Tomasello Turns Back the Clock

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Book Review

TOMASELLO TURNS BACK THE CLOCK

A Natural History of Human Thinking

By Michael Tomasello. Cambridge, MA: Harvard University Press, 2014. 192 pp. Hardcover, $37.

In the first two chapters, Tomasello outlines his hypothesis, isolating and describing what he considers to be critical components of human thinking. He presupposes that a common ancestor must have closely resembled extant nonhuman great apes in the ability to think. Tomasello cites research findings from primarily captive chimpanzees as evidence for what this common ancestor did or did not do. By book's end, Tomasello has proposed a two-stage evolutionary explanation of human thinking that started with the common ancestor using cognitive skills only somewhat socially and only for competitive advantage. Tomasello speculates that changes in ecological conditions led to a need for collaboration to obtain sufficient food and that over time increased group sizes led to conventionalized communication and culture. His evolutionary narrative ends with the speculation that the accumulation of different cognitive skills resulting from different cultures has allowed humans to conquer all sorts of previously uninhabitable places.

This commentary evaluates the quality of Tomasello's evidence. His claims of species-wide deficit in chimpanzee cognition depend on studies that are methodologically flawed. Although it may be possible that humans engage in a unique form of thinking, it is inappropriate to draw this conclusion from *A Natural History of Human Thinking*. Entire programs of research, cited frequently in Tomasello's book, confound species membership, developmental histories, and testing conditions.

Developmental Histories

Authoritative psychologists used to teach that only the most basic postural and locomotor functions develop during the first year of human infancy, and these develop almost independently of the nurturing environment. For example, Riesen and Kinder (1952) claimed,

> Maturational factors (with the spontaneous exercise and practice derived from them) are sufficient to ensure the early development of typical postural [and locomotor] behavior as long as nutrition, shelter, space for practice, and perhaps a minimum of kindness from mother substitutes for infants not left with their mothers are provided. (p. 173)

Mounting evidence of the contrast between individual and institutional child-rearing led to the current opposing view. Dennis (1960) and Hunt, Mohandessi, Ghodssi, and Akiyama (1976), for example, reported profound retardation in institutionalized children, especially in institutions with high infant to caretaker ratios. Some infants could neither sit alone nor creep at age 1, and many could not walk at age 2. Interventions that lowered infant to caretaker ratios produced dramatic effects. The mean age for sitting

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alone dropped from 39 weeks to 27 weeks, and for standing and cruising while holding onto the crib edge, from 69 weeks down to 41 (Hunt et al., 1976, pp. 207–208). More recently, Bakermans-Kranenburg, van IJzendoorn, and Juffer (2008) reiterated basic retarding effects of institutional environments on children's physical and cognitive development.

Conclusions about developmental differences between children and young of other species are justifiable only if developmental conditions are comparable (Bard, Bakeman, Boysen, & Leavens, 2014; Gardner, Scheel, & Shaw, 2011; Racine, Leavens, Susswein, & Wereha, 2008; Scheel, Shaw, & Gardner, in press). Cross-fostering is an experimental procedure that studies interactions between environmental and genetic factors by having parents of one genetic stock rear young of a different genetic stock. In this procedure, the independent variable of species membership varies between groups, while all other rearing conditions are as comparable as practical.

Cross-fostering a chimpanzee is very different from keeping one in a home as a pet, or maintaining a colony in a sanctuary, laboratory, or exhibit. True cross-fostering—treating the chimpanzee infant like a human child in all respects, in all living arrangements, 24 hours a day every day of the year—requires a rigorous experimental regime that has rarely been attempted. Indeed, Racine et al. (2008) noted that

> only two formal cross-fostering experiments have raised apes in a human culture from near-birth. The first was the study by Hayes and Hayes of a single chimpanzee subject, Viki. The second was by Gardner and Gardner; in this experiment, four chimpanzees were cross-fostered from neonates: Moja, Tatu, Dar, & Pili (Pili died at less than two years of age, so there is a limited behavioural record for him). Thus, to our knowledge, only four chimpanzee subjects in the history of science (excluding Pili) could have served, in principle, as an experimentally valid comparison to human children. (p. 73)

