How language shapes the cultural inheritance of categories

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It is widely recognized that language plays a key role in the transmission of human culture, but relatively little is known about the mechanisms by which language simultaneously encourages both cultural stability and cultural innovation. This paper examines this issue by focusing on the use of language to transmit categories, focusing on two universal devices: labels (e.g., shark, woman) and generics (e.g., "sharks attack swimmers"; "women are nurturing"). We propose that labels and generics each assume two key principles: norms and essentialism. The normative assumption permits transmission of category information with great fidelity, whereas essentialism invites innovation by means of an open-ended, placeholder structure. Additionally, we sketch out how labels and generics aid in conceptual alignment and the progressive "looping" between categories and cultural practices. In this way, human language is a technology that enhances and expands the categorization capacities that we share with other animals.

language | categories | essentialism | norms | children

It is broadly agreed that language is a distinctive human capacity and a powerful engine of cultural transmission. As such, language is important to the theme of this special issue (1). No matter how sophisticated the cultural transmission systems of nonhuman species (and they are astonishingly sophisticated; see papers in this issue) (2), they proceed without language. We can thus ask what language distinctively contributes to cultural transmission in humans and (more speculatively, but importantly) what language may distinctively contribute to cultural evolution in humans. Recent evidence from language learning in children provides new insights into these questions.

In this paper, we focus specifically on a key universal element of language, category labels (e.g., dogs, gold, women, Muslims), and their central role in the transmission and evolution of category representations. The argument, in brief, is that category labels work in an almost paradoxical way to ensure stability in the transmission process, but simultaneously to permit and even foster conceptual change. On the one hand, words are conventional and prescriptive, and provide a stable representation that is easily shared with great fidelity, but on the other hand, words have an open-ended "placeholder" structure that invites innovation. We suggest that this dual capacity contributes to what is distinctive in human cultural evolution.

Propositions vs. Presuppositions

Maynard Smith and Szathmáry argued that language is one of the major transitions in the evolution of complexity, specifically in the intergenerational transmission of information: "We accept [the origin of human speech] as being the decisive step in the origin of specifically human society" (3). Kirby et al. (4) similarly note that "Language is unique in being a system that supports unlimited heredity of cultural information, allowing our species to develop a unique kind of open-ended adaptability." And Pagel (5) likewise refers to "language's role in the transmission of the information that makes our societies possible."

The most obvious way that language transmits information is via explicit declarative propositions (e.g., "You can crack open a nut using a rock"; "I'll give you my money if you put down that gun"; "Don't trust Joe—he lies constantly"), which can share ideas, negotiate trades, deceive enemies, impress potential mates, affect reputations, and so forth. The expressive capacity of human language is virtually unlimited because of its hierarchical, combinatorial structure (6). In contrast to the communication systems of other organisms (even those as impressive as whales, bees, or vervet monkeys), human language is generative: it permits infinitely many messages to be constructed out of a limited number of elements. This remarkably flexible system has obvious survival value, as it is used in the "cognitive arms race" of competitive feedback loops implicated in cooperative interactions that involve and must deal with cheating and cheating-detection (7).

However, much of what human language conveys is not explicitly articulated via propositional content, but rather is implied via presupposition, implicature, and other forms of inference (8). Four examples follow.

(*i*) Language marks social identity through variation. There are roughly 6,000 human languages around the globe, mutually unintelligible, and (with rare exception) fully learnable only in childhood. These aspects materially affect with whom one can communicate and coordinate, and from whom one can learn. Even among those who speak the same language, accent and dialect reveal a person's cultural origins, and so serve as honest signals to identity, with consequences for whom others choose to interact with and which models others trust to imitate and learn from (9).

(*ii*) Language directs a person's attention in the moment by means of structural features of the grammar. Different linguistic communities focus on different aspects of experience, and in so doing indicate what is important (10). For example, Japanese has an honorific system that requires a speaker to decide level of politeness; Quechua has an evidential system for expressing how a speaker comes to know something: directly seeing vs. hearsay. There is debate regarding the role of these differences on nonlinguistic cognition (11, 12). But at a minimum, these structural features affect a person's thinking in the moment of speaking (13), including what information gets encoded and transmitted within a social interaction.

