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Mindshaping in nonhuman great apes

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Abstract:

The mindshaping hypothesis proposes a “de-intellectualized” explanation for human unique cooperation. In contrast to standard mindreading accounts, which emphasize the evolution of sophisticated reasoning about others’ propositional attitudes to explain how our ancestors became hyper cooperators, the hypothesis holds that sophisticated mindreading was a late-arriving product of our ancestors becoming better cooperators via the evolution of mechanisms that shape and regulate the minds of members of human groups to be suited to cooperation. Comparative research with nonhumans, especially our closest living relatives, the great apes, is of utmost importance for evaluating the mindshaping hypothesis—for instance, to what extent can apes maintain relatively complex forms of culture and cooperation without reasoning about propositional attitudes? The concept of mindshaping also opens up new questions in comparative cognition that are worth exploring in their own right, such as whether apes regulate each other’s behavior via social norms. This chapter assesses what we currently do and do not know about the nature and extent of various mindshaping mechanisms in nonhuman great apes, focusing on culture and social learning, pedagogy, and social norms.

Key words:

Mindshaping, animal cognition, animal culture, social norms

1. Human uniqueness and nonhuman mindshaping

The *mindshaping hypothesis* (Zawidzki, 2013, 2018) proposes an explanation for our species’ seemingly unique capacity to coordinate with large numbers of unrelated conspecifics on often complex long term projects. Humans are such good cooperators because of mechanisms that collectively *shape* the minds of members of human groups to be suited to cooperation. These mechanisms make us more mentally uniform: we think and act more alike—and *want* to be like others—and can cooperate with others more effectively. Core mindshaping mechanisms that have been suggested include mechanisms of social learning and pedagogy, which facilitate within-group mental homogeneity via acquiring information, preferences, and behavioral dispositions from others; social norms and their enforcement, which incentivize prosocial behavior and conformity to local ways of doing things; and capacities to create and adhere to abstract behavioral models, such as fictional or idealized agents (Zawidzki, 2013).

Though a variant of the social intelligence hypothesis, which holds that complex cognition evolved to deal with the pressures of social life (Humphrey, 1976), in contrast to more received versions, the mindshaping hypothesis denies that sophisticated capacities for mindreading (“theory of mind” or “mentalizing”)—in particular, robust representations of propositional attitudes, such as beliefs and desires—were a central player in the process. These capacities were instead part of the *outcome* of the evolution of human cooperation *via* mindshaping. We became sophisticated mindreaders, not to facilitate and reap the benefits of cooperation, avoid exploitation, or manipulate others for our own ends; rather, sophisticated mindreading was a late-arriving product of our becoming better cooperators by being better mindshapers. Fancy mindreading is adaptive when our minds are sufficiently homogenous for propositional attitude attributions to be tractable and reliable. Hence, mechanisms of mindshaping must come first in explaining both distinctively human cooperation and mindreading.

Crucially, the mindshaping hypothesis defends a "de-intellectualized" picture of complex social life and cooperation: these phenomena emerge not from cognitively complex representations of others' mental states and inferred strategies for dealing with others, but from emergent, socially-distributed, and embodied structures—such as cultures and social norms—that mold the behavioral dispositions and mental states of those within them so that individuals come to have the rights kinds of inclinations to play their cooperative roles in these structures. It was the evolution of mechanisms that perpetuated such structures, not fancy mentalizing, which solved the coordination problems standing in the way of human hyper-cooperation (Zawidzki, 2018).

Comparative research with nonhumans, especially our closest living relatives, is of utmost importance for evaluating the mindshaping hypothesis. It implies that robust representation of propositional attitudes arrived relatively late in hominin evolution, so were absent in our last common ancestor with chimpanzees and bonobos—hence, nonhuman primate cooperation exists without sophisticated mindreading. Though advocates argue that hominins evolved unique forms of mindshaping—such as our capacity to create and copy the behavior of fictional agents, encoded in public language—to account for distinctively human cooperation (Zawidzki, 2013), the extent to which other primates maintain sophisticated forms of culture and cooperation without fancy mentalizing abilities is also important to the empirical plausibility of the hypothesis' attempt to "de-intellectualize" cooperation. Comparative research can also inform our understanding of the evolutionary history of particular mindshaping mechanisms.

