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Personality Dimensions in Nonhuman Animals: A Cross-Species Review

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Abstract

The evolutionary continuity between humans and other animals suggests that some dimensions of personality may be common across a wide range of species. Unfortunately, there is no unified body of research on animal personality; studies are dispersed across multiple disciplines and diverse journals. To review 19 studies of personality factors in 12 nonhuman species, we used the human Five-Factor Model plus Dominance and Activity as a preliminary framework. Extraversion, Neuroticism, and Agreeableness showed the strongest cross-species generality, followed by Openness; a separate Conscientiousness dimension appeared only in chimpanzees, humans' closest relatives. Cross-species evidence was modest for a separate Dominance dimension but scant for Activity. The comparative approach taken here offers a fresh perspective on human personality and should facilitate hypothesis-driven research on the social and biological bases of personality.

Keywords

personality; traits; cross-species; Big Five; temperament

In a recent article in the *Los Angeles Times*, Robert Fagen, a professor of biometry, described Susie as irascible, irritable, grumpy, and manipulative. This is hardly

newsworthy, except that Susie is a bear. Scientists have been reluctant to ascribe personality traits, emotions, and cognitions to animals, even though they readily accept that the anatomy and physiology of humans is similar to that of animals. Yet there is nothing in evolutionary theory to suggest that only physical traits are subject to selection pressures, and Darwin (1872/1998) argued that emotions exist in both human and nonhuman animals. Thus, personality traits like Extraversion and Agreeableness may not be as uniquely human as once was thought (Buss, 1988). Early attempts to assess animal personality, including the pioneering studies by Stevenson-Hinde, were conducted in the 1970s, and the 1990s have seen a resurgence of research activity. Our goal in this article is to take stock of what is known about animal personality, focusing on individual differences *within* species. We ask, What are the major dimensions of animal personality?

MAPPING THE LANDSCAPE OF ANIMAL PERSONALITY

Faced with the challenge of integrating the fragmented literature on animal personality, we felt like early cartographers faced with the challenge of constructing a map of the globe. Our task—much like that of the cartographers—was to piece together the isolated reports about the landscape of personality. These reports came in different languages; used a variety of scales,

methods, and notations; and varied in their scope and reliability. Our first task was to select the most trustworthy reports; starting with more than 100 potentially relevant studies, we selected those that had sample sizes larger than 20 animals and a reasonably broad coverage of personality traits.²

To integrate the many pieces of information provided by the diverse research reports, we used the most widely accepted and complete map of personality structure: the human Five-Factor Model (FFM; John, 1990). The FFM is a hierarchical model with five broad factors (Table 1), which represent personality at the broadest level of abstraction. Each bipolar factor (e.g., Extraversion vs. Introversion) summarizes several more specific facets (e.g., sociability), which, in turn, subsume a large number of even more specific traits (e.g., talkative, outgoing). Unfortunately, no short labels capture the broad FFM dimensions adequately, so the traditional labels are easily misunderstood; thus, we use the letters N (for Neuroticism, Nervousness, Negative affectivity), A (for Agreeableness, Altruism, Affection), E (for Extraversion, Energy, Enthusiasm), O (for Openness, Originality, Open-mindedness), and C (for Conscientiousness, Control, Constraint).

Are there additional dimensions that might be of special importance for describing the personality of nonhuman animals? In adult human personality, Activity and Dominance are part of the E dimension. In children, however, Activity may form a separate dimension (John, Caspi, Robins, Moffitt, & Stouthamer-Loeber, 1994), and temperament models (Buss & Plomin, 1984) also consider it separate. Moreover, many socially living animal species show individual differences related to status in the dominance hierarchy: Individuals with high status can control others

Table 1. *The dimensions of the Five-Factor Model (FFM)*

FFM dimension label	Examples of facets
N Neuroticism vs. Emotional Stability	Anxiety, depression, vulnerability to stress, moodiness
A Agreeableness vs. Antagonism	Trust, tendermindedness, cooperation, lack of aggression
E Extraversion vs. Introversion	Sociability, assertiveness, activity, positive emotions
O Open vs. Closed to Experience	Ideas/intellect, imagination, creativity, curiosity
C Conscientiousness vs. Impulsiveness	Deliberation, self-discipline, dutifulness, order

Note. See John (1990) and Costa and McCrae (1992) for details.

and get their way. To explore whether Activity and Dominance form separate dimensions in animals, we added them to the five FFM dimensions in our preliminary framework (see Table 2).