(*iii*) Language transmits information through a rich system of pragmatic implications (14, 15). Communication involves inferring the speaker's intentions, a complex process that builds on theory-of-mind capacities (16). Pragmatic inferences not only allow a listener to infer a speaker's meaning, but also to learn about properties of the world (17).

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(*iv*) Language provides cognitive tools that aid with recall, transmission, and manipulation of concepts that otherwise can be difficult to hold in mind. For example, number words help speakers of a language, such as English or Turkish, remember and communicate exact cardinalities of sets; speakers of a language without number words (such as Pirahã) perform poorly on numerical reasoning tasks that tap into these processes (18). In this way, language provides tools much like any other informational technology, such as Arabic numerals, written language, the abacus, or even computers (19).

Our focus is on this last sort of presupposition: language as a cognitive tool. We focus on how human languages represent categories, by means of two universal devices: labels and generics. We argue that these devices convey two important presuppositions: that categories are normative and that categories have essences. We further suggest that these presuppositions are both constraining (leading to stability) and generative (leading to innovation) in the process of cultural transmission.

Categories as Cultural Inheritance

Categories are mental representations in which perceptibly distinct entities are treated as alike (e.g., the category "apple" permits one to identify a variety of different apples as edible). Every animal species uses categories to organize their representations of experience, identify newly encountered instances, and make predictive inferences, from pigeons identifying food to voles identifying kin. Categories are also a foundational component of socially transmitted behaviors, such as tool use (categories are needed to identify potential tools), vocalizations to warn of danger (categories are needed to identify predators), or rituals to maintain group cohesion (social categories are needed to decide whom to copy) (20, 21).

For humans, categories themselves are a key part of our cultural inheritance, which is to say, they exhibit learned, socially transmitted variation that cannot be explained by genetic or environmental factors (2). We are not born with a fixed set of categories (no one is born knowing of screwdrivers, or that whales are mammals, or that girls wear pink). Nor do we simply pick up on discontinuities in the biological world; rather, human categories have a cultural overlay. We see this in categories of natural kinds, social kinds, and artifacts, all of which display tremendous linguistic, cultural, and regional variation. Classifications of the natural world vary in which animals, plants, or substances are classified as edible, which are classified as medicinal, and which are classified as clean/unclean (22). Classifications of the social world vary in how gender, race, and social hierarchies are organized (23, 24). Classifications of artifacts vary in the very entities there are to be classified, with distinct types of tools, clothing, furniture, and so forth, as well as category boundaries (25). And there is marked linguistic variation in the classification of dimensions of experience, including color, number, time, space, emotions, even senses (26, 27).

Although categories can be acquired asocially by individuals via direct observations and interactions with the world, human languages provide a socially transmitted system for efficiently communicating information about which categories there are, what belongs in those categories, and which attributes those categories possess. Universally, languages use two devices for the intergenerational transmission of categories: labels (names for categories, such as "shark" or "woman") and generics (generalizations about named categories, such as "sharks attack swimmers" or "women are nurturing").

Labels express concepts that have some cultural significance; whereas there are indefinitely many concepts one can generate (e.g., "items weighing more than 500 grams," including vultures and the *Oxford English Dictionary* but not a small grapefruit), only a subset of these ideas are lexicalized, and of these, only a subset are maintained in a language over time (28). Words are distinctive to humans in their number (typically about 50,000 in an adult speaker, many of which are names for things), conceptual precision (e.g., chase vs. flee), and need to be learned (29). Children devote considerable time and effort to amassing words, learning roughly 14,000 words by age 6, which averages to learning nearly one new word every waking hour from 18 mo through 6 y of age (30). Although category membership can be inferred without language (e.g., recognizing an animal as a snake based on its shape and movement), labels have informational capacity beyond direct observation. Even for young children, they can convey surprising category membership of an individual item (e.g., that a legless lizard is not a snake) (31) or introduce wholly new categorical distinctions (e.g., to distinguish animals based on subtle variations in antennae rather than overall body shape) (32).

