A History of Animal Personality Research

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Abstract

Though the study of animal personality has experienced explosive growth in the last 20 years, its history can be traced to the early days of comparative psychology. Early descriptions of nonhuman animals as sociable or fearful and the like have been progressively replaced across the years with systematic coding of behavioral patterns across multiple dimensions of temperament, in a fashion (and with results) similar to the way the topic is studied in humans. This chapter will explore the researchers, laboratories, and methodologies of animal personality research as it evolved from a methodologically impermeable curiosity to an increasingly important determinant of individual and species variability in behavior.

For much of the twentieth century, animal personality was comparative psychology's moon: clearly visible, obvious to any observer, yet decidedly impossible to bring into the laboratory for study. For as long as there has been a comparative psychology, researchers have described, privately or professionally, the individual character of subject animals. Yet these researchers lacked any accepted framework by which they could sensibly and consistently measure individual differences in temperament or personality. The study of human personality was relatively difficult and contentious in its own right (as indicated, for example, by the longstanding person–situation debate; e.g., Kenrick and Funder 1988); not surprisingly, the methodological and philosophical challenges to the study of (nonhuman) animal personality were even more formidable.

The history of the comparative study of personality is not one of gradual progressions, of an accumulation of observations that manifest into functional theory. Neither was there an emergence of eminent animal personality theorists and dedicated research programs at each step of a coherent process. The history is disjointed; one of fits and starts, as largely isolated scientists combatted Watsonian dogma and a pre-paradigmatic lack of direction in an attempt to build a study of animal personality from the ground up. This chapter will cover the different

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J. Vonk et al. (eds.), *Personality in Nonhuman Animals*,
DOI 10.1007/978-3-319-59300-5_1

approaches to animal personality that were taken up to the turn of the twenty-first century, at which point the disjointedness began to cohere into the field of animal personality research that will be explored by the other chapters of this volume. After initial consideration of early comparative authors, this chapter will be organized as a series of extended case studies of the scholars and laboratories that fought a strong, resistant tide in their attempts to codify the vast individual differences in temperament manifest in nonhuman animal (henceforth "animal") life. Special consideration will be given to the process by which these parties innovated new methods and analyses to present a way forward for the study of animal personality.

Early Expressions

Even as the study of human personality was in its infancy, and the empirical study of animal personality was nonexistent, there was some rudimentary acknowledgement of meaningful individual differences in animals. As early as the late nineteenth century, there existed a tendency for early comparative psychologists to describe their subjects as individuals rather than as mere representatives of the norms of the species. British polymath and comparative psychologist Leonard Trelawny Hobhouse reported the results of his comparative work in such a fashion (Hobhouse 1915). A cat subject, for example, was "a sociable creature, who follows his friends about in the half dog-like way that some cats have" (p. 155); a chimpanzee had "an extremely retiring and unsociable disposition" (p. 235). The first investigation of rhesus monkeys in a psychology laboratory by A. J. Kinnaman likewise blended rigorous scholarship with informal discussion of the two monkeys' individual temperaments (Kinnaman 1902a, b). His monkeys were inferred to have expressed "triumph, villainy, jealousy, anger and risibility… in the manner and speed of limb and body movement, or in the viscera of the observers who read into them a feeling like that which they suppose they would have under similar circumstances" (p. 106). It may be that these examples are more the result of stylistic convention than empirical positions on the animal mind. These early scholars did not explicitly study animal personality, nor even necessarily regard such study as legitimate. Yet the language used to describe the dispositions, behavioral tendencies, and temperamental traits of their participant animals is noteworthy, particularly in light of the shifts in psychology that would come with the advent of Watsonian behaviorism in Western psychology years later.

Constitutional Differences and Functional Disturbances (1927)

Ivan Pavlov was perhaps the first researcher to incorporate temperament into animal research in a work often translated as "Constitutional Differences and Functional Disturbances: Experimental Neuroses" (Pavlov 1966). Over the course of his research on digestion and conditioned reflexes, Pavlov observed individual peculiarities in his famous dogs. Some animals that were selected as subjects for their attentive demeanor and enthusiasm were found to fall asleep rapidly during the experimental procedure. Others were fearful, cowering at any unexpected noise and remaining highly vigilant in behavior for the duration of experimental testing. Although Pavlov did not formally incorporate these classes of animals (translated as "temperaments", "types", or "constitutional differences", and similar to the laid-back versus uptight distinction in macaques studied in recent years by Suomi and colleagues, discussed below) into his research program, he nevertheless provided a basic framework for categorizing the temperaments of the dogs he studied in his lab.

