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Who Sees Human? The Stability and Importance of Individual Differences in Anthropomorphism

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Abstract

Anthropomorphism is a far-reaching phenomenon that incorporates ideas from social psychology, cognitive psychology, developmental psychology, and the neurosciences. Although commonly considered to be a relatively universal phenomenon with only limited importance in modern industrialized societies—more cute than critical—our research suggests precisely the opposite. In particular, we provide a measure of stable individual differences in anthropomorphism that predicts three important consequences for everyday life. This research demonstrates that individual differences in anthropomorphism predict the degree of moral care and concern afforded to an agent, the amount of responsibility and trust placed on an agent, and the extent to which an agent serves as a source of social influence on the self. These consequences have implications for disciplines outside of psychology including human–computer interaction, business (marketing and finance), and law. Concluding discussion addresses how understanding anthropomorphism not only informs the burgeoning study of nonpersons, but how it informs classic issues underlying person perception as well.

Keywords

anthropomorphism; social cognition; individual differences

General Motors (GM) ran an advertisement during the 2007 Super Bowl to demonstrate their commitment to manufacturing quality. The advertisement, rated by viewers as the fourth most popular ad shown during the game, capitalized on people's tendency to anthropomorphize by depicting a factory line robot being fired from its job after it inadvertently dropped a screw it was designed to install in a car. The ostensibly depressed robot takes a series of low-level jobs until it becomes "distraught" enough to roll itself off a bridge. GM's intended message was clear—the slightest glitch in production would not meet

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their quality standards—but so was their unintended message—that depression had led the easily anthropomorphized robot to commit suicide. The ad immediately incensed the American Foundation for Suicide Prevention who said the ad "portrays suicide as a viable option when someone fails or loses their job" and that "research has also shown that graphic, sensationalized, or romanticized descriptions of suicide deaths in any medium can contribute to suicide contagion, popularly referred to as 'copycat' suicides'" (Associated Press, 2007). This example seems to confirm David Hume's (1757/1957, p. xix) assertion that "there is a universal tendency among mankind to conceive all beings like themselves."

Marketers appear to believe that anthropomorphism matters. Hume appears to believe that anthropomorphism is a universal tendency. We evaluate both of these claims by examining whether there are stable individual differences in the tendency to attribute humanlike attributes to nonhuman agents and whether such differences map onto important judgments, decisions, or behaviors. Our research suggests that the claim that anthropomorphism is universal may be overstated; individual differences in anthropomorphism exist, and we provide a psychometrically valid measure of them (the Individual Differences in Anthropomorphism Questionnaire, or IDAQ). At the very least, anthropomorphism does not appear to be universal in the sense that it occurs to an equivalent degree across all of "mankind." Our research also suggests that marketers are right to care about anthropomorphism; individual differences in anthropomorphism matter for creating an empathic connection with nonhuman agents, for judgments of responsibility and culpability, and for creating social influence. These consequences have implications for human–computer interaction, business, law, and the inverse process of dehumanization. Because of these broad implications, we argue that psychologists should care more about understanding anthropomorphism as well.

Psychological Approaches to Anthropomorphism

Within psychology, anthropomorphism has traditionally figured as a topic of debate over the accuracy of its use in studying nonhuman animals rather than as a topic of scientific inquiry aimed at understanding when people anthropomorphize nonhuman agents and when they do not (Cheney & Seyfarth, 1990; Epley, Waytz, & Cacioppo, 2007; Hauser, 2000). Although an interesting topic, whether dogs or cats or gadgets or gods actually possess the humanlike attributes that people attribute to them is orthogonal to understanding the psychological mechanisms that lead people to attribute humanlike qualities to these agents. It is important to avoid confusing questions about anthropomorphism's accuracy with questions about anthropomorphism's variability, frequency, and consequences.

Recent years, however, have seen a rapidly increasing interest in understanding people's propensity to turn nonhuman agents into human ones (Bering, 2006; Epley et al., 2007; Kwan & Fiske, 2008). Anthropomorphism touches on central topics in virtually all major subfields within psychology, incorporating insights on the brain mechanisms underlying social cognition in neuroscience, on reasoning and induction in cognitive psychology, and on theory of mind in developmental psychology. For example, neuroscientists have examined the neural correlates of anthropomorphism (Gazzola, Rizzolatti, Wicker, & Keysers, 2007; Harris & Fiske, 2008) and identified deficits in anthropomorphism for amygdala-damaged patients (Heberlein & Adolphs, 2004), as well as people diagnosed with autism (Castelli, Frith, Happé, & Frith, 2002). Cognitive psychologists have examined anthropocentrism as a process of inductive reasoning about biological kinds (Anggoro, Waxman, & Medin, 2008; Waxman & Medin, 2007), and developmental psychologists have assessed children's capacity to perceive humanlike intentions in nonhuman stimuli (Scholl & Tremoulet, 2000) in the trajectory of learning to reason about mental states.

Work in these subdomains has proceeded largely independently, with a primary focus on the situational, developmental, or cultural determinants of anthropomorphism (Epley et al., 2007) rather than on its dispositional determinants or on the potentially important consequences of anthropomorphism in everyday life. We do the latter in this article by first presenting a measure of individual differences in anthropomorphism and then examining this measure's predictive utility for the evaluation, treatment, and social influence of a variety of nonhuman agents. Finally, we explain why understanding anthropomorphism is important for areas outside of psychology, including human–computer interaction, business, and law. Far more than just a cute and inconsequential response to stuffed animals or marketing campaigns, anthropomorphism is critical for understanding how people interact with an increasingly wide variety of technological agents, how people make decisions about seemingly agentic financial markets, and how people decide who should be treated with the respect and dignity afforded to other humans and who should not.

What Is Anthropomorphism?