Our review includes 19 factor analytic studies and represents 12 different species. We reviewed the items defining each personality factor in each study and compared them with the definitions of the seven potential dimensions in Table 2. If there was a match in item content, we classified the animal factor into one of the seven dimensions and included its label (or a short definition) in the appropriate column of Table 2.³

Extraversion, Neuroticism, and Agreeableness: Cross-Species Dimensions?

Three human FFM dimensions—E, N, and A—showed considerable generality across species. Of the 19 studies, 17 identified a factor related to E. The factor labels in the E column in Table 2 range from Surgency in chimpanzees to Sociability in pigs, dogs, and rhesus monkeys; Energy in cats and dogs; Vivacity in donkeys; and a dimension contrasting Bold Approach versus Avoidance in octopuses. The particular labels may differ, but they all reflect core features of the broad E dimension (see Table 1). Factors related to N appeared almost as frequently; again,

despite the differences in factor labels, these animal factors capture core elements of N, such as Fearfulness, Emotional Reactivity, Excitability, and low Nerve Stability. Factors related to A appeared in 14 studies, with Affability, Affection, and Affinity capturing the high pole of A, and Aggression, Hostility, and Fighting capturing the low pole.⁴

The evidence indicates that chimpanzees, various other primates, nonprimate mammals, and even guppies and octopuses all show individual differences that can be organized along dimensions akin to E, N, and (with the exception of guppies and octopuses) A. These remarkable commonalities across such a wide range of taxa suggest that general biological mechanisms are likely responsible. The way these personality dimensions are manifested, however, depends on the species. For example, whereas the human scoring low on Extraversion stays at home on Saturday night, or tries to blend into a corner at a large party, the octopus scoring low on Boldness stays in its protective den during feedings and attempts to hide itself by changing color or releasing ink into the water.

Openness: Another Potential Cross-Species Personality Dimension?

Factors related to the O dimension in the FFM were identified in

7 of the 12 species. The two major components defining this dimension were curiosity-exploration (interest in new situations and novel objects) and playfulness (which is associated with E when social, rather than imaginative, aspects of play are assessed). Although these factors are similar to the O dimension known from humans, some core facets are obviously missing; openness to ideas and interest in arts are difficult to observe in animals that lack advanced means of symbolic expression, such as language and music. The O factor in these animal studies resembles the early forms of O observed in human toddlers; lacking advanced language skills, their curiosity is manifested in an intense interest in novel objects and events, and their imagination is shown in perspective taking and role shifts characteristic of pretend play.

The evidence for an O-related factor was not consistent across multiple studies of the same species, pointing to methodological differences, most likely in the traits included in the studies. For example, the two chimpanzee studies that did not find an O factor did not include items clearly relevant to O. Given that forms of curiosity have been observed in a wide range of species, a thorough and focused search should provide more consistent evidence for O.

Conscientiousness: Only in Humans and Chimpanzees?

Although cats and dogs showed a factor that combined C and O, chimpanzees were the only species with a separate C factor. The chimpanzee factor was defined more narrowly than in humans but included lack of attention and goal directedness, as well as erratic, unpredictable, and disorganized behavior—characteristics typical of the low pole of C. Why did we not find separate C factors in any other species? The failure to include relevant items cannot explain this finding: In our own studies of dogs and cats, we included items that define C in humans, but they did not form a separate factor. Considering the “superego” aspects of the C factor (following norms and rules, thinking before acting, and other complex cognitive functions involved in the control of impulses), it may not be surprising that we found a separate C factor only in humans and in humans’ closest relatives, chimpanzees. These findings suggest C may have appeared relatively recently in the evolution of Homininae, the subfamily comprising humans, chimpanzees, and gorillas.

