



# Pointing the Way to Social Cognition: A Phenomenological Approach to Embodiment, Pointing, and Imitation in the First Year of Infancy

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I have two objectives in this article. The first is methodological: I elaborate a minimal phenomenological method and attempt to show its importance in studies of infant behavior. The second objective is substantive: Applying the minimal phenomenological approach, combined with Meltzoff's "like-me" developmental framework, I propose the hypothesis that infants learn the pointing gesture at least in part through imitation. I explain how developments in sensorimotor ability (posture, arm and hand control and coordination, and locomotion) in the first year of life prepare the infant for acquiring the pointing gesture. The former may directly enable the latter by allowing the infant to experience its own body as being "like those" of others, thus allowing it to imitatively appropriate a broader range of adult behavior. My proposal emphasizes the embodiment of mind in the development of cognition, contrary to latent dualistic tendencies in some developmental literature.

## *Public Significance Statement*

This article proposes an embodied, phenomenological approach to understanding how infants learn to understand and produce the pointing gesture in the first year of life. Emphasis is placed on the role of embodiment and imitation and how developments in embodiment and imitative ability may facilitate more general advances in social cognition.

*Keywords:* pointing, infant social cognition, infant communication, embodied cognition, phenomenology

Pointing is a cultural universal among humans and is very nearly unique to our species. Acquiring the ability to comprehend and produce the pointing gesture is recognized as a critical milestone in the life span development

of human social and communicative behavior. With some consistency cross-culturally, infants begin pointing toward the end of the first year. There is little agreement among scholars, however, as to why the gesture emerges when it does, how precisely it is learned, and what the nature and extent of the involved social cognition are. Tomasello, arguably the most influential researcher in the field, defends a rich account of the social cognition required for pointing, arguing that the infant must have some understanding of others as rational agents with communicative intentions to comprehend and produce pointing gestures (Tomasello, 2008). Lean, behaviorist approaches, by contrast, claim the gesture can be learned through the conditioned association of actions and consequences alone. Meanwhile, Gómez (2007) prefers a more balanced view according to which an in-

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fant can read the intentions of others in perceived actions themselves without having to posit concealed mental states and intentions. Regardless of the underlying cognitive requirements, little is known about how precisely the pointing gesture is acquired, whether through social learning (imitation), ritualized abbreviation of another action such as reaching, or socialization of a more general orienting or exploratory gesture (Carpendale & Carpendale, 2010).

In this article, I advance an alternative hypothesis concerning the development of infant pointing and social cognition that emphasizes, on the one hand, correlated developments in sensorimotor abilities such as postural control, reaching and grasping for object exploration, and locomotion; and, on the other, the infant's developing sense over the course of the first year of being an agent like those around it, capable of imitating others' actions and learning about itself and others through such imitation. I call this the *experimental-imitative hypothesis*. It builds upon Meltzoff's (2005, 2007, 2013) "like-me" developmental framework and offers an alternative to Tomasello's and Gomez's accounts of the early development of social cognition and the pointing gesture.

Along the way, I will emphasize the importance of taking a phenomenological approach to understanding infant cognition. Among other things, this entails an emphasis on how embodiment informs higher order modes of cognition. This raises a philosophical question concerning the underlying ontological assumptions about mind and behavior at play in developmental research. The embodied approach I advocate contrasts an implicit tendency toward a dualistic conception of mind and body that can be found in much developmental literature, including the work of Tomasello and Meltzoff. This is the most important philosophical theme of the present article. To the extent that it contributes to the dualism versus embodied cognition debate, however, it is largely an indirect contribution. As such, allow me to briefly indicate the nature of the contribution. I apply an embodied conception of cognition to help understand early infant social cognition and the acquisition of the pointing gesture. The application involves interpreting a variety of available empirical evidence and generating novel hypotheses for further research. My goal is to show that the embodied

approach interprets existing data in a more coherent and eloquent manner than other theories, generates fruitful hypotheses for further experimentation and theorizing, and brings to light weaknesses in existing alternative approaches. If I succeed in this goal in this particular application, this will count as some corroborating support for the embodied cognition paradigm more broadly. I will elaborate my phenomenological, embodied approach to understanding cognition and interpreting empirical observation in the following section. Throughout the central sections of the article, which discuss empirical details of infant social cognition and pointing, I will occasionally indicate important considerations for the dualism versus embodied cognition debate. I will return to this theme explicitly in the conclusion.

### Phenomenology and the Sciences of Mind and Behavior

For present purposes, I propose three central criteria of a minimally phenomenological approach to the study of mind and behavior. The first criterion is (a) *phenomenological accountability*, the accurate description of the way things are experienced by the subject being studied. Phenomenological accountability, I will show, is achieved via the second criterion (b), the *reconstruction of the experiential world* of the subject in question. For the study of infant behavior, this means describing how the infant experiences itself and its surrounding world.<sup>1</sup> The third criterion is (c) *embodiment*, the recognition that animal cognitive life is enabled and constrained by more basic bodily modes of relating to the environment, perception and action in particular. In the developmental context, this means emphasizing how changes in the infant's body, along with the new prospects for perception and action that such changes entail, condition higher order cognitive

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<sup>1</sup> This minimalist account of phenomenology is akin to what is sometimes called phenomenological psychology as opposed to phenomenology as a distinctively transcendental philosophical position (see Zahavi, 2013). Though I maintain that, ultimately, a commitment to the minimalist project of phenomenological psychology should lead phenomenologists and psychologists alike to questions of transcendental philosophy, such concerns can be set aside for present purposes. For discussion, see Kee, 2018, 2019.

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achievements in abstract thought, imagination, communication, and social cognition.<sup>2</sup>

Why is it important to be phenomenologically accountable when studying infant development? In at least some cases, a subject's (the infant's or child's) intentional behavior is guided by or directed toward the world *as it is experienced by the subject*, rather than toward that same world described in a more rigorously objective, perspective-neutral way. In the sciences, we are concerned with achieving objectivity, replicability, and statistical significance. But when pursuing these goals in the sciences of life and mind, it is important to recall that in many cases, the way the subjects of our observations construe their surrounding world is a mediator variable influencing the behavior that the scientist is observing. In other words, to be *objective* in a way that is adequate to the phenomena in question, we must recognize that *subjectivity*, the way the subject experiences its situation, is a constituent feature of what we are observing.

Various interrelated risks follow from failing to take phenomenological accountability seriously in experiments, naturalistic observations, and theories of mind and behavior. Any current theory of mind and behavior always reflects some presupposed concepts and methods that have been inherited from previous scientific work and ultimately from our commonsense, folk-psychological views on the mind. Both the scientific theories and folk psychology undoubtedly have explanatory value, but at the same time none is adequate to the richness of mind, behavior, and experience. They involve abstractions, theoretical constructions, and simplifications that may obscure rather than illuminate the phenomena under investigation. Such assumptions, explicit or implicit, inform the operationalization of concepts and experimental design, thus imposing a certain degree of theory-ladenness onto experiment and observation. For example, some experimental designs and ways of operationalizing concepts may not be suitable for allowing subjects to demonstrate the abilities an experiment purports to study. Ultimately, presuppositions from theory work their way into observation itself, informing the scientist's perception of the facts in question and biasing the language used to construe those observations. Further in the background, ultimate presuppositions concerning the methods,

epistemology, and ontology of the science in question always inform the way research is conducted and evidence is interpreted.

This hermeneutic situation of the sciences is inescapable. Phenomenology does not pretend to offer a way out of it. What phenomenology does provide, however, is a descriptive attentiveness to experience, consciousness, and behavior that can help assure that theory, operationalization, experimental design, and observation are as unclouded as possible by received biases in any given discipline and remain as close as possible to the phenomena we are attempting to understand.