Psychologists have used the term *anthropomorphism* rather loosely to describe everything from mistaken inferences about nonhuman agents to almost any kind of dispositional inference about a nonhuman agent, definitions that do not fit with the actual dictionary definition of attributing "human characteristics or behavior to a god, animal, or object" (Soanes & Stevenson, 2005). Xenophanes (6th Century B.C., as cited in Lesher, 1992) was the first to use the term *anthropomorphism* when describing how gods and other supernatural agents tended to bear a striking physical resemblance to their believers. Xenophanes's observation reflects one of two basic ways of anthropomorphizing. The first involves attributing humanlike physical features to nonhumans (e.g., a face, hands), and the second involves attributing a humanlike mind to nonhumans (e.g., intentions, conscious awareness, secondary emotions such as shame or joy). Anthropomorphism therefore requires going beyond purely behavioral or dispositional inferences about a nonhuman agent and instead requires attributing human form or a human mind to the agent. Regarding a fox as quick does not necessarily denote anthropomorphic reasoning, but regarding a fox as wily does. The former is simply a description of an observable behavior, whereas the latter refers to a distinctively mental quality. Anthropomorphism also goes beyond *animism*—simply attributing life to a nonliving object. The essence of anthropomorphism is therefore attributing capacities that people tend to think of as distinctly human to nonhuman agents, in particular humanlike mental capacities (e.g., intentionality, emotion, cognition). The presence of mental states constitutes both a necessary and sufficient condition for humanness, as the presence of a humanlike face or humanlike body movement generally implies the presence of humanlike mental states as well (Johnson, Slaughter, & Carey, 1998; Morewedge, Preston, & Wegner, 2007).

Although humans may not be the only agents with sophisticated mental capacities, both philosophical and lay theories of personhood focus on mental states as the defining feature that distinguishes humans from other agents (Demoulin et al., 2004; Haslam, Bain, Douge, Lee, & Bastian, 2005). Philosophical definitions of personhood focus on the possession of higher order mental capacities like self-reflection, metacognition, conscious intention, and rational thought (Boethius, 6th Century, cited in Farah & Heberlein, 2007; also see Dennett, 1978; Kant, 1785/1959; Locke, 1841/1997). People's lay theories of humanness also center on traits (e.g., imaginative) and emotions (e.g., humiliation) that implicate higher order mental states such as self-reflection, mental simulation, and prospection (Demoulin et al., 2004; Haslam et al., 2005). Anthropomorphism can therefore be operationalized as a particular form of mental state attribution.

Measuring Stable Behavioral Tendencies: The IDAQ

People may be readily able to think of a hurricane as vindictive or an animated robot as depressed, but this does not mean that such anthropomorphism is a tendency that all share in equal degrees. Stable individual differences in the tendency to anthropomorphize may arise from differences in culture, norms, experience, education, cognitive reasoning styles, and attachment to human and nonhuman agents (Epley et al., 2007). We examined the possibility of such stable individual differences by constructing the individual differences in anthropomorphism questionnaire (IDAQ) and then examining its factor structure.

Although many researchers have examined anthropomorphism, no systematic measure of individual differences has emerged. Measures have ranged from explicit questions about how much an agent looks or acts human (Kiesler & Goetz, 2002) to implicit measures of memory mistakes in which people recall supernatural agents behaving in humanlike ways (Barrett & Keil, 1996). Research in other disciplines has developed scales to measure anthropomorphic tendencies (Chin et al., 2005) or relationships with specific nonhuman targets (e.g., parasocial characters, Auter, 1992; or God, Paloutzian & Ellison, 1982), but these measures either do not measure anthropomorphism efficiently (e.g., the number of items for some measures ranges from 78 to 208), do not measure attribution of qualities that people perceive to be distinctively human (and therefore do not qualify as anthropomorphism), or do not assess anthropomorphism across a diverse array of nonhuman targets. We aim to develop a single questionnaire-based measure of anthropomorphism that predicts judgments across targets and provides a common metric to promote research on this topic.

In developing the IDAQ, we generated items by first identifying four classes of commonly anthropomorphized agents—nonhuman animals, natural entities, spiritual agents, and technological devices—and then pairing each class of agent with five anthropomorphic and five nonanthropomorphic traits (see Appendix). The 15 nonanthropomorphism items (IDAQ-NA)[1] are not part of the IDAQ, but they are included to dissociate

[1]Across studies, IDAQ-NA did not consistently constitute an internally reliable measure and we thus do not report internal consistency for this measure. This lack of internal reliability is expected because these items were developed simply to measure a diffuse set of nonanthropomorphic attributions rather than a single coherent construct. Analyses involving the IDAQ-NA thus appear as ancillary results at https://sites.google.com/site/idaqmaterials/

anthropomorphism from dispositional attribution more generally and to ensure that differences in anthropomorphism do not merely reflect differences in scale use. For purposes of theoretical focus, we have summarized all subsequent studies in the text and provide access to complete methods, materials, and additional analyses at https://sites.google.com/site/idaqmaterials/.

In Study 1, 348 individuals from the University of Chicago population completed the IDAQ. A preliminary exploratory factor analysis on responses to all 40 items revealed three factors, one that captured anthropomorphism of animal stimuli, a second that captured anthropomorphism of nonanimal stimuli (e.g., technology and nature), and a third that captured all items (both anthropomorphic and nonanthropomorphic) pertaining to spiritual agents. This spiritual agent factor suggests that participants did not discriminate between anthropomorphic and nonanthropomorphic attributions of spiritual entities and that this factor instead reflected more general beliefs about the existence of religious or spiritual agents.

Because the IDAQ should reflect anthropomorphism rather than degree of religious belief, we excluded the spiritual target items and assessed the factor structure for the 30 remaining items pertaining to material agents (animals, technology, and nature). This EFA identified a two-factor solution as optimal (RMSEA = 0.067, 90% CI = 0.062–0.073), reflecting anthropomorphism of animal stimuli and anthropomorphism of nonanimal stimuli. Nonanthropomorphism items loaded diffusely and insubstantially across both factors (see Table 1 for all factor loadings).