Generics are generalizations that refer to a category directly (e.g., "birds fly") (33). In contrast to specific utterances (e.g., "Did you see that bird?"), generics convey information that extends beyond the current context and indeed in principle cannot be demonstrated directly. Importantly, generics are input to children's developing knowledge systems, as they are frequent in child-directed speech and acquired by about 2.5 y of age (34, 35). As soon as children master the syntactic prerequisites for expressing generics in their language (e.g., in English: plurals, articles, and tense), they produce generics ("Does lions crawl?"; "I don't like babies that cry"), comprehend generics as kind-referring and distinct from specific reference, and recall whether information was provided using generic or specific language (35–37). Generics have been attested in all documented languages, including pidgins and Pirahã (38–42). Children's early capacity to learn generics is particularly striking, given that generic referents are abstract (one cannot point to a kind, only to instances of a kind) and their semantics cannot be reduced to a particular quantity (unlike "some," "most," or "all") (43–45). For example, although "Lions have manes" is acceptable despite applying only to male lions, "Lions are male" is semantically unacceptable, and preschool children understand this (46).

Two Presuppositions: Norms and Essences

On a strict reading, labels communicate the category to which something belongs, and generics communicate some fact, opinion, or belief about a category. This is the explicit informational value of these expressions. However, labels and generics in actual interpersonal use imply more than these literal meanings, and indeed we would argue that appropriate use of these expressions requires understanding these implications. Next, we review two conceptual presuppositions embedded in the use of labels and generics: that categories are normative (i.e., conventional and prescriptive) and that categories have essences.

Categories as Normative. A social norm is a shared, socially constructed, context-specific rule that indicates what is (or is not) socially appropriate (21, 47). Labels are fundamentally normative in that they are conventional (i.e., shared with other members of the speech community, a principle required for their successful use) (48, 49). A person who did not appreciate the normative value of labels might arbitrarily substitute vocalizations of their own invention for words that they hear from others (e.g., you call that a hammer, but I'll call it a blicket), and the whole communicative enterprise would never get off the ground. By the time of their first word, children appreciate the conventionality principle, expecting novel labels used by one speaker to be understood by others within the speech community (50). Not all behaviors are treated the way that labels are treated; for example, infants assume that preferences are individually varying rather than shared or conventional (51). Infants also appreciate that language operates via a division of linguistic labor, whereby more knowledgeable members of the community can be trusted to provide accurate labeling (52). From an early age, children are sensitive to social variation in labelers, for example preferentially accepting labels from adults over children and experts over novices (53), an expectation that fosters conformity. A powerful consequence of this principle is that even a simple relabeling can shift children's label

use, with only minimal explanation, as in the following examples of parents looking through a picture book with their children (34):

i) Child: That's kangaroo. (Pointing to an aardvark.)

Mother: Well, that looks like a kangaroo, but it's called an aardvark.

Child: Aardvark.

ii) Child: That's a snake. (Referring to an eel.)

Mother: It looks like a snake, doesn't it? It's called an eel. It's like a snake, only it lives in the water. And there's another one.

In experimental settings as well, children accept relabelings from others, even when they compete with perceptual evidence that children directly experience (54).

Generic information is likewise assumed to be conventional and shared with others rather than idiosyncratic, private, or subjective. Even in prelinguistic communication, an action that is displayed to others is more often assumed to be generic than information that is done for the actor himself or herself (55). With regard to language, young children treat generic statements as conveying information that is widely known (56–58). Generics are particularly frequent in pedagogical (information transmitting) contexts, such as book reading, and when taking on a pedagogical role, such as talking to a more ignorant interlocutor or pretending to be a teacher (59, 60). Although generics can express idiosyncratic or subjective perspectives (e.g., "Vegemite is delicious!"), expressing this generically implies a general truth, even to preschool children (61).

Category-referring language is normative in a stronger, prescriptive sense as well. That is, labels and generics imply that a feature linked to a category not only is but also should be (62, 63). This is particularly so for generic language, which expresses norms that may even compete with statistical observations: "Boys don't cry" is deemed true—despite being demonstrably false—because it expresses a norm (64–66). Similarly, generics such as "Scientists care about the truth" express abstract values rather than descriptively accurate features (67). Parents likewise produce generics that express prescriptive norms that conflict with the reality in the moment (e.g., "Remember, we don't stand up on chairs"; "Oh, no, you don't pull on books"; see http://childes.talkbank.org/access/Eng-NA/Brown.html).

