Body-in-Motion: Broadening the Social Mind

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Abstract

Embodiment has become an important concept in many areas of cognitive science during the past two decades, but yet there is no common understanding of what actually constitutes embodied cognition. Much focus has been on what kind of 'bodily realization' is necessary for embodied cognition, but crucial factors such as the role of social interaction and the *body-in-motion* have still not received much attention. Based on empirical evidence from child development, we emphasize the experience of self-produced locomotion behavior as a crucial driving force to the emergence of the so-called "nine-month revolution" in human infants. We argue that the intertwining of social scaffolding and self-produced locomotion behavior is fundamental to the development of joint attention activities and a 'self' in the human child.

Keywords: embodiment; social scaffolding; body-in-motion; nine-month revolution; self-produced locomotion behavior

Introduction

Theories of *embodied cognition* offer a radical shift in explanations of cognition, and can be viewed as a Copernican revolution against standard computationalist cognitive science. Cognitivists claim that cognition takes place inside the skull in form of abstract symbol manipulation and that the body only serves as an input and output device, i.e. a physical interface between internal program (cognitive processes) and external world. In contrast, the embodied approach stresses that our cognitive processes depend on experiences that come from having a body with particular sensorimotor capabilities that interact with the surrounding world. Despite nearly two decades of research under the banners of embodiment and embodied cognition, there is yet no common understanding of what actually constitutes embodied cognition, or what kind of body it might require (e.g., Anderson, 2003; Chrisley & Ziemke, 2003; Clark, 1999; Dautenhahn, Ogden & Quick, 2002; Riegler, 2002; Núñez, 1999; Wilson, 2002, Ziemke, 2001, 2003). The lack of agreement has resulted in some oversimplifications of the role of the body in cognition.

Firstly, the discussion has mostly focused on the "static" body, i.e. what kind of physical or software realization of the body is necessary for cognition. The forms of the body range from quite basic shapes that interact with the environment to more organism-like bodily forms like humanoid robots (Brooks *et al*., 1998; Ziemke, 2001, 2003). However, the crucial aspect of the *body-in-motion* has not received enough attention, although research in anthropology has shown the relevance of locomotion experience for human cognition (e.g., Farnell, 1995, 1999; Sheets-Johnstone, 1999). Farnell (1995), for instance, points out that besides treating cognizers as embodied agents, we have to recognize that this embodied agent actually *moves*. In addition, the subjective tactile-kinesthetic experiences of one's body are the bedrock of thinking, according to Sheets-Johnstone (1999). That means, the body is not a bridge connecting the subjective and the objective body, the real issue of embodiment is *not* the "packaging", since she stresses that self-experienced bodily understanding is the elemental and unsurpassable unity of embodied actions (Sheets-Johnstone, 1999). For that reason, current theories of embodied cognition have to pay more attention to the role and relevance of the "body-in-motion" for cognition.

Secondly, the focus in most theories of embodiment has been on the relation between the individual body and individual cognitive processes, but the view of the mind as first and foremost social has largely been neglected (cf. Vygotsky, 1978). Current theories of embodied cognition and artificial intelligence (AI) only peripherally address the role of embodiment in *social* interactions (Lindblom & Ziemke, 2003, 2005a), although almost two thirds of the meaning in a social situation is considered to be received from so-called nonverbal signs (Burgoon, Buller & Woodall, 1996). Albeit the interest in social interaction has grown and has received increased attention, the role of the *body* in social interaction and social cognition is far from being well understood. Empirical evidence from social psychology has shown how social thought and judgments can be affected by bodily states, actions and motivations (cf., e.g., Barsalou *et al*., 2003; Niedenthal *et al*., in press), and these findings suggest that the body might be used as a mediator or resonance mechanism in the process of perceiving others, but its function is still poorly understood (cf., e.g., Dautenhahn, 1997; Gallese & Goldman, 1998; Gallese, Keysers & Rizzolatti, 2004; Jacob & Jeannerod, 2005).

Turning our attention to theories of cultural and social cognition, on the other hand, they still mainly tend to overlook the *bodily* aspects of social interaction (Rogoff, 2003; Tomasello, 1999). Varela (1992) argues that "[s]ocial scientists are body-dead because they are conceptually brain-dead to signifying acts within the semiotics of body

movements". One reason for the absence of the body in the social sciences is the anxiety of slipping into *biological determinism*. Social sciences, therefore commonly view mind as superior to and independent of the body. However, this line of argument is quite ironical, since it actually encourages biological determinism, by stressing the dichotomy between mind and body (Farnell, 1999). It should be noted that taking a social embodiment approach, is not the same as relapsing into biological reductionism, since the supposed opposition between socio-cultural and biological aspects is misleading (Segerstråle & Molnar, 1997). Ingold (2000), for instance, points out that instead of talking of embodiment, the term "enmindment" could be used. He emphasizes that body and mind are not two separate things, other than two ways of describing the same process, i.e. the activity of the human organism in its physical and social environment.