Allow me to illustrate such concerns, and the phenomenological critique and corrective of them, by turning to a pair of studies that intend to investigate how infants learn (or fail to learn) the meaning of concrete and abstract words in the earliest stages of lexical acquisition (Bergelson & Swingley, 2012, 2013). In an eye-tracking study, Bergelson and Swingley (2012) found that 6- to 9-month-old infants understand the meanings of some words for everyday, concrete objects, such as food items and body parts. Even in the absence of bodily social cues from interlocutors, such as parental pointing, interaction, and gaze, infants of this age often were able to direct visual attention to an image of the target object in a forced-choice looking paradigm when the infant's mother, whom the infant could not see, said the word matching the target object. In the later follow-up study (2013), the same authors found that infants at this age do not, however, appear to understand "abstract" terms, such as "all gone," "hi," "kiss," and "wet." When presented with videos acting out the target concept in a forced-choice study, coupled with an auditory prompt from parents to direct attention to the target, infants in this age-group did not demonstrate an understanding of such terms.

The first concern to raise here is that the authors have not explicitly defined, operationalized, or otherwise illuminated the distinction between "ab-

<sup>2</sup> For the time being, the emphasis placed on embodiment is meant primarily as a methodological, heuristic guideline for inquiry: Focusing on the development of embodiment may grant us insights that are missed in approaches that focus on the cognitive domain in abstraction from the development of embodiment. As I will discuss in the conclusion, however, a stronger, ontological claim about the embodiment of mind makes a natural complement to this method.

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stract” and “concrete” terms. The closest they come to clarifying the notion of “abstract” words is to say that they are words whose “referents in the child’s experience are, visually speaking, more diverse from instance to instance” (Bergelson & Swingley, 2013, p. 2) than concrete words. When selecting their “abstract” terms, the authors thus chose the “most common picturable words, excluding object labels” (Bergelson & Swingley, 2013, p. 3—“object labels” would count as “concrete” terms) to occur frequently in corpuses of mother–infant interaction. But when studying infant word learning, there are countless possible ways to distinguish and categorize between types of words: abstract versus concrete, nouns versus verbs, long words versus short words, words that begin with the phoneme “ð” versus words that do not, and so forth. Experimenters owe us an explanation of *what* their distinction amounts to and *why* it is an important, relevant distinction in the context of infant word learning. I will propose an alternative categorization, clarify it from the phenomenological point of view, and argue for its priority over the abstract–concrete distinction shortly.

Note also how the experimental setup—an eye-tracking study, which involves immobilizing the infant in front of a screen—determines the types of words chosen and the way in which they are presented to the infant. That is, it determines the way in which the infant will be forced to process and interact (or, rather, *not* interact) with the words and referents involved. In the original study, infants had to choose between two still *photos* to identify the concrete referents corresponding to spoken words. In the study on abstract terms, by contrast, the infants had to choose between two simultaneously displayed *videos* in which actors act out the “referent” abstract terms. To demonstrate its understanding of the word “kiss,” for example, the infant must direct its attention to a video of a woman kissing a doll (and not to the competing video of a woman dancing), while the infant’s mother says “Look! Kiss! Kiss!” This confound (photos vs. videos, objects vs. events) is enough to increase significantly the task difficulty and modify the infant’s experience of the two experimental situations. The change thus undermines the purported parity between the experiments, and hence potentially invalidates the authors’ conclusions.

The more important point I want to make about early word learning and comprehension, however, is that the relevant difference here might not be between concrete and abstract terms, but rather between terms the infant understands primarily in a *referential* way versus those it understands primarily in an *interactive* way (cf. Fuchs, 2016). Object labels (roughly, the authors’ “concrete” words) for foods and body parts may primarily be learned and understood referentially at 6–9 months of age. By contrast, interactive words (roughly, the authors’ “abstract” words) may primarily be learned and understood through *embodied involvement* in the activities that are designated by the words in question rather than through *observation* of those activities. But once we challenge the authors’ inappropriate taxonomy of abstract and concrete terms and entertain the possibility of replacing it with the distinction between referential and interactive terms, we see how unsuitable the experimental setup is for measuring what the authors hoped to measure. For if my proposal is correct, infants do not understand “kiss” by looking at other people kissing (as the visually reliant eye-tracking paradigm requires), but by being involved themselves in the act of kissing. By the same principle, they may not understand the meaning of the word “wet” (another of Bergelson & Swingley’s “abstract” terms) primarily by *seeing* water being spilled, but by *feeling* the wetness of something.<sup>3,4</sup>

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Further, the choice of experimental setup also entails an implicit presupposition about what it means to know the meaning of a word, although the authors do not explicitly address this question. Simplifying somewhat, we can see that the

<sup>3</sup> The referential–interactive distinction is best viewed as a distinction between aspects of our understanding of words rather than between kinds of words or word meanings. It is plausible that all words (or at least all content words, broadly construed) in a young infant’s vocabulary may have both a referential and interactive aspect for the infant. We know, for example, that reading nouns associated with manipulable objects activates not only perceptual neural circuits, but also premotor regions of the brain (Marino et al., 2014). Nevertheless, one aspect, either the referential or the interactive, may be more salient for some words than others at one stage or another of development.

<sup>4</sup> This might explain the disparity between the mothers’ preexperiment evaluations of their infants’ receptive vocabulary and the findings of the experiment (Bergelson & Swingley, 2013, p. 8). The experimental design precludes the very possibility of investigating the phenomena it was meant to study.

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use of the eye-tracking paradigm to determine what words infants “know” assumes something like a truth-conditional theory of meaning: To know the meaning of a word is to be able to recognize (in this case, visually) the conditions under which sentences in which it occurs would be true (Davidson, 1967). By contrast, an interactionist approach suggests that to understand the meaning of a word might in part mean being able to use the word appropriately in real-life discourse and action situations. My aim here is not to decide this debate. I simply want to point out that the experimental setup and conclusions drawn by the experimenters imply tacit assumptions about the nature of word meaning and understanding that cannot be decided by merely empirical considerations. These are questions for philosophy and phenomenology of language. But a researcher’s stance on them, implicit or explicit, has consequences for empirical research.

We see, then, what can happen when a study’s conceptualization, operationalization, experimental setup, and interpretation of results are not guided by the criterion of phenomenological accountability. The study flounders initially because it does not ask a question of any relevance from the infant’s perspective about word learning or comprehension, such as how the infant is perceiving and interacting with the stimuli in the total word recognition situation. It does not ask whether the experimental environment adequately represents the real-life situations in which an infant would demonstrate word comprehension. Instead, it simply imposes a readymade, inappropriate, and ill-defined distinction between abstract and concrete terms. Failing to ask such questions, the researchers then go on to employ an experimental method that is unsuitable for investigating the phenomena in question, precluding the possibility of the infants interactively demonstrating their understanding of “abstract” terms.<sup>5</sup>

These various shortcomings in choice of concepts studied, their operationalization, experimental design, and interpretation of observations, are all interrelated. They all follow from the initial failure to take the infant’s perspective on word learning and comprehension in the natural environment. That is, they follow from the failure to be phenomenologically accountable by reconstructing the infant’s embodied experience of the speech context.

