and speaking

Hannes Rakoczy

Max-Planck-Institute for Evolutionary Anthropology, Leipzig

Contact information:
Max-Planck-Institute for Evolutionary Anthropology, Leipzig
Department of Developmental and Comparative Psychology
Deutscher Platz 6, D-04103 Leipzig, Germany
email: rakoczy@eva.mpg.de, phone: Tel.: +49-(0)341-3550-449

Acknowledgements:

Thank you very much to Michael Tomasello, Wolfgang Mack, John Michael, Joëlle Proust and Daniel Haun for very helpful comments on an earlier draft. This work was supported by a "Dilthey Fellowship" of the Volkswagen and Thyssen Foundations.

From thought to language to thought: Towards a dialectical picture of the development of thinking and speaking

> In both the evolution of thought in the history of mankind, and the evolution of thought in an individual, there is a stage at which there is no thought followed by a subsequent stage at which there is thought. To describe the emergence of thought would be to describe the process which leads from the first to the second of these stages. What we lack is a satisfactory vocabulary for describing the intermediate steps […] That means there is a perhaps insuperable problem in giving a full description of the emergence of thought. I am thankful that I am not in the field of developmental psychology! (Davidson, 1999, p. 11)

Developmental and comparative psychologists try to earn their living by struggling to describe the emergence of thought and language in evolution and ontogeny. The project is to characterize the development from non-minds via half-formed minds to proper minds. Philosophy can be quite unhelpful in this project – when it takes the form of either of two radical positions. *Strong lingualism* denies the intelligibility of any kind of thought in the absence of language whatsoever. There just are no half-formed minds, according to this position. There is purely differential responding on the one hand, to be described physically, and full-fledged linguistic thought on the other hand, to be described rationally, but nothing interesting worthy to be called "cognitive" in between (e.g., Brandom, 1994; Davidson, 1982, 1999). With no categorical middle-ground between the differential responses of rusting iron to humidity here and the full-blown discursive rationality of adults there, describing the emergence of thought amounts to describing the one big mystery how language (and with it thought) emerges out of mindless responses.

Language of thought (LOT) theories (Fodor, 1975), in contrast, do not see any substantial role for natural language to play in thinking. According to this position, all thought is manipulation of internal private symbols in an innately specified lingua mentis. Natural languages are merely transcriptions of private thoughts, and so acquiring a language in ontogeny does not categorically affect cognitive abilities. In terms of phylogeny, humans share the language of thought with many other species – what makes them cognitively unique are just the facts that their LOT vocabulary happens to be bigger, and that they happen to have a language module that allows the public exchange of ideas. Both radical positions

are deeply unsatisfying for the purposes of describing the development of thought.

Language of thought theories essentially neglect the role, both conceptual and empirical, of discursive practices in the shaping of full-fledged adult rationality. Lingualism, on the other hand, "over-intellectualizes the mind" (Hurley, 2001), rejecting all talk of non-linguistic animal and infant rationality as mere metaphor, and thus flies in the face of perfectly fine common sense and scientific explanatory practices. Developmental and comparative psychology (arguably, as all psychology) are just elaborated extensions of our common sense folk psychology. And while folk psychology's notion of thinking, as lingualists stress, is probably in a Sellarsian sense modelled on language (in particular, thinking aloud), this does not mean that thinking and speaking are conceived of as basically identical. Folk psychology clearly seems committed to a deep realism regarding different animals (and different stages of humans), to a continuum of cognitive abilities that implies the falsity of the lingualists' drastic dichotomy: eliminativism (or pure fictionalism) regarding non-linguistic creatures, but realism regarding speaking creatures. Now, common sense surely does not have the last word here, but it does have the first, and deviating from this commitment, I would like to argue, puts the burden of argument on animal and child eliminativism. And none of the arguments for lingualism presented so far (from the holism of the mental, for example, or from the premise that belief requires the concept of belief which requires language; Davidson, 1982) has met with much enthusiasm in developmental psychology or common sense (see, e.g., Bermudez, 2003; Glock, 2000).

In a similar vein, the ability to speak a language itself, from a psychological point of view must not be taken as a primitive, but stands in need of explanation. Such an explanatory project might be in some tension with some readings of some philosophical accounts (Wittgenstein at some place, when he talks about "Abrichten", for example, or Davidson, or Sellars in their more behaviouristic-sounding passages), where language acquisition is pictured as a mere conditioning process. No question parrots can be conditioned to parrot. But parroting is a far cry from speaking; and from the empirical point of view of comparative psychology, one of the most impressive findings in recent decades has been how pathetically even human-raised chimpanzees perform in language learning (e.g., Rivas, 2005).

From a psychological perspective, then, what we need for describing the emergence and development of thought is a *dialectical* picture that –much in the spirit of Vygotsky (1934/1986)- meets the following desiderata: (a) It does justice to the possibility and existence of no-linguistic cognition in both animals and pre-linguistic humans. (b) It acknowledges specific, uniquely human cognitive

abilities as part of the basis of language acquisition, while (c) at the same time recognizing the ways speaking enables, shapes and transforms thinking of very special kinds. I will here review recent empirical findings from developmental and comparative research to highlight and illustrate the building blocks from which such a picture could be put together.

Different ways of thought with and without language should be distinguished for this purpose. First of all, while the philosophical disputes naturally centre around the question whether and to what degree language is *constitutive* of thinking, the psychological side of it (upon which I will focus) is more concerned with the weaker question whether and to what degree language is *empirically necessary* for certain kinds of thought (and behaviour). Let me further distinguish three ways we might talk about thought without language:

(i) Thinking without speaking any language at all.

(ii) Thinking about a domain D without having (dispositionally) the requisite explicit vocabulary to talk about D.

(iii) Thinking about a domain D without thinking aloud or speaking subliminally (occurrently) with the requisite vocabulary about D.

(iii) is an interesting topic both phenomenologically (see, e.g., Dennett, 1991, on language as a Joycean consciousness machine, and also the paper by Nida-Rümelin in this volume) and in cognitive psychology dealing with the role of (subliminal) speaking in online-thinking (see, e.g., Spelke, 2003).

(i) pertains to animals and pre-verbal infants, (ii) to older children who do speak, but whose explicit linguistic abilities in a given domain lag behind their non-linguistic cognitive abilities (and also to adults, e.g., regarding the non-conceptual content of perception). Different theories regarding thought and language variously emphasize or deny the possibility of (i) or (ii). Davidson's lingualism, for example, is explicitly not concerned with (ii), but only with (i): "Language, that is, communication with others, is thus essential to propositional talk. This is not because it is necessary to have the word to express a thought (for it is not); it is because the ground of the sense of objectivity is intersubjectivity." (1994, p. 234)

Here I will mainly be concerned with (i) – in the case of animals and very young children, and (ii), in the case of older children who do have some command of language, but a very rudimentary one lagging behind the systematicity in their nonverbal actions.

In the following, I will first review findings of common cognitive abilities in non-linguistic animals and pre-verbal infants that are best described as simple forms of thinking without words. The second part deals with specifically human cognitive foundations of the emergence of language and culture. These foundations are to be found in uniquely human social cognitive abilities of understanding one another as intentional beings and of entering into shared or collective "we" intentionality. Once children have acquired a language and participate in cultural practices, however, and this will be the topic of the third part, individual cognitive abilities get radically re-shaped and transformed. Finally, in the last section I will try to explore the implications of these findings for a comprehensive picture of the dialectical developmental of thought and language.