Taken together, questions that need to be addressed in current theories of embodied cognition are, for instance, *how* humans use the body in social interaction, and *what* role and relevance does bodily movement have? Moreover, how does the body affect social interactions, which social processes are affected, and what functional roles does the body serve in social cognitive processes?

This paper aims to complement the present notions of embodiment, emphasizing that the *body-in-motion* appears to be crucially relevant to the emergence of the capacity for joint attention in the human child, which is a central building block of human social interaction. The point we want to make is that the onset of self-produced locomotion behavior and the emergence of joint attention activities take place at the same time. We suggest that this is not at all a coincidence, since the sensorimotor and social dynamics of bodily experience function as a crucial driving force in cognitive development.

The rest of the paper is structured as follows. The next section emphasizes the role of socio-cultural factors for the development of human cognition, primarily following the Tomasello's (1999) lines of argument. Next, we discuss different theoretical standpoints that stress the crucial relevance of the "body-in-motion" and social scaffolding for cognition. Then we present some empirical evidence that stresses the importance of self-produced locomotor behavior for the onset of joint-attention abilities in the human infant. The paper ends with a discussion and conclusions.

Cultural Cognition and the "Nine-Month Revolution"

The ability to engage in social interaction is a central building block of social life and cognition, and thus one of the foundations for human culture.

Humans "identify" with their conspecifics more deeply than other primates and the human child has a biologically inherited capacity for living culturally (cf. Rogoff, 2003; Tomasello, 1999). Human infants early display a large number of activity patterns that appear to be species-unique. For instance, the typical rhythm of "burst-pause-burst" during breast-feeding does not occur in other primates. Moreover, human infants show a wide range of facial expressions, rhythmical stereotypes, and complex face-to-face interaction patterns between the infant and the caregiver that are absent in chimpanzees and gorillas (Hendriks-Jansen, 1996). That means, human infants are "ultra" social already from birth, in ways that other primates are not, and the role of these social interaction patterns is supposed to "hijack" the caregivers attention to create a 'social glue' between the infant and caregiver during the infant's development. However, these early uniquely social bonding behaviors alone cannot explain why humans so strongly are able to "identify" with others. There has to be something more. Tomasello (1999) suggests that humans are also able to understand other persons as intentional agents like themselves, i.e. "animate beings who have goals and who make active choices among behavioral means for attaining those goals, including active choices about what to pay attention to in pursuing those goals" (ibid., p. 68). This understanding emerges when human infants begin to participate in various joint attention activities (Tomasello, 1999).

It has been noted that Euro-American children begin to participate in social discourse from about the age of nine months at which point they make their first attempts to share attention with other people, as well as imitatively learn from and through social interactions with them. The range of new social behaviors that emerge at this point in infant development indicate a drastic change in the way the child begins to understand the surrounding (physical and) social world – the so-called "nine-month revolution". Before that time, the interaction behaviors of human children are mostly dyadic, i.e. two-way interactions between the child and the caretaker. Then by the age of nine months, a set of *triadic* behaviors emerges, involving a coordinated interaction between child, objects, and other people. As a result, a referential triangle of 'shared attention' develops in the child, between another person and the object or event to which they focus their attention. Tomasello (1999) emphasizes that these new triadic behaviors are the result of the unique human social-cognitive adaptation to identify and understand others as intentional agents. He claims that it is this particular ability, and not any specialized biological adaptations explicitly, that is responsible for many, if not all, of the most unique and essential cognitive functions and processes of human being. The question is – *Why* does this revolution of joint attention behaviors occur at the age of nine months?

Tomasello (1999) suggests that the relation between self understanding and the similar understanding of others as intentional agents explains the nine-month social-cognitive revolution, since "the hypothesis is that as this new experience of self-agency emerges, a new understanding of others emerges as a direct result" (ibid., p. 70). However, while Tomasello nicely sorts out *what* happens around nine months of age, but this 'explanation' is questionable because it appears that the child actually flicks a 'magic

switch' at the age of nine month and he does not explain *why* this shift in understanding actually occurs. He admits that the personal experiences necessary for this understanding remain unclear, and this raises another related question – *How* does this link between self and others emerge?