Exploring nonhuman mindshaping is also important, independent of its bearing on the mindshaping hypothesis. The concept of mindshaping provides a challenge to the disproportionate focus on mindreading in both human and nonhuman social cognition research, which has come at the expense of exploring other means by which social animals (including humans) may come to create and navigate complex social environments (Andrews, 2012). This de-emphasis of mentalizing in social intelligence opens up new research questions in comparative cognition. One that will occupy some attention in this chapter is whether social norms exist in nonhuman communities (Westra et al., 2024). While some comparative researchers and philosophers have taken this possibility seriously (e.g., Rudolf von Rohr et al., 2015; Andrews, 2020; Fitzpatrick, 2020), it has typically been dismissed on the assumption that social norms require human unique cognitive capacities (e.g, Schmidt & Rackozy, 2019)—on some accounts, fancy metarepresentational capacities (e.g., Bicchieri, 2006). A mindshaping perspective invites us to question such assumptions.

My goal in this chapter is therefore to assess what we currently do and do not know about the nature and extent of various mindshaping mechanisms in nonhuman great apes (henceforth, “apes”).[1] I’ll begin by reviewing recent work on ape mindreading and then discuss evidence of key mindshaping mechanisms. I’ll close with some remarks on which forms of mindshaping may be unique to humans.

2. Great ape mindreading

Current evidence suggests that all species of great ape have some understanding of visual and auditory perspective, some understanding of others’ goals and intentions, and are able to differentiate between agents informed, say, of the location of an object, from agents ignorant of that information (Lewis & Krupenye, 2022). There is also now evidence that chimpanzees, bonobos, and orangutans anticipate that individuals will act based on false beliefs (Krupenye et al., 2016; Kano et al., 2019), and behave differently towards individuals with true versus false beliefs (Buttlemann et al., 2017). This includes some evidence that apes can project from their own experience (e.g., with a transparent versus an opaque barrier) to anticipate how an agent will act (Kano et al., 2019), which has long been thought important for distinguishing mindreading from mere “behavior reading” (Heyes, 1998).

Especially relevant to mindshaping are reports of consolation behavior in chimpanzees, bonobos, and gorillas, where bystanders provide affiliative contact (e.g., grooming, hugging) to individuals in distress, and reports of chimpanzees and bonobos offering spontaneous and targeted help (e.g., removing snares) to injured groupmates (Brooker et al., 2024). Such reports underdetermine underlying mechanisms, but when combined with evidence of emotional contagion and various kinds of affective state-matching, where affective states “spread” from individual to individual (Palagi et al., 2020) are suggestive of abilities to detect others’ emotions and, potentially, emotional perspective-taking (Brooker et al., 2004).

Nonetheless, it remains unclear how *mentalistic* is ape understanding of others’ minds. Apes may track others’ sensory awareness, beliefs, knowledge, intentions, and emotions, but we don’t know whether they are capable of higher levels of perspective-taking, such as understanding *how* a perceptual scene appears to an agent (e.g., that an object will look different from different angles), or fully adopting another’s emotional perspective (Lewis and Krupenye, 2022; Brooker et al., 2024). It is also possible to view apes as “minimal mindreaders” (Butterfill & Apperly, 2013) who represent “belief-like states”, which encode, for instance, whether an object was visible to an agent and when/where they last encountered it. These track others’ beliefs and enable reliable predictions when agents act on false beliefs about object location, but do not fully represent the semantic content of propositional attitudes, preventing apes from representing false beliefs about identity, such as believing that Clark Kent and

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[1] The family *Homidinae* (great apes) includes four genera: *Pongo* (orangutans), *Gorilla* (gorillas), *Pan* (chimpanzees and bonobos), and *Homo* (humans). Chimpanzees and bonobos are most closely related to humans (common ancestor, c. 6-7 mya), followed by gorillas (common ancestor, c. 7-9 mya) and orangutans (common ancestor, c. 16-20 mya) (Steiper & Young, 2006). Due to sampling bias, my discussion will focus on chimpanzees, and, to a lesser extent, bonobos. Gorillas and orangutans will be discussed where relevant empirical literature is available.

