Insights from the Animal Kingdom

VICKI G. MORWITZ*

Vicki G. Morwitz is Harvey Golub Professor of Business Leadership and Professor of Marketing, New York University, 40 West 4th Street, Tisch Hall, Suite 807, New York, NY 10012 (Phone: 212-998-0518; Fax: 212-995-4006; email: vmorwitz@stern.nyu.edu). The author gratefully acknowledges helpful comments from Amitav Chakravarti, Anna Greenleaf, Eric Greenleaf, Leo Greenleaf, Geeta Menon, Sankar Sen, and the *JCP* reviewers and Research Review Area Editor. This paper is based on the author's Presidential address given at the 2012 Society for Consumer Psychology Conference.

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ABSTRACT

Just as we have learned a great deal in consumer psychology by focusing on understanding how different sub-groups of humans think, this paper suggests that we can also learn from examining how different types of animals think. To that end, this manuscript offers a review of literature on topics in animal cognition that have also been investigated by consumer researchers. It first reviews research that has identified ways in which animals and humans are similar and then reviews research that has identified ways in which animals differ from humans, with a focus on ways in which some animals have been shown to outperform humans. The manuscript concludes with a discussion of opportunities for future research.

Introduction

The theories and knowledge that consumer psychologists have developed and draw from to increase our understanding of consumers concern how humans process information, think, and make decisions. In addition to enriching our understanding, this research has provided much help to humans – humans who consume, humans who make decisions for nonprofit and for profit businesses, and those who make decisions for government agencies. This same research can also be used to help non-humans. For example, we can use our theories to develop best practices for how to explain and communicate complex issues like climate change that greatly impact both humans and non-humans (Shome & Marx, 2009). Similarly, we can use psychological theories to determine which methods will work best to persuade humans that they can do things to help save wildlife and wild places (e.g., Fujita, Eyal, Chaiken, Trope, & Liberman 2008, Smith, Faro, & Burson 2013).

Is the converse true? Can knowing how non-human animals[1] think help us to better understand how consumers think and make decisions? Can we even know how animals think? People who work with animals need to understand how animals think in order to do their jobs well. For example at most modern zoos, the animals receive behavior enrichment (Mellen & MacPhee, 2001) which entails giving animals activities to keep their minds active and cognitive tasks that mimic those they would normally do in the wild. For example, zoo keepers sometimes hide an animal's food in a novel spot to simulate foraging for food in the wild (Shepherdson, Carlstead, Mellen, & Seidensticker, 1993). To create good enrichments tasks, the zoo keepers

[1] For the remainder of this article, for convenience, I will use the term "animals" to refer to non-human animals, though humans are a type of animal.

have to think a lot about what it must be like to be each type of animal. How do they perceive the world? How do they think?

Lay and professional philosophers also ponder how animals think. Many pet owners wonder how the world looks from their pet's perspective (Bradshaw, 2012; 2013; Hill, Gaines, & Wilson, 2008; Holbrook 2008). In a highly cited article in philosophy, and one of the most influential papers on consciousness, Nagel (1974) wondered how the world must seem to a bat, who perceives the world in a way we cannot, using echolocation to perceive space. Views have ranged from those who believe that animals lack consciousness, especially higher order consciousness (Carruthers 2005; Descartes 1637/1994), to those who approach the question with an anthropocentrism perspective and view animals as little humans (Wynne 2001, pp. 1-3).

Recently there has also been growing popular (for example, *National Geographic*, Inside Animal Minds, March 2008; *Time*, What Animals Think, August 16, 2010) and academic interest (for example, Gorman, 2012; Griffin, 2001; Shettleworth, 2010; Wynne, 2001) in how animals think and a growing perspective that different species think differently and that we can learn from their similarities and differences. Many new insights have been obtained from scientific research that examines how animals think. This field, which some call animal cognition, and others call comparative psychology, is a branch of psychology that emphasizes cross-species comparisons—including human-to-animal comparisons (Wasserman, 1981; 1993).

The basic premise of this article is to argue that just as we have learned a lot in consumer psychology by focusing on understanding how different sub-groups of humans think, we can also learn from examining how different types of animals think. Specifically, consumer psychology has been enriched by examining within the human species, comparisons across people based on their sex or gender identity (Dahl, Sengupta, & Vohs, 2009; Fischer & Arnold, 1990; Fisher &

Dubé, 2005; Iacobucci & Ostrum, 2008; Sengupta & Dahl, 2008; Lee & Schumann, 2009; Meyers-Levy & Zhu, 2010; Winterich, Mittal, & Ross, 2009), age (Cole & Balasubramanian, 1993; John & Cole, 1986; Yoon, Cole, & Lee, 2009), and culture (Aaker & Sengupta 2000; Briley, Morris, & Simonson 2000; Chan, Wan, & Sin 2009; Kacen & Lee 2002; Maheswaran & Shavitt, 2000; Shavitt et al., 2006; McCracken, 1986). While we tend to focus on differences across groups in the literature, we learn both from when we discover similarities across people and when we observe differences. I argue here that we can further enrich our understanding of human consumers by examining similarities and differences between how humans and other animals think.

It is important to note that many consumer and psychology researchers have studied various aspects of animal consumption, including humans' choice of animals, and new breeds of animals, as pets (e.g., Hirschman, 1994; Moore and Holbrook, 1982), how and why they welcome animals into their homes (e.g., Hickrod, Huang, & Schmitt, 1982; Holbrook, 2008; Meer 1984), and their purchase behavior for products and services for their pets (e.g., Holbrook, 2008; Holbrook & Woodside, 2008; Meer, 1984; Ridgway et al. 2008). While we have learned much from this prior work about how humans and animals interact and jointly engage in consumption activities, I examine a more narrowly defined set of issues related to implications to human consumers from formal studies of animal cognition.