Before Moja, Pili, Tatu, and Dar, Allen and Beatrix Gardner had cross-fostered a chimpanzee, Washoe, who had been captured wild and was about 10 months old when she arrived in their laboratory (Gardner & Gardner, 1973). Cross-fosterlings learned to brush their teeth, hit nails with hammers, use the toilet, and use signs of American Sign Language in an environment modeled after living and learning conditions of a human household (see Drumm, Gardner, & Gardner, 1986; Gardner & Gardner, 1985 for detailed descriptions). Infant chimpanzees under cross-fostering conditions compare well with wild infants on early measures of physical and social development (Gardner & Gardner, 1989, Table 1). However, laboratory-reared chimpanzees lag behind both cross-fostered and wild chimpanzees on these measures (Gardner & Gardner, 1989, Table 1).

Cross-fostered infants compare well with human infants on early measures of language development (Gardner & Gardner, 1994). Throughout 5 years of cross-fostering, size of vocabulary, appropriate use of sentence constituents, number of utterances, proportion of phrases, variety of phrases, length of phrases, complexity of phrases, and use of inflection all grew robustly in the casual conversations of Washoe, Moja, Tatu, and Dar. Wherever there are comparable measurements, cross-fostered chimpanzees paralleled children's characteristic developmental patterns. In addition, Gardner and Gardner (1998) reported that cross-fosterlings initiated most conversations and named objects and pictures of objects in situations in which they were unlikely to receive reward. Indeed, Gardner and Gardner found that the cross-fosterlings were distracted by treats and would often ask for rewards by name at critical points during tests, making it difficult for observers to tell whether the chimpanzees were asking for treats or naming a picture. As a result, Gardner and Gardner eliminated extrinsic rewards from test procedures (Gardner & Gardner, 1984, p. 386).

A decade after the start of Project Washoe, Rumbaugh and his associates taught the chimpanzee Lana to use a multiple-choice response panel to obtain a variety of goods and services (mostly foods and drinks) while living, 24 hours a day, under captive conditions closely patterned after an operant conditioning chamber for pigeons (Gill & Rumbaugh, 1977). Still later, Savage-Rumbaugh and her associates used a similar multiple-choice response panel with cage-reared chimpanzees named Sherman and Austin. This project concentrated on naming, rather than pressing keys in specific sequences, and trainers handed rewards to chimpanzees directly rather than relying on automatic dispensers. With greater social interaction between experimenters and chimpanzees and relaxation of some of the operant rigor of reward delivery, Sherman and Austin produced more advanced results. But the Rumbaughs taught Sherman and Austin to use the panel step by step according to the same model of language learning as before. Each step in the conditioning program consisted of a still

more elaborate way to beg for food rewards (Savage-Rumbaugh, 1984, pp. 230–247).

Still later the Rumbaughs tried to communicate with Kanzi, a bonobo, as they would with a child—within the limits that their personnel, laboratory facilities, and response panel would permit. Although the Rumbaughs fell short of cross-fostering Kanzi, the further relaxation of efforts to tie communicative behavior to food reward, or to demands in general, led to more advanced results (Savage-Rumbaugh et al., 1986) than before but still different from those of human children.

In *A Natural History of Human Thinking,* Tomasello cites only studies of chimpanzees living in cages (Greenfield & Savage-Rumbaugh, 1990, 1991; Rivas, 2005) when he claims "that over 95% of the communicative acts produced by [chimpanzee]s are some form of imperative (and the other 5% are questionable)" (p. 105). Failure to consider evidence from cross-fostering studies, in favor of studies that systematically confound living conditions and species, represents a fundamental misunderstanding of experimental method. As Racine et al. (2008) observed,

> There seems to be a very widespread misconception that any ape raised by humans is therefore cross-fostered by humans to the same degree, regardless of the diversity of circumstances in which these apes have lost their biological mothers, the wide variations in the social, emotional, and physical environments in which they were raised from birth, and the extraordinarily large differences among captive apes in their relative familiarity with humans. (p. 73)

Throughout his book, Tomasello refers to chimpanzees who frequently interact with humans as *human-raised*. For example, on page 22 Tomasello uses "human-raised" in reference to chimpanzees who had been raised from birth by humans and lived in an animal park open to the public. For the first 12 months of life they were raised within a human family. They were subsequently introduced into a group of other human-raised chimpanzees, but all still interacted directly (i.e., not through caging) with humans for at least 2 hours per day in various training and enrichment activities (Buttelmann, Carpenter, Call, & Tomasello, 2007, p. F32).