The phenomenologist Merleau-Ponty, drawing on Gestalt psychologist Wolfgang Köhler’s studies of chimpanzees, proposed a phenomenological approach to the study of animal cognition and experience analogous to the one I am proposing for infant studies:

Köhler’s work shows [. . .] that, in addition to our own perceptual universe, we have to reconstitute the animal’s universe in all its originality, with its “irrational” connections, its short-circuits, and its lacunae, and that any success we may have will come from taking our human experience of the animal as our starting point, describing the curve of its conduct as it appears *to us* [. . . U]ltimately one’s research concludes not with quantitative stimulus-response laws which would be applicable to all species, but with an overall view of how the chimpanzee, for example, elaborates on given stimuli, of the chimpanzee’s behavioral universe as revealed by methodical interpretation of his conduct.<sup>6</sup>

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Merleau-Ponty’s approach is qualitative, emphasizing the agency and experience of the subject being observed. It attempts to bring to the fore characteristics of the natural phenomenon that are often compromised when objectivity and quantification are overemphasized to the neglect of the subjective dimension of mind and behavior. But if Merleau-Ponty is correct about what a phenomenologically accountable theory of behavior requires, the scientist ignores this subjective dimension on pain of grossly misunderstanding the organism being studied.

My proposal is that a research program analogous to the one just described for comparative psychology should be pursued in developmental psychology. Just as with the chimpanzee, we must reconstruct the perceived world of the infant and child if we are to understand their behavior and developmental trajectory. We must ask not only *what* infants are looking at, but *how* they are perceiving it, what sense and relevance it has for them. In this article, I will apply such an approach through a critical en-

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<sup>5</sup> There may be no hard and fast rules for assessing relevance. Doing so will probably only be possible through a holistic interpretation of behavior as a diachronic and global phenomenon—a “methodical interpretation of conduct” (see following paragraph). As phenomenologists have emphasized, the basis for such an interpretation of animal behavior is our empathic access to the world of the animal as a being that shares much of our embodied way of being. See Thompson, 2005, 2007, p. 165; Thompson, 2011.

<sup>6</sup> Merleau-Ponty, 1964, pp. 83–84; see also Merleau-Ponty, 1963; Husserl, 1973, pp. 173–185; and, for discussion, Kee, 2018, 2019.

agement with the current developmental literature on how infants learn to point.

### Pointing the Way to Social Cognition

In this section, I put the minimal phenomenological method I have proposed to work by applying it in a critical engagement with theoretical claims and experimental studies on the acquisition of the human pointing gesture and early social cognition. The discussion is meant to illustrate and deepen the phenomenological method I am advancing, while at the same time developing a novel hypothesis concerning the development of the pointing gesture in infancy.

#### Why Do 12-Month-Old Infants Point and 3-Month-Old Infants Do Not? Tomasello on the “9-Month Revolution”

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Acquiring the ability to understand and produce deictic gestures—exemplified by, though not limited to, referential pointing with the index finger (cf. Engelland, 2014)—constitutes a critical milestone in the normal development of human social interaction and cognition. It is an important marker of the transition from the dyadic, self–other mode of infant–caretaker communication characteristic of primary intersubjectivity to the triadic, self–other–object structure characteristic of joint attention and secondary intersubjectivity (Trevarthen, 1979). In Western cultures, infants consistently begin pointing sometime between 9 months and the first birthday, a development that usually anticipates the onset of more robust verbal language use (Goldin-Meadow, 2015; Iverson & Goldin-Meadow, 2005). There is even some evidence to suggest that the onset of this behavior occurs at around the same age cross-culturally (Butterworth, 2003) in spite of considerable cross-cultural differences in how adults interact with and regard infants and some variation in the onset of later-emerging social–cognitive achievements (Wellman, 2013). Though some apes raised in captivity learn to point for some of the same motives as humans (Leavens, Hopkins, & Bard, 2005), and there is some evidence for pointing in the wild among corvids and primates (Pika & Bugnyar, 2011), humans are without a doubt the planet’s most prolific and precocious pointers.

The predictability of this developmental marker cross-culturally calls for explanation. Why do infants consistently begin to point at roughly the same moment in development? Why does the “9-month revolution” occur at (roughly) 9 months and not at, say, 3? As Tomasello (2008) observes, the 3-month-old infant already possesses the “behavioral form of infant pointing”: Infants at this age often hold their hand in a distinctive shape with an extended index finger. Further, they possess at least two of the three basic motives for communication posited by Tomasello, the requesting and sharing motives, evidenced respectively by infant crying to obtain food or comfort and the sharing of emotions in face-to-face proto-conversations. However, though the behavioral and motivational factors that ought to elicit the pointing gesture are in place at 3 months, it is rare for an infant to point before 9 months.

Tomasello’s explanation of this fact is that the 3-month-old infant lacks the relevant social–cognitive foundation to perform the pointing gesture. Although he grants that we still do not know how infants learn to point, Tomasello nonetheless advances a rich interpretation of the cognitive prerequisites of the gesture, stating that,

*To begin directing the attention of others to things for a reason, infants must have something in the direction of the entire social–cognitive, social-motivational infrastructure characteristic of mature human communication, and [three-month-old infants] do not yet have the necessary skills of either individual or shared intentionality. (Tomasello, 2008, 138—emphasis added)*

According to Tomasello, to even *begin* pointing, infants must begin to understand others as rational agents who have goals, who choose means for pursuing those goals in accordance with reasons, and who have an epistemic perspective on the world (pp. 139–140). Specifically, they must recognize that others have communicative intentions, which presupposes conceiving of others as rational, communicative agents behind whose overt communicative behavior a hidden motive and sense must be projected. And infants must be capable of a rudimentary form of “shared intentionality,” participating in the common attentional ground required for cooperative communication (pp. 140–141). Robust social cognition, on this account, precedes pointing: It is only once the infant understands other agents in the relevant

way that it will grasp that it can use a pointing gesture to influence their behavior.

Though not explicitly stated, we should note here in passing the tendency toward an underlying dualistic ontology of mind and body. In the absence of a further descriptive specification of what is involved in grasping the communicative intention of an interlocutor, we tend to fall back upon a dualistic conception of such access to other minds. The bodily pointing gesture through which the communicative intention is expressed is, on such a view, only an external manifestation of the internal mind that lies behind such comportment. Crucially, on the dualistic view, the connection between internal mental state and external behavioral manifestation is accidental. Because mind and body are radically separate, there is no reason why any given mental state should be intimately associated with a particular orientation, expression, or action of the body rather than any other. As such, the infant's access to the other's mind by way of the latter's behavior must be cognitive and inferential. We will see shortly that conceiving the connection between mind and body more intimately allows for an understanding of early social cognition—indeed, of social *perception*—that puts the mind of the other directly on display in bodily comportment.

Without a doubt, the development of infant social-cognitive capacities will play a role in an explanation of infant pointing. But explaining the onset of pointing at circa 9 months by way of the development of social cognition only raises the question of why social cognition makes the advances it does in the months leading up to the first birthday, and not sooner or later. Hence, even if the appeal to social cognition turns out to be necessary, a more complete explanation of infant pointing will include an explanation of why the relevant advances in social cognition occur when they do, and whether they develop prior to, hand-in-hand with, or posterior to infant pointing.<sup>7</sup> I will respond to this challenge by discussing the development of the infant's possibilities of relating to its social and material world as its prospects for perception, object exploration and manipulation, and locomotion advance with the maturation of the infant body. As we shall see, between the age of 3 and 12 months, the infant undergoes dramatic changes in its embodied way of relating to the world and

others that will transform its horizons of perception and action. This focus on the body, however, will allow us to rethink social cognition from the perspective of infant embodiment, which will suggest an alternative to Tomasello's account and a refocusing of the questions surrounding the development of infant social cognition.