1 The roots of non-linguistic cognition in animals and infants

Piaget (1952, 1954) set the scene for work on the roots of non-linguistic thought in infancy. He and much subsequent research focused on the early development of intentionality in perception and goal-directed action. And recent comparative psychology has found striking parallels in the cognitive developments of pre-verbal infants and other animal species in these areas: Both infants and other animals (notably primates) perceive and segment the world around them, with a (proto-conceptual[1]) grasp on such basic categories as objects, numerical identity, relations, space, and themselves; they use this grasp in simple forms of instrumental reasoning and inferences. And they act goal-directedly and solve problems in flexible, insightful and creative ways, often involving the use of tools (for a comprehensive review, see Tomasello & Call, 1997).

To illustrate these common cognitive abilities, let me focus on two philosophically relevant domains: the most basic forms of objective thought, namely object cognition; and the most basic form of practical rationality, namely goal-directed action.

1.1 Object cognition

All thinking requires a minimal notion of objectivity: an at least implicit distinction between things perceived and the perceiver, some sensitivity to the fact that things persist unperceived. Positing objects, or reification, can be seen as the most basic form of objective thought.

---

[1] I follow much philosophical and psychological writing in calling such pre-linguistic cognitive abilities 'proto-conceptual'. In the final section I will briefly turn to the question what that might actually mean.

Let us, following philosophical tradition (Strawson, 1959), distinguish three kinds of object perception and cognition[2]: (a) mere *feature placing*, (b) *spatio-temporal tracking of physical bodies*, and (c) full-blown *sortal object individuation*. *Feature placing*, on a wide reading ("Lo! Redness!", "Raining" etc.), is involved in all kinds of sensory receptivity and does not necessarily involve any kind of positing persisting individuals. *Spatio-temporal tracking of physical bodies,* in contrast, is the most basic form of reification. Here the world is segmented into non-overlapping, bounded bodies that move cohesively and continuously through space and time[3]. Though this does not yet supply full individuation under sortals, it does supply some primitive criteria for persistence and countability (Xu, 1997). Piaget (1954) was the first to study this kind of object tracking (dubbed "object permanence") in infancy. In manual search behaviour, the simplest form of object permanence appears around 8 months of age: while younger infants would not care about objects that disappear behind an occluder ("out of sight, out of mind"), from this age on infants actively search behind the occluder and try to remove it- which is plausibly interpreted as an awareness that the object still must be there[4]. While this form of object permanence is still limited in some respects, at around 18 months infants master full object permanence: they now track physical bodies even when their movements are not directly perceivable. In the classic task (the so-called "invisible displacement task"), the infant sees an object disappear in a small container A, which is then subsequently moved into the bigger containers B and C, and finally taken out again. Younger infants tend to randomly search at one location and then give up, while infants from 18 months systematically search all three containers. This is standardly interpreted in the following way: infants track the physical body, even when its displacement is not directly visible, making use of a primitive sense of necessity and reasoning from a negated disjunct: "It is in either A, B, or C. If it is not in A, then it must be in B or C"[5].

Research with non-human animals has revealed that many species (including cats, dogs, and monkeys) reach the stage of simple object permanence appearing in human ontogeny around 8 months. The great apes, furthermore, reach the

---

[2] For an excellent review of philosophical and psychological approaches to these kinds of object cognition, and how they relate to each other, see Clark, 2004

[3] Which have been called in developmental psychology "Spelke object", and "proto-object" in research on visual attention (see, e.g., Pylyshyn, 2000).

[4] Subsequent research with so-called habituation measures has revealed even much earlier sensitivity to object permanence; see, e.g., Baillargeon, 1987.

[5] Additional evidence for such an interpretation comes from a recent study showing that children (some years older, though) increase their speed of searching as more alternatives become excluded (i.e. when moving from the first to the second to the third container; Watson et al., 2001). For more work on reasoning from negated disjuncts in apes, see Call (2004). For a philosophical treatment of this form of reasoning in non-linguistic creatures, see Glock (2000).

stage of full object permanence mastered by children at 18 months (for a review, see Tomasello & Call, 1997).

Merely tracking physical bodies, however, still falls short of providing a full-fledged schema for individuating objects in the proper sense (see Wiggins, 1997). Merely spatio-temporal tracking bodies does not allow a distinction between an A (say, a piece of clay) disappearing and then a B (say, a statue made of clay) appearing, and the same A disappearing and re-appearing. Sortal concepts are needed for such distinctions regarding numerical identity ("Is it the same A?") and full-fledged object individuation. Now, in the case of language users we have very good and clear criteria for mastering sortal concepts (use of count nouns and identity statements). But what about pre-verbal analogues to such conceptual abilities?

Recent studies have again used looking time and search behaviour as an index of such pre-verbal analogues. When young infants see two objects simultaneously disappear in a box and then only find one, they continue searching. This just requires object permanence and can be done based on merely spatio-temporal criteria. In a crucial variation supposed to tap proto-sortal individuation, however, infants saw an A disappear in a box, then a B appear from the box and disappear again, and then only found one object. Purely spatio-temporal information is of no help here, as it does not specify criteria of identity and distinctness. Empirically, younger infants, though capable of object permanence and mastering the spatio-temporal version, fail the proto-sortal version[6] (Xu & Carey, 1996; van de Walle et al., 2000). Only from around 10-12 months do infants begin to master the latter, and such mastery has been found to be correlated with language comprehension (Xu & Carey, 1996).

These findings lend prima facie support to the idea, popular in philosophy (e.g., Quine, 1974), that reification comes with language and is therefore uniquely human (Xu, 2002). Subsequent research with non-human primates, however, has documented analogous cognitive abilities in non-linguistic creatures. Both monkeys and apes perform in spatio-temporal and proto-sortal individuation tasks in exactly the same way as human 1-year-olds do (Mendes, Rakoczy & Call, in press; Phillips & Santos, 2007; Santos et al., 2002).

In sum, thus, pre-linguistic infants and non-linguistic animals share with mature thinkers the basic roots of objective thought: the ability to track and

[6] It might be objected that this task does not require (proto-) sortal object individuation but just sophisticated feature-placing: Infants see A-features and B-features, but then only find A-features and thus look for the missing B-features. Empirically, this does not seem very plausible: Infants in such tasks do not take into account just any property differences between objects. In particular, they have been found to dis-regard property differences within, but not across kinds which indirectly suggest that they track the object as of a certain kind and not just as bundles of properties (Xu, Carey & Quint, 2005; Feigenson & Carey, 2003).

individuate objects persisting "out there" independently of being perceived. And they use such abilities in systematic and flexible ways in simple forms of reasoning (e.g. from negated disjuncts).

Correlatively with awareness of individuals persisting in space and time even when unperceived, another prerequisite for objective thought is some rudimentary awareness of oneself as an object in space (Strawson, 1959). Again we have very clear criteria in speaking creatures (use of personal pronouns etc.), but what could count as a pre-/non-verbal indicator of some such rudimentary awareness in non-lingustic animals? The non-linguistic task that came standardly to be used in developmental and comparative psychology is the so-called "mirror rouge" task (Amsterdam, 1972; Gallup, 1970). A mark of rouge is surreptitiously applied to the infant's/animals forehead (infants are distracted, animals often narcotised), and then the subject is placed in front of a mirror. Touching one's own face to remove the mark is interpreted as an indicator of some rudimentary awareness of oneself as an object in space (the "Me" sensu James (1890) and Mead (1934)). While younger infants and most other species, including monkeys consistently fail the task (they treat the mirror image likes a conspecific), infants from around 18 months begin to master this task, and great apes have been shown to succeed (see Tomasello & Call, 1997, for an overview)[7].