Study 1 also revealed that these two factors are positively correlated, differing only in terms of the target stimuli rather than in the relative degree of anthropomorphic attributions. Anthropomorphism may therefore be a more general behavioral tendency that people engage in more or less across all nonhuman targets (see Guthrie, 1993, and Mithen, 1996, for similar suggestions). In Study 2, we investigated this possibility that a single superordinate factor can account for anthropomorphism of both classes of stimuli, and also examined the reliability of the factor structure observed in Study 1 by drawing participants from a different population.

In Study 2, 609 individuals from the general population completed the revised 15-item IDAQ (accompanied by the 15 nonanthropomorphism items). A confirmatory factor analysis (CFA) of all 30 items specified the 10 anthropomorphic items pertaining to nonanimals as a first factor and the 5 anthropomorphic items pertaining to animals as a second anthropomorphism factor, permitting the nonanthropomorphism items to load on both factors. This model provided good fit (RMSEA = .073, 90% CI = .070–.077; see Box 1 for additional measures of fit), and revealed a significant correlation between the two first-order anthropomorphism factors ($r = .52$, $p < .001$). To determine whether this reflects a single superordinate factor, we applied a second-order CFA (using only the 15 IDAQ items), which specified factors assessing anthropomorphism of animals and anthropomorphism of nonanimals and indicated “general anthropomorphism” as the superordinate factor. This model provided good fit (RMSEA = .077, 90% CI = .070–.085; see Fig. 1), with the superordinate factor of general anthropomorphism loading highly on the animal anthropomorphism factor (0.88), and moderately highly on the nonanimal anthropomorphism factor (0.57; see Table 2). The 15 items assessing anthropomorphism across agents are also highly intercorrelated ($\alpha \geq .82$ in all studies). Anthropomorphism of both animate and inanimate stimuli therefore appear to be manifestations of a more general tendency to anthropomorphize nonhuman agents.

Box 1

Alternate Measures of Fit for Two-Factor Model (Preliminary Analysis) in Study 2

Sample discrepancy function value	4.12
Population discrepancy function value, Fobias adjusted point estimate	3.43 (90% CI: 3.18, .3.70)
Expected cross-validation index point estimate (modified AIC)	4.27 (90% CI: 4.02, 4.53)
CVI (modified AIC) for the saturated model	1.53
Test statistic	2505.202
Degrees of freedom	420
Effective number of parameters	45

Note: AIC = Akaike's Information Criteria, CVI = cross-validation index.

A third study examined the temporal stability of the IDAQ by having participants from Study 1 complete the measure a second time, 12 to 19 weeks after the initial study. This yielded evidence of reasonable temporal stability, $r(67) = .55$, $p < .0001$. Together, these findings demonstrate a reliable tendency for some people to anthropomorphize more than others, and they provide a psychometrically valid measure of this tendency. Of course, measuring stable tendencies is worthwhile only to the extent that they predict judgments or behaviors that matter in everyday life. Having developed a reliable measure of anthropomorphism, we now use the IDAQ to examine why it matters.

Consequences of Anthropomorphism

Perceiving an agent to have a humanlike mind has at least three major consequences for both the perceiver and the agent perceived (Epley & Waytz, 2009). First, perceiving an agent to have a mind means that agent is capable of conscious experience and should therefore be treated as a moral agent worthy of care and concern (Gray, Gray, & Wegner, 2007). Second, perceiving an agent to have a mind means that the agent is capable of intentional action and can therefore be held responsible for its actions (Gray et al., 2007). Finally, perceiving an agent to have a mind means that the agent is capable of observing, evaluating, and judging a perceiver, thereby serving as a source of normative social influence on the perceiver. In this section, we review previous research on these consequences and provide novel data using the IDAQ to illustrate each one.

Moral Care and Concern

One of the most widely hypothesized consequences of anthropomorphism is that it grants nonhuman agents moral regard, conferring rights such as freedom and autonomy. "Anthropomorphizing nature allows it to be moralized" (Gebhard, Nevers, & Billman-

Mahecha, 2003, pp. 97–98), presumably because of a general sentiment that "when moral worth is in question, it is not a matter of actions which one sees but their inner principles which one does not see" (Kant, 1785/1959, p. 23). Bentham appeared to agree with Kant when he argued that the key question for animal rights was not whether animals were capable of certain behaviors (e.g., talking), but rather "can they suffer?" (Bentham & Browning, 1843, p. 143). Indeed, emerging psychological evidence of higher order mental experiences—such as sadness and depression—in chimpanzees has fueled causes like the Great Ape Project (Cavalieri & Singer, 1993), an organization that advocates for the extension of basic legal rights to great apes. Our first set of studies on the consequences of anthropomorphism therefore examined whether those who tend to anthropomorphize nonhuman agents are also more likely to treat them as moral agents worthy of empathic care and concern.

Secondary emotions—We first examined whether anthropomorphism (measured by the IDAQ) predicts the attribution of secondary emotions, a set of emotions that people commonly consider to be uniquely human (Demoulin et al., 2004; Leyens et al., 2003). Attributing secondary emotions to victims of a natural disaster increases the desire to help those victims (Cuddy, Rock, & Norton, 2007). People are also more likely to attribute secondary emotions to ingroup members than to commonly dehumanized outgroup members (e.g., Leyens et al., 2003).

In this study, 40 individuals from the University of Chicago population completed the IDAQ and then watched two short videos: one of three kittens playing together and one of two snakes fighting with each other (order counterbalanced). Participants then rated the extent to which each animal experienced 10 primary emotions (pain, fear, panic, fright, surprise, suffering, anger, affection, attraction, and pleasure) and 10 secondary emotions (admiration, resentment, shame, remorse, embarrassment, guilt, hope, nostalgia, humiliation, and optimism). Prior research has shown that people perceive these primary emotions to be the least uniquely human emotions, and these secondary emotions to be the most uniquely human emotions (Demoulin et al., 2004). Participants rated the experience of these emotions on scales ranging from 1 (*not at all*) to 7 (*very much*).

The IDAQ significantly predicted the attribution of secondary emotions to the nonhuman animals, $\beta = .61$, $t(38) = 4.71$, $p < .0001$. This relationship held when controlling for participants' attribution of primary emotions to the stimuli, $\beta = .49$, $t(37) = 3.91$, $p < .0001$.