Superman are distinct individuals. Such a view is consistent with the mindshaping hypothesis. Zawidzki (2013) generalizes it both to our homo ancestors who broke through the barriers to distinctively human cooperation, and to much modern human infant and adult social cognition—which, he claims, also doesn't require full-fledged propositional attitude representation.

Let us now turn to specific mechanisms for mindshaping in apes.

3. Great ape mindshaping

Mindshaping mechanisms are mechanisms that aim "to make a target's *behavioral dispositions* match, in relevant respects, some model" (Zawidzki, 2013, p. 32). "Aim" here means *proper function* (Millikan, 1984): the function for which the mechanism was selected. Zawidzki also argues that mindshaping mechanisms must be "minimally cognitive, that is, involve a representation of the respects in which it aims to match a target to a model" (2013, p. 33)—though, of course, they need not involve *meta*representations. This is intended to rule out the simplest forms of social learning as mindshaping mechanisms. Acquiring a food preference just by having a preference for the odor found on one's mother's breath needn't require representations of the model's behavioral dispositions—a simple imprinting mechanism would do. However, learning mechanisms underlying the abilities of human children to imitate the behavior of those around them would count as mindshaping mechanisms.

Interesting to consider in this context are mechanisms of behavioral mimicry. Like humans, other apes exhibit facial and other forms of behavioral mimicry thought to facilitate affiliation and coordination (Brooker et al., 2024). As noted above, there is also evidence for emotional contagion and affective state-matching. While these mechanisms need not be representational, they are thought to be precursors for other-directed emotional capacities such as empathy, often understood as representational (Preston & de Waal, 2002). This suggests that apes have mechanisms that tune their emotions to their group mates, particularly friends and kin, which evolved to strengthen interpersonal bonds, and may count as mindshaping mechanisms. Emotional sensitivity and emotion sharing with others is one way to bring about greater mental homogeneity and is likely necessary for cooperation on larger scales.

However, arguably the most powerful varieties of mindshaping in humans are mediated via human culture. Our minds have mechanisms for inculcating such things as social norms and local ways of doing things into ourselves and others, including capacities for imitation, pedagogy, and norm enforcement. To what extent do such structures and mechanisms exist in apes?

3.1. Social learning and culture

The existence of cultures in apes was the subject of hot debate for decades (Langlitz, 2020). The debate now focuses not on whether apes have cultures, but on the nature and extent of ape cultural complexity (Tennie et al., 2020; Whiten, 2022). It is clear that the minds and behaviors of apes are shaped by their local cultures in far-reaching ways.

Cultures can be understood as those group-typical behaviors that are sustained by social learning (Laland & Hoppitt, 2003)—learning by observing and/or interacting with others and/or their products (Heyes, 1994). Evidence of ape culture comes partly from ethnographic studies of wild and sanctuary-living populations. Whiten et al. (1999) documented 39 behaviors, such as nut cracking, termite fishing, and handclasp grooming, common in some wild chimpanzee groups, but absent in others. Subsequent research has revealed further dimensions of inter-group variation (Boesch et al., 2020), including potential dialects in vocal and gestural communication (Badihi et al., 2023; Kalan et al., 2023). This is reinforced by experimental and observational studies of social transmission of behavior, such as novel behaviors like moss-sponging for water spreading through chimpanzee social networks (Hobaiter et al., 2014). Though studied less intensively, patterns of inter-group variation that cannot be attributed to genetic or ecological differences between populations have been found in orangutans (van Schaik et al., 2003), bonobos (Hohmann & Fruth, 2003; van Leeuwen et al., 2020), and gorillas (Robbins et al., 2016).

