construction" (environmental adaptations that favor and reinforce cultural characteristics; Laland et al. 2000). For example, it may not matter whether people drive on the left or right side of roads; but once there is a consensus in a given culture, it is adaptive to conform to it. Researchers may have privileged insight in their own culture into what is important or what experimental manipulations are likely to achieve interesting and reliable results, and they may find it natural to study these sorts of things. But the very fact that the results are important, interesting, or reliable in one's home culture makes it more likely that one's culture represents an extreme with respect to those results (see Medin & Bang 2008).

The other main factor reinforcing apparent extremes among WEIRD samples is their status as the originating research population. Research methods and theoretical constructs are calibrated to the populations they have been selected and designed for: in psychology's case, WEIRD people. A side-effect is that these same tools are less well fit or even ill fit to other populations, in much the same way that any adaptation evolved for a particular niche will not function as well in other niches. For example, imagine a literature on sense of humor evolved from studies with undergraduates at major U.S. universities. Jokes that proved to be effective would tend to appear in later studies and ones that fell flat would tend to go by the wayside. If one then got the bright idea of doing a cross-cultural comparison, it may seem natural to use the same jokes favored by U.S. college students, with the more or less inevitable consequence that other populations wouldn't find these jokes quite so funny, and the U.S. college sample would appear to be an extreme.

Consider the Müller-Lyer illusion mentioned above and discussed in the target article. That particular illusion is a classic of Western psychology, taught in any introductory class discussing perceptual illusions. And it is taught because it is so readily demonstrated, a fact that reveals both general properties of the perceptual system and a response to the perceptual environment in which Westerners live. Small wonder that the effect is weaker in populations exposed to a different perceptual environment. Similarly, some novel perceptual illusion discovered in some other population is likely to be smaller in magnitude when tested with our WEIRD sample. But that is just our point – overwhelmingly, psychological research originates with the WEIRD sample and then is applied elsewhere – the converse pattern is rare. We believe that this habit of using research methods and theoretical constructs (stimuli, procedures, models, etc.) for cross-cultural comparisons that originated with WEIRD samples, coupled with insider information about what those WEIRD samples find important and which experimental manipulations are likely to achieve interesting and reliable results, may well account for the apparent extremity of the WEIRD population. Had psychology started with Chinese rice farmers studying members of their own community and then later their research protocols and theoretical constructs were exported for cross-cultural comparison and tested for universal validity, then, on our account, Chinese rice farmers would be the cultural outliers and WEIRD people would look more like everyone else.

Away from ethnocentrism and anthropocentrism: Towards a scientific understanding of "what makes us human"

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Abstract: The quest to understand "what makes us human" has been heading towards an impasse, when comparative psychology compares primarily individuals that are not representative of their species. Captives experience such divergent socioecological niches that they cannot stand for their wild counterparts. Only after removing ethnocentrism and anthropocentrism will we be able to progress in our understanding of "what makes us human."

Henrich et al.'s review of cognitive differences among human cultures is very timely in reminding us that different living conditions have consequences for cognitive development. Not all humans are Westerners, and this is true also for their cognition. Here, I want to address how this affects our understanding of cognitive differences between humans and chimpanzees, and requires reconsideration of many claims about "what makes us human" (Boesch 2007; 2008). To become a science, comparative psychology will have to include population differences in its theoretical thinking and empirical approaches.

Comparative psychology suffers from the same weaknesses as noted by Henrich et al. for psychology. Bold claims about "human uniqueness" are made based on the assumption that WEIRD (Western, Educated, Industrialized, Rich, and Democratic) societies' humans (I referred to them as WMC, or Western middle class, humans; Boesch 2007) and captive chimpanzee populations are representative of each of the two species (Boesch 2007; de Waal 2001). Comparative psychology predominantly compared captive chimpanzees with free Western humans (see black arrow A in my Figure 1). The overwhelming conclusion of these studies was that humans clearly outperform chimpanzees in such different cognitive domains as folk physics, altruism, cooperation, theory of mind, and gaze following (e.g., Hermann et al. 2007; Povinelli 2000; Povinelli & Vonk 2003; Silk et al. 2005; Tomasello et al. 2005).