Moral judgments—Given that the IDAQ predicts attributions of complex emotional experience to nonhuman agents, we next examined whether the IDAQ predicts moral judgments about the treatment of these agents as well (Study 5). Kant (1785/1959) described this basic moral principle of autonomy when arguing that "every rational being exists as an end in himself and not merely as a means to be arbitrarily used by this or that will … rational beings are called persons inasmuch as their nature already marks them out as ends in themselves" (quoted in Farah & Heberlein, 2007, p. 6). Dennett (1996) also noted the centrality of mental states to ethical debates:

> Some think it's obvious that a ten-week-old fetus has a mind, and others think it's obvious that it does not. If it does not, then the path is open to argue that it has no more interest than, say, a gangrenous leg or an abscessed tooth—it can be destroyed to save the life of (or just to suit the interests) of the mind-haver of which it is a part. If it does already have a mind, then, whatever we decide, we obviously have to consider its interests along with the interests of its temporary host. (p. 6)

If anthropomorphism involves attributing humanlike mental states to nonhuman agents, then it should also predict the extent to which people consider and respect a nonhuman agent's interests and wellbeing. We examined this prediction in Study 5.

Fifty visitors to the Museum of Science and Industry in Chicago volunteered to complete this study. They completed the IDAQ ($\alpha = .88$) and then read a series of vignettes about nonhuman stimuli (based on materials by Greene, Sommerville, Nystrom, Darley, & Cohen, 2001). In the three moral dilemmas, participants made judgments about the morality of destroying IBM's legendary chess-playing computer, "Deep Blue" (−3 = *absolutely morally wrong* to +3 = *absolutely morally right*), the appropriateness of leaving a bed of rare flowers to be demolished (−3 = *absolutely not* to +3 = *absolutely yes*), and the appropriateness of destroying a prized motorcycle to save a human life (−3 = *absolutely not* to +3 = *absolutely yes*). In two nonmoral dilemmas, participants evaluated the "morality" of waiting to purchase a computer at a lower price and replacing an ingredient of a cookie recipe.

As predicted, the IDAQ significantly predicted how wrong participants reported it was to harm the computer, $\beta = -.47$, $t(48) = 3.64$, $p = .001$, the motorcycle, $\beta = -.38$, $t(48) = 2.84$, $p < .01$, and the flowers, $\beta = -.33$, $t(48) = 2.42$, $p < .05$. The IDAQ also significantly predicted evaluations of wrongdoing for all moral scenarios when controlling independently for judgment of the two nonmoral scenarios (all ps < .025). Anthropomorphism did not significantly predict judgments of the nonmoral scenarios (both ps > .50).

Environmental concern—The relationship between anthropomorphism and moral care may be especially clear and increasingly important in how people view nature. Research has demonstrated that empathizing with nature increases concern for the environment (Gebhard et al., 2003; Schultz, 2000) and that taking the perspective of a harmed animal increases environmental concern (Sevillano, Aragones, & Schultz, 2007). Cultures that anthropomorphize nature, such as the Guatemala Itza Maya community that ascribes "spirits" to their rainforest habitat, follow more sustainable ecological practices than do other groups inhabiting the same area (Atran & Medin, 2008; Atran et al., 2002). And it is surely no accident that environmentalists frequently refer to the planet as "mother earth."

In Study 6, we examined whether anthropomorphism, (measured by the IDAQ) predicted environmental concern. In this study, 52 adults completed the IDAQ in an online study alongside a four-item measure of concern for the environment ("It upsets me when I hear about a forest being destroyed," "I am not very concerned with the well-being of nature," "The government should do more to prevent pollution of the environment," "The protection of plants and trees is not very important"). Participants rated these items on a scale of 1 (*strongly disagree*) to 7 (*strongly agree*) and we computed an environmental concern score

(α = .67) from the mean of these items (reverse-scored where appropriate). The IDAQ predicted environmental concern, $\beta = .28$, $t(50) = 2.12$, $p < .05$, again demonstrating a relationship between anthropomorphism and moral care toward nonhuman agents in nature. Promoting anthropomorphism of nature, as many have suggested, may indeed be an effective way to increase concern for environmental issues such as global warming, air pollution, and water contamination, whereas reducing anthropomorphism may diminish concern.

Responsibility and Trust

Granting an agent mental capacities also means that the agent is capable of autonomous self-directed behavior and can therefore be held responsible for its actions. Existing research demonstrates that people more willingly punish an agent they consider mindful (Gray et al., 2007), and corporations represented as single, personified agents may be held more legally responsible for moral violations than corporations that are represented as collectives of disparate individuals (see French, 1986). In centuries past, legal practices even allowed for criminal prosecution of nonhuman agents such as rodents and statues based on the belief that these agents were conscious intentional actors (Berman, 1994; see also Sunstein & Nussbaum, 2004). If the presence of a thoughtful humanlike mind renders agents worthy of blame, then it may also render agents worthy of trust when their competence is required. In an age where technology is increasingly used to make critical life or death decisions in medical settings, to make investment decisions in stock market settings, or to catch liars in legal settings, the extent to which people trust such technology is becoming increasingly relevant. We predicted that those who are especially likely to anthropomorphize nonhuman agents would also be more likely to trust technology with important tasks.

To test this hypothesis, we asked 54 adults in Study 7 to complete the IDAQ and then indicate whether they would trust a human or a technological agent to predict heart attack risk, detect when a person is lying, determine the best college football team in the country, wash a fragile set of dishes, calculate the cost of preventing air pollution, and select individuals to admit to a university. For each decision, participants read a scenario explaining the situation and then indicated whether they would trust a human or technology with completing a particular task. For instance, participants read that a person had been accused of murder, read the details about the case, and then reported whether they would trust a trained psychologist or a polygraph machine to detect whether or not this suspect was lying. Regressing both age and the IDAQ on a composite measure of participants' trust in technology revealed a significant predictive effect for the IDAQ, $\beta = .30$, $t(51) = 2.29$, $p < .05$. Those more likely to anthropomorphize nonhuman agents were also more likely to report that they would trust technological agents to make important decisions. These findings are consistent with an existing experiment in which people working collaboratively with a robot attributed more responsibility for the overall work to the robot when they were led to anthropomorphize the robot (Hinds, Roberts, & Jones, 2004) and other experiments in which people rated anthropomorphized agents as more credible and capable than nonanthropomorphized agents (Burgoon et al., 2000; Nowak & Rauh, 2005).

