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AUTHOR'S RESPONSE

Self-Perception as a Foundation for Self-Knowledge

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The arguments in my target article were based on the implications of James Gibson's direct-realist, ecological theory of perception for the origins of self-knowledge. The aim was to review evidence for self-awareness prior to the onset of mirror self-recognition, a behavior usually considered to be symptomatic of self-knowledge in early development. The implication of my target article is that mirror self-recognition demonstrates ontogenetic and phylogenetic discontinuity. It almost certainly marks a new "level" of self-awareness but it should not be considered as a kind of "graduation ceremony" from which only a few privileged organisms emerge with the self intact. The essence of the ecological argument being proposed is that continuities as well as discontinuities—between species, between developmental levels, and between levels of biological organization—need to be considered in explaining the acquisition of self-knowledge. I wish to elaborate these basic points in my reply to the commentators.

My article was originally presented at the MacArthur Foundation Symposium on "The Self in Transition" in 1985 (see Cicchetti & Beeghly, 1990). Since then, additional theoretical support for my own position by Neisser (1988) has become available and I am grateful to Loveland for her outline of this work. Neisser distinguished between five kinds of self-knowledge each based on a different kind of information.

1. The ecological self, which is the self as directly perceived with respect to the physical environment.
2. The interpersonal self, also directly perceived, which depends on emotional and other species-typical forms of communication.
3. The extended self, which is based on memory and anticipation.
4. The private self, which reflects knowledge that our conscious experiences are exclusively our own.
5. The self-concept, which is a theory of self based on sociocultural experience.

All begin early in life and each has a separate developmental history. Neisser argued that these separate aspects of self are not generally experienced as distinct because they are all co-located in the same individual and the various types of information involved overlap.

Much of my article pertains to Neisser's innate "ecological" self. I reviewed evidence on infant's responses to optic flow patterns in "moving room" studies, in support of my argument that development begins with a fundamental dis-

tinction between self and world. It is important to note that this starting assumption differs fundamentally from that of "adualistic confusion" common to the Piagetian and Freudian positions on the origins of self. In Gibson's account, perception operates on information that objectively specifies properties of objects and events. The commentaries by Loveland, Mitchell, and Kellman suggest that I may not have been absolutely clear on this. To have written about sensory perception, when I meant perceptual specification, may have been misleading because the whole point of Gibson's theory is to substitute an information-based account of perception for sensation-based theories. Indeed, the distinction between sensation and perception lies at the foundation of ideas about "adualistic confusion" where sensation is meaningless in the absence of experience. I should like to take this opportunity to make clear that the alternative, Gibsonian starting-point, which I envisage, is based on the inherently informative value of perception. I certainly did not mean to imply that I consider perception to be a misleading or inadequate means of understanding the world. On the contrary, my whole argument rests on the adequacy of perception for providing information about self.

Bertenthal comments on the information value of the optic flow pattern. He suggests that even if the information for a distinction between self and world is implicit in perception, it may not be accessible to conscious awareness. This comment touches directly on a point made by Neisser (1988) that may serve as a reply:

Are we conscious of our ecological selves? To answer this question in the negative would be to claim that ecological self perception was phenomenally "silent." I believe, on the contrary, that it is often accompanied by a definite—and often powerful—kind of awareness. This is presumably true not only of adults but also of infants, indeed of all animals whose perceptual systems pick up self specifying information. Nevertheless awareness of this kind is not what we would ordinarily call self consciousness. (p. 8)

Bertenthal argues for *explicit* self-consciousness as his criterion for self-knowledge, which seems to correspond to what Neisser referred to as *self-consciousness*. However, Neisser's other kind of self-awareness is also evidenced in moving-room studies. Infants as young as 2 months (when they first acquire head control) compensate for the nonexistent loss of balance of the head specified by the moving room, as if maintaining a stable head posture is a powerful set-goal of the system (Pope, 1984). The commentary by E.