### What's the Point? Sensorimotor, Cognitive, and Motivational Characteristics of Infant Pointing

Let us begin with a provisional account of the minimal sensorimotor, motivational, and cognitive-behavioral conditions of a successful, deliberate infant pointing gesture performed by an infant who is already competent in the use of the gesture. Pointing is a voluntary gesture. It requires visually attending to two distal objects in alteration, the *addressee* (the person for whom the infant is pointing) and the *referent* (the object pointed to, where the "object" may be a person, thing, event, or location). Whichever of the two target terms, the referent or the addressee, is not the current focus of visual attention must be held in working memory. Transferring visual focus from one object to the other may require movement of the head in addition to the eyes, so the neck and other postural muscles must be strong enough to support the infant in an active posture toward its environment with at least one arm free for the pointing gesture itself.<sup>8</sup> The arm, hand, and finger

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<sup>7</sup> Explanations in terms of cognitive-developmental stages (e.g., Piaget) and critical periods (e.g., Chomsky) enjoy a certain prestige in developmental psychology. They promise to help us understand how different aspects or modules of cognitive architecture relate to one another. As will become clear, the gradualist, multimodal view of development I advocate complements a model of "developmental cascades" (Masten & Cicchetti, 2010; Thelen, 2000)—i.e., of gradual, interdependent developmental reinforcement between different aspects of perception, motricity, cognition, emotion, and sociality, rather than a more saltatory and segregated progression of independent cognitive modules.

<sup>8</sup> Of course, eye movement and head movement can in principle be decoupled. However, in a study of 18- to 24-month-olds engaged in toy play, Yoshida and Smith (2008) found that head and eye movement were coupled 90% of the time. I am not aware of a similar study for the pointing task with younger infants, but I would cautiously anticipate similar findings.

movement must be coordinated with visual information to be directed toward the referent, and the infant must be strong enough to hold its arm steady long enough for the addressee to distinguish this as a pointing gesture rather than another arm movement such as a swing, a reach, or a grab. As for motivation, the infant must be sufficiently interested in distal objects to take an active orientation toward them. Developing this active attitude toward distal objects may be greatly facilitated by the onset of self-generated locomotion as a new means of relating to the distal environment, a possibility I will explore in the following text.

The triadic structure and conventional nature of the pointing gesture make it unique in the infant's experience. When pointing, the infant's primary motoric orientation is toward the referent (the hand stretches out toward it, not the addressee). But unlike other similar motor acts the infant is familiar with, the *motoric* movement toward the referent has no *direct causal* influence on it (as it does in, e.g., prehensile acts) and does not even attempt to contact the object (as in reaching more generally). Indeed, to the extent that the act may be "causally" efficacious, its effect is upon the addressee, toward whom the infant is only motorically oriented in a secondary way. The addressee may in turn act upon the referent or reorient herself toward it. From the infant's perspective, then, pointing results in somewhat inconsistent and indirect contingent effects of the action's motoric orientation upon the addressee and referent. Hence, it is considerably more complex and unpredictable in its contingent consequences than is, for example, dyadically structured waving, another conventional gesture many young infants begin to experiment with in the first year of life. The highly irregular outcome of the pointing gesture probably increases the difficulty of learning its correct use.

Such is the sensorimotor and attentional challenge of pointing for the infant. But what must the infant's cognitive and experiential situation be like in order for it to initiate a voluntary pointing gesture? How is it experiencing others, itself, its environment, and its possibilities for action and communication, when it begins pointing?

### **Becoming an Agent: Developments in Infant Embodiment, Sensorimotor Ability, and Locomotion From 3 to 12 Months**

To begin answering this question, let us briefly survey the developments in the infant's experience of itself, others, and its environment between 3 and 12 months of age. At 3 months of age, the infant's existence is still largely passive. It lacks the core and neck strength for upright sitting and has no power of self-generated locomotion. Coordination of motricity and perception are poor. Reaching (or batting) actions are imprecise and grasping remains largely reflexive. Visual interest in distal objects is minimal, and visual attention remains largely reflexive. Working memory and executive control are weak, and the infant is easily distracted. It is only during the second half of the first year that the object limit for short-term working visual memory increases from one item to three (Reynolds & Romano, 2016; Ross-Sheehy, Oakes, & Luck, 2003). This is a crucial development for acquiring the pointing gesture, given its bifurcated orientation toward referent and addressee. Interactions with others consist primarily of affective "protoconversations" in which the infant will sometimes imitate a caretaker's facial expressions and exchange vocalizations. These imitative efforts provide some evidence that the infant has a nascent ability to correlate its proprioceptive sense of its own body with the visual presentation of the caretaker's face, recognizing that the caretaker is in some important respects "like me" (Meltzoff, 2013—see Section "Acquiring a Gesture: Imitation, Social Cognition, and the "Like Me" Hypothesis).

This brief discussion can serve as a starting point for a phenomenologically adequate account of the minimal conditions of successful pointing and the 3-month-old's embodied experience of itself and its world. We can already see how misleading it is to claim, as Tomasello did (2008, p. 136), that the "overt behavioral form of pointing" can be observed in infants as young as 3 months of age. Infants at this age completely lack essential sensorimotor prerequisites of control and coordination for the pointing gesture. Further, any one aspect of the complex pointing act, such as focusing perception, coordinating motor action, or responding so-

cially to others, is independently already a considerable cognitive exertion for such a young infant. Asking a 3-month-old to combine these acts together into an integrated communicative and sensorimotor action would likely be well beyond the cognitive capacity of the infant at this time, even if it possessed the rudimentary sensorimotor and social–cognitive abilities for each component in isolation. Hence the fact that 3-month-olds occasionally involuntarily hold their hand in something resembling the form of a pointing hand cannot be taken as an indication that they possess the “overt behavioral form of pointing.” To think so would be analogous to concluding from the fact that young infants and even fetuses kick their legs that they possess the “overt behavioral form” of playing football, then to ask why they do not pass and shoot like older children when we put them on the football pitch.<sup>9</sup>

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Much will transform in the infant’s body and relation to its surrounding world between 3 and 12 months. If at 3 months, the distal world beyond what the infant’s body can contact is largely a spectacle to be passively observed, at 12 months, the world beyond the infant’s immediate reach calls out for exploration and appropriation. The 3-month-old is a passenger in its body, whereas the 12-month-old is the driver. Developments in postural and limb control and coordination, as well as locomotion, will transform the infant from a spectator of the world into an actor. By 6 to 8 months, the infant has the core and neck strength to hold itself in a seated position with head rotation (Hadders-Algra, 2005), freeing arms and hands for reaching, grasping, and eventually pointing. With these developments, interest in objects increases and ability to manipulate them improves (Meares, 2016, pp. 94–95; Soska & Adolph, 2014). Meanwhile, expanding locomotor options will radically change the way the infant interacts with its surrounding world. By the end of the first year, many infants are beginning to stand and even take their first steps, a tremendous advance toward agency and autonomy. New vistas for object exploration and manipulation emerge. What is out of reach is no longer beyond the sphere of the infant’s agency. “Over there” is now a possibility that the infant can realize through its own volition. We can speculate that adopting this more active attitude to

what is spatially remote may partially motivate the acquisition of the pointing gesture.

Is there a correlation between (a) these developments in sensorimotor and locomotor ability and (b) the developments of social cognition that occur around the end of the first year, illustrated by the increase in joint attention, pointing, and productive and receptive vocabulary? Yes. Campos, Contaldo, Caselli, and Volterra (1997) found that infants at 8.5 months who had experience with self-generated locomotion, either through crawling or use of a walker, were better at following adult gaze to a distal referent than were infants of the same age who still have no locomotor experience. In a study with infants from 10.5 to 13 months, Walle (2016) found that infant initiation of joint engagement (including pointing) and following of the parent’s joint engagement cues increases as a function of infant walking experience, not age. Further, infant walking experience was a significant predictor of infant receptive and productive language.<sup>10</sup> And Libertus and Violi (2016) found a significant correlation between the emergence of sitting skills early in the first year and receptive vocabulary size at 10 and 14 months of age.