1.2 Goal-directed action and practical rationality

Infants and many animals do not just sensorily register features –they perceive, track and reason about individuals, themselves as one among them. And infants and many animals do not just behave in response to stimulation (as iron rusts in response to humidity), but act intentionally. Again, while we have clear criteria for intentional action in speaking creatures (expressions of intentions; non-inferential descriptions of what one is doing; explicit practical inferences; statements about success and failure etc.), how do we know this in creatures without language? How do we distinguish mere silent behaviour from silent action? And again, common sense folk psychology supplies us with an explanatory practice that has a set of rather clear indicators for silent action – indicators which developmental and comparative psychology (as sophisticated common sense) have inherited: flexibility and generativity, sensitivity to means-ends structures, hierarchical and sequential behaviour organization, persistence and signs of (non-) fulfilment as a function of goal-attainment are among the most prominent ones.

[7] Perhaps dolphins and elephants are capable of mastering the task as well, as some recent (though difficult to interpret) studies suggest (Reiss et al., 2001; Plotnik et al., 2006).

We don't want to say that iron rusts intentionally, or that sweating as such is an intentional action, and we do want to say that annoying a hated neighbour by making his car rust, or going to the sauna in order to sweat can be perfectly fine instances of intentional action, because the latter behaviours can have, and the former lack, just these characteristics.

Piaget (1952) pioneered the study on the development of intentional action in preverbal infants: From around 8 months, the time object permanence begins to emerge, infants' behaviour for the first time displays instrumental structure: Infants begin to engage in sequences of action that bear some means-ends relations (e.g., remove an obstacle to be able to reach an object), persistently pursuing their goals, varying the means if necessary, and indicating fulfilment (happiness) or non-fulfilment (frustration). From this age on, infants' instrumental actions begin to incorporate tool use in more and more sophisticated and flexible ways (Chen & Siegler, 2000; Willatts, 1985, 1999). Infants early in their second year also grasp the basic intentional structure of others' instrumental acts, as indicated in their imitation (see also section 2). When in a recent study they observed another person perform an instrumental act with a bizarre means (e.g., switch on a light with the head), they saw this only as a means to an end when the other person could not have done otherwise (e.g., because her hands were occupied): they themselves subsequently switched on the light with their hands. In contrast, when the model could have done otherwise (had her hands free), infants saw the means as an end in itself: they faithfully imitated the bizarre means (Gergely et al., 2002).

Turning now to non-human animals, the flexible and insightful use of tools for instrumental purposes in chimpanzees, both in the wild and in experimental settings, is well-known. For example, in the wild, chimpanzees flexibly and systematically use stones as nutcrackers in quite sophisticated ways (Boesch & Boesch, 1990), and they use different kinds of sticks adaptively for fishing different kinds of insects (Goodall, 1986). Most well-known from experimental settings is probably the problem-solving of Köhler's (1926) apes who –in creative and in insightful ways- used different kinds of novel tools to obtain out-of-reach food. Beside many documentations of such problem-solving in chimps, more recent experimental research has found that many primate species that have not been reported to use tools in the wild, readily do so in creative and novel ways in experimental settings (see Tomasello & Call, 1997). Some apes have recently been reported to even store tools systematically for future use (Mulcahy & Call, 2006). And in some problem-solving tasks, apes clearly outperform human children up until the age of 6 years (Mendes, Hanus & Call, submitted). Also, systematic tool use seems not confined to primates. Crows, for example, have been found to actively shape tools (in the form of a hook) for subsequent usage to retrieve food from out of a test-tube (Weir & Kacelnik, 2006; Weir, Chappell & Kacelnik, 2002).

To summarize the findings from just these two areas of non-linguistic cognitive abilities –object cognition and instrumental action: we see analogous abilities here in pre-linguistic infants and non-linguistic animals that common sense and academic psychology don't hesitate to describe as simple forms of thought. "The infant sees two objects disappear in a box, finds only one and thus knows there must be another one" or "The ape wants to eat the nut, knows that using a stone helps, and therefore uses the stone" are the natural ways to describe the phenomena in question. In contrast to "The flowers are looking forward to the spring" they're meant perfectly non-metaphorically. Granted, there do lurk serious conceptual challenges regarding the ascription of contentful attitudes to creatures in the absence of full-blown linguistic concepts, in particular regarding the determinacy of content (Does the ape intend to crack the nut, or the brown object, or the thing with the nut-appearance, or undetached nut-parts etc.?). But the radically holistic manoeuvre to conclude from the fact that there are many things the ape does not know about nuts (that they're a product of biological processes, no prime numbers etc.) that the ape cannot intend to crack nuts, to common sense folk psychology seems more like a reductio ad absurdum of radical holism (or a joke) than a serious problem for apes.

2 From thought to language: Social cognition and the acquisition of culture

Both infants and other animals, we have seen, engage in rudimentary forms of objective thought and practical rationality. Why then don't other animals start to talk? Given the remarkable commonalities and continuities in the development of non-linguistic thought in infants and many animals, why do only infants begin to speak a language and grow into a full-blown culture? In particular, why don't even chimpanzees raised in human environments with extensive sign language training acquire anything close to human linguistic and cultural abilities? Recent research strongly suggests that it is not so much the absence of the right kind of speech apparatus or proto-grammatical abilities[8] that explains why the brutes remain brute, but missing pragmatic, socio-cognitive background abilities. Infants and other animals seem to cognitively relate to the physical world around them in basically the same ways. But socio-cognitively, non-human animals don't relate to each other in the right kind of way to develop language and culture.

[8] That, contrary to a recent claim by Hauser, Chomsky & Fitch, 2002 might be present even in birds (Gentner et al., 2006).

2.1 Understanding persons

From a broadly Gricean point of view, language has to build upon some basic folk psychology, some grasp of conspecifics as persons – as rational agents and potential cooperative and communicative partners. In human ontogeny, much recent research has found, the first crucial milestone in the development of folk psychology occurs around one year of age and lays the foundation for language acquisition (see Tomasello, 1999; Tomasello et al., 2005, for an overview): after having interacted dyadically with either objects or persons for the first months of their life, infants now begin to enter into triadic interactions with other people oriented towards objects: They follow the gaze and the pointing gestures of others to external objects, and begin to use the pointing gesture in varied ways themselves. They use others' emotional responses towards ambiguous situations to guide their own actions ("social referencing"). And they imitate others' acts on objects and join into shared collaborative actions[9]. These behaviours which emerge in systematic and synchronic fashion together, and which reliably precede and predict language acquisition (Brooks & Meltzoff, in press; Carpenter et al., 1998a), have been interpreted in the following way: What is dawning here is a simple folk psychology in the sense that children begin to perceive one another as persons with perceptual access to the world and engaged in intentional rational action. Making use of Searle's (1983) taxonomy of intentional phenomena, one could say: Just as intention is the biologically and ontogenetically primary attitude with world-to-mind direction of fit, and perception the corresponding primary attitude with mind-to-world direction of fit, so understanding perception and action are the primary forms of folk psychology (intentionality of second order).

The main evidence for understanding intentional action comes from imitation: straight imitation, but more convincingly imitation in cases of mis-match between the mere behaviour seen and what was intended: imitation of unfulfilled attempts (Meltzoff, 1995), differential imitation of accidents versus intentional acts (Carpenter et al., 1998b), and what has been dubbed "rational imitation" (Gergely et al., 2002, see above). The main evidence for understanding perception comes from children's gaze and point following (from around 1), and (somewhat later from around 24 months) from engagement in what has been called "level 1 perspective taking" (Flavell et al., 1981; Moll & Tomasello, 2006) – the ability to understand that different people may perceive different things ("I see something you do not see").