Tomasello emphasizes that in coming to understand others as intentional agents around the age of nine months, another crucial factor enters the scene – the ability to more or less *simulate* the other person's intentional actions by analogy to one's own actions, and as a result, the self becomes intentional. Tomasello stresses that there is no need for the child to be able to conceptualize before simulating, since it is enough to perceive the other person's intentional actions via an analogy to the self.

Roughly speaking, simulating the other individual's point of view is adopted by matching the other person's mental states with a resonance state of one's own, putting oneself in another person's 'shoes' by simulating the behavior of another individual 'off-line', in order to predict or determine the behavior of the other agent. Gallese *et al.* (2002, p. 459) suggested "that the capacity to empathize with others – may rely on a series of matching mechanisms that we just have started to uncover". Such a mechanism may rely on, or be a part of special kinds of visio-motor neurons in the premotor cortex in monkeys, so-called *mirror neurons* (cf., e.g., Gallese & Goldman, 1998; Rizzolatti *et al.*, 2002). These neurons are able to respond, for example, both to particular performed hand actions, and when observing the same action while it is performed by other conspecifics (Gallese & Goldman, 1998). For that reason, mirror neurons are supposed to constitute a cortical system, which is able to fit observation and execution of *goal-related* motor actions. Empirical evidence indicates that such a system actually is present in human beings as well, and the functional role of this matching system might be a part of, or a precursor to, a general mind-reading capability. Recent empirical results indicate that mirror neuron activity also correlates with action understanding as well as experiential understanding of others' emotions (Gallese, Keysers & Rizzolatti, 2004; see also Jacob & Jeannerod (2005) for a critique of motor theories of simulation).

However, the idea of simulating the other person's view for understanding that other people also have intentions results in the question – *How* does the child create and distinguish between one's own first-hand experience and those third-hand experiences performed by others? This is an underestimated problem in theories of simulation theories that has not received enough attention, despite the fact that the ability to shift between first-hand and third-hand perspectives is an essential aspect of social cognition (Jacob & Jeannerod, 2005).

The 'explanation' offered by Tomasello (1999) is that the time when the child starts to understand that other persons have intentions and goals like themselves, is a result of our species "ultra" social ability. On the contrary, we suggest that neither our "ultra" social ability nor simulation theories alone are able to explain how this intentional understanding emerges in the child. Instead, we argue that self-experienced locomotion behavior is another missing piece in the puzzle for the emergence of the social understanding of the self. In the following sections we elaborate this hypothesis in more detail.

"Body-in-Motion" and Social Scaffolding

Trevarthen (1977, in Hendriks-Jansen, 1996) pointed out that one reason for the neglect of the moving body in psychological research was that the actual movement patterns of humans were as difficult to observe before the invention of cinephotography as were the planets before the development of the telescope. Psychology therefore became more of a static science of perception, cognition and action than a science of dynamic interactions. On the other hand, when researchers actually pay attention to embodied movement, it often appears that the moving body has lost its mind (Farnell, 1995). However, a shift in the study of human body movements has occurred more recently, from a distal observer's description of behavior to the stance of viewing body movements as dynamically embodied actions (Farnell, 1995, 1999).

The French philosopher Merleau-Ponty (1908-1961) strongly stressed that the mind was essentially embodied and interacted with the world, arguing that bodies are deeply 'cognitive' in themselves (cf. Dreyfus, 1992; Loren & Dietrich, 1997; Priest, 1998). On the other hand, Sheets-Johnstone (2003) emphasizes that although Merleau-Ponty is viewed as the "knight of the Body", he overlooked the deeply engrained role of self-experienced movement in embodied beings. She claims that the core of being is the relation between the body and movement, emphasizing that "consciousness does not arise in *matter*, it arises in organic forms, forms that are *animate*" (ibid. p. 43). The human infant is not born inanimate, but already moving, and has to catch herself in the tactile-kinesthetic apprenticeship of her own body. That means, there is a need to discover how we actually "put ourselves together" (Sheets-Johnstone, 2003). On the other hand, what both Merleau-Ponty and Sheets-Johnstone overlook, in our opinion, is the first and foremost *social* nature of the human mind, and therefore the apprenticeship of body-in-motion is not an individual enterprise. Embodiment is more than the organism or the "packaging", more than the experience of doing - there is the movement itself, which is more than just manipulating limbs, since "the body is both a means and the end of communicational intentions" (Varela, 1994, p. 168), and this primacy of the body-in-motion entails both language and gesture.