Generic language leads to normative judgments, even when the categories are novel and the content is innocuous. In a series of experiments, children 4–13 y of age learned of two novel groups that contrasted with one another in some harmless behavior, such as the music they listen to or the food they eat (e.g., Hibbles listen to one kind of music, and Glerks listen to another kind of music). Children reported that it was "not OK" for an individual to fail to conform to the group behavior (e.g., for a Hibble to listen to music that is more typical of Glerks) (68). In other words, children interpreted an unfamiliar descriptive regularity as if it were prescriptive (see also refs. 69–71 for additional evidence that descriptive and prescriptive norms are conflated in children's and adults' concepts). Language plays an important role in licensing this normative response: when the vignettes depicted individuals (not groups) that received category labels in either specific statements (e.g., "This Hibble listens to this kind of music") or generic statements (e.g., "Hibbles listen to this kind of music"), children made normative judgments; when the vignettes depicted individuals without category labels or generics (e.g., "This listens to this kind of music"), children did not make normative judgments (72). Thus, category labels and generic statements license a prescriptive reading of novel, innocuous behaviors: they imply that members of the labeled group should behave a certain way. The establishment of norms is itself a mechanism that fosters the stability of group behaviors (70).

Essentialism.

> [Essence is] the very being of anything, whereby it is what it is. And thus the real internal, but generally . . . unknown constitution of things, whereon their discoverable qualities depend, may be called their essence.
>
> Locke (73)

A striking aspect of human categories—and the words that express them—is that they often defy appearances: stick-bugs look like sticks, pyrite looks like gold. It is not surprising that scientific categories extend beyond the obvious, given that the natural world provides evolved mechanisms that lead appearances to mislead, including homologies, camouflage, mimicry, and sexual dimorphism. What is notable is that nonscientists, including children, share the expectation that categories have hidden structure and that words in ordinary language (e.g., bug, gold) capture this structure (74). This expectation contrasts with classic theories of cognitive development, which propose that young children are "perceptually bound" thinkers, and that concepts shift from similarity-based to conceptually based over development (75, 76).

We refer to this assumption as "psychological essentialism": an intuitive belief that categories of the natural world share not just observable features, but also a deeper, nonobvious reality: they "carve up nature at its joints" (74, 77, 78). Thus, tigers share more than a certain size, gait, striped fur, and ferocity, but also internal parts, temperament, instincts, as well as an innate, unchanging tiger "essence." This essence might be blood, DNA, or even an unspecified, unknown placeholder, an expectation that there is an essence without knowing what it might be. For example, young children report that an animal's behavior is caused by its own insides or energy before they can have detailed expectations about the particular form that such causal force might take (79–81).

Evidence for psychological essentialism comes from research with adults as well as young children (74, 82). Even in infancy, children expect members of a category to share internal, nonobvious, or causal similarities, even in the face of superficial dissimilarities (31, 83–85). Boundaries between categories are treated as discontinuous and objectively correct, and category membership itself is viewed as immutable (24, 86–89). Category members are thought to have innate potential that resists environmental influences (90–92). Internal bodily organs are thought to have the power to modify the recipient's behavior (93, 94). That essentialist beliefs have been documented in young children and across a variety of cultural contexts suggests that essentialism is a fundamental component of human cognition (23, 95–99). Although which categories are essentialized varies cross-culturally, especially for categories of people (such as race, gender, or ethnicity) (100), essentialism of both natural kinds and social kinds has been broadly and consistently documented (101–103). Essentialized social categories have important implications for evolutionarily significant behaviors in humans, including patterns of affiliation, mating, reproduction, and conflict. For example, essentialized social categories are often conceptualized as less human and more threatening than nonessentialized social categories (104, 105), and both children and adults are reluctant to share resources with members of essentialized out-groups (101, 106).

Essentialist expectations are linked to category labels. Hearing that a pterodactyl is a "dinosaur," that a swaddled baby is a "boy," or that a child received the heart of a "monkey" leads to the inference that the pterodactyl does not live in a nest, that the baby will grow up to like football regardless of its upbringing, and that the donated heart will confer a slight but inevitable uptick in one's tendency to eat bananas. Essentialist expectations attach also to wholly novel labels applied to wholly novel categories (107–109). This is not to say that labels automatically trigger essentialist reasoning; they do not (74, 110). However, when a label is applied to a category that has some coherent conceptual basis (e.g., shared features) then essentialist beliefs follow (32).