In keeping with the physiological timbre of his work, Pavlov initially classified his animals into broad groupings based on what he understood to be the qualities of their nervous systems. The highly enthusiastic dogs that he chose for his first experiments could be understood as the product of a highly excitatory nervous system. In addition to their manic behavior, animals of this

type required demonstrably more stimulation in order to maintain attention to the experimental procedure. If the dogs did not receive novel stimuli at a rapid pace, their excitatory predispositions gave way to drowsiness and rest. This type contrasted sharply with another class of dogs observed by Pavlov that he viewed as having a much more equilibrated and inhibited nervous system. These often fearful dogs were quick to engage in specific motoric behaviors—shrinking to the floor, fleeing with tucked tail—but this lack of inhibition was not a more general character of the animal. Rather, the animals remained active across a variety of experimental settings and were capable of substantial inhibitory activity that was demanded by the experimental setting. Pavlov found that most dogs could be explained in terms of two dichotomous dimensions: their tendency to exhibit moderate or extreme excitation and their tendency to exhibit moderate or extreme inhibition.

Pavlov recognized that his animals fell into temperamental categories besides these as well, and conjectured that 24 or more types of nervous system may be described. Most commonly he adopted a framework with four principal nervous system types, in homage to Galen's temperaments (e.g., Stelmack and Stalikas 1991). The rapidly excited and rapidly inhibited animals described first were classified sanguine, and the more fearful and measured animals classified as melancholic. More uncommonly, Pavlov encountered animals of phlegmatic temperament. These dogs were extremely restrained in their behaviors, seeming disinterested and neither friendly nor hostile, yet capable of extreme excitation when the inhibited restraint was upset. Finally, choleric animals could be described by the inconsistency of their inhibitory responses.

Application of these human temperament constructs to dogs, even informally, is notable. Pavlov himself would perhaps not agree with this recognition, as he shifted fluidly between discussions of the mental activity of dogs and humans throughout his writing. He suggested that he felt that the empirical definition of stable, heritable nervous system types would be forthcoming. Instead, the particular way in which Pavlov framed his observations of the individual character of his dogs would become a rarity for most of the twentieth century (see Burdina and Melikhova 1961 for one return to the analysis of animal nervous system types).

A Behavior Rating Scale for Young Chimpanzees (1938)

In 1938, the Yale Laboratories of Primate Biology and Meredith Crawford published the first empirical exploration of animal personality in the form of "A Behavior Rating Scale for Young Chimpanzees" (Crawford 1938). Crawford's motivation for the exploration was clear from the outset: "Only a few days' work with a group of chimpanzees is sufficient to impress the observer with the vast differences between particular animals" (p. 79). And like Pavlov's proposed research into animal temperament, the scale was both an empirical investigation into observed individual differences and a pragmatic pursuit. The ability to capture the particular behavior patterns of an animal would likely be relevant and useful for the handling, caretaking, and research participation of the animal.

The paper describes the development and application of the rating scale from its conception. In the first version of the scale, six raters were asked to rate chimpanzees on 44 multiple-choice items divided into five groups: interactions with humans, interactions with other chimpanzees, behavior in experiments, individual characteristics, and trait ratings. The items that made up the scale took many forms, from behavioral indices (e.g., "Amount of motor activity displayed", "Amount of masturbation") to introspected states (e.g., "Apparent confidence in observer", "Desire to please observer") to assessment of more general qualities of the animal (e.g., "Intelligence", "Friendliness"). Notably, and with credit to the empiricism of Crawford, items were then assessed for both their reliability and validity.

Raters had less direct contact with the adult chimpanzees of the colony, and thus were unable to use earliest versions of the rating scale to

assess these animals confidently. The use of multiple-choice options on the scale was found to be inadequate, and raters more easily rated each animal's score for an item on a continuous line between two extremes. For example, an animal might be rated as halfway between silent and boisterous on a measure of "Noisiness". Raters also ascribed a score to their own confidence in rating each animal on each item. Items were removed from the scale for a few reasons. Items related to sexual activity were particularly subject to the hormonal cycles of individual animals, and thus removed from the scale. Unreliable items were removed, and highly intercorrelated items were collapsed together.

When the scale was used to assess the chimpanzees in two consecutive years, an additional measure of reliability, the test–retest reliability of the ratings, was measured. On each measure of reliability, the items of the final scale are high, above .7 in most cases by each measure. This indicates not only the potential usefulness of the measure, but also the stability of individual characteristics as chimpanzees develop year-after-year. The items that were most and least reliable, however, are telling. The items that were more behavioral (e.g., amount of motor activity) tended to be least reliable, whereas those that required more inference by the rater (e.g., desire to please) were the most reliable. This can be interpreted as evidence that what the rating scale primarily measured was the raters' shared anthropomorphizations of the animals, compounded by the fact that the raters, as caretakers, almost certainly discussed their general impressions of individual animals on a regular basis. Crawford acknowledged as much, and also suggested that the raters may have been consciously or unconsciously attempting to match the ratings of animals on second assessment to what they reported on the initial assessment (pp. 85–86).