Even within this narrower domain, I follow other consumer research scholars who have already made the case that animal behavior is relevant for improving our understanding of human consumption (Holbrook, 1987). For example Alba (2000), in his ACR Presidential address, argues that simple models from animal cognition and animal self-control research that don't rely on mindfulness may parsimoniously explain much consumer behavior. van Osselaer

(2004) makes a similar point when he discusses how the seemingly complex ways in which consumers evaluate products and make choices between branded goods can be explained by very simple processes of associative learning that have been examined in depth in rats, dogs, and other animals.

For the remainder of this article, I review relevant literature on animal cognition and thus build from the work of Alba, Holbrook, van Osselaer, and others to further the argument that we **c**an we learn from cross species research in the same way we have learned from gender studies, studies of age differences, and cross cultural studies. I first discuss some ways in which other animals are similar to humans, first some general ways, and then some surprising ways in topics of particular interest to consumer researchers. I then discuss some differences between animals and humans with a focus on ways in which some animals have been shown to outperform humans in areas of interest to consumer researchers. I conclude with a brief discussion of opportunities for future research.

We humans are not so unique

We humans have long considered ourselves to be truly unique (Premack, 2010). Yet, each year scientists prove that some traits that we thought were unique to humans are found in other animals. Among other traits, these include such general ones as having a sense of humor, using complex communication, having emotions, having culture, having self-awareness, and constructing and using tools.

Some have argued that only humans have a sense of humor and that laughter as a response to humor was a uniquely human response (Lynch 2010). However research has shown that three other great apes in addition to humans (chimpanzees, gorillas, and orangutans) react in similar ways when they are tickled by another member of their species. While humans tend to laugh when tickled, the other great apes pant in a manner similar to laughter (McGhee, 1979; Paterson & Linden, 1981). More recently scientists have even uncovered evidence of laughter among young rats while playing (Pankepp and Burgdorf, 2003). There has been evidence of pranks and humor among other primates (Gould and Gould, 1994). There have also been anecdotal reports of apes in the wild (gibbons) taunting tiger cubs by repeatedly pulling their ears, tails, and patting them (Lepage, 2001).

Some have argued that humans have special brain mechanisms that work together with our anatomy to uniquely allow us to engage in speech and use complex syntax (Lieberman, 1991). Although there is no evidence that other animals can talk verbally in the manner that we do (which is not surprising since modern human language is probably only between 100,000 and 250,000 years old (Wynne, 2001)), great apes have been taught to communicate using American sign language and other communication systems (Gardner and Gardner, 1969; Patterson, 1978; Savage-Rumbaugh, Rumbaugh, & McDonald, 1985).

Some researchers argue that only humans are capable of feeling emotion, and others have classified emotions as those that are non-uniquely human (primary emotions such as fear) and those that are uniquely human (secondary emotions such as sorrow) (Demoulin et al., 2004). Grief for example has been argued to have social and cultural aspects and interpretations that take a uniquely human form (Neimeyer, Prigerson, & Davies, 2002). Empathy has also been considered a unique capability of humans (Clark, 1980). Yet there is evidence of elephants waiting for and helping injured herd members, and they appear to show empathy and mourn for their dead (Plotnick et al., 2010).

Some researchers argue that culture shapes all aspects of how humans live and that social aspects of life are both learned and created in social ways that are uniquely human (Chase, 2006). While researchers debate the precise meaning of culture, culture is increasingly believed to be important in other species (Cantor & Whitehead, 2013). For example, *w*ild dolphins, who were recovering from an illness in an aquarium in Australia, were observed to have learned to tail walk only from their seeing this behavior exhibited by other dolphins that lived in captivity, and not from working with human trainers. Once released these same dolphins were observed exhibiting this behavior in the wild and then other wild dolphins were also observed doing the same behavior (Angier, 2010).

Researchers have also debated whether self-awareness is unique to humans (Lewis, 1991). Though some have debated the validity of the commonly used red spot test as a way of determining whether non-human animals have self-awareness or a theory of the mind (Heyes, 1998), there is evidence that great apes, dolphins, elephants, and magpies recognize their own reflection in the mirror and if they see anything unusual in their reflection, try to inspect or remove it (Prior, Schwarz, & Güntürkün, 2008), which has been taken as evidence that these animals are self-aware.

Finally, tool use was long considered to be a characteristic that significantly differentiated humans from all other species (Oakley, 1956). However, we now know that the great apes and other primates use tools (Peeters et al., 2009). Ravens have also been observed to use stones to crack eggs, sometimes immobilizing an egg with a bigger stone and hitting it with a smaller one (Caffrey, 2001).

In sum, over the years, research has overturned many of the characteristics of humans that were considered to be unique in the animal kingdom. In a similar manner, many of the findings from social and cognitive psychology, that we draw on in understanding consumer psychology, not only apply to humans but also to other animals. In the next section, I summarize some recent findings from animal cognition on topics that are also of interest to us, as consumer psychologists, where animals and humans perform similarly, and discuss some implications for understanding consumer cognition.