Dominance and Activity: Two Additional Dimensions?

Dominance emerged as a clear separate factor in 7 of the 19 studies. Although interpreted as Confidence in rhesus monkeys and Assertiveness in hyenas, the factor was essentially the same, correlating substantially with dominance rank.⁵ Across studies, the Dominance factor was typically defined by assertiveness or boldness (high E), physical aggression (low A), and low fearfulness (low N). Thus, dominance had more diverse personality implications in animals than in humans, for whom it is related only to the E

dimension. Perhaps these differences arise because humans participate in multiple dominance hierarchies that are less clearly defined and involve widely divergent skills: The class bullies may dominate in the school yard, but the conscientious students will get the grades to advance academically, and the open-minded artists will win prizes for their creations. Future research needs to examine more closely the links between dominance rank and personality traits. Personality may vary even among animals of the same rank, and rather than being viewed as a personality trait, dominance rank may be better conceived as a social outcome determined by both personality and physical traits (Buss, 1988).

Finally, our review uncovered scant evidence for the idea that Activity should be retained as a separate dimension of animal personality, with only 2 of the 19 studies showing support. Of the 3 chimpanzee studies, only the study of infants identified a separate Activity factor. This age difference in chimpanzees parallels findings in humans suggesting that Activity may not become integrated with the E dimension until late adolescence (John et al., 1994).

THE SPECTER OF ANTHROPOMORPHISM

A number of the studies summarized in Table 2 relied on human observers rating animals on trait adjectives defined in brief behavioral terms (e.g., playful was defined as “initiates play and joins in when play is solicited”). Although some researchers argue that observer ratings are the best way to assess personality, others are skeptical and worry that these ratings might be anthropomorphic projections. Three kinds of evidence

argue against this concern. First, for a wide range of species, including chimpanzees, rhesus monkeys, and hyenas, studies show that independent observers agree about the relative ordering of individuals on a trait. Second, many of the studies reviewed here used behavioral tests in specific situations or carefully recorded ethological observations. Both types of data yielded similar factors. For example, when piglet behavior was tested in specific situations, the E factor was defined by number of vocalizations, number of nose contacts, and location in the pen; when chimpanzee behavior was observed in naturally occurring settings, the E factor was defined by behavior patterns such as “pull limb” (playful social contact), “grasp and poke” (boisterous but relaxed contact), and “gymnastics” (exuberant locomotory play, such as swinging, dangling, turning somersaults). It is remarkable that such similar factors were discovered using such diverse methods. In fact, studies using multiple methods have demonstrated the validity of trait ratings (Capitanio, 1999). Third, our finding that the factor structures showed meaningful differences across species argues against the operation of general rating biases in observers. For example, in our own work, we found the familiar FFM dimensions for humans but only four factors for dogs, even when we collected personality ratings using the same instrument for both species; the items defining a clear C factor in humans failed to form a separate factor in dogs (Gosling & John, 1998). These differences show that personality structure depends on the individual rated, rather than on the particular items in the rating instrument.

Sex differences are another domain where cross-species differences in the meaning and implications of personality factors can be

Table 2. Review of animal personality factors: Factor labels organized in terms of the Five-Factor Model (FFM) plus two potential additional dimensions