---

[9] This bears interesting relations to Davidson's notion of triangulation a discussion of which, however, goes beyond the scope of the present paper (see Brink, 2004; Eilan, 2005; Roessler, 2005).

Why do we (folk and professional psychologists) want to call these abilities cognitive ones? As in the case of simple individual intentionality, the main reason is that the behaviours which are the basis for ascribing these abilities to infants manifest a differential, systematic and generative structure that is reminiscent of the inferential structure of full-blown linguistic thought (a point I will return to in the final section).

While it was long thought that no other species, not even great apes, follow humans in the development of this simple folk psychology, some recent evidence led to qualifications of this bland proposal: Chimpanzees, it has been found, are in fact capable of a simple understanding of intentional action (they systematically distinguish between unfulfilled acts where the actor is unwilling from those where the actor is unable; Call et al., 2004), and of understanding perception in the form of level 1 perspective taking (they take into account what a conspecific has and has not seen in a food competition task; Hare et al., 2000, 2001)[10].

Simple forms of folk psychology thus no longer seem to be uniquely human: Infants and chimpanzees share basic abilities of interpreting conspecifics as individual agents.

2.2 Collective "We" intentionality

Understanding each other as individual agents is surely necessary for entering into linguistic practice (one can get a grasp on reference only with a rudimentary notion of other speakers' perceptual perspectives (e.g., Quine, 1990), and with a rudimentary understanding of what interlocutors are up to). But to participate in linguistic and other cultural practices, it is not enough to understand others as individual agents. What is needed beyond such simple individual intentionality of second order, is the ability to engage in shared or collective "we" intentionality: "The biologically primitive sense of the other person as a *candidate for shared intentionality* is a necessary condition of all collective behavior" (Searle, 1990, p. 415, my italics). What humans develop early in ontogeny and what other species lack is just this propensity for collective intentionality (Rakoczy & Tomasello, in press; Tomasello & Rakoczy, 2003; Tomasello et al., 2005).

With collective intentionality we deal when two or more subjects share an intentional "we" attitude which is not straightforwardly reducible to individual

[10] These empirical data fit nicely with a more conceptually derived claim that in the absence of language (and the recursive embedding it allows in propositional attitude ascriptions), folk psychology is confined to understanding non-epistemic perception and goal-directed action by José Bermudez (2003).

intentional attitudes[11]. When you and I meet and agree to take a walk together, to take an example from Margaret Gilbert (1990), we form and then pursue the joint We-intention "*We* walk together", which is not reducible to the sum of my individual intention "I walk" plus your analogous one (not even when supplemented with our mutually knowing about these intentions). And the irreducibility of collective intentionality becomes even clearer, of course, in the case of more wide-ranging social affairs. "We play/one plays chess like this" is clearly no sum of "I play it like this", "You play it like this" and "She plays it like this".

Specific normative dimensions go along with collective intentionality. In simple cooperative actions, the partners bind themselves to acting jointly and are thus committed to the pursuit of the joint goal. And in the case of more wide-ranging social affairs, more obviously the way "one does it" fixes a framework of right and wrong moves.

In human ontogeny, simple collective intentionality develops from the second year in the domains of cooperative actions and pre-linguistic communication. Children from one and a half begin to engage in collaborative games with complementary roles and turn-taking structure, and in collaborative instrumental activities with clearly differentiated roles (Brownell & Carriger, 1990; Eckerman & Didow, 1996; Warneken, Chen & Tomasello, 2006). In the course of such collaborative acts, they communicate pre-linguistically in appropriate ways (e.g., pointing to the required place for the partner). When the collaboration threatens to break down, they re-engage the partner and assign him his role (again by pointing; Warneken et al., 2006[12]). Children this age, but not chimpanzees, also seem to have a simple understanding of complementary roles in joint activities, as indicated in their spontaneous role-reversal imitation (children: Carpenter et al., 2005; chimpanzees: Tomasello & Carpenter, 2005).

And communication itself, of course, is a cooperative activity characterized by collective intentionality. Even pre-linguistically, using pointing and other gestures, infants make proto-declarative communicative acts that are not just instrumental for attaining some individual end (like in proto-imperative acts of the form "gimme…"; Rivas, 2005): They point out information, for example, that

---

[11] For the central works in recent analytical philosophy on this, see Bratman, 1992; Gilbert, 1990; Searle, 1990, 1995, 2005, Tuomela, 1995; Tuomela & Miller, 1988. For an overview, see Tollefsen, 2004.

[12] While human-raised chimpanzees in this study did show some social coordination in instrumental problems that needed two individuals for the solution, they did not engage in such communication and re-engagement behaviour. More generally, many researchers have argued that prima facie truly cooperative behaviours in chimpanzees, in particular social hunting, in fact are just sophisticated social coordination: one individual starts hunting at a certain place, then the next individual starts hunting, but cannot take the same place, then the third individual has to take even another place etc.; see, e.g., Tomasello & Call, 1997; Tomasello et al., 2005.

others need (e.g. about the location of a lost object; Liszkowski et al., 2006). Chimpanzees, in contrast, do not spontaneously point, and the ones who learn to do so in human environments, only ever use it proto-imperatively for instrumental purposes (Rivas, 2005; Tomasello et al., 2005). Infants' rudimentary "sense of the other as candidate for shared intentionality" enables participation in these forms of joint cooperative and communicative activities which in turn function as a foundation and scaffold for the acquisition of language (Bruner, 1983; Tomasello, 2003).

Young children's participation in shared intentional activities is not confined to simple cooperation. Even pre-verbally they begin to partake in activities with collective assignment of status functions to objects and thus with proto-institutional structure, in particular in the domain of playing games. From around 18 months, children begin to engage in games of social pretend play – mostly organized topic-wise around such mundane things as pretending to eat, drink etc. (for example, pretending that a wooden block is an apple, pretending to peel, cut and eat it). And only human children do so. Though there are a few anecdotes of pretence-like behaviour in some human-raised animals (for an overview, see Mitchell, 2002), these are difficult to interpret, and generally it is quite clear that no other species reliably engages in pretend play as we know it (for excellent reviews of precursors to pretend play in great apes, see Gomez & Martin-Andrade, 2002, 2005). Established rule games are among the paradigmatic examples of activities with constitutive rules and status function assignment ("this piece of wood counts as a queen in chess", "moving it thus and thus counts as attacking"; Searle, 1969, 1995). And games of pretence can be seen as local, ad-hoc analogues of established games. The two levels of fact and fiction mirror the two levels of institutional phenomena generally (institutional fact laid on top of brute facts: "X counts as a Y in context C"). "This wooden block counts as 'apple' in our pretence game" is on a par with "This piece of wood counts as a queen in chess" or "This slip of paper counts as money in our currency area" (Walton, 1990).

These assignments of fictional status functions bring with them a normative structure of the joint pretence activity. "X counts as Y in context C" means that in C, X ought to be treated accordingly as a Y. In the block/apple pretence game: once declared an apple, the block ought to be treated accordingly in the game. Some pretence acts are inferentially licensed in the game, others are not. Pretending to peel the block/apple, pretending to eat it or to bake a cake with it are licensed, pretending to drive it or pretending to fax it are not (see Walton, 1990).

Children from 2 years do in fact seem to grasp this normative structure created through joint pretence stipulations – as indicated in their inferentially appropriate responses to others' pretence acts. When an experimenter pretended to pour tea into a cup, for example, children pretended to drink from the cup.