Animals and humans perform similarly on many tasks

Learning

Theories and tests of associative learning that have been conducted on animals can be used to explain how consumers evaluate and choose among brands in the face of marketing-provided information (van Osselaer, 2004). As van Ossealaer discusses (2004), experiments that Pavlov (1927) conducted demonstrated that dogs learned to associate a cue (e.g., a sound) to a stimulus (e.g. food) and could be trained to respond the same way (e.g., salivate) to the cue (conditioned response) that they did to the stimulus (unconditioned response). Thus with Pavlovian conditioning the animal responds to a seemingly innocuous stimulus, but one that signals to the animal that something will happen, and their response to the innocuous stimulus is appropriate given that outcome. Pavlovian conditioning has been demonstrated in a wide range of animals including small marine snails, bees, Siamese fighting fish, lemon sharks, leopard frogs, Bengal monitor lizards, pigeons, rats, mice, rabbits, cats, marsupials, farm animals, and of course dogs (Wynne 2001, 37-39).

van Osselaer (2004) notes how brands and product attributes are cues that can be used to predict an outcome like the taste of peanut butter, just like a sound can be used to predict the appearance of food in Pavlov’s experiments. He goes on to discuss how learning processes in consumers that on the face of it seem complex and sophisticated - such as how consumers learn to combine multiple cues about a product, such as its brand name and attribute information, to predict its quality - can be explained simply by associative learning processes commonly observed in animals (van Osselaer & Alba 2003). These animal learning models explain well how consumers can quickly determine which product characteristics are most predictive of quality. Associative learning models, while quite simple, can explain a wide variety of behaviors in animals (Wynne 2001, 52) and humans (van Osselaer 2004; van Osselaer & Alba, 2003).

Numerical Cognition

Theories of numerical cognition have been used in our field to better understand consumer behavior (e.g., Monroe and Lee, 1999); indeed I have relied on these theories in some of my work with Manoj Thomas on behavioral aspects of pricing (Thomas and Morwitz, 2005; 2009). How and to what degree animals can count and represent different numbers of objects is also of core interest in animal cognition. Research has shown that in addition to human adults and children, a wide range of animals have numerical cognition systems, including nonhuman primates, raccoons, horses, dolphins, pigeons, African gray parrots, white-necked ravens, domestic chicks, and even salamanders, mosquitofish, and honeybees (Bogale et al., 2011).

A few of these studies involved animals that could speak in a way humans could directly understand (Pepperberg, 1994). An African gray parrot, Alex, could vocally state, using English words, numbers and the number of objects in a set with a particular characteristics, such as a particular color or shape. The results demonstrated that an animal who was neither a human nor a primate was able to demonstrate numerical abilities that were equivalent to those of a human.

Since most animals cannot verbalize numbers in the ways some parrots can, other methods are typically used to study numerical abilities in animals. For example in one study researchers examined whether South American sea lions, in the absence of training, can determine the larger of two quantities (Abramson et al., 2011). In one study, sea lions participated in one to three daily sessions of forced choice trials that involved 10 to 12 sets of two boxes. Pairs of boxes, with opaque lids and with different amounts of fish in them (1 vs. 2 fish; 1 vs. 3; 1 vs. 4; 1 vs. 5; 2 vs. 3; 2 vs. 4; 2 vs. 5; 2 vs. 6; 3 vs. 4; 3 vs. 5: 3 vs. 6; and 4 vs. 6) were presented simultaneously to the sea lions. In each trial the sea lions could select one of the two boxes, by coming to it and touching it, and then could eat all the fish in their selected box. The experimenter recorded how many times the sea lions selected the box that had more fish. Prior to the start of the experiment, the boxes to be used across the trials were first filled with the specified number of fish. This was done in an area outside the view of the sea lions and their trainers. During each trial, the trainer placed the boxes approximately 50 cm from the sea lion and uncovered the boxes. The position of the boxes allowed the sea lion to see the contents, but not the trainer, so that the trainer could not inadvertently cue the sea lion to the right choice. In a second study, the choice sets and basic procedures were the same, but rather than using boxes, the trainer took out pieces of fish from a cube and dropped them one by one into buckets. The buckets were high so the sea lions could not see their contents. The only way they could judge the relative quantity of fish in the two buckets was to watch as they were dropped one by one into the buckets or by listening to the associated sounds of dropping the fish in the buckets. The trainer wore sunglasses and looked down to avoid cuing the sea lion to the correct answer. This study, like many others with other animals, showed that animals can discriminate larger from smaller quantities, though the results were weaker when presentation was sequential.

But like what has been observed when humans are asked to perform similar tasks, the researchers typically also observe distance and magnitude effects. With distance effects, performance declines as the difference between the numbers reduces. In other words it is easier to tell that five fish are more than two fish, than it is to tell that three fish are more than two fish. With magnitude effects, performance decreases as the numbers being compared increase. In other words it is easier to tell that five fish are more than two fish than it is to tell that 15 fish are more than 12 fish (Dehaene, 1997, p. 26). This has been taken as evidence that humans and other animals represent numbers in analog form and provide support for the accumulator model (Abramson et al., 2011). Researchers agree we can still learn much about how humans process numbers by noting the similarity between humans' and other animals' numerical cognition systems (Dehaene, Dehaene-Lambertz, & Cohen, 1998; Feigenson, Dehaene, and Spelke, 2004). For example there is still debate about the mapping between numerals and numeric magnitudes in the brain, and about whether durations and numbers are processed in the same manner, both of which have much relevance for consumers, how they process price information, how they perceive time, and how they monetize time.

Categorization

Consumer psychologists (Sujan & Dekleva, 1987; Moreau, Markman, & Lehmann, 2001) and animal cognition researchers (Herrnstein & Loveland, 1964; Range at al., 2008) are both interested in how individuals categorize objects. For example, animal cognition studies have demonstrated that pigeons can categorize paintings by the artist who painted them.

In one study pigeons were trained on one set of paintings (four by Van Gogh including his *Way of Cypress and Stars* and four by Chagall including his *Around Her,* which both contained a lot of the color blue and images of trees). The Pigeons could discriminate the artist's work even when paintings were reproduced in black and white, partially occluded, or processed as mosaics. They could also properly categorize new paintings by the same artist that they had not seen before. The pigeon’s performance was comparable to that of humans who were asked to perform the same task (Watanabe, 2001).

Research has also shown that pigeons can generalize from one artist to a similar one. For example Watanabe, Sakamoto, and Wakita (1995) showed that pigeons recognized that Monet's work is similar to that of other impressionists and post impressionists like Cezanne, and that Picasso's work is similar to Matisse's, and use that recognition in categorization tasks. While the pigeons in these studies used visual information to categorize, other research has shown pigeons can discriminate between the music of Bach and Stravinsky as well as can college students (Porter and Neuringer, 1984).