However, three essential points that invalidate their conclusions have been too often forgotten in the interpretation of such studies. First, the characteristics of the animal populations included in these studies are typically not representative of their species. The Louisiana captive chimpanzee group that has been used extensively in a variety of widely cited cognitive studies (e.g., Povinelli 2000; Povinelli & Vonk 2003; Silk et al. 2005; Vonk et al. 2008) nicely illustrates this point (see Fig. 1). This group was created by putting together seven 2- to 3-year-old chimpanzees that were kept in isolation as a same-aged peers group all their lives, in a small, stable, and restricted man-made environment (see Povinelli 2000). Such a history cannot be more different from the one of young chimpanzees in the wild. Wild individuals live in large, flexible, fission-fusion groups, with 30 to 100 individuals of different

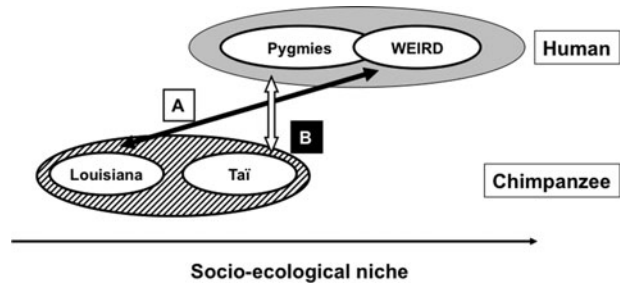

Figure 1 (Boesch). Schematic representation of the cognitive landscape in humans and chimpanzees as a function of the different socioecological niches that each species encounters. For each species, the possible range of cognitive performance is illustrated by an ellipse including all the individual population performances. Two types of cross-species comparisons are illustrated: The first one, the classical comparative psychology approach, compares two outlier populations for their species (black arrow A compares captive chimpanzees with WEIRD humans); and the second one compares populations of two species facing similar socioecological niches (white arrow B).

ages, in kilometer-wide ranges where food has to be located and extracted, and where life-threatening neighbors and predators loom (e.g., Mitani et al. 2002). True, captive conditions range from highly ecologically deprived environments, typical for the early 1950s, to much more enriched conditions, as seen in modern settings. Moreover, social conditions vary from complete isolation to more social groups. However, all captive conditions differ from wild ones in that captives are forced to live in much smaller, stable social groups, in very passive environments where food is provided and no competition with others exists. The fields of developmental and social psychology have shown that such differences have important effects on cognitive development in humans (Carpendale & Lewis 2004; Nelson et al. 2007).

No surprise that some captive chimpanzees have difficulties in understanding unseen relationships (Povinelli 2000), whereas wild chimpanzees transport stone hammers to distant, out-of-sight nut-producing trees (Boesch & Boesch 1984) and use tools to extract unseen underground resources (Boesch et al. 2009; Sanz et al. 2004). Similarly, some captives are unable to share food (Silk et al. 2005; Warneken & Tomasello 2006) or to work as a team with shared goals (Tomasello et al. 2005), whereas wild individuals share vast quantities of food with unrelated group members for extended periods of time and work as a close team when hunting prey, chasing leopards, or during risky intergroup encounters (e.g., Boesch & Boesch 1989; Boesch et al. 2008; 2010; Goodall 1986; Mitani & Watts 2005).