When the experimenter pretended to spill tea on the table, in contrast, children pretended to clean the table (Harris & Kavanaugh, 1993; Rakoczy & Tomasello, 2006; Rakoczy et al., 2004). And they systematically distinguish such pretence acts from superficially analogous behaviours with different intentional structure: when an experimenter pretended to pour from a (full but closed) container into a cup, they themselves –inferentially appropriately- pretended to drink from the cup. However, when the experimenter made the same pouring movements with the same kind of container, but marked them as frustrated attempt, they –again inferentially appropriately- completed the failed attempt by opening the container and really pouring (Rakoczy & Tomasello, 2006; Rakoczy et al., 2004). Interestingly, though children this age have acquired simple forms of language, their competence in action revealed in these studies by far exceeds explicit verbal competence: only some years later could children reliably tell explicitly whether the experimenter had pretended or tried to pour (Rakoczy et al., 2006).

Not only do children act inferentially appropriately themselves in joint pretence games. They also indicate an awareness of the normative structure of such games more directly in their responses to others' mistakes: When in the context of a shared pretence game, a third party entered and then confused the pretence identities (status functions) of the objects children intervened by protesting, criticizing and teaching (Rakoczy, submitted; for similar results in the domain of simple non-pretence rule games, see Rakoczy et al., in press).

In summary, pre-verbal children and apes share not only abilities of non-linguistic intentionality, they also share some rudimentary folk psychology (second order intentionality). Human infants, however, do not just interpret each other as individual agents, but develop a "sense of the other person as a candidate for shared intentionality" (Searle, 1990, p. 415) in the second year, and thus enter into collective we-intentionality in the domains of collaboration and pre-verbal communication, out of which language acquisition grows. Children in their second year also begin to enter into collective intentional practices with a proto-institutional structure, in particular, joint games, around the same time they begin to acquire language, but where their cognitive abilities as indicated in their systematic actions by far exceeds explicit verbal competence.

3 From language to thought: The development of linguistic cognition

The acquisition of a natural language has its cognitive prerequisites – social cognition and particularly shared intentionality being, as I would like to argue, a prime candidate that makes humans, and only humans ready for becoming linguistic. But of course language acquisition does have its cognitive consequences, too.

From a philosophical point of view, the central question is how language constitutes new forms of thinking. In the following, I will deal with the much narrower, empirical psychological question how language in fact changes and shapes cognition. Of special interest here are areas where there is some pre-verbal cognitive competence (that is, where some thinking without words is possible in the first place, in contrast to areas such as, say, theoretical physics where we do not even know what thinking pre-verbally about them could mean). Two examples of such areas that have been the focus of much recent research are numerical and spatial cognition.

Regarding numerical cognition, many habituation studies have shown that pre-verbal infants and other primates share two simple abilities of representing numerosity: A so-called "subitizing" system for simultaneously tracking very small numbers (< 4) of objects (this, again, is just more complex object permanence), and an approximate analogue magnitude system for roughly estimating the sizes of assemblies of individuals (for an overview, see, e.g., Carey, 2001; Feigenson, Dehaene & Spelke, 2004). But these systems are very confined in their application and of course a far cry from anything like mathematical cognition proper. One prominent hypothesis recently pursued in this context is that language (in particular the acquisition of the counting routine) is the medium that transforms the limited cognitive abilities due to these two primitive systems into a general and truly mathematical competence (Carey, 2001; Spelke, 2003).

Regarding spatial cognition, quite similarly, pre-verbal infants and other animal species share some basic though domain-limited abilities for spatial cognition (e.g., Wang & Spelke, 2002). However, the acquisition of spatial language has been found to dramatically increase the flexibility and relational complexity of spatial thought[13] (Hermer-Vazquez, Spelke & Kasnelson, 1999; Spelke, 2003; see also Carruthers, 2002, for a general account along such lines).

The most interesting example in the present context, however, the one that most clearly illustrates the need for a dialectical picture of the development of thought and language, is the development of more sophisticated forms of folk psychology. Already pre-verbally, we have seen, infants (and to some degree) apes develop some rudimentary folk psychology: they interpret one another as individual intentional agents capable of perception and action. Some such rudimentary folk psychology is part of the foundation of language acquisition. But clearly, such rudimentary folk psychology is quite rudimentary indeed. Above all, it does not yet involve a full-fledged notion of propositional attitudes

[13] Here I am dealing only with the (somewhat simplified) question how language (singular) shapes cognition. Cross-linguistic research documents impressively how different languages (plural) differentially shape spatial cognition, e.g., through the acquisition of egocentric versus allocentric frames of reference (Haun et al., 2006).

organized around belief as the most central one (and consequently an explicit distinction between appearances and reality is still missing). Though it does allow for some rational action explanation (based on perception and intention), it doe not yet permit reconstructing others' practical reasoning in the form of practical syllogisms based on belief and pro-attitude premises (Perner, 1991).

Such more sophisticated folk psychological abilities have been found to emerge ontogenetically around the age of four years. Children this age begin to predict and rationally explain actions based on false beliefs (Wimmer & Perner, 1983; for an overview, see Wellman et al., 2001), and to explicitly master the appearance-reality distinction (Flavell et al., 1983). Further developments in reflexive self-consciousness such as growing self-control and autobiographical memory go along with these developments (Perner, 1991).

Much recent research has documented the language-dependence of this developmental step (for an overview, see Astington & Baird, 2005). First, numerous correlation studies have found that 4-year olds' folk psychology is highly correlated with language input and competence (where different studies have stressed different aspects of language, among them general linguistic competence, pragmatic competence, and specific tensed "that"-complementation (deVilliers & deVilliers, 2000)). More convincingly (pure correlations are difficult to interpret), a second line of research has used a training methodology and found that training with specific linguistic material (mostly complemented propositional attitude discourse) significantly boosts false belief and related understanding (Hale & Tager-Flusberg, 2003; Lohmann & Tomasello, 2003). And finally, research with deaf populations has documented that while native signing deaf children develop false belief reasoning in parallel to hearing children, orally educated deaf children with delayed linguistic competence reveal a dramatic delay, sometimes of several years, in folk psychology (deVilliers, 2005)[14].

In sum, while simple forms of folk psychology (understanding conspecifics as perceiving and acting subjects) seems to be a common non-/pre-linguistic cognitive heritage of human infants and other apes, sophisticated folk psychology (centred around the notion of belief) arises much later in human ontogeny and is essentially dependent on language[15].

---

[14] So Davidson might be partly right: You do need language to have the concept of a belief. But this does not mean that you need the concept of belief to have beliefs (as Davidson claims).

[15] For an elaborated philosophical argument that full-fledged belief-desire folk psychology (but not the more rudimentary infant folk psychology) requires a natural language as a meta-representational medium, see Bermudez, 2003. For a similar approach trying to reconcile philosophical approaches (in particular, Sellars) with psychological ones (in particular, Vygotsky) see Garfield et al. (2001).

4 Conclusion

The recent findings in developmental and comparative psychology reviewed so far illustrate the need for a dialectical picture of the development of language and thought, a picture meeting the following three desiderata: (a) doing justice to the common pre-linguistic cognitive abilities in humans and other animals. (b) acknowledging species-specific human (social) cognitive abilities as part of the foundation of language acquisition; and (c) recognizing the ways speaking a language shapes and transforms thinking.