Pigeons are not the only art connoisseurs in the animal kingdom. Wu et al. (2012) using the same paintings as Wantanabe et al. (1995) showed that honeybees are also able to discriminate between the complex impressionist paintings by Monet and the cubist paintings by Picasso, both when that work was shown in color, and when it was shown in grayscale. Like pigeons, the honeybees could even correctly categorize paintings they had not seen before of the same style. The authors conclude that the ability to process, learn, and categorize the visual characteristics of complex visual images is something shared by humans and other animals and that it is not a sign of higher cognitive function since honeybees have a “brain the size of a grass seed.” Understanding this can help enhance our understanding of how consumers categorize new products based on their appearance, details versus more global elements, and how they contend with missing information (Moreau, Markman, & Lehmann, 2001).

One of the most fascinating findings in this area was in Watanabe’s recent work (2010, 2011). Even though some argue beauty is a socially constructed concept, he showed that pigeons could discriminate between children’s art that humans had previously judged to be good (beautiful) or bad (ugly). The author speculates that work that builds from this can help us to understand how humans judge aesthetics, a topic of much interest among consumer psychologists (Bloch, Brunel, & Arnold, 2003).

Metacognition

Metacognition, fluency, and feelings of knowing have been of great interest recently in our community (Alba and Hutchinson, 2000; Alter and Oppenheimer, 2009; Janiszewski and Meyvis, 2001; Novemsky et al., 2007; Rucker & Tormala, 2012; Schwarz 2004). Until recently, the ability to reflect on our own mental processes has been thought to be a defining feature of being human (Tomasello and Rakoczy, 2003).

Recent research in animal cognition focuses on whether animals also have knowledge of their own cognitive states (Smith, 2009; Smith, Shields, & Washburn, 2003; Suda-King, 2008). This research uses experimental paradigms that examine whether an animal behaves differently when it knows it does not remember, or when it feels it may get an answer wrong, and hence may not get a reward. For example, Foote and Crystal (2007) showed that rats know when they do not know the answer to a duration discrimination task. Rats had to classify brief noises as short or long by pulling a lever with their nose. If they got the task right, they got six food pellets. If they got it wrong, they got none. In trials when a decline option was available, rats got a guaranteed, but smaller reward of three pellets. Durations near the middle of the range are of course more difficult to discriminate. Rats were more likely to decline these more difficult tests, consistent with what would happen if they knew they did not know the answer. These findings are consistent with metacognition.

Research by Call (2010) that involved four different types of great apes (bonobos, chimpanzees, gorillas, and orangutans) showed that these apes would decide whether to forgo a larger reward when they were uncertain by obtaining additional information based on the value of the reward, and the effort and cost associated with obtaining information. This study demonstrated that apes, like humans (Payne, Bettman, & Johnson, 1988), reflect on and decide what decision strategies to use based on what they know, the effort required to use those strategies, and the possible rewards. These similarities may help us to better understand how emotional reactions to uncertainty and cognitions interact in consumers' metacognitive experiences and use of lay theories and decision strategies.

Deceit

Consumer research has shown that consumers may attempt to lie or deceive another person to increase one's self esteem or to manage one's impressions with others. For example Sengupta, Dahl, and Gorn (2002) showed that consumers will intentionally misrepresent the price they paid for a good, whether they purchased it on discount, and their wealth, and posit they do so to boost their self-esteem. These authors pose as a question for future research how consumer deception might vary across cultures. Lalwani, Shavitt, and Johnson (2006) examine the relationship between culture and providing socially desirable responses to a survey and show that people's tendencies to deceive help explain the relationship between culture and these untruthful survey responses.

Humans are not the only animals that engage in deceitful behaviors, and examining deceit across species may offer novel insights into why and when humans will attempt to deceive others. Premack (2007) discusses how plovers will attempt to deceive intruders that approach their nest by faking that their wing is broken. Once they lead the intruder far from the nest, they fly off, having successfully used deceit to protect their nest. Woodruff and Premack (1979) studied pairs of chimpanzees and humans that worked together. The chimpanzees were shown two containers, only one of which held food, and had to choose one. The chimpanzees could see but could not reach the containers but a human trainer could. However the trainer did not know which container held the food. The chimpanzees would indicate to the human by point or gaze which container they chose. There were two different trainers, one who if the chosen container had food shared it with the chimpanzee, and one who kept the food for himself. The experiment lasted over a year. The chimpanzees always correctly indicated the container that held food to the sharing experimenter. However, for the non-sharing experimenter, the oldest chimpanzee learned over time to deceive the trainer by pointing to the container he knew held no food. Osvath and Karvonent (2010) report observations of a chimpanzee in a zoo who manufactured projectiles and designed innovative ways to hide them. When he could in a position in his exhibit that was close enough to observing zoo visitors, he would then throw the projectiles at the visitors before they could move away. The chimpanzee also observed that whenever he displayed aggressive behaviors zoo guides would quickly move the visitors away. On one occasion, when the visitors returned after earlier being moved away, the chimpanzee was observed not displaying his typical aggressive behavior. Instead, he picked up an apple, took a bite from the apple while approaching the visitors, and then threw projectiles at the visitors, which he had concealed in his hands prior to picking up the apple.

Research like this on animal deceit might help inform us of the underpinning of deceit in humans, whether we should expect it to vary across cultures, and in what circumstances it is most likely to manifest. Findings concerning deceit in animals might help us better understand and predict when consumers are likely to lie to each other and to firms, when sales people and other marketing representatives might be most likely to attempt to deceive consumers, and to what extent these types of deceitful behavior can be reduced.