Human-raised and *cross-fostered* are far from equivalent. Indeed, human parents who raised children under Tomasello's "human-raised" circumstances would be considered unfit (Kennedy, 2011).

Other citations appearing in *A Natural History of Human Thinking* refer to comparisons Tomasello and his colleagues made between children raised in German homes and orphaned chimpanzees of various ages housed at Tchimpounga Chimpanzee Sanctuary, Republic of Congo (e.g., Haun, Rekers, & Tomasello, 2012; Herrmann, Call, Hernández-Lloreda, Hare, & Tomasello, 2007; Herrmann, Keupp, Hare, Vaish, & Tomasello, 2013; Warneken, Hare, Melis, Hanus, & Tomasello, 2007) or at Ngamba Island Chimpanzee Sanctuary in Uganda. These chimpanzees undoubtedly differ from the children in amount of time in quarantine, time in cages, whether they experienced the death of a parent, how many hours a day they interact with a human adult, and so on. (See Tchimpounga Sanctuary's Web site for the video called "A Day in the Life: Chimpanzees at Tchimpounga Sanctuary" and Ngamba Island's Web site for biographies of their chimpanzees.) Hobson (2005) expressed concern for such differences between chimpanzee and human subjects in his commentary on Tomasello and Carpenter (2005):

> There are special difficulties when the chimpanzees in question are raised in atypical circumstances, having been rejected by their mothers and raised partly by humans and partly in the company of other orphans. Just as one might argue that all the human input would have accustomed the chimpanzees to people and their experimental maneuverings and have fostered their social abilities to an optimal degree, it is also open to skeptics to wonder if this is really the best way to study the most that chimpanzees can achieve by way of social engagement and social cognition. No wonder if critics were to raise objections that even human infants wrested from their mothers at an early age and nurtured by members of another species might respond to experimental conditions in ways that are far from typical of their species. (pp. 133–134)

Likewise, Racine et al. (2008) wrote,

> If one compares individuals from two separate groups with radically different rearing histories and finds a significant difference in a dependent variable between those two groups, then one cannot rationally conclude that you have uncovered a group, but not a rearing history, difference; it is entirely unclear, in these kinds of research designs, whether differences between apes and humans are attributable to species dif-

ferences (i.e., different evolutionary histories), rearing history differences, or some interaction between these evolutionary and developmental factors. Whenever a researcher concludes, [as Tomasello did,] from research designs like this that they have identified a species difference in social cognition, this conclusion can only illustrate the interpretive bias of the researcher. (p. 73)

Testing Conditions

Valid group comparisons require comparable testing conditions. Nevertheless, Boesch (2007) noted that "the vast majority of experimental procedures used in comparative cognitive sciences violate this central experimental paradigm. . . . Many key differences are systematically introduced into the experimental procedures" (p. 233). For example, video published in *Science* to supplement Herrmann et al. (2007) shows how marked differences between testing conditions prohibit any valid experimental conclusions about differences between species. Differences in experimenter expectations and rapport between experimenters and subjects are abundantly illustrated in these published videos (http://www.sciencemag.org/cgi/content/full/317/5843/1360/DC1). A static image from their online supplement (Figure 1) shows how chimpanzees took their tests alone in a bare, dark cage. An observer–tester presented testing materials from outside the cage with minimum social interaction. Children, on the other hand, took their tests in a room with one or two friendly adults, and a sociable experimenter presented testing materials. During trials infants sat on the lap of a knowledgeable parent across a small table from a knowledgeable tester and beside a knowledgeable data collector. Without proper controls, the tester, data collector, or parent could have influenced responses (Gardner, Scheel, & Shaw, 2011). More than 100 years ago, scientists described this problem and provided its remedy (Marbe, 1917; Marbe, Shaw, & Gardner, 2011; Pfungst, 1907/1965): The only certain way to prevent this error is to prevent anyone with sight, hearing, touch, or any other contact from gaining any information that could lead subjects to correct or incorrect answers. Sufficient yet simple methods for implementing control for leading are readily available in more recent scientific literature as well (e.g., Fagot & Leinbach, 1989; Gardner & Gardner, 1984; Kuhl et al., 2006; Werker & McLeod, 1989).