Labels may play a particularly important role for social categories, given how culturally variable they are (86, 111).

Generics also facilitate the social transmission of essentialism. They have two semantic features that support essentialism: they express properties that are timeless and nonaccidental (e.g., "birds have hollow bones"), and they minimize within-category variability (e.g., "birds lay eggs," even though only adult females do so). Preschool children appreciate both these points (46, 58). Moreover, hearing novel generics about novel categories leads to more within-category inferences (36, 112), assumption of core features (57), and essentialist inferences about that category, above and beyond labeling per se (108, 109).

Elsewhere we have argued that essentialism is a flawed ontology that oversimplifies by underestimating within-category variability, overestimating between-category differences, and assigning too much causal significance to imputed essences (74). Viewing biological categories as immutable, and viewing variation as only superficial, contributes to persistent misconceptions about evolutionary processes, genetics, and other aspects of science (113–116). Attributing existing patterns of social inequities to hidden, inherent, and inalterable causes in individuals is an oversimplification that ignores structural and historical factors (117, 118) and contributes to a variety of social ills, including stereotyping, prejudice, and discrimination (102, 119–125). For example, essentialist beliefs about gender promote disrespect and lowered expectations toward girls and women in schools and academia (104, 126), and essentialist beliefs about "Blackness" predict the perception of Black people as less than human, which subsequently predicts greater violence toward Black children and increased rates of applying the death penalty toward Black men in the United States courts system (127, 128).

So then, why do we essentialize? In the words of Medin (78), "psychological essentialism is bad metaphysics … [but] may prove to be good epistemology." In other words, essentialism is factually wrong but heuristically useful. Essentialism promotes learning and conceptual change by providing a placeholder structure that promotes the search for underlying causes and modifications over time. The evidence reviewed above demonstrates the placeholder notion of essentialized concepts in three interrelated respects: (*i*) children expect items with the same label to share nonobvious similarities that they have not yet learned; (*ii*) children are guided by labeling and generics even when in competition with children's own direct experiences (e.g., "a whale isn't a fish"; "boys don't cry"); and (*iii*) labeling and generics operate according to a "division of linguistic labor," whereby children defer to more expert others to inform them about the classifications and generalizations of experience (129–131). Importantly, these placeholder expectations, in turn, permit and promote conceptual innovation, because children's classifications build upon the expertise of others, and because children are motivated to search for underlying causal similarities that members of a category share. That even young children view categories in essentialist ways suggests that categories are not just structures for organizing what is already known, but placeholders for further knowledge that is expected to accrue. The meaning of a word is not a list of known features or learned facts. Rather, a word serves as an invitation to form a category (132) and to extend and modify it with growing knowledge and expertise. "Dog" is not a tag for a fixed set of observed features, but rather a pointer to "things of that nature," where the "nature" will be filled in via learning and input from others. Here we endorse Putnam's (133) famous assertion that "'meanings' just ain't in the head!" Words refer to placeholder concepts that do not have fixed content and thus can be modified. Language "is not a mirror of our inner states but a complement to them. It serves as a tool whose role is to extend cognition in ways that on-board devices cannot" (19).

Conformity and Innovation

Biological evolution requires inheritance and mutations. Similarly, cultural evolution requires both conformity and innovation (134–137), and we suggest that the linguistic presuppositions discussed above—norms and essentialism—contribute to both these processes. Because labels and generics are fundamentally normative (conventional and prescriptive), they provide stable representations that are easily shared with great fidelity. Because labels are understood to be conventional and shared among members of one's language group, a child who hears a word in context rapidly maps an initial meaning on the basis of a single exposure (30, 138), although a full understanding emerges more slowly and gradually (30, 139). Because generic information is viewed as not only descriptively accurate but also as prescriptively correct, children may judge that failure to conform to generically stated category regularities (such as acting at variance with one's in-group) is wrong or even risks punishment (140). At the same time, the open-ended, placeholder structure of essentialism, also implied by labels and generics, invites category change. This is perhaps most evident in the ease with which children accept counterintuitive labels offered by knowledgeable others (e.g., accepting that a legless lizard is not a snake) as well as the inductive potential of labels and generics, wherein new information is rapidly learned and generalized to new instances. These presuppositions suggest a transmission process that fosters change, at the same time that it resists change in the transmission process.