Exchange-related Processes

One text book definition of marketing is that it is "human activity directed at satisfying needs and wants through an exchange process" (Kotler and Turner, 1981). However, as I argued in Morwitz (2008), given this definition, marketing extends beyond humans. As I discussed in that article, research has shown chimpanzees engaging in exchange with other chimpanzees and with humans in experimental settings (Nissen & Crawford, 1936; Savage-Rumbaugh, Rumbaugh, & Boysen, 1978). Research has also shown cases involving no human intervention, where captive, adolescent chimpanzees spontaneously exchanged objects directly with each other (Paquette 1992). This is consistent with Frans de Waal's (1997) view that chimpanzees have a reciprocal service economy where they trade both goods and services (e.g., food and grooming) (de Waal, 2005).

Research has also shown that biases that we study in human consumers in exchange processes, such as loss aversion and reference dependence, are shared with an ancestrally related New World primate, the capuchin monkey and other primates (Chen, Lakshminaryanan, & Santos, 2006; Lakshminaryanan, Chen, & Santos, 2011). Capuchins also display an endowment effect in a token trading task (Lakshminaryanan, Chen, & Santos, 2008). Gorillas display endowment effects for food but not for non-food items (Drayton et al., 2013). Other research has shown that rhesus macaques display ambiguity aversion even when costly (Hayden, Heilbronner, & Platt 2010). The authors of all these studies conclude that these common biases show that we humans rely on cognitive systems that are more evolutionarily ancient than previously thought—

and that common evolutionary ancestry shared by humans and these other primates may account for the occurrence of these effects across species. The similarities and differences in behavior observed across species might help us to resolve the ongoing debate in our field about why humans are prone to the endowment effect, why humans are ambiguity averse, and whether and when debiasing techniques are likely to succeed.

It is both interesting and important to note that while much of the exchange-oriented research has been conducted on primates, because they are closely related to humans from an evolutionary perspective, John Kagel and his colleagues (for example, see Kagel et al., 1975, 1981, 1990) conducted controlled, experimental economic studies with real consequences using traditional lab animals. In this body of work Kagel tested basic propositions of economic theories using rats and pigeons. These studies demonstrated by and large that rats, pigeons, and humans all behave in manners consistent with economic theories of choice, consumer demand, labor supply, and choice under uncertainty. Kagel and his colleagues argued that if animals commonly used in laboratory research behavior similarly to humans with respect to economic behaviors, then these animals can be used, largely as a matter of experimenter convenience, in experiments to tests aspects of economic theory that are too complex to test in a straightforward way with humans, or that involve conditions that would be unacceptable or unethical to test on humans. For example, in Kagel et al. (1975) in one study the price of food was increased by 400% which resulted in the subject, a rat, losing a considerable amount of weight. This work is interesting in and of its own right in terms of the similarities between humans, rats, and pigeons, and because it shows that it is not just humans who behave as if they are calculating formulas to maximize utility, but also rats and pigeons. However, as Santos and Platt (2014) discuss, this work is less useful for understanding the evolution of human decision making than work that was conducted using our closer relatives in the animal kingdom.

Differences between animal and human perception and cognition

So far the research I summarized has shown that animals perform in unexpectedly similar ways to humans. In this section I summarize research that shows ways in which animals outperform humans.

Sensory Perception

There has been growing interest in marketing on sensory perception and its impact on consumers (Krishna, 2011). There is still much to learn about how our senses influence our perceptions and preferences. The research to date clearly indicates that what we infer about the world around us from our senses has a strong impact on us.

However we humans do not have the tools to sense all aspects of the world we live in and we are more limited in our sensory perception than some other animals. Consumer researchers have examined how the color of stimuli influences us (Moore, Stammerjohan, & Coulter, 2005; Tavassoli, 2001). Our eyes and our brains provide a window to our world, but they also limit what we can see. For example, as discussed in Wynne (2001), we do not see the full spectrum of light or electromagnetic radiation. In fact the portion of the spectrum that we can see is quite small, ranging from about 420 nanometers (violet) to 700 nanometers (red). The full light spectrum includes wavelengths outside of this range that we cannot see including shorter (ultraviolet) and longer (infrared) wavelengths. We are also limited by the number of color receptors in our eyes, which is three for most humans. Each of our color receptors is tuned to a different wavelength. It is because of our limited number of color receptors that mixtures of colors (for example blue and yellow) appear as a solid color to our eyes (green). The mixture is not actually the same as the solid color; it just appears that way to our human eyes.

Other species do not have these same limitations and can see and process wider ranges of the spectrum including parts that we cannot see. Many animals also have more color receptors and these animals can perceive the difference between color mixtures and what appears to be a solid color to us. Fish and reptiles, and a few human women have four color receptors and see more colors than most of us. Birds have as many as six. Pigeons have remarkable vision. They have at least six color receptors and can see ultraviolet light. Pigeons, like anthropods, can also see the polarity of light. Since it changes with the position of the sun, they can use it as a compass to navigate, even on overcast days when they can't see the sun (Wynne 2001).

Consumer researchers are also interested in how our sense of smell influences our perceptions and preferences (Krishna, Elder, & Caldara, 2010; Mitchell, Kahn, & Knasko, 1995; Spangenberg, Crowley, & Henderson ,1996). Wynne (2001) discusses the differences between humans and other animals' sense of smell. Though consumer research has found that scents influence humans in general and in consumer contexts, as Wynne discusses, scent overall is not an especially salient aspect of our sensory experience relative to our other senses and compared to other animals. Wynne gives the examples of how Turkish hamsters can recognize individuals by their smell and can even tell the difference between brothers by their smell.