While evidence of culture is robust, it remains an open question whether there exists *cumulative culture* in apes—practices incrementally modified and ratcheted up in complexity over time (Tennie et al., 2009). There are examples that *may* meet some definitions of cumulative culture, such as chimpanzee moss-sponging, which appears to be a functional improvement on leaf-sponging (Lamon et al., 2018), and some interesting cases of chimpanzees incorporating object manipulation (such as targeted throwing of rocks at trees) into displays that involve vocalizations and gestures (Kalan et al., 2023). Nonetheless, the massive cumulative complexity of human practices and artifacts (e.g., languages, religions, cities, and computers) is a clear difference between human and nonhuman ape cultures.

Ape social learning mechanisms are likely representational in nature and thus full-fledged mindshaping mechanisms. For example, chimpanzee nut cracking is a multistep behavior, the acquisition of which plausibly involves representing at least some features of what the observed model is doing. Apes reproduce observed sequences of steps to solve foraging puzzles (Horner & Whiten, 2005; van Leeuwen et al., 2024) and have social learning *biases* that have been identified as important in human cultural transmission, such as a bias towards copying majority behaviors and a bias towards copying high-status individuals (Kendall et al., 2015; van Leeuwen & Hoppitt, 2023).

One way that one might try to distinguish between human and ape social learning with respect to mindshaping is to argue that nonhuman social learning is primarily *instrumental*, whereas human social learning is *intrinsically* motivated. Humans don't just copy when others have useful information, but also seem to *want* to be like others to the point of overriding their own beliefs or preferences to conform to community behavior and expectations, as in Asch's (1951) seminal studies of conformity.

Some captive studies suggest that chimpanzees and orangutans either just stick with behaviors they have previously learned and do not adjust to conform to what others do (Haun et al., 2014), or will adjust their behavior only to maximize individual foraging payoff (van Leeuwen et al., 2013). However, other research paints a different picture. Albeit limited, there is evidence of immigrant female chimpanzees switching their behavior to conform to that of a new social group. Luncz and Boesch (2014) observed a female chimpanzee progressively switching from the nut cracking hammer material choice of her natal group to that of her new group. Hammer material choice in chimpanzee groups (wood vs. stone hammers) appears to be stable over time, despite generational turnover and immigration from neighboring groups with different material traditions, and differences in the efficiency of materials. Young chimpanzees also gradually converge on the handclasp grooming "style" of their group (van Leeuwen & Hoppitt, 2023). In another interesting case, two female chimpanzees were introduced into a zoo-housed group that has a female-specific behavioral tradition, the cross-armed walk, which seems to serve no functional purpose and limits walking efficiency. One quickly adopted this behavior, while the other did not. The researchers report that later the female who adopted the tradition appeared to be better integrated into the group (Goldsborough et al., 2021). There is also evidence of social conformity from other primates, such as vervet monkeys forgoing available food to conform to an experimentally-induced food color preference in their social group (van de Waal et al., 2013).

I'll address the question of whether ape culture and conformity is "normative" in nature in Section 3.4, but it definitely seems that apes (albeit to a lesser extent than humans) are adapted to shape their behavior and preferences (at least in some domains) to conform to that of their group. This doesn't seem to be *just* for instrumental purposes—such as acquiring useful foraging behavior—but also for *social* reasons relating to integration and inclusion (Harrison et al., 2024). This is reinforced by "ghost" experiments where novel techniques are demonstrated but without conspecific models, which show that social models are necessary for apes to learn (Hopper et al., 2007).

3.2. Over-imitation

Zawidzki (2013) argues that a key signature of human social learning being intrinsically motivated rather than merely instrumental is "over"-imitation, where causally *unnecessary* and well as necessary features of an action are copied (Lyons et al., 2007). Horner and Whiten (2005) reported that children and chimpanzees would reproduce all steps of a demonstrator's action when the mechanism involved was opaque, but when the causal features of the mechanism were visible, chimpanzees would only reproduce the causally necessary parts of the action, while children also reproduced the unnecessary parts. Clay and Tennie (2018) report similar results, comparing children and bonobos. A related phenomenon is "rational" imitation. Gergely and colleagues (2002) found that children copied an adult's use of their head to turn on a light when their hands were free, but not when their hands were occupied. Some captive apes have been shown to engage in rational imitation (Horner & Whiten, 2005; Buttlemann et al., 2007). However, Zawidzki (2013) regards a putatively enhanced tendency of human children to copy even non-functional aspects of demonstrators' behavior as a key human-unique mindshaping mechanism.