Varela (1994) suggests that a reliable theory of embodiment has to acknowledge the dynamic nature of human action, including the person that enacts the body, all kinds of physical and social actions, as well as meaning accomplished through actions. The main idea is that neither bodies nor minds themselves have intentions; it is only persons, a "self" or an *intentional* agent, in Tomasello's

vocabulary, that have intentions. The point Varela wants to make is that the "enactment" of the body is a social act, and in order to direct oneself, you have to consider how others will act and react in response to your own actions.

How then does a movement become transformed into an intention or an embodied action? So-called "objective" descriptions of observed bodily movements exist, but they are un-convincing since they do not consider the non-observable social situation at hand, which actually is what adds the meaning to the visible embodied actions. By using the term 'action' instead of 'movement' Farnell (1995) highlights that socially embodied actions are a set of movements that have agency, meaning or intentions for the actual person or agent in view of the fact that "*bodies do not move and minds do not think – people just do*" (Farnell, 1995, p. 14).

The role of social interactions for the transformation of bodily movements into *intended actions* was illustrated already by Vygotsky in the mid-1930s, when he explained the essential role of social interactions for the development of pointing in the child (Vygotsky, 1978). Initially, it is only a simple and incomplete grasping movement directed towards a desired object, and is only constituted by the child's bodily movements, and nothing more. When the caretaker assists the child, the meaning of the situation itself changes. The child's 'failed' reaching attempt provokes a reaction, not from the desired object, but from another person. The individual gesture 'in itself' becomes a gesture 'for-others'. The caretaker interprets the child's reaching movement as a kind of pointing gesture, resulting in a socially meaningful communicative act, whereas the child at the moment is not aware of its communication ability. After a while, however, the child becomes aware of the communicative function of the performed movements, and then begins using referential gestures towards other people, rather than to the object of interest that was the child's primary focus initially. For that reason, *"the grasping movement changes to the act of pointing"* (ibid. p 56). Kozulin (1986) pointed out that it is essential to note that the child herself is the last person who 'consciously' grasps the 'new' meaning of this pointing gesture.

That means, the social surrounding functions as a social scaffold for the development of pointing, where the initial quite simple bodily movement becomes an *intentional action*. Thus, our embodiment constrains while cultural customs affect, but do not determine, the organization of social interactions (Famell, 1999).

Self-Produced Locomotion Behavior

The experience of self-produced locomotion behavior is a rather neglected factor, despite the fact that research has shown its significance in the child's social as well as emotional development. It should be stressed that locomotion is not necessarily a causal factor in itself. Instead, the child's cognitive and emotional changes emerge from the *experiences* that result from the child's own locomotion behavior. When the human child starts to locomote voluntarily, i.e. crawling and creeping, these behaviors produce a wide range of changing experiences in the infant's social and emotional development (Campos *et al*., 2000). The role and relevance of this new social interaction situation should not be disregarded. It becomes necessary for the child to adapt to the new situation, paying close attention, both to their environment as well as to their self-produced movement with respect to the environment.

As a result, some pervasive consequences occur, which in turn, affect the physical and social world around the child, in particular the *interaction* between the child and its surroundings (Campos *et al*., 2000). Campos *et al*. (2000) use an analogy based on a French saying, which states that "when the finger points at the moon – the idiot looks at the finger". On the whole, the empirical data they present suggests that children without self-produced locomotion experience perform like the 'idiot' in the French saying, whereas children with locomotion experience are able to follow, to various degrees, referential gestures towards a distal target (Campos *et al.,* 2000). Hence, their proposal is that crawling is the cradle of "social referencing phenomenon", since it is mainly after the child starts to crawl that she receives social signals that have an obvious distal referent. When the child begins to locomote there is a sudden increase of the behavioral pattern of checking back and forth to the caregiver. This behavior is a crucial feature of the "information-seeking" aspect of social referencing, which makes it possible for the child to understand how the regulation of social interaction is affected by distal communication.

Hence, it is via these regulations of interaction that the child develops a shared meaning with its caregiver, and at around nine months the child is able to respond to gestural communication when the target is absent from its own visual field. That means, at that point in time the child is able to differentiate between its own visual field and the gesturer's visual field. In other words, the child displays a beginning for *perspective taking*. This social ability then develops further and encompasses communicational signs from others, which make it possible for the child to grasp that other people also have intentions. For example, creeping and crawling infants appear both to be more attentive and actively search for communicative signals from the experimenter while performing Piaget's well-known "A-not-B-task" (Campos *et al.,* 2000). Empirical research shows that infants with locomotion experience perform better on tasks assessing the tendency to follow referential gestural communication than pre-locomotor children (i.e. gaze-following, head-turn, and pointing). Similar results were shown in studies on Chinese children (they begin to locomote at a later time than Euro American children due to cultural factors) and infants with motor disabilities (Campos *et al*., 2000).