(c) is relatively uncontroversial nowadays– with the exception, perhaps, of very very hard-nosed nativist LOT theorists. Interestingly, in psychology, after having been dead for some time, a moderate Whorfianism currently seems to be experiencing a renaissance, yielding a newly booming field of research on the role of language and languages in shaping cognition (see, e.g., Gentner & Goldin-Meadow (Eds.), 2003). Even many broadly Fodorian modularity theorists now grant a relatively substantial role to language in cognition. The basic idea here is that language functions as a domain-general glue to bind together encapsulated information from separate modules (e.g., Carey, 2001; Carruthers, 2002; Spelke, 2003). Similarly, from a connectionist perspective, Andy Clark and Annett Karmiloff-Smith have argued that initial know-how represented in local networks gets re-described into domain-general know-that, inter alia through the acquisition of language (Clark & Karmiloff-Smith, 1993; Karmiloff-Smith, 1992; see also Dennett, 1993).

More controversial and challenging is the question how we should describe the common pre-linguistic abilities in infants and other animals. Do they deserve the title "cognitive"? Radical lingualists say 'no'. Only full-fledged participation in discursive practices counts as cognitive, descriptions of infant and animal rationality being mere metaphor. What infants and animals do is no more than complex discrimination, on a par with iron's responses to humidity. Thought and language come together as one big package. LOT theorists, in contrast, say 'yes'. Infants and animals think just the same way as adults do, limited only in the scope and expressability of their thoughts.

The truth probably lies in an intermediate position. On the one hand, the abilities of animals and infants in the domains of object tracking, problem-solving and social understanding – to name just a few examples reviewed here- clearly go beyond dumb discrimination, and even beyond Dummettian proto-thoughts (superimposition of spatial images on spatial perceptions; Dummett, 1993). In contrast to complex but largely pre-programmed and inflexible behaviours (such as spider's nest-weaving), they deserve the title 'cognitive' because they are flexible, systematic, general, and compositionally and (proto-) inferentially structured in ways analogous to the structure of linguistic cognition

(see Clark & Karmiloff-Smith, 1992; Bermudez, 2003; Hurley, 2003). Lingualist functionalism views thoughts as defined through their position in the systematic network of language-entry moves, language-language moves and language-exit moves (Brandom, 1994; Sellars, 1974). Analogously, we (folk and academic psychologists) ascribe non-linguistic thoughts due to their position in a systematic network of reliable responses to states of affairs, (proto-) inferential relations among each other, and practical reasoning relations to action. In contrast to the lingualists' dichotomy –rusting iron, animals and infants on the discrimination side, adult speakers on the reason side- what this suggests is a gradation of cognitive abilities along phylogenetic and ontogenetic lines: "There is certainly a continuum of possibilites between proto-conceptual and fully conceptual behavior (and in the case of some of the higher primates, it may be that the line is blurry)" (Putnam, 1999, p. 161). One of the pressing conceptual questions, though, is how to spell out exactly non-linguistic analogous of full-blown conceptual and inferential abilities. In the absence of language as a formal vehicle, what model of drawing inferences should we look for other than relating sentences as premises and conclusions? Should non-linguistic (proto-) inferences be modelled on causal reasoning (Bermudez, 2003)? Or is there a viable truth-functional notion of material inference applicable at the non-linguistic level?

Comparably difficult are the questions in which ways exactly non-linguistic thought –granted that there is such a thing- falls short of being full-fledged thought as we find it in speaking creatures, and how exactly language re-shapes cognition. Clearly lack of determinacy and restrictions of scope set apart non-linguistic cognition from full-fledged thought. Malcolm's and Wittgenstein's dogs can think something like "The cat went up this tree" and "My master is coming", though they can't think "The cat went up the biggest oak tree in this country" and "My master might come the day after tomorrow". But why exactly is this? Where is the line between what can and what cannot be thought without language[16]? Regarding language's role in re-shaping thought, Putnam has noted that "one must not make the mistake of supposing that language is merely a 'code' that we use to transcribe thoughts we could perfectly well have without the code" (1999, p. 48). But what exactly beyond transcribing is it that language does?

All in all, the problems we are facing in describing the emergence of thought surely are deep ones, as Davidson noted, but in contrast to his categorical pessimism, they might not be insuperable. We know, at least in principle, what kind of conceptual and theoretical solutions we are in need of. To date, however, the fact that in talking about non-linguistic cognition we haven't got beyond using "proto-" so much –meaning not much more than "somehow but not fully

[16] For an initial and incomplete attempt at listing scope restrictions of non-linguistic thought, see Searle, 1994.

like the real thing, but I don't know exactly how and why"- highlights the challenges we are still facing. It still is "somewhat surprising how little we know about thought's dependence on language" (Schiffer, 1994, p. 593).

References

Amsterdam, B. (1972). Mirror self-image reactions before age two. *Developmental Psychobiology, 5*, 297–305.

Baillargeon, R. (1987). Young infants' reasoning about the physical and spatial properties of a hidden object. *Cognitive Development, 2*, 375-392.

Bermudez, J. (2003). *Thinking without words*. Oxford: Oxford University Press.

Boesch, C., & Boesch, H. (1990). Tool use and tool making in wild chimpanzees. *Folia Primatologica, 54*, 86-99.

Brandom, R. (1994). *Making it explicit*. Cambridge, MA: Cambridge University Press.

Bratman, M. (1992). Shared cooperative activity. *The Philosophical Review, 101*(2), 327-341.

Brinck, I. (2004). Triangulation and radical interpretation. *Dialectica, 58*(2).

Brooks, R., & Meltzoff, A. (in press). Infant gaze following and pointing predict accelerated vocabulary growth through two years of age: A longitudinal, growth curve modeling study. *Journal of Child Language*.

Brownell, C., & Carriger, M. S. (1990). Changes in cooperation and self-other differentiation during the second year. *Child Development, 61*, 1164-1174.

Bruner, J. (1983). *Child's talk*. Oxford: Oxford University Press.

Call, J. (2004). Inferences about the location of food in the great apes (*Pan paniscus, Pan troglodytes, Gorilla gorilla* and *Pongo pygmaeus*). *Journal of Comparative Psychology, 118*(2), 232-241.

Call, J., Hare, B., Carpenter, M., & Tomasello, M. (2004). 'Unwilling' versus 'unable': Chimpanzees' understanding of human intentional action. *Developmental Science, 7*(4), 488-498.

Carey, S. (2001). Evolutionary and ontogenetic foundations of arithmetic. *Mind and Language, 16*, 37-55.

Carpenter, M., Akhtar, N., & Tomasello, M. (1998b). Fourteen- through 18-month-old infants differentially imitate intentional and accidental actions. *Infant Behavior & Development, 21*(2), 315-330.

Carpenter, M., Nagell, K., & Tomasello, M. (1998a). Social cognition, joint attention, and communicative competence from 9 to 15 months of age. *Monographs of the Society for Research in Child Development, 63*(4), 176.

Carpenter, M., Tomasello, M., & Striano, T. (2005). Role reversal imitation and language in typically developing infants and children with autism. *Infancy, 8*(3), 253-278.

Carruthers, P. (2002). The cognitive functions of language. *Behavioral and Brain Sciences, 25*(6), 657-726.

Chen, Z., & Siegler, R. (2000). Across the great divide: Bridging the gap between understanding of toddlers' and older children's thinking. *Monographs of the Society for Research in Child Development, 65*(2).

Clark, A. (2004). Feature-placing and proto-objects. *Philosophical Psychology, 17*(4), 443-469.

Davidson, D. (1982). Rational Animals. *Dialectica, 36*, 317-327.

Davidson, D. (1994). Davidson, Donald. In S. Guttenplan (Ed.), *A companion to the philosophy of mind*. Oxford: Blackwell.

Davidson, D. (1999). The emergence of thought. *Erkenntnis, 51*, 7-17.