FIGURE 1. Testing conditions for chimpanzee subjects. A chimpanzee sits on the floor in a cage with only the researcher present. From Herrmann, E., Call, J., Hernández-Lloreda, M., Hare, B., & Tomasello, M. (2007). Humans have evolved specialized skills of social cognition: The cultural intelligence hypothesis. *Science, 317*(5843), 1360–1366. http://dx.doi.org/10.1126/science.1146282. Reprinted with permission from AAAS

Absence of Evidence

Absence of evidence cannot serve as evidence of absence. In *A Natural History of Human Thinking,* Tomasello makes numerous claims for uniquely human behaviors or capacities based on lack of evidence for similar behaviors in caged chimpanzees. For example, he writes about young children engaging in joint attentional activities, "like giving and taking objects, rolling a ball back and forth, building a block tower together, putting away toys together, and 'reading' books together" (p. 44). He claims these reflect a uniquely human capacity for joint attention on the grounds that he and his colleagues were unable to elicit such behavior in caged chimpanzees (Tomasello & Carpenter, 2005). By completely overlooking research programs involving cross-fostered chimpanzees, Tomasello missed substantial evidence of just the sort of behaviors he failed to find in his caged chimpanzees. For example, in their 1973 film, Gardner and Gardner featured Washoe engaging in picture book reading with two members of her foster family. They turn pages and look at pictures together, with Washoe signing names of the animal types in the pictures. In this same film, Washoe accepts sips of soda from and offers a snack of leaves to Beatrix Gardner. Figure 2 shows frames from film of Washoe engaging in a game of catch with Roger Fouts (Gardner & Gardner, 2016).

Later in his book, Tomasello claims,

> When apes are raised by humans in the midst of all kinds of human-like social interaction and artifacts they do not develop more human-like skills of physical cognition (e.g., space, object permanence, tool use), but they do develop more human-like skills of imitation and communication. (p. 147)

FIGURE 2. Washoe throws a doll to Roger Fouts. © 2016 by R. Allen Gardner

However, Tomasello again fails to cite any cross-fostering studies. Instead, he cites his own collaborations with Call (Call & Tomasello, 1996; Tomasello & Call, 2004). Tomasello fails to specify what he means by "space." But Hayes and Hayes (1952) reported that the cross-fostered chimpanzee, Viki, learned to use several tools appropriately. Photographs (Hayes, 1951) and film footage (Hayes & Hayes, 1951) of Viki using tools are readily available. Moreover, Wood, Moriarty, Gardner, and Gardner (1980) demonstrated that cross-fostered chimpanzees develop childlike object permanence. The work of Wood et al. is particularly noteworthy because chimpanzees and children had similar rearing conditions and were tested at roughly the same ages with standard human procedures, materials, and performance requirements.

Conclusion

In 1925, Köhler wrote, "There has arisen among animal psychologists a distinct negativistic tendency, according to which it is considered particularly exact to establish *non*-performance, *non*-human behavior, mechanically-limited actions and stupidity in [nonhuman] animals" (1925/1959; p. 241). Tomasello's book would have fit nicely in the negativistic zeitgeist among comparative psychologists in the 1920s. Likewise, experiments appearing in the book effectively turn back the clock on almost a century of methodological progress in comparative psychology by failing to address the importance of comparable rearing and testing conditions. Tomasello and his collaborators occasionally acknowledge the importance of standard experimental design and protocols but typically fail to implement them in their own studies (e.g., Hobson, 2005; Tomasello & Carpenter, 2005). Therefore, results of these fundamentally flawed studies cannot support the conclusions Tomasello presents in *A Natural History of Human Thinking*.

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