Species	Neuroticism	Trait dimensions in the human FFM				Additional dimensions		Study
		Agreeableness	Extraversion	Openness	Conscientiousness	Dominance	Activity	
Chimpanzee	Emotional Stability	Agreeableness	Surgency	Openness	Dependability	Dominance		King and Figueredo (1997)
	Audiovisual Reactivity		Affect-Extraversion		Task Behavior		Activity	Bard and Gardner (1996)
	Excitability-Agitation	Aggression; Affinity ^a	Social Play			Submission		Hooff (1973)
Gorilla	Fearfulness	Understanding	Extroversion			Dominance		Gold and Maple (1994)
Rhesus monkey	Tense-Fearful	Aggressive	Solitary	Curious-Playful				Bolig, Price, O'Neill, and Suomi (1992)
	Excitability		Sociability			Confidence		Stevenson-Hinde and Zunz (1978); Stevenson-Hinde, Stillwell-Barnes, and Zunz (1980)
Vervet monkey	Fear	Hostility	Affiliation					Chamove, Eysenck, and Harlow (1972)
Hyena	Excitability	Opportunistic-Self-Serving	Playful-Curious ^b			Social Competence		McGuire, Raleigh, and Pollack (1994)
		Sociability; Human-Related Agreeableness ^a		Curiosity		Assertiveness		Gosling (1998)
Dog	Emotional Reactivity	Affection	Energy		Competence ^c			Gosling and John (1998)
	Stability vs. Excitability		Sociability		Learning and Obedience Ability ^c	Dominance-Territoriality		Coren (1998)

Table 2. continued

Species	Trait dimensions in the human FFM					Additional dimensions	
	Neuroticism	Agreeableness	Extraversion	Openness	Conscientiousness	Dominance	Activity
	Nerve Stability	Affability; Aggression ^a Aggression (Disagreeableness)	Lively Temperament Reactivity (Surgency)	Trainability (Openness)			Wilson and Sundgren (1997) Hart and Hart (1985) (reanalyzed by Draper, 1995)
Cat	Emotional Reactivity	Affection	Energy	Competence ^c			Gosling and John (1998)
Donkey		Obstinacy	Vivacity				French (1993)
Pig		Aggression	Sociability	Exploration- Curiosity			Forkman, Furuhaug, and Jensen (1995)
Rat	Emotionality	Fighting vs. Timidity; Freezing vs. Aggression ^a					Billingslea (1941)
Guppy	Fear-Avoidance		Approach				Budaev (1997)
Octopus	Reactivity		Bold vs. Avoiding			Activity	Mather and Anderson (1993)

Note. All studies are based on factor analyses of individual animals, except Coren (1998) and Hart and Hart (1985), who analyzed experts' ratings of breeds. Several studies did not include factor labels at all or included labels too brief to understand without further information; for these cases, we used high-loading items to help name the factors.

^aThese four studies yielded two separate factors related to Agreeableness.

^bThis factor combined both social and imaginative elements and thus reflects both Extraversion and Openness.

^cThese factors combined elements from both Openness and Conscientiousness.

illustrated. Research on the human FFM has repeatedly shown that women tend to be more emotional and prone to worry (i.e., higher on N) than men (Costa & McCrae, 1992). Does the same sex difference emerge in other species? Not necessarily. To illustrate this point, we collected observer ratings of humans using items previously used in a study of hyenas (Gosling, 1998). In humans, women were described as somewhat higher on N than men; in hyenas, the sex difference was reversed, with males being considerably more high-strung, fearful, and nervous than females (see Fig. 1). What explains this dramatic interaction effect? The key is the difference in social organization: In the hyena clan, dominance rank is transmitted through a matrilineal system, and females are larger than males and more dominant. This example suggests that sex differences in personality may be related to the ecological niches occupied by the two sexes in a species, and illustrates how a comparative approach can offer a fresh perspective on the interplay between social and biological factors in personality.

CONCLUSIONS AND FUTURE DIRECTIONS

The cartographic metaphor serves to highlight some limitations of the initial map of animal personality dimensions presented in Table 2. First, Antarctica will be discovered only if one sails south: The lack of evidence for a dimension does not necessarily prove the factor does not exist; studies may not have included the items relevant for the factor. To show that a dimension does not exist in a species requires that future researchers actively search for that dimension. Equipped with our ini-