Dennett, D. (1991). *Consciousness explained*. Boston, MA: Little, Brown & Co.

deVilliers, P. A. (2005). *The Role of Language in Theory-of-Mind Development: What Deaf Children Tell Us*: Astington, Janet Wilde (Ed); Baird, Jodie A (Ed).

Dennett, D. (1993). Learning and labelling. *Mind and Language, 8*(4), 540-548.

deVilliers, J. G., & deVilliers, P. A. (2000). Linguistic determinism and the understanding of false beliefs. In P. Mitchell & K. J. Riggs (Eds.), *Children's reasoning and the mind.* (pp. 191-228). Hove, England: Psychology Press/Taylor & Francis (UK).

Dummett, M. (1993). *The origins of analytical philosophy*. London: Duckworth.

Eckerman, C. O., & Didow, S. M. (1996). Nonverbal imitation and toddlers' mastery of verbal means of achieving coordinated action. *Developmental Psychology, 32*, 141-152.

Eilan, N. (2005). Joint attention, communication, and mind. In N. Eilan, C. Hoerl, T. McCormack & J. Roessler (Eds.), *Joint attention: Communincation and other minds* (pp. 1-33). Oxford Clarendon.

Feigenson, L., & Carey, S. (2003). Tracking individuals via object-files: evidence from infants' manual search. *Developmental Science, 6*(5), 568-584.

Feigenson, L., Dehaene, S., & Spelke, E. (2004). Core systems of number. *Trends in Cognitive Sciences, 8*(7), 307-314.

Flavell, J. H., Everett, B. A., Croft, K., & Flavell, E. R. (1981). Young children's knowledge about visual perception: Further evidence for the Level 1-Level 2 distinction. *Developmental Psychology, 17*(1), 99-103.

Flavell, J. H., Flavell, E. R., & Green, F. L. (1983). Development of the appearance-reality distinction. *Cognitive Psychology, 15*(1), 95-120.

Fodor, J. A. (1975). *The language of thought*. New York: Crowell.

Gallup, G. G. J. (1970). Chimpanzees: Self-recognition. *Science, 167*, 417 – 421.

Garfield, J. L., Peterson, C. C., & Perry, T. (2001). Social cognition, language acquisition and the development of the theory of mind. *Mind & Language, 16*(5), 494-541.

Gentner, T., Fenn, K., Margoliash, D., & Nusbaum, H. (2006). Recursive syntatctic pattern learning by songbirds. *Nature, 440*, 1204-1207.

Gergely, G., Bekkering, H., & Király, I. (2002). Rational imitation of goal-directed actions. *Nature, 415*, 755.

Gilbert, M. (1990). Walking together: A paradigmatic social phenomenon. *Midwest Studies in Philosophy, 15*, 1-14.

Glock, H.-J. (2000). Animals, thoughts and concepts. *Synthese, 123*, 35-64.

Gomez, J. C., & Martin-Andrade, B. (2005). Fantasy play in animals. In A. Pellegrini & P. K. Smith (Eds.), *The nature of play: Great apes and humans* (pp. 139-171). New York: Guilford.

Gómez, J. C., & Martín, B. (2002). Possible precursors of pretend play in non-pretend actions of captive gorillas. In R. Mitchell (Ed.), *Pretending in animals and humans* (pp. 255-268). Cambridge: Cambridge University Press.

Goodall, J. (1986). *The chimpanzees of Gombe. Patterns of behavior*. Cambridge, MA: Belknap Press of Harvard University Press.

Haight, W., & Miller, P. J. (1992). The development of everyday pretend play: A longitudinal study of mothers' participation. *Merrill Palmer Quarterly, 38*(3), 331-349.

Hale, C. M., & Tager-Flusberg, H. (2003). The influence of language on theory of mind: A training study. *Developmental Science, 6*(3), 346-359.

Hare, B., Call, J., Agnetta, B., & Tomasello, M. (2000). Chimpanzees know what conspecifics do and do not see. *Animal Behaviour, 59*(4), 771-785.

Hare, B., Call, J., & Tomasello, M. (2001). Do chimpanzees know what conspecifics know? *Animal Behaviour, 61*(1), 139-151.

Harris, P. L., & Kavanaugh, R. D. (1993). Young children's understanding of pretense. *Monographs of the Society for Research in Child Development, 58*(1)[231]), v-92.

Haun, D., Rapold, C., Call, J., Janzen, G., & Levinson, S. C. (2006). Cognitive cladistics and cultural override in Hominid spatial cognition. *Proceedings of the National Academy of Sciences of the USA, 103*, 17568-17573.

Hauser, M. D., Chomsky, N., & Fitch, T. (2002). The faculty of language: What is it, who has it, and how did it evolve? *Science, 298*, 1569-1579.

Hermer-Vazquez, L., Spelke, E. S., & Katsnelson, A. S. (1999). Sources of flexibility in human cognition: Dual-task studies of space and language. *Cognitive Psychology, 39*(1), 3-36.

Hurley, S. (2001). Overintellectualizing the mind. *LXII*(2), 423-431.

Hurley, S. (2003). Animal action in the space of reason. *Mind and Language, 18*(3), 231-257.

James, W. (1890). *The principles of psychology*. New York: Holt.

Köhler, W. (1926). *The mentality of apes*: Routledge & Kegan Paul.

Liszkowski, U., Carpenter, M., Henning, A., Striano, T., & Tomasello, M. (2004). Twelve-month-olds point to share attention and interest. *Developmental Science, 7*(3), 297-307.

Lohmann, H., & Tomasello, M. (2003). The Role of Language in the Development of False Belief Understanding: A Training Study. *Child Development, 74*, 1130-1144.

Mead, G. H. (1934). *Mind, self, and society*. Chicago: University of Chicago Press.

Meltzoff, A. (1995). Understanding the intentions of others: re-enactment of intended acts by 18-month-old children. *Developmental Psychology, 31*, 838-850.

Mendes, N., Hanus, D., & Call, J. (submitted). Raising the level: Orangutans use water as a tool.

Mendes, N., Rakoczy, H., & Call, J. (in press). Ape metaphysics: Object individuation without language. *Cognition*.

Mitchell, R. (Ed.). (2002). *Pretending and imagination in animals and children*. Cambridge: Cambridge University Press.

Moll, H., & Tomasello, M. (2006). Level I perspective-taking at 24 months of age. *British Journal of Developmental Psychology, 24*(3), 603-613.

Mulcahy, N., & Call, J. (2006). Apes save tools for future use. *Science, 312*(5776), 1038 - 1040.

Perner, J. (1991). *Understanding the representational mind*. Cambridge, MA: MIT Press.

Phillips, W., & Santos, L. (2007). Evidence of kind representations in the absence of language: Experiments with rhesus monkeys (Macaca mulatta). *Cognition, 102*(3), 455-463.

Piaget, J. (1952). *The origins of intelligence*. New York: Basic Books.

Piaget, J. (1954). *The construction of reality in the child*. New York: Basic Books.

Plotnik, J., de Waal, F., & Reis, D. (2006). Self recognition in an Asian elephant. *Proceedings of the National Academy of Sciences of the USA, 103*(45), 17073-17057.

Putnam, H. (1999). *The threefold cord: Mind, body, and world*. New York: Columbia University Press.

Pylyshyn, Z. (2000). Situating vision in the world. *Trends in Cognitive Science, 4*(5), 197-207.

Quine, W. V. O. (1990). *Pursuit of truth*. Cambridge, MA: Harvard University Press.