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The correlation between developments in sensorimotor ability and social cognition is thus well-documented. The question remains, however, how best to make sense of these correlations (cf. Oudgenoeg-Paz, Volman, & Leseman, 2016). After all, the explanation might just be that infant motricity, social cognition, and language skills all correlate with some domain-general measure of precociousness (a “general developmental factor”) such that infants who are early or late bloomers in any one category will tend to be early or late in the others as well. Moreover, there are contingent reasons why early walkers will develop more quickly in social cognition and linguistic ability. Increased mobility generates further occasions for social interaction and language learning. It extends the

<sup>9</sup> Merleau-Ponty (2010), follows Wallon in distinguishing between the “pseudo-gesture” of the newborn and the “true gesture”: “What is decisive is not the *elements* of which behavior is composed. Rather, the internal *sense* is decisive” (p. 349).

<sup>10</sup> See also He, Walle, and Campos (2015); Iverson, 2010; Oudgenoeg-Paz, Volman, and Leseman (2012); Walle and Campos (2014).

range of the infant's practical and social world, thus giving the infant and caretakers more to (proto)talk about. Additionally, caretakers tend to take walking infants more seriously as social agents and hence offer them more social, linguistic, and object-directed stimuli than they do to crawling infants.

Such considerations suggest what we might call indirect, or weak, explanations of the correlation of the development of infant embodiment with social and linguistic ability: Sensorimotor development is correlated with social-cognitive development because the former merely provides more of the required occasions for developing social cognition. On this explanation, sensorimotor development does not contribute to advances in social cognition in any deeper, more direct way. If such an account is correct, then Tomasello's explanation of the timing of the onset of infant pointing may be essentially correct but simply in need of being complemented by these further points about the development of sensorimotor and locomotor ability. The existing research up to this point leaves the question of the more precise genesis of infant pointing unanswered, and perhaps unanswerable. In the following section, I will suggest an alternative explanation according to which focusing on the embodied features of infant development and experience leads us to reconsider Tomasello's account of the nature of the initial social cognition required for infants to begin pointing. This will result in a stronger, more direct, and, I believe, more phenomenologically accountable proposal concerning the onset of infant pointing.

### Acquiring a Gesture: Imitation, Social Cognition, and the "Like Me" Hypothesis

In this section, I will draw on Meltzoff's "like-me" developmental framework, which complements the phenomenological approach I have advanced. I will apply that combined theoretical framework to interpret the social-cognitive import of the developments in postural, sensorimotor, and locomotor ability that occur in the first year as they relate to infant pointing. I will work out the details of my own experimental-imitative hypothesis concerning how infants learn to point. At the same time, I argue that the considerations of the development of embodiment in the first year of life

suggest an extension of Meltzoff's framework to a more global scale of relating self and other.

Tomasello, as we have seen, emphasized the priority of social cognition over communicative action and comprehension: It is because the infant understands that the people around it are rational agents, with covert communicative intentions, acting for reasons through means to obtain goals, that it can comprehend and eventually produce pointing gestures of its own. Understanding a pointing gesture, Tomasello and colleagues write, "requires at least some implicit understanding of the formula *she intends that I attend to X (and wants us to know this together) for some reason relevant to our common ground*" (Tomasello, Carpenter, & Liszkowski, 2007, p. 716). However, Tomasello granted that we do not know how infants learn to point, whether through ritualization of some other action (e.g., reaching and grasping), cultural learning (imitation), or the retooling of a more general orientating movement.<sup>11</sup> With this question left unanswered, it is unclear whether the social cognition Tomasello claims is required for the mature act of pointing must be in place before the infant begins pointing, or rather whether it is learned along the way with pointing. Is it possible that learning to point, rather than *requiring* an understanding of communicative intentions on the part of fellow rational agents, in fact conversely *facilitates* learning about communicative intentions?

This would suggest a model according to which naturally occurring developments in sensorimotor ability provide a scaffolding for the development of social cognition. Andrew Melt-

<sup>11</sup> Behne, Liszkowski, Carpenter, and Tomasello (2012). See also Tomasello, 2008, pp. 112–113:

No one knows whether pointing is somehow ritualized by infants from some other behavior, or whether they learn it from others by imitation. Given that many apes come to request things from humans by "pointing" (almost certainly not by imitation), and given that some kind of pointing is very likely universal among human societies, the most plausible hypothesis at the moment is that infants do not acquire their pointing gesture by imitating others; rather it comes naturally to them in some way—perhaps as a nonsocial orienting action that becomes socialized in interaction with others. But there is no directly relevant research here, and it may be that even the fully socialized version requires no learning. Or it may be that even though there is no learning initially, imitation plays a role later as the child notes the correspondence between her pointing gesture and that of others. We simply do not know.

zoff's approach to the early development of social cognition is congenial to such an interpretation of the developmental sequence, allowing us to see the imitative bodily activity of pointing as prior to and paving the way for the full breadth of social cognition that accompanies the mature use of the pointing gesture. At the heart of Meltzoff's (2005, 2007, 2013) "like me" approach to the development of social cognition is the thesis that infant imitation is connected with the infant's perception of others as "like me" and its understanding of other minds. There is a causal connection between imitation and understanding other minds. But whereas Tomasello assumes that understanding other minds is a causal condition of imitation, for Meltzoff, the causal influence runs in the opposite direction: "Imitation, and the neural machinery that underlies it, begets an understanding of other minds" (Meltzoff, 2005, p. 56). Meltzoff argues that infants begin with a starting state in which their proprioceptive and kinesthetic sense of their own bodies is connected to the visual perception of other bodies through a supramodal network. Evidence for this claim is provided by neonatal facial imitation (Meltzoff & Moore, 1997). As the infant develops and accumulates more everyday experience, it increasingly maps relations between its own bodily states and corresponding mental experiences, producing a "bidirectional map linking mind and behavior" (Meltzoff, 2005, p. 57). This map provides the grounds for the infant to project the mental state they associate with their own behavior when they see others acting "like me."<sup>12</sup>

As a simple illustration of the view, Meltzoff discusses how infants can use their own intentional actions as a framework for interpreting the intentional actions of others. Infants, especially in the second year of life, have goals and act intentionally. In pursuing those goals, however, they often find themselves thwarted by the world. In such cases, they must experiment with other means to achieve their ends. Successes and failures are often marked by characteristic emotional associations of satisfaction or dissatisfaction, and the series of efforts is often terminated after a success. When infants see an adult acting out an analogous pattern of behavior, they may conclude that the other person, too, has goals and pursues them by various means, and experiences corresponding emo-

tional states along with her successes and failures. The infant thus concludes that those acts are intentional, "just like mine" (Meltzoff, 2005, pp. 75–76; cf. Meltzoff, 1995).

The specific experiences that the infant has had will make it better able to understand what another is experiencing. Brooks and Meltzoff (2002) found that 12-month-olds follow the gaze of an adult whose head turns significantly more often if the adults' eyes are open than if they are closed. However, in the same study, they found that infants are just as likely to follow the direction of the head turn if the adult's eyes were covered with an opaque blindfold. In a later study, Meltzoff and Brooks (2008) found that when infants of the same age were given experience with having their own vision occluded by the blindfold, they no longer followed the head turn of an adult who was wearing a blindfold.