We believe these findings raise at least three very interesting questions for future research. First, the data above come from hypothetical scenarios without any real consequences for participants' responses. It is critical to examine whether these scenario results can replicate in real and consequential decisions. Second, if anthropomorphizing technology makes them appear more competent and capable, then it may increase social loafing among people on tasks that require collaboration between humans and nonhumans. Finally, if anthropomorphizing non-human agents makes them appear more responsible for their actions, then the humans controlling those agents may appear less responsible themselves. Modern warfare, for instance, is increasingly becoming a battle of technology in which harm is done indirectly between humans through robots or other military technology. Ron Arkin, a robotics expert, has noted that "it appears inevitable that increasing levels of autonomy will be moved onto unmanned and robotic systems … there are a range of effects [that can occur]: difficulty of responsibility-attribution in the event of war crimes, the potential lowering of the threshold of entry into war, proliferation of the technology into terrorist organizations, and many more" (Bennett, 2008). If robots in war, computers in admissions decisions, or automobiles in accidents appear humanlike, does this decrease the perceived responsibility of the people who programmed the robots, wrote the computer algorithm, or drove the car during possible instances of war crimes, racial discrimination, or vehicular manslaughter?

Social Surveillance

Agents with humanlike minds may appear able to feel, think, and control their own actions, but these mindful agents may also evaluate, judge, and form impressions. In fact, these anthropomorphized agents may be able to form impressions of us. People are more likely to follow social norms—typically behaving more desirably—when watched by other people than when alone, in large part because people care deeply about what others think of them and do their best to make a good impression (Leary, 1995). Other mindful agents therefore serve as sources of social influence. Does anthropomorphizing a nonhuman agent—whether it be a robot, a pet, or a god—increase adherence to socially desirable norms?

Some existing research is consistent with this possibility. People with anthropomorphic representations of God believe God to be more judgmental than those with less anthropomorphic representations (Morewedge & Clear, 2008). And religious systems that propose an omnipresent and judgmental God appear better able to enhance cooperation between group members, possibly because of the capacity for these gods to watch people's behavior at all times and serve as a constant source of social surveillance (Norenzayan & Shariff, 2008). People also present themselves more desirably to a computer interface that has a human face than to one that is purely text-based (Sproull, Subramani, Kiesler, Walker, & Waters, 1996), and they behave more cooperatively in an economic game when humanlike eyes are presented on the computer screen (Haley & Fessler, 2005). Those who are more likely to anthropomorphize nonhuman agents may therefore behave more desirably (or normatively) in the presence of those agents than people who are less likely to anthropomorphize.

We tested this hypothesis (Study 8) by asking 38 participants to complete the IDAQ and then answer an eight-item version of the Marlowe–Crowne scale of socially desirable responding (Crowne & Marlowe, 1964; Ray, 1984), asked over a computer interface by an easily anthropomorphized robot named Kismet. For example, participants would see the robot appear on the screen asking, "Have there been occasions when you have taken advantage of someone?" and would then respond "yes" or "no." As expected, the IDAQ significantly predicted socially desirable responding, $\beta = .42$, $t(36) = 2.77$, $p < .01$. These results suggest that anthropomorphism may increase the social influence of nonhuman agents. Being watched by others matters, perhaps especially when others have a mind like one's own.

Anthropomorphism: A Central Concept Within a Hub Discipline

We have thus far provided a reliable measure of anthropomorphism and provided evidence that this measure matters for some behaviors that psychologists care a great deal about, including judgments about the emotions and mental capacities of other agents, the degree of trust placed in these agents, and the potential influence of these agents on one's own behavior. We believe anthropomorphism matters, however, not simply for psychology but for disciplines far beyond psychology as well. Over the past decade, psychology has emerged as a hub discipline, functioning as one of several core academic domains through which other disciplines communicate and connect (Cacioppo, 2007). Rather than operating as an insular field of study, psychology is highly interdisciplinary and capable of informing these multiple other fields, reflected in the degree to which these other fields cite psychological research and theory (Boyack, Klavans, & Börner, 2005). Given anthropomorphism's consequences for moral concern, perceived responsibility, and social surveillance, we believe understanding it can provide insight into adjacent domains that care about these topics as well. Here, we focus on three in particular: human–computer interaction, business, and law.

Human–Computer Interaction

Anthropomorphism is directly relevant to human–computer interaction, a domain that encompasses artificial intelligence, computer science, and engineering. Recent work in artificial intelligence has produced robots with traces of the most sophisticated of human capacities, with further advances in creating humanlike technology becoming increasingly dependent on psychology. In turn, psychologists have now begun to speculate about the challenges of increased human–android interaction in the next 50 years (Roese & Amir, 2009). Within the past decade alone, engineers have developed robots that can express emotion (Breazeal & Aryananda, 2002), recognize emotional and social cues (Breazeal, 2002), and even imitate human action and behave interdependently (Breazeal & Scassellatti, 2002).

Although people anthropomorphize in varying degrees, these humanlike agents seem to induce at least some anthropomorphism quite readily in most people. One recent neuroimaging study demonstrated the same neural circuitry underlying the perception of human behavior and that of an anthropomorphized robot (Gazzola et al., 2007). Not only do people perceive robots to be humanlike, but people appear to behave toward technological agents following the same social conventions and rules as when interacting with other humans (Nass & Moon, 2000). Capitalizing on this tendency, engineers now routinely design the front side of motorcycles and automobiles to resemble “faces” in order to convey particular impressions (Taylor, 2008).

