Are human infants born with an innate sense of self? How does that sense of self change as they develop? How do great apes compare to human infants and children in their sense of self? Are they capable of embarrassment? What kind of self-awareness do monkeys have? Do they recognize their own images in mirrors? Do dolphins? Do pigeons? These are some of the many questions addressed in *Self-Awareness in Animals and Humans*, a collection of original articles on self-awareness in monkeys, apes, humans, and other species, including dolphins. This volume, which grew out of an interdisciplinary conference on self-awareness, focuses on controversies about how to measure self-awareness, which species are capable of self-awareness and which are not, and why. Several articles focus on the controversial question of whether gorillas, like other great apes and human infants, are capable of mirror self-recognition (MSR) or whether they are anomalously unable to do so. Other articles focus on whether macaque monkeys are capable of MSR. Various contributors present competing theories about which abilities accompany and underlie MSR and which capacities underlie developmentally earlier forms of self-detection in human infants. The focus of the articles is both comparative and developmental: Several contributors explore the value of frameworks from human developmental psychology for comparative studies. In particular, various contributors present differing opinions concerning the relationship between MSR and object permanence, imitation, and theory of mind. This dual focus – comparative and developmental – reflects the interdisciplinary nature of the volume, which brings together biological anthropologists, comparative and developmental psychologists, and cognitive scientists from Japan, France, Spain, Hungary, New Zealand, Scotland, and the United States.
Self-awareness in animals and humans
Detail from “A little culture” by A. Wczerzick; published in *Die Gartenlaube* (Leipzig: Verlag von Ernst Keil), probably before the turn of the century.
Self-awareness in animals and humans
Developmental perspectives

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Foreword

Louis J. Moses

Big questions are back on the agenda in the cognitive sciences. We are seeing a renewal of interest in the very nature of subjective experience. Once-suspect notions like consciousness, awareness, meaning, and mind are again being pursued with some vigor. Consciousness, for example, is now variously being "rediscovered" (Searle, 1992), "reconsidered" (Flanagan, 1992), and even "explained" (Dennett, 1991). At the heart of this resurgent enterprise are questions of self and self-awareness. If we are ever to understand psychological experience we will need to grapple with questions concerning the subject of that experience. What is a self? Does it have real, tangible status or is it perhaps a mere cognitive or cultural construction that conveniently lends coherence to what would otherwise be quite disparate aspects of experience? What is the structure of the self? Is it unitary or multifaceted? If multifaceted, what are these facets and do they cohere in some organized fashion? What difference does self-awareness make? Does it have verifiable consequences for the psychological and behavioral life of an individual? It is questions of this order that have captured the interest of the various contributors to this volume. Their collective approach to studying the self is an especially fascinating one, focusing on the emergence of a sense of self from two perspectives. One is the perspective of human ontogeny: Do infants enter the world with a ready-made sense of self, or is a self only gradually constructed through some maturational or enculturative process? The other is a comparative perspective: Which species can be said to have a sense of self and what is the evolutionary history of self-awareness? Is a sense of self a primitive phenomenon arising early in evolution and common to many species, or is it a much later arrival, perhaps common only to a handful of primate species?

The empirical study of self-awareness is notoriously difficult, and the ontogenetic and comparative perspectives bring with them their own special challenges. We have no direct way of knowing what the mental life of an infant is like and, a fortiori, the same is true with respect to other, more exotic, forms of life. This of course is no more than a restatement of the well-known "problem of other minds" that pervades any attempt to know the inner, subjective life of another individual. Nevertheless, at least in the case of mature members of our own species, intuitions derived from personal
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experience might serve us reasonably well; moreover, we can always ask others to tell us about their experience. When it comes to young infants and psychologically distant species, however, the luxury of self-report is no longer an option, and the intuitions on which we are likely to fall back may well lead us dangerously astray. Consequently, whether ontogenetic and phylogenetic questions concerning the self are answerable will ultimately depend on how carefully they are framed and on whether we can devise alternative methodologies allowing us to put the questions to nature in some tractable form.