J. Gibson and Adolph also lists further evidence for very early sensitivity to self-motion specified by optic flow patterns, in support of my thesis. Furthermore, babies show emotional reactions to discrepant optic flow patterns long before they can overrule the misleading visual information (Butterworth & Cicchetti, 1978). An ability to partially overrule discrepant visual proprioception can first be observed at about 14 months. This kind of explicit self-consciousness—where the baby turns to see “what is making the room move?”—shows that the event is recognized to have occurred outside the child's own agency (Butterworth & Cicchetti, 1978). The developmental transition from self-specification to self-knowledge may therefore lie between (a) a type of consciousness where agency in the normal ecology is specified in the optic flow pattern and (b) the developmentally later emergence of an autonomous self-consciousness, which comprehends its own agency over the optic flow field. Self-produced locomotion may indeed be one source of the latter type of knowledge, but it may not be responsible for the basic distinction between self and world.

Moving-room studies also speak to the question of the relation between species. It is not a matter of misinterpreting nonhuman psychology to identify important continuants between species or between different levels of human development (to reply further to Mitchell). I agree with Neisser that we may need to attribute the basic self-specifying properties of the optic flow pattern to any organism capable of picking up the information. In a recent study, we demonstrated that 24-hr-old chicks (*Gallus domesticus*) are sensitive to discrepant feedback in a moving room. They swayed, contingent on the onset of misleading visual flow, as if compensating for a nonexistent loss of balance (Butterworth & Henty, 1991). We need to consider continuities and discontinuities in self-knowledge to arrive at an evolutionarily appropriate account of self-knowledge and its development. Optic flow patterns are one source of information revealing continuity between organisms and within the same organism over time in making the self–nonself distinction.

Fogel's commentary is basically sympathetic to my thesis. He adds information from Stern (1985) on the interpersonal aspects of self. It is a challenging question whether social objects are fundamentally different from physical objects, as Fogel seems to be arguing. I have suggested elsewhere that knowledge of social objects incorporates additional attributes over physical objects but these two kinds of knowledge must be mutually embedded. Social objects are simultaneously physical objects (Butterworth, 1982). The distinction between the ecological and the interpersonal self, made by Neisser, may need to be elided somewhat so that knowledge of self and of the physical world interpenetrate. For example, early communication may arise, at least in part, through experiences of physical objects that are held in common with others (Butterworth & Jarrett, 1991). Another reason is that peripheral vision, which is implicated in maintaining postural stability, also specifies the visuospatial background in relation to which interpersonal aspects of event perception may take place. Thus, the physical world provides both an ecology for the individual organism and a forum within which interpersonal relations take place. Notwithstanding these complications, Fogel is correct to argue that specifically interpersonal factors may differentiate the self-concept, especially in its social and cultural aspects.

The commentaries by E. J. Gibson and Adolph and by

Walker-Andrews present further extensive evidence in support of my basic thesis. They draw attention to the ways in which development of action systems will render different aspects of the environment informative for self, as the affordances of objects come to be perceived. The child learns about her own capacities for action and thus further elaborates the ecological self. Walker-Andrews discusses the role perception of emotions plays in development of self. She and Fogel spell out some of the implications of Stern's (1985) theory of “affect attunement” for development of the interpersonal self. If it is correct that imitation depends on detection of higher order variables which transcend sensory modalities, and that perception of emotion depends on detecting the invariant feeling states which accompany emotional expressions, then specification of self is clearly not a matter of traditionally conceived sense perception. It may be better thought of as a “metaphorical” process of detecting abstract correspondences within perceptual information. In reply to Mitchell, this may also offer an insight into the level at which information for self is specified. Mitchell seems to assume that imitation is about modality-specific sensory discrimination, but this is not what a Gibsonian would argue. There is no question of attributing a more developed account to the neonate than is warranted. Neonatal imitation is different from imitation at 1 year in many respects. For example, the newborn infant imitates the dynamics of tongue protrusion whereas the 1-year-old can imitate the end state (protruded tongue) without needing to see the tongue in motion (Vinter, 1986); the 1-year-old, but not the neonate, can use tongue protrusion symbolically, as Piaget's (1945/1951) infant daughter showed by working out how the sliding drawer of a matchbox operates by sliding her tongue in and out of her mouth. The point is that the foundations of the interpersonal self, as revealed in neonatal imitation, can also be explained in terms of direct perceptual specification.