Rakoczy, H. (2006). Pretend play and the development of collective intentionality. *Cognitive Systems Research, 7*, 113-127.

Rakoczy, H. (2007). Play, games,and the development of collective intentionality. In C. Kalish & M. Sabbagh (Eds.), *Conventionality in cognitive development: How children acquire representations in language, thought and action. New Directions in Child and Adolescent Development. No. 115* (pp. 53-67). San Francisco: Jossey-Bass.

Rakoczy, H. (submitted). Young children understand the normative structure of joint pretend games.

Rakoczy, H., & Tomasello, M. (2006). Two-year-olds grasp the intentional structure of pretense acts. *Developmental Science, 9*(6), 558-565.

Rakoczy, H., & Tomasello, M. (in press). The ontogeny of social ontology: Steps to shared intentionality and status functions. In S. L. Tsohatzidis (Ed.), *Intentional Acts and Institutional Facts: Essays on John Searle's Social Ontology*. Berlin: Springer Verlag.

Rakoczy, H., Tomasello, M., & Striano, T. (2004). Young children know that trying is not pretending - a test of the "behaving-as-if" contrual of children's early concept of "pretense". *Developmental Psychology, 40*(3), 388–399.

Rakoczy, H., Tomasello, M., & Striano, T. (2006). The role of experience and discourse in children's developing understanding of pretend play actions. *British Journal of Developmental Psychology, 24*(2), 305-335.

Rakoczy, H., Warneken, F., & Tomasello, M. (in press). The sources of normativity: Young children's awareness of the normative structure of games. *Developmental Psychology*.

Reis, D., & Marino, L. (2001). Mirror self-recognition in the bottlenose dolphin: A case of cognitive convergence. *Proceedings of the National Academy of Sciences of the USA, 98*(10), 5937-5942.

Rivas, E. (2005). Recent use of signs by chimpanzees (Pan troglodytes) in interactions with humans. *Journal of Comparative Psychology, 119*(4), 404-417.

Roessler, J. (2005). Joint attention and the problem of other minds. In N. Eilan, C. Hoerl, T. McCormack & J. Roessler (Eds.), *Joint attention: Communincation and other minds* (pp. 230-259). Oxford Clarendon.

Santos, L. R., Sulkowski, G. M., Spaepen, G. M., & Hauser, M. D. (2002). Object individuation using property/kind information in rhesus macaques (Macaca mulatta). *Cognition, 83*(3), 241-264.

Schiffer, S. (1994). Thought and language. In S. Guttenplan (Ed.), *A companion to the philosophy of mind*. Oxford: Blackwell.

Searle, J. (1969). *Speech acts: An essay on the philosophy of language*. Cambridge, MA: Cambridge University Press.

Searle, J. (1994). Animal minds. *Midwest Studies in Philosophy, 14*, 206-219.

Searle, J. R. (1983). *Intentionality: An essay in the philosophy of mind*. Cambridge: Cambridge University Press.

Searle, J. R. (1990). Collective intentions and actions. In P. Cohen, J. Morgan & M. Pollack (Eds.), *Intentions in communication* (pp. 401-415). Cambridge, Mass.: MIT Press.

Searle, J. R. (1995). *The construction of social reality*. New York: Free Press.

Searle, J. R. (2005). What is an institution. *Journal of Institutional Economics, 1*(1), 1-22.

Sellars, W. (1974). Meaning as functional classification. *Synthese., 27*, 417-437.

Spelke, E. (2003). What makes us mart? In D. Gentner & S. Goldin-Meadow (Eds.), *Language in mind. Advances in the study of language and thought* (pp. 277-311). Cambridge, MA: MIT Press.

Strawson, P. F. (1959). *Individuals: An essay in descriptive metaphysics*. London: Methuen.

Tollefsen, D. (2004). Collective intentionality. In *The Internet Encyclopedia of Philosophy. Retrieved 12/22/2005 from http://www.iep.utm.edu*.

Tomasello, M. (1999). *The cultural origins of human cognition*. Cambridge, MA, US: Harvard University Press.

Tomasello, M. (2003). *Constructing a language: A usage-based theory of language acquisition*. Cambridge: Harvard University Press.

Tomasello, M., & Call, J. (1997). *Primate cognition*. New York, NY, USA: Oxford University Press.

Tomasello, M., & Carpenter, M. (2005). The emergence of social cognition in three young chimpanzees. *Monographs of the Society for Research in Child Development, 70*(1), 1-136.

Tomasello, M., Carpenter, M., Call, J., Behne, T., & Moll, H. (2005). Understanding and sharing intentions: The origins of cultural cognition. *Behavioral and Brain Sciences, 28*, 675-691.

Tomasello, M., & Rakoczy, H. (2003). What makes human cognition unique? From individual to shared to collective intentionality. *Mind and Language, 18*(2), 121-147.

Tuomela, R. (1995). *The importance of us: A philosphical study of basic social notions.* Stanford: Stanford University Press.

Tuomela, R., & Miller, K. (1988). We-intentions. *Philosophical Studies, 53*, 367-389.

Van de Walle, G. A., Carey, S., & Prevor, M. (2000). Bases for object individuation in infancy: Evidence from manual search. *Journal of Cognition & Development, 1*(3), 249-280.

Vygotsky, L. (1934/1986). *Thought and language*. Cambridge, MA: MIT Press.

Walton, K. L. (1990). *Mimesis as make-believe*. Cambridge, MA: Harvard University Press.

Wang, R. F., & Spelke, E. S. (2002). Human spatial representation: Insights from animals. *Trends in Cognitive Sciences, 6*(9), 376-382.

Warneken, F., Chen, F., & Tomasello, M. (2006). Cooperative activities in young children and chimpanzees. *Child Development, 77*(3), 640-663.

Watson, J., Gergely, G., Csanyi, V., Topal, J., Gasci, M., & Sarkozi, Z. (2001). Distinguishing logic from association in the solution of an invisible displacement task by children (Homo sapiens) and dogs (Canis familiaris): Using negation of disjunction. *Journal of Comparative Psychology, 115*(3), 219-226.

Weir, A., & Kacelnik, A. (2002). Shaping of hooks in New Caledoian crows. *Science, 297*, 981.

Weir, A., & Kacelnik, A. (2006). A New Calendonian crow (Corvus moneduloides) creatively re-designs tools by bending or unbending aluminium strips. *Animal Cognition, 9*, 317-334.

Wellman, H. M., Cross, D., & Watson, J. (2001). Meta-analysis of theory-of-mind development: The truth about false belief. *Child Development, 72*(3), 655-684.

Wiggins, D. (1997). Sortal concepts: A reply to Xu. *Mind and Language, 12*(3-4), 413-421.

Willatts, P. (1985). Adjustment of means-ends coordination and the representation of spatial relations in the production of search errors by infants. *British Journal of Developmental Psychology, 3*(3), 259-272.

Willatts, P. (1999). Development of means-end behavior in young infants: Pulling a support to retrieve a distant object. *Developmental Psychology, 35*(3), 651-667.

Xu, F. (1997). From Lot's wife to a pillar of sand: Evidence that *physical object* is a sortal concept. *Mind and Language, 12*(3/4), 365-392.

Xu, F. (2002). The role of language in acquiring object kind concepts in infancy. *Cognition, 85*(3), 223-250.

Xu, F., & Baker, A. (2005). Object individuation in 10-month-old infants using a simplified manual search method. *Journal of Cognition and Development, 6*(3), 307-323.

Xu, F., & Carey, S. (1996). Infants' metaphysics: The case of numerical identity. *Cognitive Psychology, 30*(2), 111-153.