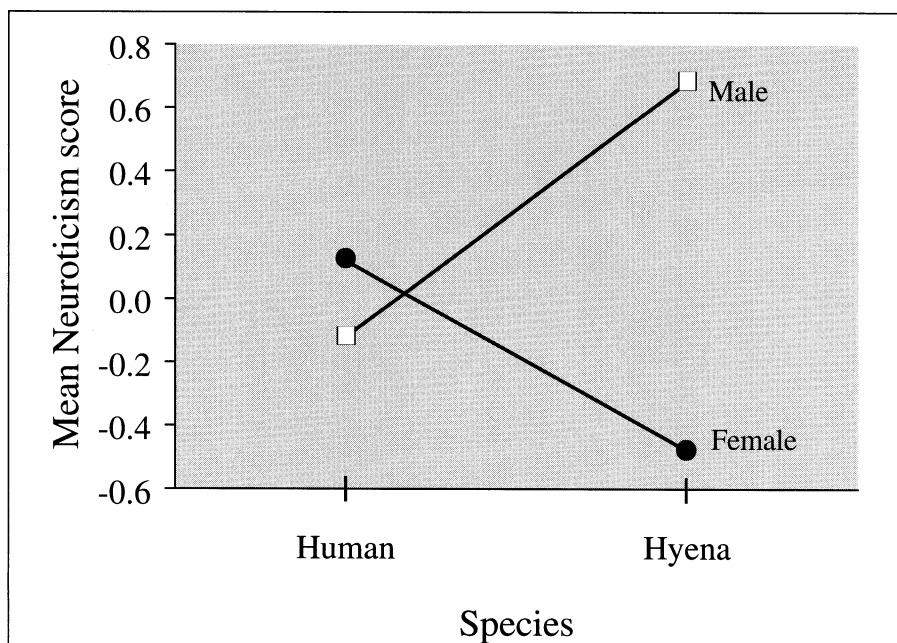


Fig. 1. Sex differences in standard (z) scores for Neuroticism among humans and hyenas. The ratings for hyenas are from Gosling (1998); the humans ($n = 100$) were described by peers on the same rating scales used for hyenas.

tial map, we can now conduct hypothesis-driven research. For example, we may hypothesize that solitary species (e.g., orangutans) would not show a separate A dimension, or that O occurs only in species that depend on a great variety of food sources. Second, just as early maps look rough by today's standards, with missing land masses and poorly defined boundaries, we expect that future researchers will refine our rough initial sketch and discover new islands, perhaps even continents. Third, much work remains to be done on the internal geography of the continents. For example, a great many species appear to inhabit the curiosity area of the O continent, but other areas may be inhabited solely by humans and perhaps chimpanzees. Fourth, researchers need to move from mapping personality continents to formulating theories about the movements of tectonic plates, addressing how and why the continents emerged; animal models of personality may be uniquely suited

to identify genes for complex traits and to study how these genes work (i.e., functional genomics). Finally, the early sailors knew their maps were not perfect, but imperfect maps were better than no map at all; it is in this spirit that we offer the present classification of animal personality, hoping that future researchers may find this initial sketch helpful in their quest for new discoveries.

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Notes

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2. A number of factor analytic studies did not sample personality traits broadly but focused on a single trait. The numerous studies of emotionality in mice are an example of this approach.

3. There were a number of complications due to differences in the way factor analytic procedures are used and reported in this literature (e.g., some studies did not rotate factors; others did not report factor loadings), but we cannot discuss these complications in the space available here. Only a small number of animal factors could not be classified; most of these factors would not be considered part of personality (e.g., physical coordination in chimpanzees and indoor vs. outdoor suitability in dogs).

4. Although four studies yielded two separate factors related to A, these findings may reflect methodological artifacts. For example, in Wilsson and Sundgren's (1997) study of dogs, separate Affability (high A) and Aggression

(low A) factors were found, but Affability was defined by only one item. In Gosling's (1998) study of hyenas, the two dimensions related to A (Human-Related Agreeableness and Sociability) were positively related.

5. Unlike all the other species reviewed, octopuses are clearly solitary (rather than social) and thus cannot exhibit dominance rank.

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