As computer scientists, robotics developers, and engineers have begun to identify anthropomorphism’s effects on human interaction with technology, understanding the determinants of anthropomorphism can identify the conditions under which these effects will be most potent. In many cases, anthropomorphism appears to enhance human–computer interaction. One study has demonstrated that anthropomorphizing an alarm clock and a robot (as well as a dog and a series of shapes) makes these agents appear more understandable and predictable (Waytz et al., 2009). Other studies demonstrate that anthropomorphic avatars appear more intelligent (Koda & Maes, 1996) and more credible (Nowak & Rauh, 2005) than nonanthropomorphic ones. Anthropomorphic computer interfaces tend to increase engagement (Nass, Moon, Fogg, Reeves, & Dryer, 1995), and appear more effective in collaborative decision-making tasks (Burgoon et al., 2000). People also like robots more when they express emotions in a more humanlike fashion (Siino, Chung, & Hinds, 2008). Anthropomorphic companion robots also provide social support for the elderly, improving both physical and mental health (Banks, Willoughby, & Banks, 2008; Melson, Kahn, Beck, & Friedman, 2009).

Although anthropomorphized technology increases engagement and perceived intelligence, these advances can have some undesirable side effects as well. Certain anthropomorphic computer “assistants,” such as the Microsoft Word paperclip, are strongly disliked because they seem very distracting, much like a insensitive colleague who pops in to one’s office far too often (Shneiderman, 1995; Swartz, 2003). The uncanny valley hypothesis (Mori, 1970) also suggests that robots that look too humanlike actually repulse and discomfort users (MacDorman, Green, Ho, & Koch, 2009). Beyond appearance, the enhanced degree of responsibility afforded to anthropomorphic agents presents some problems as well. People are more likely to treat anthropomorphic interfaces as scapegoats when the technology malfunctions (Serenko, 2007), and they feel less responsible for success on tasks that use humanlike interfaces (Quintanar, Crowell, & Pryor, 1982). Anthropomorphism can also generate inappropriate expectations for how computers and robotics are capable of behaving (DiSalvo & Gemperle, 2003; Shneiderman, 1980). Some research has attempted to address these concerns by proposing an optimal level of anthropomorphism for robotics design (Duffy, 2003). The present research does not necessarily offer prescriptive claims for the anthropomorphism of technology, but it does help determine when and for whom anthropomorphism’s effects are most likely to occur. Computer scientists, robotics developers, and engineers can use this research in their efforts to optimize technology by focusing on the consequences of anthropomorphism and also identifying the people that are most prone to these consequences.

Business: Marketing and Finance

Just as engineers humanize technology, advertisers continue to humanize a wide array of products, and marketing is one of two business-related domains (along with financial decision making) that anthropomorphism can inform. Marketers have long provided anthropomorphic representations of products ranging from Kool-Aid to condoms to car parts with considerable success (Aggarwal & McGill, 2007; Arnheim, 1969; Biel, 2000). Brand "personalities" influence consumer decision making because individuals often attempt to utilize these personalities to express their own self-concepts (Aaker, 1997). Specific humanlike cues, such as an apparent smile in the grill of a car, can also enhance product evaluations if consumers are already primed with an anthropomorphic schema (Aggarwal & McGill, 2007). The anthropomorphic appearance of a product (such as a watch that appears to be smiling when its hands are set to 10:10) can increase liking of that product as well (Labroo, Dhar, & Schwarz, 2008). Given people's natural attentiveness to humanlike cues, anthropomorphism provides an effective way to increase attention to advertising. Studying variation in anthropomorphism can determine who is likely to be influenced by these campaigns and how to make them more (or less) effective (for better or worse).

Equally powerful is the effect of anthropomorphism on the interpretation of the complex and unpredictable working of financial markets. In one study, for instance, the anthropomorphic emotions evoked by particular market sectors predicted investors' willingness to invest in those sectors (MacGregor, Slovic, Dreman, & Berry, 2000). In another, describing the stock market in anthropomorphic terms (as opposed to mechanistic terms) increased predictions that price trends would continue (Morris, Sheldon, Ames, & Young, 2007). In a third, the higher people scored on the IDAQ, the more they predicted stock market trends to continue, as if guided by the stable intentions or goals of a mindful agent (Caruso, Waytz, & Epley, 2010). Adam Smith's metaphor of the "invisible hand" may have more literal consequences for investor decision making than he would have guessed. Practitioners and researchers working at the intersection of psychology and economics—generally called *behavioral economics*—can benefit from understanding how the anthropomorphic depictions of financial systems interact with the presentation of more objective data (e.g., stock prices) to affect economic behavior.

Law

Anthropomorphism's implications for an agent's moral status have immediate relevance to legal practice. Not only do judgments of guilt or innocence center on whether the agent in question is capable of intentional action, but legal decisions about an agent's rights rest on that agent's perceived mental capabilities as well. Animal rights is perhaps the most obvious legal issue relevant to anthropomorphism. Debates over whether animals can be used in biomedical research, whether animals should be treated as property, and whether it is acceptable to eat certain animals all center on these agents' mental similarity to humans (Hauser, Cushman, & Kamen, 2006; Morton, Burghardt, & Smith, 1990). Recently, Spain's lower house of parliament supported a manifesto granting human rights—"life, liberty, and freedom from physical and psychological torture"—to great apes. Spanish congresswoman Joan Herrera justified this decision by noting that these animals are "capable of recognizing themselves, and have cognitive capabilities." Marta Tafalla, a law professor specializing in animal rights, added, "They are animals with highly developed intelligence and emotional capacity" (Abend, 2008). Psychological research on anthropomorphism may not to be able to make such definitive claims about the humanness of various agents, but it can determine the conditions under which people are most likely to represent these agents as humanlike, and what consequences such inferences might have on people's behavior toward those agents.

Equally complex legal decisions concern the rights of humans with ambiguous or incomplete capacities such as a 12-week old fetus, a brain-damaged individual, or a diagnosed sociopath. Topics ranging from abortion, to capital punishment, to euthanasia, to torture center on the humanness of a particular agent to determine whether the agent deserves fundamental human rights. Anthropomorphism may powerfully influence people's judgments on these critical issues. Psychological research on anthropomorphism can contribute to the domain of law by identifying when the attribution of human rights is most likely to occur and identifying the critical preconditions for perceiving humanlike mental capacities in other agents.