To reply to Gallup and Lewis, the very deep biological roots of the self are well captured in the workings of the immune system, in cellular self-recognition, and so on. This is exactly what would be expected from the standpoint of genetic epistemology, as Piaget (1967/1971) discussed in his book, *Biology and Knowledge*. That higher order aspects of self should be rooted in biological principles of self-regulation is also a rational implication of ecological psychology and direct perception. Additional implications for a theory of development of self actually flow from this example. Of course the workings of the immune system do not require the same level of self-consciousness as mirror self-recognition. However, the example reveals the importance of individuality (uniqueness) to the biological workings of the self. Charles Darwin long ago made clear that natural selection operates on variation, but we have not yet built into accounts of self-development the ways in which we perceive or know ourselves to be unique. Our sense of self as unique is perhaps at the core of the problem of self to be explained.

As Gallup argues, mirror tasks reveal a rather special way in which an organism can become an object of its own attention. To date, only humans, chimpanzees, and orangutans have been found to succeed in the rouge-removal task using a mirror. I do not share Gallup's view that this is a case of Haeckel's biogenetic law; there is no reason to suppose that ontogeny recapitulates phylogeny (for extensive discussion of the relation between evolutionary and developmental theories, see Butterworth, Rutkowska, & Scaife, 1985). It would

be more accurate to argue that humans, chimpanzees, and orangutans share the same capacity for basic aspects of cognitive development and it is this that differentiates some species from others.

Kellman doubts whether it is correct to speak of a perceptual-to-conceptual shift in development. We agree that self-perception is a mode of relation to the world which we do not grow out of, but I did not wish to characterize the developmental process as a *shift* from perception to conception. On my view, perception of self becomes *embedded* within other modes of knowing. Let me elaborate this point in the context of mirror self-recognition, where I argue that a cognitive aspect of self does emerge in development.

Lewis and Gallup agree that the self, as revealed in mirror tasks, implies a level of reflective self-awareness which may serve to differentiate both phylogeny and ontogeny. Whether it is appropriate to speak of mirror self-recognition as an aspect of concept formation might be answered by reference to contemporary research on the child's theory of mind, as Gallup suggests. Perner (1991) offered an extensive discussion of levels of representation which potentially applies to mirror self-recognition. In many respects (save for Piaget's characterization of infant perception) such an account resembles Piaget's theory of concept formation, with a succession of stages of representation, each related to earlier developmental levels. James and Eleanor Gibson's "direct realism" has implications that need to be elaborated in a theory of cognitive development. My own suggestion was merely to argue that there is a logically necessary link between direct perception and cognitive development. The transition from perceiving to thinking has been characterized by Neisser (1987) as being from direct perception of reality to a cognitive model of the world. As I suggested in my target article, the developmental implication is that information obtained through direct perception is what feeds the earliest model of self. Once a mental model of self becomes available, then the directly perceived self and stored information about self can stand in mutual support. Under some circumstances they may conflict in interesting ways, as in the moving-room and mirror tasks. Such tasks may reveal self-knowledge through the *conflicts* they engender between mental models and direct perception. This could explain why mirror self-recognition occurs toward the end of infancy and only in those species capable of the appropriate level of mental representation (see Perner, 1991; Whiten, 1991). The simultaneous availability of directly perceived information and stored knowledge is what makes my developmental account of the transition from self-perception to self-conception different from one based simply on "perceptual learning," as Kellman advocates.

In summary then, we can distinguish not only between the various aspects of self to which Neisser has drawn our attention but also to different developmental levels of the self.

Awareness of the self–nonself distinction is fundamental and shared with many other organisms. Reflective consciousness of the self's own mental states is later developing and may be a capacity shared with only a few other primates. Recognition of self in a mirror is a useful way of distinguishing between different levels of self-awareness, but it should not be considered as the occasion when the "real self" stands up (Lewis). From the perspective of direct realism, all the aspects of self I have discussed are equally real. The problem for the developmentalist is to explain how they come to be interrelated.

Note

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