In this section we suggest two additional mechanisms by which the linguistic representation of categories may promote cultural transmission and cultural evolution: they transform variable input into categorical representations, and (in the case of human kinds) they involve looping effects between categories and the people being categorized.

From Variable Input to Categorical Representations. A uniquely human aspect of language is that it takes variable, idiosyncratic experiences and transforms them into discrete, symbolic, shared representations (28). The world is a complex, continuously dynamic array of sensory inputs, and no two people experience identical environmental cues. The experience of categories is thus doubly variable: in the range of instances that an individual encounters and in the experiences of individuals across the language community. Language reduces and regularizes this remarkable variety. Consider the use of a simple word, "bird," which extends from hummingbirds to dodos, from downy chicks to vicious birds of prey. We converge on a shared label, regardless of our varied experiences: which birds we have seen or heard, which ones we have owned or eaten, whether our experience comes from real-world encounters, plush toys, or Big Bird.

This gap between the variability of experience and the commonality of labels presents a puzzle: "If biological and real world constraints are not enough then how is it nevertheless possible for a group to arrive at a sufficiently shared set of conceptual distinctions to make language possible?" (141). In other words, the transmission of language requires conceptual alignment or compatible mental representations that are abstracted away from varying experiences and knowledge bases (142, 143).

We suggest that the manner in which labels and generics abstract away from experience aids in conceptual alignment. Category labels abstract away from the particulars that make individuals unique (a small poodle and a large Great Dane are both "dogs"), and generics abstract away from any particular context ("birds fly," even when the only birds in sight are penguins) (144, 145). Speakers don't require shared experiences to have a shared system of communication. A 12-mo-old infant and a biologist can communicate with the word "dog," despite radically different understandings.

Generics are particularly well-suited for expressing abstract, shared representations because, as noted earlier, they systematically

underplay variations in experience by glossing over exceptions. Generics are not disconfirmed by counterexamples (the existence of a nonflying bird does not disconfirm the generic claim that birds fly) (45, 46), which means that generic messages can trump a listener's personal experiences. People produce generics about features they consider conceptually important (e.g., dangerous or distinctive), even when they know them to be variably present in a category, but those who hear such generics (whether adults or young children) tend to assume that the feature is almost universally present among category members (43, 146). This results in systematic distortions in the transmission process, from variability to category-wide consistency.

The Looping Effect of Human Kinds. Hacking (147) speaks of a "looping effect" in social categories: specifically, that classifications of people have cognitive consequences for those that are classified, which feedback into these same classifications:

> To create new ways of classifying people is also to change how we can think of ourselves, to change our sense of self-worth, even how we remember our own past. This in turn generates a looping effect, because people of the kind behave differently and so are different. This is to say the kind changes, and so there is new causal knowledge to be gained and perhaps, old causal knowledge to be jettisoned. . . . that new knowledge in turn becomes part of what is to be known about members of the kind, who change again. . . . Kinds are modified, revised classifications are formed, and the classified change again, loop upon loop" (147).

We have sketched out linguistic mechanisms that may contribute to this looping effect. Labels and generics stake out categories, which then are altered through human action to reify such categories. In contrast to Hacking, however, we see this looping effect not only for categories to which one belongs, but also for categories of others. History is replete with modifications that differentiate groups. Thus, for example, male/female differences are exaggerated by differences in clothing, hairstyles, gait, bodily deformations (e.g., foot-binding), and styles of speech. Modifications may be imposed (e.g., Jews in World War II Germany being required to wear stars) or chosen (e.g., fashions worn by self-identified hipsters). Social groups may be physically separated, either by explicit policy (e.g., segregationist policies toward Blacks in the southern United States; Japanese internment camps in the United States during World War II) or by other practices and constraints (e.g., low-income families restricted to neighborhoods with unclean water and air). Concepts of human kinds may lead to a cyclical pattern in which cultural practices lead groups to appear more distinct from one another, which confirms the categorizations, leading to more differentiating practices, and so forth. Viewing social kinds as having deep differences has cycling effects on behaviors that contribute to the reality of that social kind.