In sum, empirical evidence show that there is a significant developmental change in referential gestural communication around the age of nine months, and that self-produced locomotion experience is involved in that particular shift.

Discussion and Conclusions

This paper extends current theories of embodied cognition by including the role and relevance of the *body--in-motion* for broadening the social mind. Crucial to the embodiment of cognition, according to this account, is perhaps not so much the physical realization of the static body, or its interactions with the environment as such. Instead, we stress the elementary and intertwined relation between the experiences of one's own moving body and its interplay with the physical and social environment. The following argument is our preliminary answer to the questions raised above: *Why* does the nine-month revolution actually take place at around that age, and *How* does the child create and distinguish between first-hand experiences and third-hand experiences?

The guiding issue here is the role and relevance of self-produced locomotion behavior for the emergence of the "nine-month revolution", the point in time when the child begins to understand that others are intentional beings as themselves. Hence, that point in development when children begin to understand themselves and others as *intentional* agents, around nine months of age (in European-American children), 'coincides' with the onset of self-produced locomotor behavior. We suggest that this is in fact no coincidence at all. Instead, it is primarily through the experience of self-produced locomotion and the subsequent experience of literally *perceiving* the (physical and social) world and *acting* upon it from different perspectives, depending on one's own embodied action, that infants develop the capacity of understanding others as having different perspectives and own intentions. That means, when children begin to locomote by themselves, they acquire an individual experience of the surrounding world through their own actions and perceptions. As a result, the child distinguishes between itself and the surrounding world, a distinction from which a primitive "self" emerges.

Consequently, when the child can put itself in another person's physical situation, the child becomes able to relate both to the other person's perspective and its own situation. This perspective-taking is grounded in the experiences of self-produced locomotion behavior, which might be a fundamental aspect for distinguishing between first-hand and third-hand experiences. This emerging understanding is bootstrapped through socially scaffolded bodily experience, which gives the child access to the actual meaning of the social-communicative situation. Subsequently, that understanding of perspective-taking might be used during *embodied simulations*, making it possible for the child to simulate "off-line" what it would be like to be in the other person's situation, based on its own self-produced locomotor experience. In that sense, the sensorimotor and social dynamics of bodily experience function as a crucial driving force in cognitive development

We therefore suggest that the experience of self-produced locomotion behavior needs to be addressed more in current research on embodied cognition and artificial intelligence (AI). We elsewhere discuss (Lindblom & Ziemke, 2005b) the implications of the social dynamics of bodily experience for android science, which is an approach that designs 'human-like' robot bodies in attempts to construct 'human-like' AI.

In addition, it should be noted, for instance, that empirical results show that perceiving moving (non-animate) geometrical stimuli prompts humans to ascribe emotions and social intentions to these stimuli. That means, moving non-animate objects in fact trigger an illusion of social interactions directed by social intentions (cf. Jacob & Jeannerod, 2005).

Furthermore, the communicative function of *touch* is one of the least researched areas in infant development, although there are indications for its importance in the child's cognitive and social development (cf. Hertenstein, 2002). Perhaps touch is another crucial communicational aspect in the "ultra" social interaction patterns between infant and caregiver, making the foundation for the emerging "social glue" between them. There are many more theoretical as well as empirical aspects to address, but space limitations do not allow for an in-depth discussion here.

Another question is if there are other fundamental milestones earlier or later in children's life that, like the onset of self-produced locomotion behavior, have major fundamental consequences? Language acquisition, for instance, might be such an important occasion. It has been noted that gesture and speech are deeply intertwined and language production itself is based in quite complicated muscular movements (cf. Goldin-Meadow, 2003; Iverson & Thelen, 1999; McNeill, 1992). There is converging empirical evidence that gesture and speech originate in hand-mouth associations early in infant development. In other words, the systems of hand and mouth movements are not two separate systems; rather they should be viewed as intimately linked in language production. From an embodied cognition point of view, Iverson and Thelen (1999) suggest that this integrated communicative "speech-language-gesture" system is a convincing proposition for a sensorimotor origin of thought and cognition.

To summarize, this paper has argued that our cognition is firmly grounded in our *moving* bodies. If current theories of embodied cognition are to move beyond the present bounds of the static realization of embodiment, they need to address the crucial impact of the body in socially scaffolded motion.

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