We may note in passing that Meltzoff's like-me framework attempts to satisfy at least two of the three criteria for a minimally phenomenological science of mind and behavior laid out earlier. It (a) aspires to phenomenological accountability by way of (b) reconstructing the experience of the infant. Meltzoff takes infant and even neonate imitation to be "genuine" imitation, with the goal of matching the behavior of the person imitated (Meltzoff, 2010, pp. 18–19). Whatever else this claim amounts to, Meltzoff is at least claiming that the action is deliberate as opposed to stereotyped or instinctive. And as a deliberate action, it is a response to the infant's subjectively experienced situation rather than to the surrounding world described in strictly objectivist terms. As such, to understand the action, we must reconstruct the experiential world within which the action unfolds. As for (c), the emphasis on embodiment, though it is perhaps implied in Meltzoff's dis-

<sup>12</sup> Here as in Tomasello's descriptions, we find in the language of "projection" a tendency toward the dualistic assumption that mind is concealed and must be inferred from behavior, rather than being manifested in it. I will return to this critique in Section "Embodied Versus Dualistic Approaches to Development" and propose a modification to the like-me hypothesis in light of it.

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cussions, foregrounding it may allow for a deeper insight into the like me hypothesis.<sup>13</sup>

How might the like-me framework help us understand the correlations between the developments in posture, object manipulation and exploration, and locomotion; and those in communication, language ability, and social cognition? Let us begin with a rather obvious point: In many of the respects essential to a human mode of existence, the 3-month-old infant is *not at all like* the adults and older children with whom it interacts. As we have seen, the 3-month-old is largely a passive observer of its world, whereas those around it are practical agents. Indeed, if a 3-month-old infant had sufficient cognitive ability and interest to speculate about such things, on the evidence available to it, it might justifiably classify itself as a quite different kind of living creature than the agentic human beings it observes around it. It is no surprise, then, that infant imitation at this stage is limited to simple face-to-face protoconversations, and perhaps some simple, nonreferential finger movements (Nagy, Pal, & Orvos, 2014). Although the 3-month-old infant has some precocious ability to imitate, it does not experience itself as sufficiently like others to view the actions of others' bodies as possible actions for its own body.

The situation is very different for the infant late in the first year of life. As it progresses from passenger to driver in the world through the development of posture, object exploration, and locomotion, the extent of the possible analogy between its own body and behavior and those of others expands considerably. If at 3 months, the infant could sense itself to be like others on an emotional level, having a face capable of affective-expressive exchange, by the end of the first year, it is increasingly capable of seeing itself as like others in its *practical*, sensorimotor, object-oriented undertakings. And with this dilating sense of being like others, the horizon of actions and gestures performed by others that can serve as potential targets for the infant's imitation also expands. This bidirectionality of perception and production is clearly evidenced in infant imitative tool use in the second year of life (Meltzoff, 1995): On the one hand, infants infer that others who act in ways they have previously acted experience similar correlated inner states; on the other hand, insofar as they already identify themselves as being like others, they perceive

the actions of others as potential targets for imitation.

The like-me framework, then, suggests an alternative ontogenesis of pointing and explanation for its predictable arrival in the infant's behavioral repertoire toward the end of the first year. With the development of the infant's sensorimotor prospects through experience with reaching, grasping, new postures, and locomotion, the infant not only has the essential sensorimotor capacities and interest in distal objects to fulfil the motivational, perceptual, and motoric demands of the pointing gesture. It also has an increased sense that its own body's possibilities for behavior are akin to those of the people it sees around itself. This opens the possibility of imitatively appropriating the pointing gesture—or some early, approximative form of it—*whether or not the infant possesses the social cognition and understanding of communication that Tomasello assumed is prerequisite to the communicative gesture of pointing*. Indeed, it could be that the infant begins by imitatively pointing, and through experimenting with pointing comes to understand the appropriate use and communicative force of the gesture, thereby learning something about other minds in the process. On this interpretation, the infant imitatively “tries on” the pointing gesture the way an adult might experiment in a foreign language with a figure of speech that she only partially comprehends and that has no counterpart in her native tongue—hence I title my proposal the “*experimental-imitative hypothesis*.” Through experimentation and assessing the response of native speakers, she comes to learn the appropriate use conditions of the expression, thereby gradually refining her understanding of what others mean in using it as well. Whereas on Tomasello's view, the infant already needs to know a great deal about pointing and other minds to begin pointing, on my hypothesis, the infant begins pointing and through the practice comes to learn about pointing and other minds.

Up until now, most research on the like-me hypothesis has focused on how observing or participating in particular actions and experiences bidirectionally influences infant social

<sup>13</sup> Meltzoff has been directly influenced by authors identifying with the historical and contemporary phenomenological tradition. See Gallagher & Meltzoff, 1996.

cognition. For example, as discussed earlier, infants' experience wearing a blindfold informs their understanding of what other people experience when wearing a blindfold. In the other direction, observing others performing a particular behavior provides infants with a target action for imitation. Note, however, that my proposal entails an extension of the like-me hypothesis to a more global, general scale of applicability. For to begin deliberately imitating the gestures of others, the infant must at least be responding to the body of the other agent as being like its own in the relevant way. My suggestion is that as the infant realizes—through broad advances in sensorimotor ability, locomotion in particular—that its own body and range of potential actions resemble those of more mature humans in general, its horizon of potential target behaviors for imitation also expands in a comparably global manner. It begins to experience its body as “like others” not only in the limited sense of this or that action, as the case of facial and manual imitation early in the first year. Rather, it experiences itself as “like others” in a more open, flexible, and general way: *Anything* you can do, I can (at least attempt to) do.<sup>14</sup>

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### Supporting the Experimental–Imitative Hypothesis

Direct empirical support for the experimental–imitative hypothesis is thin. This is to be expected at present, given the state of theory, experiment, and observation of infant pointing. For one, we simply have too little in the way of detailed, qualitative, longitudinal studies of the onset of pointing. Further, as no one has yet entertained the experimental–imitative hypothesis, the observations that might have been made in support of it have likely been ignored or discarded as irrelevant to the acquisition of pointing. However, if the experimental–imitative hypothesis is correct, we should be interested not only in the earliest “complete” and successful pointing gestures. We should also expect to find earlier, incomplete, unsuccessful, and even absurd attempts at experimentally trying out the pointing gesture. Cherry-picking ideal illustrations of early successful pointing may not be the best way to gain insight into the processes through which pointing is learned and mastered. Such a selection bias might lead us to neglect pseudo- or proto-pointing be-

haviors that could provide valuable insight into the genesis of the mature form of the gesture.<sup>15</sup>

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In one of the few qualitative, longitudinal studies of the onset of pointing in the first year, Kettner (2014) provided examples from two different infants of such early experimental–imitative proto-pointing that seems to lack the full sense of the mature pointing gesture. In one example, a mother describes the proto-pointing of her 29-week-old daughter:

I've noticed a few times now that as I carry her around the condo, she'll have one arm sticking straight out, and the configuration of her hand is always changing. She tends to stick her index finger up and twist her wrist, which makes it look to me like she's pointing, although I do not think she's gesturing at anything in particular, and she's not looking up at me to try to show me what she's looking at. (p. 21)

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A parental report of a 40-week-old boy reads as follows:

The first time I noticed [him] pointing was when we were all sitting around the dinner table and his twin sisters were both pointing and then mom and dad started pointing and AI looked around at all of us and also put his finger out and thumb in and pointed in front of him. Since then he has pointed quite a lot. He occasionally points and says “ba” very emphatically, maybe because his father has pointed to a ball? However, he does not actually point to a ball and usually looks at his finger when he does this. (p. 21)

These are the best documented examples of early experimental–imitative pointing I have been able to find. They exhibit exactly the types of proto- and pseudopointing activity predicted by the experimental–imitative hypothesis.