Consumer researchers have also investigated the impact of sounds on our processing (Krishna, 2012; Spangenberg, Grohmann, & Sprott, 2005), which is affected by our sense of hearing. Our limits in our sense of hearing have parallels to the limits in our vision since we can only hear within a limited range of all possible sounds (from 100 Hz to 20 kHz). As Wynne

(2001) explains some animals, for example chinchillas, fox squirrels, gerbils, guinea pigs, and kangaroo rats have good low frequency hearing and can hear sounds below 150 Hz. Animals that echolocate, such as bats and dolphins, can produce and hear sounds at frequencies that are octaves higher than humans can hear (64 to 100 KHz). Thus like vision, we are not sensing all of the auditory aspects of the world in which we live.

Finally we are limited by the senses that we have as humans. There are senses that other animals have and rely on, for example magnetic sensitivity, electric sense, sensitivity to air pressure, that we are not even aware of in our sensory world, but that other animals use to process aspects of our world (Wynne, 2001). Understanding the range and limits of humans and other animals' sensory experiences can perhaps help us to better understand how and why consumers use those senses. For example, scientists have found that magnetic fields may play some role in how the central nervous systems of humans function (Fuller et al. 1994). There is also some evidence that humans may possess a magnetic sense that can aid in navigation (Baker 1980), and as noted in Kirschvink (1997), "some humans, particularly Polynesian navigators seem to be able to judge direction in the absence of all obvious cues (Sun, Moon, stars, waves and so on)" (Finny, 1995). Although at this point, findings across studies vary considerably, studies and methods used with animals may help to yield important insights into how humans respond to magnetic fields, if at all (Cook, Thomas, and Prato, 2002). Another example involves our sense of hearing. As discussed many animals can hear and discriminate between sounds that humans cannot. However, there is some new evidence that neurons in the human brain selectively respond to sound frequencies and can discriminate between bandwidths for which other animals succeed but humans fail to discriminate in hearing tests (Bitterman et al., 2008). This suggests that humans' senses may be able to discriminate between very subtle objective differences at a subconscious level, and that our senses may impact our cognition and behavior in ways previously unexplored.

Though some animals may outperform humans in their sensory abilities, these abilities are a function of animals' physical features and animals' ecological niches, so may not seem so surprising. What may be more surprising is when animals outperform us on tasks we associate within humans as being related to cognitive ability and perhaps even intelligence. I discuss this next.

Numerical cognition

As I discussed earlier, animal cognition research has examined animals' abilities to compare quantities and determine in dichotomous judgments, which of two quantities is larger. Irie-Sugimoto et al. (2009) showed that Asian elephants perform well on magnitude comparison tasks when food was presented simultaneously or sequentially, and when they needed to do addition to figure out the total. What was most surprising about their findings was that the elephants, unlike other animals that have done similar tasks, and humans, did not exhibit distance and magnitude effects.

These findings suggest that elephants may use a different mechanism to compare and represent quantities than what other species, including humans use. Irie-Sugimoto et al. (2009) discuss how elephants' exceptional memory abilities may allow them to use an object file model, which had been previously proposed by Kahneman et al. (1992) and others for humans. Although these findings have recently been questioned and failed to replicate with two African elephants (Perdue et al. 2012), this research still can potentially help scientists better understand numerical cognition in other animals, including humans.

In general, many questions remain in how humans and other animals process numeric information and how arithmetic reasoning works. Gallistel and Felman (2000) review research on how continuous and integer numeric information are processed by verbal humans, non-verbal human infants, and other animals. They conclude by listing several questions about numerical cognition in humans that can perhaps only be answered with a comparative approach. These questions include, “Are small numerosities represented discretely in the minds of infants (and other animals?), rather than by the mental magnitudes that represent larger numerosities? If so, are these discrete representations of small numerosities arithmetically processed? Is the development of numerical cognition in humans rooted in the discrete representation of small numerosities or in a magnitude-based system for representing numerosities of any size, or both? If humans represent numerosities in terms of magnitudes, why do they have so much trouble learning the mathematical conception of rational numbers (mastering fractions)?”

Forecasting

Consumer researchers are interested in how humans process past information to form expectations and predictions about what will happen in the future (Oliver and Winer, 1987). Because of differences in how animals and humans make sense of past patterns, animals can more accurately predict than humans for certain types of tasks.

For example, consider the following experimental protocol. Two light bulbs, one green, and one red, flash in a random sequence across trials. In each trial, either the green bulb or the red bulb will light. The green light flashes 80 percent of the time, the red one 20 percent of the time. Given the task to predict which light will flash next, surprisingly, pigeons outperform humans (Rampell, 2011; Zweig, 2000).

Because animals tend to maximize or always choose the most frequent option, pigeons would always pick green and would be right 80 percent of the time (Hinson & Staddon, 1983a, b). Humans instead try to guess which of the two events will occur next. Their guesses usually match the observed frequency, but this leads them to be correct only 68 percent of the time (.8*.8+.2*.2) (Wolford, Miller, & Gazzaniga, 2000).

Humans try to find patterns in sequences even when they are told that the sequences are random. Wolford et al. (2000) discusses how the left hemisphere of humans' brains houses a cognitive mechanism that tries to make sense of past patterns. Their research shows that if we use only the right hemisphere of our brains for tasks like this, we then use the more accurate maximization strategy like pigeons do. They did this by examining split brain patients whose corpora callosa had been severed as treatment for epilepsy. They found these humans match frequencies or maximize depending on which side of the brain they used.

While pigeons and other animals do better on these tasks than humans, as Wolford et al. discuss, searching for and positing causal relationships has benefits. It may have helped our ancestors determine which caves stay dry and where food could be found. But it also leads to many of the common errors in decision making that we know about. Given humans are capable of both using a less accurate frequency strategy or a more accurate maximization strategy, it would be interesting to further examine when and why consumers deploy these strategies, how it varies across humans, and what interventions can be done to increase accuracy.