Certain aspects of self lend themselves more readily to empirical scrutiny than others. William James (1892/1948) observed long ago that we can think of the self in two distinct ways: “the self as knower” and “the self as known.” The self as knower or the “I” is the subjective self, the self who thinks, feels, and experiences. The self as known or the “Me” is the objective self, involving those aspects of self that the “I” can reflect upon. The self as known is in other words a conception of self. James was quick to point out that the subjective aspects of self are more difficult to study than the objective aspects and, by and large, subsequent research has borne out his impression. Most contemporary work on the self tries to illuminate the nature of self-awareness indirectly through the study of self-knowledge or self-conception. A fundamental aspect of self-conception that has received more attention than any other, and that forms the centerpiece of the current volume, is self-recognition. It seems reasonable to suppose that any animal with even a minimal conception of self should be capable of recognizing who or what it is. Certainly, if we could somehow demonstrate whether or not an animal recognized itself, we would at least have forced an initial wedge into broader aspects of self-conception.

But how could we know whether an animal was capable of self-recognition? In the early 1970s, a profoundly important methodological breakthrough was made, one that effectively revolutionized the field of self-recognition and self-awareness. Working with chimpanzees, Gordon Gallup (1970) developed a simple yet elegant technique for assessing a certain kind of self-recognition, namely recognition of self in a mirror. After giving his chimpanzees several days’ prior exposure to mirrors, Gallup anesthetized the animals and then marked their faces with red dye. When the chimpanzees later awakened, they were again confronted with a mirror and Gallup observed how they reacted to the red mark they saw on the mirror image. He reasoned that if the chimpanzees recognized themselves they would be inclined to touch the corresponding marked region of their own faces significantly more often than they had touched that region prior to having their faces marked. If, on the other hand, they did not recognize themselves then they would show little such “mark-directed” behavior, and might instead treat the image in the mirror as a conspecific or perhaps ignore it altogether. A less invasive, but conceptually similar, variation of the procedure was independently developed at about the same time for use with human infants (Amsterdam, 1972; see also Lewis & Brooks-Gunn, 1979). The mirror task has subsequently
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proven to be an enormously productive research tool, appearing in numerous studies designed to assess self-recognition in a wide variety of species. Thus far, only humans (by roughly 18 months of age), chimpanzees, and orangutans, have offered unambiguous evidence of self-recognition.

The mirror task serves as a point of departure for many of the contributions in this volume. We have learned a great deal from how animals respond to their mirror images in the past two decades; but we ought to be nervous about sole reliance on a single measure, no matter how fruitful that measure might have been in the past, as an index of any conceptual ability. Much of what is written in the pages that follow can be seen as a response to anxiety of this kind. The response takes different forms – attempts to extend, defend, qualify, and sometimes even deny, the significance of mirror recognition – but, in one way or another, the various chapters represent efforts to confront either methodological or conceptual doubts surrounding the mirror task.

Methodological uneasiness arises because the task is hardly likely to be a psychometrically perfect measure of self-recognition, relying as it does on just one kind of recognition (visual recognition) in a medium (the mirror) that is surely low in terms of ecological significance for most species. Moreover, mirror recognition arguably requires cognitive abilities extraneous to a conception of self, most notably some minimal conception of representational relations (the relation between the self and the mirror image). Consequently, we cannot be entirely confident that an animal failing the test is incapable of any form of self-recognition. One healthy reaction to these methodological qualms that is well represented in this volume involves an attempt to find converging and/or better techniques for assessing emerging conceptions of self. Some of these new methods are close cousins of the mirror task: for example, whether an animal recognizes itself in a videotaped image, in a photograph, or even in its own shadow. Other methods take us farther afield: for instance, recognition of self in the imitative actions of another. The latter appeals as a particularly promising measurement tool because it nicely avoids some of the theoretical and ecological problems that beleaguer the mirror task.

The conceptual brand of doubt is more troubling. How should we interpret successful mirror recognition? What kind of self-conception should we grant to an animal who passes the mirror task? Do we accord the animal an elaborate self-conception similar in kind to that which fully developed members of our own species seem to share? That is, do we want to say that what the animal sees in the mirror is a self with a sense of its own continuity, of its enduring yet finite existence, of its agency and intentionality in moving through the world, of what makes it unique compared to other selves and, at the same time, of its psychological commonality with those other selves? Or do we want to attribute a much more delimited conception of self to the animal, one that involves none of this rich psychology? Perhaps the animal is only aware of its physical self, and perhaps only dimly aware at that. The animal might simply recognize its body in the mirror while having little in the way of a conception of its own mental life.
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No simple solution to this interpretive dilemma will be found in the pages of this volume. What we see instead is an impressive effort to resolve the dilemma by means of situating mirror recognition within a wider comparative and epigenetic framework. The epigenetic aspects of this framework require searching for psychological correlates of mirror recognition and tracking its developmental history. That is, we might be better able to judge the significance of mirror recognition if we could locate psychological changes that are concomitant with it and isolate factors that affect its onset. With respect to correlated changes, the kind of variables that will be important should depend on the sophistication of the underlying self-conception. If that conception is merely a rudimentary physical or bodily conception, then self-recognition should have only limited implications for the psychological life of the animal, whereas if it is a more complex conception the ramifications should be widespread.