Several broader developmental observations also provide indirect support for the plausibility of this hypothesis. The first is the onset of infant waving. Though there needn't be a necessary developmental ordering of waving and pointing, the earliest reports of waving are somewhat earlier than those of pointing, with nearly 20% of full-term infants waving at 7 months and over 90% by 12 months of age (Matsui, Ohtoshi, & Takada, 2013). Waving is a communicative and conventional manual gesture like pointing. Further, both are arbitrary gestures, with no natural connection between the meaning expressed and the form of expression. This makes waving un-

<sup>14</sup> In the conclusion, I will discuss ways in which this more global like-me hypothesis might be testable.

<sup>15</sup> See Kettner, 2014, pp. 20–21.

like other bodily expressive gestures that have a natural associative connection between their expression and their meaning (smiling is naturally associated with positive feeling, and bodily convulsion naturally follows from negative feeling and frustration). Waving also does not appear to be an ontogenetically ritualized gesture, an abbreviation of some full-fledged act that would more directly express the intention behind the gesture. And it is unlike other motor actions of the hand that infants learn, as there is no causal contact between the acting body and the person or object acted upon. It seems clear, then, that waving is learned through imitation. Though I am aware of no longitudinal, qualitative study of the topic, I anticipate that the infant's employment of the gesture will display something of the experimental character I discussed earlier, with much hesitation, uncertainty, and perhaps occasional contextually inappropriate employments in the early stages of acquisition.

Second, waving and pointing are just two ways in which infants at around this age are becoming increasingly deliberate and attentive in exploring communicative contingencies with caretakers. With the increased range of actions afforded them by their developing bodies, infants are learning not only how to interact with their world in different ways, but also how different ways of bodily and verbal action and expression will elicit contingent responses from caretakers. This is clearly seen in the classic still face experimental paradigm, where a caretaker breaks off contingent interactions with an infant it has been engaging with, suddenly maintaining a still face for 2 min.<sup>16</sup> During this period, the infant will attempt everything in its behavioral repertoire to restore the caretaker's contingent response. It will attempt verbalizations, facial expressions, and bodily gestures. Those who can will recruit more directed social cues such as pointing in an attempt to win back the caretaker's interest. Such behavior is a further illustration of the increasingly experimental tendency in infant communicative behavior throughout the first year.

Third, though the specifics of the pointing gesture vary cross-culturally (Kita, 2009), infants will eventually converge on the morphology of the pointing gesture that is conventionally employed in their surrounding culture. This suggests that imitation is playing a role, at least in securing the final form of the gesture in a

culturally literate individual's behavior. Finally, infants are usually capable of comprehending the pointing gesture, at least to some degree, before producing their own. Given what we know about infants' ability for deferred imitation (Barr, Dowden, & Hayne, 1996), this further supports the possibility that the gesture is learned through imitation, with the precise sense and appropriate use of the gesture becoming gradually clear to the infant as it appropriates the act for itself.

These corollary considerations do not provide direct support for the experimental-imitative hypothesis. I have already explained why we should not expect there to be a great deal of such evidence on the books at present. However, the overall coherence of the hypothesis in light of a broad range of considerations, and its ability to accommodate a coherent network of indirect evidence, combined with the few cases of direct evidence, should provide sufficient motivation for further empirical research that could corroborate or challenge the experimental-imitative hypothesis.

### Summary

Let me now pull together the aforementioned considerations concerning developments in infant embodiment and sensorimotor ability and the "like-me" developmental framework to provide an overview of the proposed understanding of infant pointing and the explanation of its onset that I would like to advance. Taking the infant's point of view, we see that the pointing act is much more perceptually, motorically, and cognitively complex and demanding than is usually acknowledged. It places demands on attention and short-term visual working memory that the infant is only able to meet toward the end of the first year. It requires a posture that allows support and movement of the head to take in divergent and distal visual fields, and that frees the arms for the gesture itself. Minimally, this is a self-supported seated posture. The arms themselves must have sufficient strength and coordination to indicate the referent object even while visual attention is shifting from the referent to the addressee. To even have the motivation to actively orient itself toward a

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<sup>16</sup> For review, see Mesman, van IJzendoorn, & Bakermans-Kranenburg, 2009.

distal object, the infant must conceive itself as an agent in space for whom distal objects are possible objects of exploration and encounter. Although self-generated locomotion may not be a necessary condition for taking this attitude toward distal objects, it certainly strengthens this active interest in what is beyond immediate reach and hence may play a facilitating role in the acquisition of the pointing gesture. Finally, if the experimental–imitative hypothesis is correct, the infant must view itself as sufficiently like the more mature humans around it who already use the pointing gesture to view this as a potential target gesture for imitative appropriation. This sense of “like me,” I have argued, develops along with maturation of the infant’s body, especially in posture, locomotion, and object exploration and manipulation.<sup>17</sup>

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### Conclusions

If this account is correct, it provides us an explanation of how pointing is learned, something lacking in most current discussions of infant pointing. It also explains the predictable developmental onset of pointing late in the first year of life. But it does so not simply by appealing to social cognition, a response that only raises the next question as to why social cognition emerges when it does. Rather, it explains the onset of particular milestones in social cognition in terms of underlying developments in the infant’s embodiment and sensorimotor activity. These advances extend the horizon of prospective acts for imitation, affording the infant further opportunities to learn about other minds. In learning how to point, the infant comes to learn something about the meaning and use of the pointing gesture, and hence about the minds of those beings who also point “like me.” On this view, action slightly precedes cognition, though the two advance hand in hand, with new experiments in action deepening social cognition, which in turn expands the infant’s horizon of possible imitative action, social engagement, and social understanding. I want to close with some further considerations concerning the empirical viability and testability of the experimental–imitative hypothesis, and some reflections on how the account proposed here both applies an embodied understanding of the mind while also providing further corroborative support for the embodied theory of mind.

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### Empirical Predictions, Future Directions of Research, and the Need for Further Qualitative Research

As discussed earlier (Section “Supporting the Experimental–Imitative Hypothesis”), we currently lack sufficient detailed, naturalistic observations of early infant pointing and pseudo-pointing.<sup>18</sup> This is a desideratum in this line of research. Further research targeting the earliest stages of acquiring the pointing gesture and conducted under the guidance of the experimental–imitative hypothesis could determine whether the hypothesis is correct or not.<sup>19</sup>

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Recent developments in the use of neuroimaging to study how the infant brain processes action could provide an alternative approach to testing part of the hypothesis advanced earlier. Electroencephalography studies in adults, children, and infants have shown desynchronization of mu rhythms both when subjects perform an action and when they perceive the same action being performed by another. Seeking corroboration of the “like-me” hypothesis and the role of self-experience in facilitating it, Marshall and Meltzoff (2014) showed that an infant’s experience with objects influences their mu rhythm response when observing others interact with objects the infant itself has interacted with, with greater mu rhythm desynchronization when infants observe actions they themselves have previously executed. This illustrates how a *particular*

<sup>17</sup> This perception of others as being “like me” presumably comes in degrees, a claim that is supported by recent infant electroencephalography studies that show a greater or lesser response to the observation of target acts performed by others. It would be interesting to know what other factors influence the degree of response. Does greater or lesser familiarity with the individual performing the target act inform the degree of response? What about differences in gender, race, or other salient factors of embodiment? To what extent are the bodies of human infants at different stages of development in sync with those of other, nonhuman animals of various kinds? What factors of embodiment and social interaction influence whether or not an infant will imitate a robot (cf. Meltzoff, Brooks, Shon, & Rao, 2010)? We now have the experimental resources to begin empirically researching such questions (see the following text, Section “Empirical Predictions, Future Directions of Research, and the Need for Further Qualitative Research”).

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<sup>18</sup> Two important exceptions are Bibok, 2011, and Kettner, 2014 (cited earlier).