That claim of human uniqueness is, however, premature. The idea that apes don't copy non-functional features of observed behavior is belied by apes copying seemingly arbitrary behaviors, such as the cross-armed walk (Goldsborough et al., 2021), placing a piece of grass in one's ear (van Leeuwen et al., 2014), and adopting an unusual motor pattern exhibited by a disabled individual for no obvious functional purpose (Hobaiter & Byrne, 2010).

There are also methodological problems with existing experiments on over-imitation in apes. Allen and Andrews (2024) note that in human studies, the human demonstrator is likely perceived as an in-group member, whereas in ape studies, the human demonstrator is a member of a different species. There is experimental evidence that dogs over-imitate, but selectively, over-imitating their owner, not unfamiliar humans (Huber et al., 2020). Hence, apes' perception of the social relationship with the demonstrator is a potential confound. In addition, the literature generally holds that over-imitation functions for learning social rituals, conventions, and norms (Legare & Neilsen, 2015; Hoel et al,. 2019). While paradigms with children have an overt game-like character, eliciting childrens' sensitivity to rules, ape studies are not designed with potential rituals or norms in ape communities in mind (Allen & Andrews, 2024). Doing that may require looking beyond typical contexts of foraging and tool manipulation to social and communicative contexts where we see more ritualistic/conventional elements. I'll return to the question of ape social norms in Section 3.4, but it is clear that much care is needed interpreting the current lack of experimental evidence of ape over-imitation.

3.3 Pedagogy

Teaching is a socially extended mindshaping mechanism (Zawidzki, 2013). The seeming readiness of even very young children to pick up on behavioral cues from adults (such as eye contract) that what happens next is a pedagogical demonstration has been taken to show that humans are naturally adapted to give and receive pedagogy (Csibra & Gergely, 2011).

The animal literature defines teaching functionally in a fairly minimal way, as behavior: 1) performed only in the presence of a naive individual; 2) costly to the demonstrator; and 3) causes an improvement in the learner's performance in the activity (Caro & Hauser, 1992). This falls short of many intuitive definitions of pedagogy, which add requirements like the demonstrator slowing down or repeating steps, correcting mistakes, providing communicative cues to the learner (eye contact, guiding behaviors, etc.), or demonstrating sensitivity to the existing skill of the learner. Though teaching is often glossed intuitively in terms of mindreading, the mindshaping hypothesis emphasizes that even these more demanding notions of teaching needn't necessarily require representations of propositional attitudes.

The clearest evidence of teaching in the minimal functional sense is outside of the primate order in meerkats, ants, and birds (Thornton & Raihini, 2008). However, there is suggestive evidence of teaching in chimpanzees and orangutans, including examples of seeming facilitation of offspring behavior by mothers. Chimpanzees in the Goualougo Triangle, Republic of Congo, use multiple tools for termite fishing: a sharp stick to poke a hole in a nest and a probe to fish out termites. Mothers have been found to transfer these tools to their young and appear to prepare in advance, carrying two sets of tools to the nest location or splitting a tool lengthwise to create a second one (Musgrave et al., 2016). Similar transfers and facilitation have been found in the nut-cracking behaviors of Taï chimpanzees (Boesch & Boesch-Achermann, 2000). Orangutan mothers in the Suaq population in Sumatra adjust their behavior in response to food solicitations from offspring and those responses vary with age and task complexity: they adjust less to older offspring and more with more complex tasks (Mikeliban et al., 2021). In the social realm, chimpanzee mothers with sons also seem to adjust their behavior to facilitate their infant's integration into male social networks: mothers with sons are more gregarious and spend more time in social groupings with males early in their son's life (Murray et al., 2014).