Norms and Essentialism in Nonhuman Species

Are nonhuman animals also capable of learning categories with prescriptive implications and a nonobvious basis? This question is timely, given recent discoveries of remarkably sophisticated categorization and social transmission abilities in nonhuman animals (see other papers in this issue). For example, consider an ingenious experiment demonstrating that chimpanzees conform to cultural (descriptive) norms of tool use (148). The researchers first taught a high-ranking chimpanzee one of two manners of tool use to obtain food out of a puzzle box (e.g., using either a poking or a lifting motion). When let loose within the group, other members picked up the demonstrated solution strategy, even adhering to the method common in the group after having successfully used the alternative method. Certainly language was not required.

Nonhuman primates are also capable of categorizing based on nonperceptible features. For example, baboons engage in sophisticated categorizations of conspecifics, with dominance hierarchies that simultaneously rank by individual rank and family group using matrilineal kinship, friendships, and causal theories (149). These categories have a nonobvious basis (e.g., infants "inherit" the rank of the mother) and are learned (e.g., members need to learn which individuals fall into which group). Seyfarth and Cheney propose: ". . . when it comes to recognizing matrilineal kin groups, baboons are 'essentialists' . . . They act as if the members of kin groups 'have essences or underlying natures that make them the things that they are'" (149).

Monkeys and great apes can also track category membership across radical featural transformations, and privilege kind (essential features) over superficial appearance (surface features). For example, one study presented rhesus macaques with food items in which the inner identity was transformed (e.g., an apple was disguised as a coconut) (150). After a piece of this transformed fruit was placed in a container, if the animal reached in and found a piece that matched the appearance rather than the inner kind, they continued to search for another piece, indicating that they had been expecting the sample to match the inner kind and not the appearance. The researchers interpret the findings as "evidence that macaques share this one primitive aspect of psychological essentialism" (150). Similarly, in another study, bonobos, orangutans, and chimpanzees viewed a transformation process in which one piece of food was disguised to look like another (e.g., a carrot slice was disguised as a banana slice) (151). When given a choice between a true piece of banana versus a disguised piece of carrot that only looked like a banana, animals preferred the true banana. The authors interpret this as "a kind of psychological essentialism, perhaps the phylogenetically and ontogenetically most basic one" (151). Again, language was not required to consider an appearance–reality conflict and to privilege the inner identity.

These impressive capacities demonstrate that humans share with at least other primates the ability to categorize based on subtle, nonperceptible cues, and the ability to conform to normative regularities (although conformity is substantially greater in humans) (152). Indeed, norms and essentialism may precede language in human development, as preverbal infants infer general ways of interacting with objects from pedagogical demonstrations, evaluate others based on their social interactions, categorize based on nonobvious features, and distinguish individuals from kinds (55, 80, 153–155).

Nonetheless, we suggest four key respects in which human language may be unique in fostering the social transmission and evolution of categories.

Efficiency in Transmitting Category Information. First and most obviously, labels and generic language ensure speed, fidelity, and ease of transmitting category information, by means of an overt and stable representational format. This would be difficult (perhaps impossible) to achieve by means of actions alone. (Note that language is not necessarily more efficient for transmitting all sorts of information. For example, showing the location of an object is likely more efficiently done by pointing; teaching weaving is likely more efficiently done by demonstration.) Consider the case of conveying that an item is not what it appears to be. The studies with nonhuman primates required a lengthy and rather elaborate shared context (the transformation process itself), carried out by an expert with special tools and procedural know-how. Someone who was not present during this demonstration would not have access to the relevant information. Contrast this with the human language case, which efficiently corrects a misconception with a single sentence ("This looks like a banana, but really it's a carrot"). Anyone who hears the new label—even a nonexpert or young child—could then share it with others, ensuring a transmission chain. Consider, too, the case of conveying the scope of a feature: if eating a mushroom makes you sick, is it because of that particular mushroom (e.g., maybe it rotten or was sprayed by pesticides) or mushrooms of that type more generally? Again, this is efficiently conveyed via generic

language ("Death cap mushrooms are poisonous"), but difficult (perhaps impossible) to convey nonlinguistically. Notably, generic information is conveyed equally well whether it expresses preference or avoidance, whereas nonlinguistic social learning mechanisms may be asymmetric in this regard (e.g., the Norway rat can learn which foods to try by sniffing the breath of conspecifics, but cannot learn which foods to avoid by sniffing the breath of a sick conspecific) (156, 157).