<sup>19</sup> Such experimental design would count as an application of “front-loaded phenomenology.” See Gallagher & Brøsted Sørensen, 2006.

self-experience sensitizes the relevant infant neuron systems to be perceptually activated when others perform the same action on the same object. The current article proposes that infants' self-experience with locomotion should influence the extent to which they are able to perceive other human beings as "like me" on a global, *general* level. If correct, this should predict that, controlling for age and other developmental factors, increased mu rhythm desynchronization when observing a broad range of adult actions should correlate with infants' locomotor experience as infants increasingly come to feel their own bodies to be like those of other human beings in a general and flexibly applicable way.

Of course, even if self-experience and imitation have a role to play in the acquisition of the pointing gesture and the development of social cognition, these need not exhaust the explanation, nor need we assume that there is only one path that leads to social cognition. Self-experience, Meltzoff writes, is not the "royal road" to social cognition. We would expect infants with delays or disruptions of normal sensorimotor development ultimately to converge on a comparable understanding of their own agency and other minds, even if they achieve this by alternative means (just as infants who develop alternatives to crawling usually end up walking normally just like crawlers). Even within the normal range of acquiring the pointing gesture, there may be a variety of paths by which infants learn to point. Again, in the absence of more detailed qualitative research, we are left to speculate. However, it is possible to distinguish two versions of the experimental-imitative explanation I have advanced. According to the stronger version, infants first begin pointing in an attempt to imitate the pointing gestures of others around them. According to the weaker version, an infant's first pointing gesture may emerge out of some other gesture or action (as proposed by Carpendale & Carpendale, 2010), but it is only when they realize the equivalence between their pointing and the pointing of others around them that they begin to understand the social and communicative meaning of the gesture. Even on the weaker version, then, it is still through recognizing the gesture as imitative—that is, as equivalent to the gestures of others—that the infant's understanding of other minds develops, and not vice versa, as claimed by Tomasello.

## Embodied Versus Dualistic Approaches to Development

I want to close by considering the ontological implications of the approach proposed in the preceding pages and to juxtapose it with the views from developmental psychology I have engaged. Developmental psychologists do not generally begin their articles and books with reflections on the underlying ontology of their research. However, as discussed earlier (Section "Phenomenology and the Sciences of Mind and Behavior"), such philosophical assumptions are nonetheless at play in all empirical research. They provide the conceptual framework of an empirical discipline, determine the questions asked, and inform the interpretation of facts garnered from empirical observation. The approach I have advocated emphasizes the role of embodiment in the development of social cognition. Until now, I have treated this primarily as a methodological guideline. Let us now consider the deeper, ontological aspect of the embodiment claim.

I would contend, along with Engelland (2014), that much contemporary work in developmental psychology continues to be implicitly committed to a strong dualism of mind and body. This can be seen from the very statement of the problematic of acquiring social cognition, which is often cast in terms of making a cognitive and even *inferential* leap from the external, bodily comportment of another human being, to an internal, mental state that supposedly accompanies the external behavior. Hence, Tomasello emphasizes the *cognitive* aspect of the social understanding of others, describing human beings as "the world's experts at mind reading" (Tomasello, Carpenter, Call, Behne, & Moll, 2005, 675). Similarly, Meltzoff (2005) writes that infants must "project" from their own experience to understand that others who are externally "like me" in terms of body and behavior also have "internal states" like mine.

Phenomenologists have long critiqued such cognitivist approaches to understanding other minds (and the dualistic ontology of mind and body that tends to accompany them), developing an approach according to which such projection or inference is not required (Husserl, 1977; Merleau-Ponty, 2012). Because so much of our "mental" life is already on display in our bodily behavior, and because minds are essentially embodied, "mental" states can be directly

*perceived* in the embodied behavior of others. I see in the bodily pointing gesture itself that my interlocutor is attempting to direct my attention somewhere, just as I can see pain expressed in the grimace and joy in the smile. As Gadamer put it, “A gesture is something wholly corporeal and wholly spiritual at one and the same time” (Gadamer, 1987, p. 97). Thus, many authors in contemporary cognitive science influenced by phenomenology ascribe to some version of a direct social perception hypothesis: Understanding others occurs first and foremost on the bodily, perceptual level (Zahavi, 2011). If human beings are indeed “the world’s experts at mind reading” (Tomasello et al., 2005, p. 675) it is only because we are initially experts at *body* reading (cf. Gallagher, 2005). This needn’t entail that we do not use forms of inference and mind reading to reason about the thoughts and feelings of others, nor that all our mental life can be infallibly read off of our bodily expression. Pretense and subvocal thinking are of course possible, and we are often mistaken both in our immediate perception of others’ experiential states and in our reflective reasoning about them. The direct social perception approach only attempts to locate such higher order social cognition as dependent upon and an elaboration of a more basic, perceptual–bodily mode of social perception.

If this line of reasoning is correct, it leads to a stronger, *ontological* version of the *methodological* embodiment criterion advanced earlier. The methodological criterion advanced for the phenomenological inquiry into development advises us to consider ways in which bodily experience in perception and action influences the acquisition of higher order cognitive achievements. Such explanations promise to be more parsimonious than explanations that posit distinct cognitive modules, the evolution of which is often left a mystery. The ontological counterpart to this methodological commitment to embodiment claims that the *nature of mind itself* is not something entirely distinct from the body. Mind is essentially entangled with body and its activities, and more basic modes of bodily comportment are the foundation upon which higher order cognitive achievements are elaborations. The ontological claim can be seen as a natural companion to the methodological guideline, though it does not follow from the latter with strict necessity.

In advancing my hypothesis concerning the development of infant pointing, I have followed the methodological embodiment guideline. In doing so, I have attempted to show just how intimately and indissociably social cognition is interwoven with the development of the body in action and perception. We understand the communicative intentions and “mental states” of others primarily because we can feel our own bodies resonating with theirs in gesture, action, and expression. We feel their bodies to be “like ours” and ours to be “like theirs.” If the experimental–imitative hypothesis is correct, then it illustrates the value of the method applied. And insofar as the ontological embodiment claim is the most coherent philosophical interpretation of the facts of development brought to light through the method, the ontological claim gains some partial support from the success of the account advanced here.<sup>20</sup>

Such an understanding would modify somewhat the way we construe the “like-me” hypothesis. Because the primary way of relating to others on the account I propose is basic and bodily perceptual, the infant should not be seen as “projecting” its own mental state upon or into others, but rather as directly perceiving the emotional and psychological aspect in the action itself. However, this does not rule out the possibility that at times, infants do rely on more cognitive, higher order feats of social reasoning to simulate, theorize about, or project themselves into the mental state of others. Is the distinction between the more perceptual and the more cognitive aspect of understanding other minds to be conceived as a difference in kind or a difference in degree? And at what stage of development do infants advance to more reflective, cognitive modes of reasoning? Such questions remain open and are only to be answered by careful observation in natural and experimental settings complemented by phenomenological and philosophical interpretation that is based on thorough familiarity with the empirical findings.

With such questions in mind, it is clear that developmental psychology is a most fruitful area of investigation for applying, testing, and refining the hypotheses of the embodied approach to cognition. For if higher order cognitive achievements

<sup>20</sup> On the ontological component of the embodied-phenomenological approach advanced here, see Fuchs, 2018; Thompson, 2007; Zahavi, 2017.

are based in more foundational modes of relating to the world in perception and action (as most advocates of embodied cognition would agree) then we should be able to witness the development of the former out of the latter in ontogenesis. The current article attempts to illustrate this in the case of pointing and the gradual emergence of higher order social cognition from more basic, bodily modes of relating to and understanding others.

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