One potentially discriminating set of factors in this regard is social. If mirror recognition is a symptom of an animal's emerging ability to reflect on its own mental life then, as Gallup (1985) has argued, we might expect to see in the animal's behavior some dawning appreciation of the mental lives of its conspecifics. It is here that research on self-recognition begins to coalesce with recent work on developing "theories of mind." In the last decade or so a whole new subfield in developmental psychology has emerged devoted exclusively to the study of children's conceptions of mental states like belief, desire, and intention (e.g., Flavell, 1988; Moses & Chandler, 1992). A first pass through some of the relevant literature might lead one not to be especially sanguine about Gallup's hypothesis: Whereas infants of around 18 months of age show clear signs of mirror recognition, the prevailing wisdom in writings on theories of mind is that a mature conception of mind does not begin to emerge until well into the preschool period. Any tight coupling between self-recognition and the attribution of mental states to others would seem to be out of the question. On closer inspection, however, the prospects for such a coupling are not so dim after all. The particular conception of mind that is believed by many to be acquired by age 4 or 5 rests on an appreciation of epistemic mental states like knowledge and belief. Wimmer and Perner's (1983) now classic task assessing whether children understand that others sometimes fall prey to, and subsequently act on, false beliefs is frequently viewed as a kind of litmus test for such a theory of mind. It turns out, though, that the significance of the false belief task is perhaps even more controversial than that of the mirror task, with some arguing that a genuine understanding of false belief might well be in place considerably earlier (Lewis & Mitchell, in press). In addition, it is not clear that self-recognition should necessarily be related to an understanding of the false beliefs of others. All that need be argued is that an ability to reflect on one's own internal experience might lead one to posit that others too experience subjective, psychological states of mind. That the potentially more advanced step of understanding the precise representational relations between those states of mind and states of the world (e.g., understanding false beliefs) is not taken until sometime later
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is neither here nor there. If we recast Gallup’s hypothesis in these terms, the evidence is now considerably more supportive. For example, at about the same time that infants first recognize themselves in mirrors, they also begin to show a nascent appreciation of the perceptions, desires, and emotions of others (Wellman, 1993). Looked at in this way, tantalizing support for a developmental relation between self-recognition and children’s early theory of mind can be seen.

Social factors may also play a role with respect to the other epigenetic aspect of the framework, namely that focused on the origins of self-recognition. Here again there are potential links to the literature on children’s theories of mind. An ongoing controversy in that literature concerns what role our first-person experience of mental states might play in the development of an understanding of mental life more generally. According to one prominent view (the “simulation theory”; see Harris, 1991), we have direct, privileged access to our own mental states and we come to infer the mental states of others through a process of imaginative simulation. In this view mental states of self are primary, those of others are derivative. A contrasting and equally prominent view (the “theory theory”; see Gopnik & Meltzoff, SAAH10), holds that mental-state conceptions are abstract entities constructed at the same time for self and other on the basis of all of the available evidence. By these lights, while we might have direct access to our own subjective experiences, those experiences can have little meaning until rendered interpretable within some more general theoretical conception.

In the literature on self-recognition, the natural tendency has been to side implicitly with the simulation theory. That is, an ability to attribute mental states to others has typically been seen as a potential offshoot of self-recognition: Once an animal has developed some conception of self, the way is then cleared for a conception of others to be acquired. Nevertheless, consider the alternative possibility: Perhaps conceptions of self and other are constructed simultaneously through evidence available in social interaction. This is certainly not a new idea. We see elements of it in ideas about the “looking-glass self” in the writings of the early self theorists (Cooley, 1902/1964; Mead, 1934/1974). These theorists proposed that the self is born out of reflections in a social mirror, that the self is a reflection of how one is viewed by others. One clear prediction of this proposal is that some kind of social experience should be necessary for the development of self-recognition and self-awareness. Findings relating social imitation to self-recognition in this volume and elsewhere (Asendorpf & Baudonnière, 1993) are fully consistent with this view, as are Gallup’s early observations that chimpanzees reared in social isolation failed to develop mirror recognition (Gallup, McClure, Hill, & Bundy, 1971). Of course, other explanations might well be found for these effects, but they do illustrate the potentially important role that social factors might play in the development of self-recognition.