However, we have much left to learn about ape pedagogy. Skeptics may question how much is learned by the learner from the demonstrator in these examples. Though there are some anecdotes (Boesch, 2012), we also lack clear evidence of things like slowing down demonstrations, correcting learner mistakes, and the communicative cuing features characteristic of more demanding definitions of teaching. Nonetheless, whether or not one refers to them as pedagogy, the above examples do indicate that mothers are mindshapers.

3.4 Social norms

We've seen that apes are somewhat inclined to conform to group-typical behaviors. However, human communities are also governed by *normative* standards—rules about how people should or shouldn't behave in particular circumstances—to which conformity is *enforced* by regimes of social reward and punishment. Social norms are extremely important mindshaping structures. Enforcement of norms of cooperation is key to the evolution of human cooperation (Henrich and Muthukrishna, 2021). Over-imitation in children also seems linked to norms. Are ape communities governed by social norms?

Potential norms in ape communities have been suggested (de Waal, 2014; Andrews, 2020; Fitzpatrick, 2020). Inspired by anecdotal reports of bystanders making vocal protests and sometimes intervening to stop infanticidal attacks, Rudolf von Rohr et al. (2015) sought to test whether chimpanzees have norms prohibiting violence towards infants. They found that captive chimpanzees looked longer at videos of chimpanzee infanticide, compared with videos that featured violence between adults, hunting of monkeys, or other videos featuring infants—a result they interpreted as the detection of a norm violation. An interesting anecdote in wild bonobos is also suggestive of potential norms surrounding sex and dominance: a high-ranking female threw a temper tantrum when her repeated solicitations for sex with a younger female were rejected, her frustration perhaps indicative of a violation of social expectations (Clay et al., 2022).

The suggestion of nonhuman social norms has met with considerable skepticism (e.g., Schlingloff & Moore, 2017; Schmidt & Rackozy, 2019). One source for this is the assumption that social norms require uniquely human cognitive capacities. Schmidt and Rackozy (2019) link social norms with capacities for collective intentionality, where individuals adopt the perspective of the group "we" to understand what *we* qua group demand of each other (Tomasello, 2014). Bicchieri (2006) defines social norms explicitly in metarepresentational terms, as clusters of beliefs about the beliefs and normative expectations of one's groupmates. Without reasons to think apes have these or similar capacities isn't it implausible to attribute norms to apes?

Another source of skepticism comes from failures to elicit third-party punishment in apes in experimental contexts. Third-party punishment is widely regarded as a key behavioral signature of norms (e.g., Schmidt & Rackozy, 2019). The dominant bonobo mentioned above may simply have been venting her own personal frustration about not receiving sex from the younger female; if unaffected bystanders behaved punitively towards the younger female that would be more compelling evidence of a norm violation. Riedl et al. (2012) gave pairs of chimpanzees the opportunity to steal food from a conspecific and the opportunity for either the affected party or a bystander to punish the thief by preventing their access to the food. Chimpanzees punished as second parties, but not as third parties. In contrast, much has been made of the willingness of humans in experimental economic games to engage in costly "altruistic punishment" of antisocial behavior (Fehr & Gächter, 2002).

There are problems with both lines of skepticism. A mindshaping perspective urges us to consider how we might de-intellectualize social norms as emergent social structures that needn't rely on sophisticated cognitive or metacognitive capacities. There are theoretical models of human norm-learning and conformity that emphasize more basic and phylogenetically widespread mechanisms, such as reinforcement learning and prediction-error minimization (Heyes, 2018; Theriault et al., 2021).

Existing studies of punishment in apes likely also don't tell the full story. What if the studied communities have norms but not about theft of food? The human propensity to engage in third-party punishment of norm violators is itself variable across cultures and domains and can take a multitude of forms, from direct physical aggression, to avoidance, to gossip and ridicule (Henrich and Muthukrishna, 2021). Hence, we must avoid narrow assumptions about how and when apes may punish norm violators.