Cognitive illusions and the Monty Hall problem

A particularly vexing cognitive illusion for humans is the Monty Hall problem. The Monty Hall problem is a well-known probability puzzle where players try to guess which of three doors conceals a valuable prize. In the old game show, *Let's Make a Deal*, the valuable prize was a car, and behind the other two doors were goats. After a (human) contestant picked a door, say door number two, the show's host, Monty Hall, who always knew what was behind all the doors, opened one of the other two doors, for example door one, and revealed that behind that door was a goat, which was viewed to be an inferior prize. Monty Hall then asked the contestant, "Do you want to switch doors?"

Research has shown that most humans opt to stick with their initial guess, in this case door number two, and they do not switch to door three, though they would actually double their odds of winning if they switched (Posner, 1991; Tierney, 1991). Humans tend to have a very difficult time believing that switching is optimal, even when the solution is explained to them. Krauss and Wang (2003) concluded that no other statistical puzzle perplexes humans so consistently. Although they could double their chances by switching, humans across cultures including the US, Sweden, Brazil, and China (Granberg, 1999) and even expert human mathematicians (Herbranson & Schroeder, 2010) all tend to stick to their original choice.

The trick to this problem is that the host knows what is behind each door. When the contestant originally picks door two, there is a 1/3 probability that the car is behind that door and a 2/3 probability that it is instead behind one of the other doors – door one or door three. The probability that the car is behind door two does not change, when the host, who knows what is behind door one, reveals that it is a goat. Therefore, the probability that the car is behind door three is now 2/3 and it is optimal to switch.

Herbranson and Schroeder tested pigeons on a variant of the Monty Hall problem, involving lights and rewards of bird feed. Pigeons quickly learned the optimal strategy and switched 96 percent of the time. They also tested undergraduate human participants, who were trained in the same way, with more suitable rewards for humans. The humans failed to adopt the best strategy even with practice. Ironically, Herbanson and Schroeder note that prior studies have shown that younger children are better at this task than older humans. Among the youngest group tested, 8th graders, a small but significant fraction figured out that switching is optimal. The authors hypothesize that education and life experiences lead humans to think in certain ways, that while efficient, can interfere with performance for some tasks.

Note, the Monty Hall problem is an example of the more general forecasting topic discussed in the previous section. For this problem too, people seem to probability match while pigeons maximize. Herbanson and Schroeder propose that the difference in human versus pigeon behavior might be rooted in the difference between classical and empirical probability. Pigeons don't use theories, and seem to be empirical probabilists. This is slower, less elegant, and more brute force, and for this problem, also more accurate. For this problem, humans tend to over analyze which leads them astray. Interestingly, the mathematician Paul Erdos, according to his biography, was fooled by this problem and was only convinced about the answer to this puzzle when he was shown the results of a Monte Carlo computer simulation – that uses empirical, pigeon, style probability (Choi 2010).

As mentioned in the previous section, research on differences across humans of different ages and across different animals might help us increase our understanding of why adult humans use suboptimal strategies, and help us to design interventions to increase accuracy. Ironically these might involve having humans suppress their tendency to think, analyze, and use their supposedly greater knowledge. This comparative research might help explain why humans' fast and frugal heuristics can often be quite accurate (Dougherty, Franco-Watkins, & Thomas, 2008; Gigerenzer, Hoffrage, & Goldstein 2008) and why when humans think too much it can sometimes be detrimental (Wilson et al. 1993).

Short term memory

Some animals, seed caching birds, and elephants, have remarkable long term memory that can rival our own (Balda and Kamil, 1992; Hart, Hart, & Pinter-Wollman, 2008). However humans are generally believed to outperform close relatives like chimpanzees in the performance of their short-term or working memory (Premack, 2007).

This belief was recently challenged by Inoue and Matsuzawa (2007), who showed that young chimpanzees have remarkable short term memory, better than that of adult humans. Young chimpanzees and their older mothers, and human university students, participated in a memory task using a touch screen computer. Single digit numbers appeared on the computer screen in different positions during each trial. Participants had to touch the digits in ascending sequence. After participants touched the first digit, after a limited duration, set and varied by the researchers, all the other numbers were masked by white squares. Participants had to remember by location where each number was to successfully complete each trial. The results showed the young chimpanzees outperformed humans in both accuracy and speed of recall and were not affected by the amount of time for which the digits first appeared on the screen. Another interesting finding was that that younger chimpanzees seemed to be better at this task than older ones.

The authors noted that the young chimpanzees' ability to at a quick glance memorize the location of digits on a touch screen monitor is related to the question of eidetic imagery, more commonly known as photographic memory. There is some controversy about whether this type of memory even exists (Minsky, 1988). Studies supporting it show it is more common in children than adults and occurs among normal children with some frequency (Gray & Gummerman, 1975). Some researchers believe that children lose these memory abilities as their brains develop perhaps as they shift from more right brain intuitive thinking to more left brain rational, cognitive thinking (Haber, 1979).

I should note that there is now some controversy about the findings from the Inoue and Matsuzawa (2007) chimpanzee study, and some subsequent research suggests that humans can do as well as the young chimpanzees with practice (Silverberg & Kearns, 2009), though it may be worth noting that the two human subjects in Silverberg and Kearns were the authors. More recent work shows that two university students, who worked in the authors' lab, outperformed the chimpanzee in Inoue and Matsuzawa's (2007) study (Cook & Wilson, 2010).

As Cook and Wilson note, whether or not young chimpanzees outperform humans, this stream of research still raises many interesting questions. It would be interesting to learn what triggers superior memory across individuals, species, and tasks, what kinds of training can increase memory performance, and why memory performance declines with the increased cognitive development that comes as children and young chimpanzees grow.

Conclusions

In conclusion, we humans are not alone in our ability to think, think about thinking, invent, plan, remember, contemplate, mourn, and even plot, lie, rape, or murder (Crawford & Galdikas, 1986; Morell, 2008). Darwin, in *The Descent of Man*, wrote that he felt that the human mind differs only in degree, but not kind, from the minds of non-human animals. If so, then just like we can learn from differences across humans, which are also more a matter of degree than kind, then we can also learn from differences across species.