Concluding Thoughts: Implications for Person Perception

The exponential increase in natural, biological, and manufactured nonhuman agents in the 21st century makes it increasingly important to study how people understand and treat these agents. Anthropomorphism provides a far-reaching construct for studying how people interact with agents ranging from pets that provide social companionship, to typhoons that decimate entire cities, to robots that perform open-heart surgery. The research presented here examines the existence of stable individual differences in anthropomorphism and uses those differences to identify important consequences of anthropomorphism for psychology and related disciplines. This research complements the most recent theoretical treatment of anthropomorphism (Epley et al., 2007), and expands on empirical demonstrations of predictable variability in anthropomorphism across situations (e.g., Epley, Akalis, Waytz, & Cacioppo, 2008), personality types (e.g., Epley, Waytz, Akalis, & Cacioppo, 2008), developmental stages (e.g., Carey, 1985), and cultures (e.g., Asquith, 1986; Medin & Atran, 2004; Waxman & Medin, 2007). Understanding how these situational, biological, and cultural factors work in concert to create reliable individual differences in anthropomorphism is a very interesting and relatively unexplored topic for future research. Another interesting topic is the relation between the explicit measure of anthropomorphism we have provided here and more implicit manifestations of anthropomorphism that may be reflected in people's behavior but that may not be consciously accessible.

Although the present article focuses on anthropomorphism's effects on perceptions of nonhuman agents, the tendency to anthropomorphize should also influence evaluations of other humans. Humanness exists on a continuum such that individuals can attribute humanlike capacities to nonhuman agents through anthropomorphism and can also fail to attribute these same capacities to other people through dehumanization. The antecedents and consequences of anthropomorphism and dehumanization may be closely linked (Epley et al., 2007; Kwan & Fiske, 2008; Waytz, Epley, & Cacioppo, 2010), and recent empirical work suggests that the same factors that increase anthropomorphism may likewise influence dehumanization. For example, just as an agent's similarity to humans increases anthropomorphism (Morewedge et al., 2007), those who seem very different from the prototypical human are also the most likely to be dehumanized (Harris & Fiske, 2006).

Those who are socially connected are less likely than those who are lonely to anthropomorphize nonhuman agents (Epley et al., 2008), and those who are socially connected also appear more likely to dehumanize other humans (Waytz & Epley, 2009). Even the moral rights and responsibilities granted to humanized agents may be the same ones that are denied to people who are dehumanized (Waytz et al., 2010). Understanding individual differences in anthropomorphism not only seems important for identifying who is likely to treat nonhuman agents as humanlike, but also for identifying who is likely to treat other humans as animals or objects.

Dehumanization has equivalent and opposite implications of anthropomorphism for moral treatment of an agent. Anthropomorphism increases moral concern, whereas dehumanization increases moral disengagement that can license immoral action toward others (Bandura, Barbaranelli, Caprara, & Pastorelli, 1996). For instance, dehumanization increases aggression toward individuals and groups (Bandura, Underwood, & Fromson, 1975; Struch & Schwarz, 1989), endorsement of discrimination toward racial outgroups (Goff, Eberhardt, Williams, & Jackson, 2008), general negative attitudes toward outgroups (Hodson & Costello, 2007), and justification for past wrongdoing toward outgroups (Castano & Giner-Sorolla, 2006). Dehumanization may similarly decrease attributions of responsibility and trust or diminish perceptions of social surveillance, and these domains are ripe for future research to address. In identifying the structure of individual differences in anthropomorphism and consequences of the tendency to "see human," the present research should contribute to an understanding of these well-established topics within person perception just as it contributes to the burgeoning study of nonperson perception.

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Appendix. Scale Development

We generated items for a preliminary version of the IDAQ by first identifying four classes of commonly anthropomorphized agents—nonhuman animals, natural entities, spiritual agents, and technological devices—and pairing each class of agent with five anthropomorphic and five nonanthropomorphic traits. The nonanthropomorphic traits consisted of qualities related to clearly observable or functional features of a stimulus (the extent to which a stimulus is “durable,” “useful,” “good-looking,” “active,” and “lethargic”). The nonanthropomorphic items are not part of the IDAQ, and we simply included these items to dissociate anthropomorphism from dispositional attribution more generally and to ensure that differences in anthropomorphism did not merely reflect differences in scale use.

The mental state attributes used in items for scale development (the extent to which a stimulus has “a mind of its own,” “has free will,” “has consciousness,” “has intentions,” and “can experience emotions”) reflect properties captured in previously used measures of attribution of human uniqueness and higher order cognition to human targets (e.g., Demoulin et al., 2004; Haslam et al., 2005; Kozak, Marsh, & Wegner, 2006). This method of item generation yielded 40 items—20 assessing anthropomorphism and 20 unrelated to anthropomorphism—that we then reduced to 30 items, as shown in Box A1. The 10 items related to spiritual agents ultimately were not used as part of the IDAQ based on the results of Study 1.

Box A1

All IDAQ Items

1	To what extent is the desert lethargic?
2	To what extent is the average computer active?
3	**To what extent does technology—devices and machines for manufacturing, entertainment, and productive processes (e.g., cars, computers, television sets)—have intentions?**
4	**To what extent does the average fish have free will?**
5	To what extent is the average cloud good-looking?
6	To what extent are pets useful?
7	**To what extent does the average mountain have free will?**
8	To what extent is the average amphibian lethargic?
9	**To what extent does a television set experience emotions?**
10	To what extent is the average robot good-looking?
11	**To what extent does the average robot have consciousness?**
12	**To what extent do cows have intentions?**
13	**To what extent does a car have free will?**
14	**To what extent does the ocean have consciousness?**
15	To what extent is the average camera lethargic?
16	To what extent is a river useful?