Second, comparative psychology has favored experimental studies using anthropocentric designs and assumptions. These might allow testing human abilities in other species, but are unlikely to uncover cognitive abilities of nonhuman animals. For example, to understand the altruistic abilities of chimpanzees, experiments have been designed on the ethnocentric assumption that sharing should be preferred over nonsharing when there is no cost to oneself (Silk et al. 2005). However, sharing implies a contractual obligation in some human populations (Henrich et al. 2006; and present study in the target article); and, therefore, this assumption does not even hold in all human populations. Similarly, numerous experiments with captive chimpanzees used a WEIRD notion of causality. In gaze-following experiments, tested animals needed to understand that a human gaze indicated an honest positive interest (Hermann et al. 2007; Tomasello et al. 2005). In helping experiments, tested individuals had to understand that experimenters pretending to not master a task needed to be helped (Warneken & Tomasello 2006). Less ethnocentric and anthropocentric experiments would bring us a long way to understand other species.

Third, by favoring experiments in captive settings, comparative psychology has opted for low ecological validity. For example, altruism in wild chimpanzees is expressed mainly in situations where a highly sought after food, meat, is shared with individuals that are socially important to the giver, either because they are hunting partners or social allies (Boesch 2009; Mitani & Watts 2001). Such a social dimension has rarely been considered in comparative experiments. Similarly, chimpanzees primarily cooperate during life-threatening situations, such as during intergroup fights or when predators are near, or to get meat (Boesch 2009; Goodall 1986). The difficulties with mimicking such situations in experiments have not prevented comparative psychologists from making strong claims about chimpanzees' limitations (Herrmann et al. 2007; Povinelli 2000; Tomasello et al. 2005). Comparative psychologists' inability to mimic natural cooperative conditions is not proof that cooperative ability is absent in other animal species.

The quest to understand "what makes us human" has been heading towards an impasse. It will progress again once the socioecological diversity of humans and other species are considered. I am asking for greater care before making sweeping claims based on only a few captive individuals. Knowing that cognitive diversity is natural in species living in different socioecological conditions, we need to compare what is comparable (following white arrow B in Figure 1). Only when this condition is met will our quest to understand "what makes us human" progress.

The WEIRD are even weirder than you think: Diversifying contexts is as important as diversifying samples

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Abstract: We argue that Henrich et al. do not go far enough in their critique: Sample diversification, while important, will not lead to the detection of generalizable principles. For that it will be necessary to broaden the range of contexts in which data are gathered. We demonstrate the power of contexts to alter results even in the presence of sample diversification.

We commend Henrich et al. for pointing out the (over)reliance on participants from WEIRD societies and the tenuousness of universal laws whose support is based on a single subpopulation of a single society. Notwithstanding the merit of studying participants from diverse races, social classes, and national cultures, this will not in itself lead to generalizability of findings because it leaves unaddressed other threats to generalization, including the restricted physical, ideological, and attitudinal parameters of most research, and the omission of social meanings that participants attach to their choices.

Even when researchers include non-WEIRD participants, they rarely include contextual variation. Few of our principles are based on data from diverse settings and conditions. On those occasions when researchers do insert contextual diversity into their designs, it becomes apparent that theorizing is paradigm-bound – confined to the specific physical, motivational, and psychological conditions under which the data were gathered. Below we argue for the power of manipulating the context and social meanings, independent of sample diversity.

Motivational context. When researchers contrast paradigms across settings, stimuli, and/or conditions, the results sometimes fail to replicate. For example, Ceci and Bronfenbrenner (1991, cited in Ceci 1996) asked children to predict where on a monitor geometric shapes would migrate after children pressed the space bar. A curvilinear algorithm determined where each shape would migrate[1]:

$$.8\sin(x) + .6\sin(y) + .4\sin(z) + 5\%\text{error}$$

Even after 750 trials, children were still unable to predict the shapes' migration. The implication is that multiplicative reasoning is beyond their capability.

As shown in our Figure 1, however, when the identical algorithm controlled a video game in which the object was to predict the destination at which vehicles would meet a roadblock, children reached ceiling by 450 trials (Ceci 1996). Thus, behavior in ecologically challenging contexts led to findings at odds with those from socially sanitized settings.

Semantic context. Much research on memory, reasoning, and moral development is based on stimuli expunged of meaningful associations (e.g., nonsense syllables) in the belief this will reveal underlying principles. For example, Wason's deduction