Though my focus has primarily been on what we can learn about humans though other animals, knowledge of course flows in both directions, and we can also learn much about animals based on research that involves humans. Kagel et al. (1975; 1981) discussed how we can use what we know about economic behavior among humans to test animal behavior. For example these authors discuss how we can conceptualize and model how animals respond to changes in environmental conditions using models of how humans respond to changes in relative prices. As they note, doing so can also allow us to make predictions concerning the environmental impact of human's choices on animal behavior. van Osselaer (2004) describes how research on associative learning in humans involving brands and attributes can increase our knowledge of how associative learning works among all animals. More generally, future research on animal consumption, that for example examines the foraging behaviors of animals, may benefit from insights from theories and findings on human consumption.

One possible limitation to using human knowledge to learn more about animals is that we may make implicit assumptions about animals based on our greater knowledge and understanding of human cognition. For example, the research on self-awareness, discussed earlier, often uses a method where a red spot is put on the animal while anesthetized. The animal is classified as self-aware if it looks in a mirror and makes self-directed movements to the red spot. This test and definition likely were based on an introspection of self-awareness in humans. Thus our knowledge of self-awareness among animals was informed by our interpretation of self-awareness in humans. This human lens has provided much insight into our understanding of animal self-awareness, but also likely introduces its own biases. For example, as Bekoff discusses (2002), the red spot test does not take into consideration that only a few wild animals may know what they look like (e.g., birds who may see their reflection in water), and that animals may distinguish themselves from others in their same species based on sound or scent and not vision.[2]

Given the rising interest among humans in how animals think, another area for future research is to examine whether and how humans desire to consume animal-related products changes as they learn more about how animals think and as they become aware of the similarities between humans and animals. Research has shown that while some consumers decide to give up the consumption of animal-related products primarily for health and environmental reasons, others do so for moral reasons (Fessler et al., 2003; Rozin, Markwith, & Stoess, 1997). Those who give up the consumption of animal products for moral reasons often have strong emotional reactions to thoughts related to consuming animals, particularly disgust, and this is often initiated by a sudden realization that the products they had been consuming came from a previously living animal (Jabs, Devine, & Sobal,1998). The decision to give up consumption of animal-related products has been shown to also alter consumers' actual internal preferences, such that a previously liked food becomes disliked (Rozin et al., 1997). Not all consumers of course react in the same manner. Some, rather than giving up consumption of all animal-related products instead limit their consumption to sources they perceive raise the animals in a humane manner and kill them in a manner that minimizes suffering (McMahon, 2008). Interestingly, others even feel an obligation to observe or participate in the killing of an animal they will consume (Pollan, 2002). Past research has implicated factors such as consumers' past experience with animals, for example whether they owned a pet as a child or whether they hunt animals, as being associated with concern for animal well-being and consumption of animal-related products (Kendall, Lobao, & Sharp, 2006). Future research could add to this by examining the interplay between

[2] I thank a reviewer for raising this important point.

interest and knowledge about how animals think, past experience with animals, concern for their well-being, and consumption of animal-related products.

Some of the research summarized here highlighted biases in judgment and decision making that humans and other animals have in common. Though not reviewed here, similar research on visual illusions has shown that humans and chimpanzees are both prone to overestimate the amount of food placed on a small versus a large plate (Parrish & Beran, 2013; Van Ittersum & Wansink, 2011). These findings are consistent with the idea that such visual illusions have an evolutionary basis. This suggests that such biases in consumption stem less from cultural aspects and more from contextual factors related to food stimuli. Continued studies of both animals and humans can help glean insights into how, if at all, consumers can learn to avoid such effects, and what marketers can do to encourage healthier eating among humans.

More generally, Santos and Platt (2014) note that our knowledge that humans are imperfect decision makers begs the question of where human biases originate. Are they learned, do they originate to deal with specific contexts? Examining whether the same biases are observed in other animals can elucidate whether some of these biases are more evolutionary in original and thus are not caused by individuals' learning, experience, context, exposure to market economies, or culture. For example, the presence of biases in judgment and decision making in distantly related primates and other animals suggests that such strategies have existed for some evolutionary time, raising the possibility, as others have argued, that they might serve some ultimate use (Gigerenzer & Selton, 2001; Gigerenzer & Todd, 1999). Future research should look at how and in what circumstances biases like the endowment effect could be evolutionarily useful since we see it in non-human animals (see Beggan, 1992 and Lakshminarayanan et al., 2008 for a similar discussion). Understanding this can help us to better understand why it occurs among consumers, when it may be beneficial to humans, and when it would be detrimental, as is commonly assumed.

Research can also look at the neural basis for these biases. Neuroscience research on humans has explored the neural underpinnings of loss aversion, the endowment effect, and other related biases, typically using fMRI functional imaging methods (de Martino et al., 2006; Tom et al., 2007). Although these methods have led to insights into the neural basis of loss aversion and related biases, we often obtain even greater insights when functional imaging methods are combined with physiological techniques that can examine what is happening in the brain at the single neuron level.

There is now some single neuron work with humans (Cerf et al., 2010), but this is limited to particular kinds of medical patients, and also particular areas of the brain. Most single neuron research is still being done with animals. To date, little research has addressed the neural underpinnings of decision biases like the endowment effect from a neurophysiological perspective in large part because it was unclear that these biases could be observed in species other than humans. But some of the newer work showing these effects in animals suggests we can think of ways to examine these biases, and topics like the nature of ownership and value, at the neural level.

Finally, the research identified some tasks where animals outperform humans. Ideally we can learn from these how to improve our memory, make better decisions, and maybe even to create a more peaceful society, like our closest animal relatives, the bonobos (Furuichi, 2011).

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