17	**To what extent does the average computer have a mind of its own?**
18	To what extent is a tree active?
19	To what extent is the average kitchen appliance useful?
20	**To what extent does a cheetah experience emotions?**
21	**To what extent does the environment experience emotions?**
22	**To what extent does the average insect have a mind of its own?**
23	**To what extent does a tree have a mind of its own?**
24	To what extent is technology—devices and machines for manufacturing, entertainment, and productive processes (e.g., cars, computers, television sets)—durable?
25	To what extent is the average cat active?
26	**To what extent does the wind have intentions?**
27	To what extent is the forest durable?
28	To what extent is a tortoise durable?
29	**To what extent does the average reptile have consciousness?**
30	To what extent is the average dog good-looking?

Note: IDAQ items are bolded. All items are rated on a 0 (*not at all*) to 10 (*very much*) scale. To compute the IDAQ response score, sum items 3, 4, 7, 9, 11, 12, 13, 14, 17, 20, 21, 22, 23, 26, 29. To compute IDAQ-NA, sum items 1, 2, 5, 6, 8, 10, 15, 16, 18, 19, 24, 25, 27, 28, 30. Unused items with spiritual agents are: "To what extent does a spirit (or spirits) have a mind of its own?", "To what extent does a ghost have free will?", "To what extent do supernatural beings have intentions?", "To what extent does the average spiritual agent have consciousness?", "To what extent does a god experience emotions?", "To what extent are deities durable?", "To what extent is a god useful?", "To what extent is the average supernatural being good-looking?", "To what extent is a spirit (or spirits) active?", and "To what extent is the average spiritual agent lethargic?"

Sample discrepancy function value	2.732
Population discrepancy function value, Fo	2.092
Expected cross-validation index	2.98
CVI (modified AIC) for the saturated model	1.53
Test statistic	1661.23
Degrees of freedom	389
Effective number of parameters	76

	tmind	twill	tintent	tcon	temo	amind	awill	aintent	acon	aemo	nmind	nwill	nintent	ncon	nemo
tmind	1														
twill	.41	1													
tintent	.35	.28	1												
tcon	.44	.48	.31	1											
temo	.25	.28	.25	.18	1										
amind	.21	.14	.18	.16	.07	1									
awill	.16	.16	.20	.15	.13	.61	1								
aintent	.12	.14	.12	.15	.05	.45	.52	1							
acon	.13	.12	.10	.15	.05	.51	.46	.51	1						
aemo	.09	.12	.14	.10	.08	.39	.46	.55	.46	1					
nmind	.27	.29	.35	.28	.23	.40	.33	.32	.30	.32	1				
nwill	.37	.33	.36	.27	.28	.21	.29	.24	.18	.22	.54	1			
nintent	.36	.37	.43	.30	.32	.30	.30	.28	.24	.29	.57	.58	1		
ncon	.33	.29	.30	.35	.22	.25	.25	.26	.27	.25	.59	.53	.56	1	
nemo	.31	.24	.34	.27	.27	.25	.28	.25	.22	.33	.51	.49	.53	.56	1

Fig. 1.

Alternate measures of fit and covariance matrix for two-factor model (secondary analysis) in Study 2. AIC = Akaike's Information Criteria, CVI = cross-validation index. For each item, first letter indicates type of agent (a = animal, n = nature, t = technology) with attribute indicated by the following code: mind = mind, will = free will, intent = intentions, con = consciousness, emo = emotions, act = active, leth = lethargic, goodl = good looking, dur = durable, and use = useful.

Table 1

Items From Study 1 and Factor Loadings

Item	Factor 1: Pattern coefficients	Factor 2: Pattern coefficients	Factor 1: Structure coefficients	Factor 2: Structure coefficients
tmind	**.615**	.023	.623	.228
twill	**.756**	−.064	.735	.189
tintent	**.512**	.047	.528	.218
tcon	**.523**	−.007	.521	.168
temo	**.596**	−.085	.568	.114
tdur	−.039	.166	.016	.153
tuse	−.205	.249	−.122	.181
tgoodl	.133	.155	.185	.199
tact	.038	.222	.112	.235
tleth	.261	.072	.285	.159
amind	.029	**.740**	.276	.750
awill	.002	**.787**	.265	.788
aintent	.011	**.695**	.243	.699
acon	−.053	**.746**	.196	.728
aemo	.040	**.653**	.258	.666
adur	.026	.310	.130	.319
ause	.008	.329	.118	.332
agoodl	.068	.318	.174	.341
aact	−.029	.412	.109	.402
aleth	.068	.124	.109	.147
nmind	**.708**	.137	.754	.373
nwill	**.762**	−.018	.756	.237
nintent	**.775**	−.049	.759	.210
ncon	**.761**	.027	.770	.281
nemo	**.736**	.026	.745	.272
ndur	.007	.390	.137	.392
nuse	−.165	.290	−.068	.235
ngoodl	.190	.254	.275	.317
nact	.251	.287	.347	.371
nleth	.292	.084	.320	.182

Note: Loadings >.45 are in bold. For each item, first letter indicates type of agent (a = animal, n = nature, t = technology) with attribute indicated by the following code: mind = mind, will = free will, intent = intentions, con = consciousness, emo = emotions, act = active, leth = lethargic, goodl = good looking, dur = durable, and use = useful.

Table 2

Factor Loading Matrix for Secondary Factor Analysis in Study 2

Item	First-order factor	Point estimate
tmind	inanimate	0.499
twill	inanimate	0.474
tintent	inanimate	0.512
tcon	inanimate	0.461
temo	inanimate	0.378
amind	animate	0.710
awill	animate	0.746
aintent	animate	0.713
acon	animate	0.674
aemo	animate	0.654
nmind	inanimate	0.733
nwill	inanimate	0.722
nintent	inanimate	0.773
ncon	inanimate	0.734
nemo	inanimate	0.685

Note: For each item, the first letter indicates type of agent (a =animal, n =nature, t =technology) with attribute indicated by the following code: mind =mind, will = free will, intent =intentions, con =consciousness, emo =emotions, act =active, leth = lethargic, goodl = good looking, dur = durable, and use = useful.