If we now look to the comparative side of the framework, clear parallels with its epigenetic counterpart can be found. That is, just as we can use information about related conceptual abilities to gauge the developmental
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significance of mirror recognition, the same can be done with respect to the significance of its phylogenetic emergence. If mirror recognition is indeed a symptom of a rich conception of self, then those species capable of it ought to show a constellation of other abilities in the arena of mental-state attribution and associated domains like imitation, deception, pretense, and empathy. Although the data are admittedly sketchy, the preliminary evidence is by and large supportive: Those species that pass the mirror task (e.g., chimpanzees) show some of the relevant abilities whereas those that fail (e.g., monkeys) do not (Gallup, 1985; Mitchell, 1993; Povinelli, 1993). Should the data continue to fall out in a generally consistent manner, we might eventually be in a position to use some of these other abilities as markers to help decide ambiguous cases (e.g., gorillas and dolphins) for which the mirror results prove difficult to interpret.

The future of this comparative program rests on what are essentially anthropomorphic assumptions. We currently have a decidedly more solid theoretical and empirical foundation with respect to human ontogeny than we do with respect to how development proceeds in most other species. The comparative approach seeks to rely on well-established theories of human development and well-replicated developmental milestones in examining how the relevant capacities might have evolved in these other species. There are, of course, inherent dangers in anthropomorphic assumptions. Even the most thoroughly tested empirical markers and the most firmly entrenched developmental theories can and do fall by the wayside with disturbing frequency. Consequently we need to be highly cautious in relying on human ontogeny as a theoretical and empirical base.

Even if this foundation were entirely solid, however, extrapolating to other species could still lead us astray in several ways. Suppose that the mirror task does in fact capture a developmental watershed for our own species such that very young infants who fail the task have little or no conception of self. We have no guarantee that the same developmental watershed would be found for other species that show mirror recognition. Nature may not have arranged things in so orderly a fashion. Similarly, we cannot be sure that sharp discontinuity in self-awareness will exist when we compare species that do with those that do not show mirror recognition. Self-recognition – and self-conception more generally – may not have been attained in a single all-or-none step but rather might be a considerably more incremental evolutionary achievement. Finally, we have no assurance that the mirror task even measures the same thing across species (Mitchell, SAAH6). It is at least conceivable that the task taps different conceptions in different species, perhaps a simple bodily conception for some and a far more elaborate psychological conception for others.

In the end, however, the critical test of any scientific framework is whether it leads us to new discoveries. For all the potentially hazardous assumptions embedded within it, the comparative approach has an enviable record in this respect, having already generated important advances in our understanding of self-awareness in various species. Besides, anthropomorphic assumptions
are ultimately empirically testable, and doing so represents an important part of the comparative-epigenetic program that drives much of the research described in this volume. In what follows we see a state-of-the-art report on some of the most exciting and innovative comparative work being carried out today, work that will be of great interest not only to students of developmental and comparative psychology but to anyone wanting to know the place of the self in contemporary cognitive science. The study of self-awareness, self-conception, and self-recognition carries along with it a whole raft of provocative questions. The collective efforts brought together in this volume offer a rich set of remarkable observations that move us significantly closer to some definitive, empirically based answers.

References

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Note added in proof

The alert reader will notice inconsistencies among the various chapters with regard to a variety of issues. They are particularly common in reference to the following topics:

1. criteria for MSR;
2. the number of gorillas displaying mirror self-recognition (MSR);
3. the age of onset of MSR in chimpanzees;
4. the developmental relationship between embarrassment and MSR;
5. the relationship between the development of mirror-aided object localization and MSR;
6. the presence or absence of controls in various studies of MSR in human infants;
7. the age of onset of theory of mind (ToM) in human and nonhuman species;
8. the relationship between imitation and mental representation; and
9. the terminology relating to self-generated feedback from the mirror image (i.e., kinesthetic–visual vs. somesthetic–visual vs. proprioceptive–visual).

In some cases, these inconsistencies may have resulted from lack of access to revisions of other chapters in the volume; in others, from the use of different sources, or from differences in memory or interpretation.