Conceptual Innovation and Change. Language can evoke conceptual change, not just providing new information (e.g., that dandelions are edible) but also abandoning an old classificatory framework (e.g., learning that plants are alive). Human classification systems undergo reorganizations throughout history, and naming patterns have shifted to accommodate these changes (158). It is less clear that nonhumans engage in conceptual change. Consider the sad case of seabirds that consume plastic they find in the ocean, resulting in poisoning and malnutrition. They do so because the chemical odor of the plastic is similar to that of dimethyl sulfide, a compound found in marine algae (159). The birds are effectively tricked into eating plastic because it smells like food. Thus, a categorization capacity that was useful for locating food went awry when the environment changed. It is not clear how one could convince seabirds to abandon this classification system, even when it's a matter of survival.

Scope of Application. In nonhuman animals, the examples we have seen of sophisticated social transmission, adherence to group norms, and nonobvious categorizations fall within a narrow set of domains, primarily involving food and within-group social relations (e.g., mating, dominance). In contrast, human norms and essentialism extend beyond content with obvious survival value to include any aspect of experience. Essentialism applies to natural substances, living kinds, human social groups, personal characteristics, diseases, and in some respects even artifacts (31, 82, 113, 160–165). Similarly, normative expectations extend to a vast array of behaviors, including which clothing to wear, which music to listen to, or which games to play (68).

From Models to Morals. Although nonhuman animals are capable of conforming to high-ranking group members (copying modeled behaviors) and "punishing" others by retaliating when they are wronged, we are unaware of evidence that they display moral condemnation or punishment of nonconformity in others. For example, in one study with chimpanzees, an actor could punish a thief by depriving them of food reward (via trapdoor) (166). The actor only retaliated when their own food was stolen, not when another chimpanzee's food was stolen. This is in sharp contrast to the findings with young children, who exhibit strong moral evaluations of others (47, 167, 168). One might say that social transmission processes in nonhuman animals provide models of what behaviors are possible (i.e., models), whereas social transmission processes in human animals provide models of what behaviors are appropriate (i.e., morals).

Conclusions

The evolution of culture involves not only behavioral practices and material artifacts, but also the representation of these practices and artifacts in the human mind, including categories. Cultural evolution (as opposed to mere change) entails an increase in diversity and complexity; it cannot just be the recycling of behaviors (169, 170). We suggest at least three ways that categories can be said to evolve. First, as technologies evolve, so do the categories they belong to and the labels that express them. For example, in English we have words for hammers, trucks, and violas (all invented technologies), and in many languages, old words are refitted to accommodate new inventions (e.g., "fire vehicle" means train in Mandarin). Young children have no difficulty acquiring these words; they do not lag behind the acquisition of categories that were in our distant evolutionary history. Second, as theories change and evolve, so do our labeled categories: a whale is no longer a fish; Pluto is no longer a planet; "female hysteria" is no longer a disease. And third, human kinds arguably become increasingly diversified and complex by means of "looping effects." Here, however, it is important to note that the evolution of categories can be negative as well as positive. Cumulative cultural change can be a good thing: tools get more sophisticated, social organizations get more complex, means of food production get more varied. But there is negative ratcheting as well, in the form of bigotry, polarization, and the perpetuation of social hierarchies.

Levinson notes the special role of language in the process of enculturation of cognition: "... language appears to play a crucial role [in how culture gets into the head]: it is learnt far earlier than most aspects of culture, is the most highly practiced set of cultural skills, and is a representation system that is at once public and private, cultural and mental" (171).

In the case of learning categories, we suggest that cumulative cultural evolution is enhanced by labels and generics, which provide a simple yet powerful means of passing along the wisdom (and prejudices) of prior generations. In this way, language enhances and expands (nonlinguistic) capacities to categorize that we share with other animals. A full understanding of this process will require studying how it intersects with a variety of other important cognitive capacities that are present early in human development, including theory of mind, alertness to testimony, attention to ritual, and a drive for causal understandings (134, 172–174).

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