Both lines of skepticism thus make the mistake of conflating the *explanandum*—social norms—with the *explanans*—specific and tendentious hypotheses about the psychology and enforcement of human social norms. To move forward with the empirical question of whether social norms exist in nonhumans, we need a clearer view of the explanatory target.

My co-authors and I have suggested a less psychologically-loaded and more operationalizable characterization of social norms as what we call *normative regularities*: socially maintained patterns of behavioral conformity in a community (Andrews et al., 2024; Westra and Andrews, 2022; Westra et al., 2024). The crucial concept here is the concept of *social maintenance*. Social norms differ from non-normative patterns of behavior, such as simple cultural traditions, or genetically or environmentally induced patterns of behavior common to a group of animals in that conformity to norms is socially incentivized by the behavior of others. Third-party punishment is a form of social maintenance, but there are others, including second-party punishment, teaching/facilitation of the behavioral regularity, and gains in social inclusion, affiliation, or status that may come from conforming to the regularity (Andrews et al., 2024).

Third-party punishment may still be particularly informative positive evidence, but shouldn't be seen as the only way to establish normative regularities; rather, a more wide-ranging approach to investigating social maintenance is needed.

It remains to be seen the extent to which there exist normative regularities and of what kinds in ape communities. Studies like Rudolf von Rohr et al. (2015) don't tell us how chimpanzees would actually respond to supposed norm violations; similarly, it would be interesting to know what happened after the bonobo's temper tantrum.

There are some examples that point to how we could study social maintenance more directly (Westra et al., 2024). Recall the two chimpanzees introduced to the group that performs the cross-armed walk (Goldsborough et al., 2021). The female who adopted this behavior later appeared to be better integrated into the group than the female who did not. Detailed observations of what happens in the period surrounding such integration events could help us to identify potential forms of social maintenance. For instance, how do observers react the first time they observe an immigrant performing the group-typical behavior—e.g., do rates of affiliative behavior increase? Do behaviors towards immigrants change if they persistently fail to perform the behavior and in what way?

4. Human unique mindshaping?

Nonhuman apes are mindshapers. They have complex social structures, including group-variable material and social cultures that extend into, and shape, almost every aspect of their lives. Though there are important open questions about the nature and extent of their propensities to copy the behaviors of others (Tennie et al., 2020; Whiten, 2022), apes are prodigious social learners. Ape social learning isn't just instrumental at an individual level, but also plays key social functions, including integration and learning of non-functional behaviors. Apes are sometimes disposed to abandon what they have previously learned or forgo valuable alternatives to conform to what those around them are doing, and mothers, in particular, facilitate the learning of their offspring. It remains an open question whether ape conformity is normatively enforced, but there are suggestive examples of "normative regularities" and some promising routes for studying potential social norms (Westra et al., 2024).

That all of this is so without (currently) strong evidence of representations of propositional attitudes is grist for the mill of the mindshaping hypothesis. Yet, there are vast differences in the scale of human and ape cooperation: apes cooperate with friends and kin, and sometimes at larger scales (e.g., border patrols and cooperative hunting in chimpanzees [Boesch & Boesch-Achermann, 2000]), but that pales in comparison to corporations and nation states. So, how may human and ape mindshaping differ? According to Zawidzki:

> [D]istinctively human mindshaping has the following profile: it is intrinsically motivated; the mechanisms that implement it are often socially distributed; the models are often virtual, nonactual individuals; and the respects in which models can come to match targets include any aspect of any behavior of which human beings are capable. (2013, p. 62)

Some of these supposed distinctive features of human mindshaping—conformist and imitative motivation and socially distributed mindshaping, such as teaching and norms—may turn out to be more differences of degree than kind, though the cumulative effect of many such differences may still be significant. However, while advances in the study of ape communication suggest richer capacities than previously thought (Kalan et al., 2023), the absence of representational power comparable to human language makes it unlikely that apes construct and copy fictional models.

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