In the final version of the behavior rating scale, the animals were meaningfully rated on 22 items measured on a continuous scale. This acted as the first quantitative index of animal personality, and Crawford described his research as a preliminary investigation into chimpanzee personality types that acted as a proof of concept for what is possible in the study of animal personality. Moreover, the level of detail in Crawford's methods and analyses is instructive given the novelty of using such a scale to assess animal personality, and, indeed, the novelty of assessing animal personality empirically in any form. His concerns with using a behavioral rating scale with sophisticated observers would become a constant thread of animal personality research into the twenty-first century (see Gosling 2001 for review). Crawford's questions were the same as those that motivate twenty-first-century trait-rating studies: Do reliable differences between animals' item ratings indicate individual differences in psychical constructs? Do reliable intercorrelations between items indicate the presence of reliable trait groupings?

In the introduction to the rating scale, Crawford was adamant: "So different from that of every other animal, and so consistent with itself is the behavior of each ape, that one cannot escape the conclusion that every chimpanzee must possess a distinct personality" (p. 79). Robert Yerkes, the founder and director of the Yale Laboratories of Primate Biology, agreed. In his 1925 book *Almost Human*, Yerkes wrote that "[Apes] are so highly individualized and they so quickly make a place for themselves in one's world of social relations that it is entirely inadequate to describe them merely by type, or as gibbons, orangs, or chimpanzees" (p. 52). Alas, this zeal for this exploration of animal personality did not translate into progress in the field more broadly: publications on the subject would not become any less scarce in the ensuing decades (Freeman and Gosling 2010). The innovation of Crawford's rating scale thus became a mere footnote to his distinguished career in military psychology (for more details, see Benjamin et al. 2002).

The Relationship Between Emotionality and Various Other Salients of Behavior in the Rat (1940)

Billingslea (1941) published a short investigation on personality variation of different rat strains, although this fact is heavily disguised by the

behaviorist language of the author. Strains of rats bred for their 'emotionality', as indexed by the frequency of their urination and defecation in an open field, were then tested on additional measures of the rats' five "salients of individuality" (p. 69). An activity salient was measured by the number of turns each rat made on a rodent wheel in its home cage. Problem-solving ability was measured by how well the animals learned to complete two tasks. In one task the rats were required to learn to tear through a paper barrier to reach food, and in the other, the animals were required to learn to use their paws to reach food that could not be reached with their mouths. Aggression was measured both by the amount of fighting an animal participated in and by the animals' reactions to being "attacked" by a jet of air blown by the experimenter. Timidness–savageness was measured by the animals' reaction to miniature versions of the open-field test and by the animals' responses to experimenters. Finally, neuroses were indexed in the same way as emotionality: the open-field test. Billingslea's preliminary analysis toward this purpose reported that emotional rats were less aggressive and neurotic while being more timid and active than the non-emotional rats.

Although Billingslea divided rats into emotional and non-emotional groups for his analyses, his stated goal was to better understand how the measured dimensions combine to make up the specific behavior profile of an individual animal. The personality and individuality of the ubiquitous white rat is rarely considered, and it is perhaps assumed by experimenters that the homogeneity that rat colonies are designed to maintain must eliminate individual variation of this kind. Billingslea's modest investigation into this question at a time in which animal personality research was all but nonexistent is truly exceptional.

Temperament in Chimpanzees (1949)

Upon assuming the directorship of the Yale Laboratories, Karl Lashley promised a program of research on "Individual Differences in Temperament" (King and Weiss 2011). Yet the execution of this proposed research program was inconsistent. The duty largely fell to Lashley's former doctoral student Dr. Donald Hebb, a brilliant physiologist and psychologist with no experience with chimpanzees nor desire to study them (Beach 1987). In spite of Hebb's initial reservations about the project, his 1949 "Temperament in Chimpanzees" is an elegant contribution to the early study of animal personality.

Hebb's investigation was conducted by observing individual chimpanzees' behaviors toward human- and object-based stimuli. The first set of observations of chimpanzee behaviors toward humans was of each chimpanzee's behaviors toward the caretaker during the animal's daily, midday meal. The second and third observations were of the chimpanzees' responses to two human confederates, one who played the role of a timid subordinate and one who played the role of a fearless dominant. Object-based observations were similarly subdivided. Some objects were highly salient and primate-related (e.g., a chimp skull, a stuffed spider monkey), whereas others were not (e.g., representations of dogs or snakes). In addition, chimpanzees were given pictures of familiar individuals and strangers, and a board that they could use to enact events outside of their cages.

The behaviors elicited by the animals across these situations were coded; however, Hebb found little to analyze when using only the individual behavior ratings. It was only when these behaviors were collapsed together into larger categories that meaningful interpretations could be made. Hebb's broad categories included friendly behaviors, aggressive behaviors, quasi-aggressive behavior, avoidance, and unresponsiveness. Like Crawford before him, Hebb had a keen interest in determining the reliability of the chimpanzees' scores on these categories as both a measure of the appropriateness of his methodology and as a measure of the stability of chimpanzees' behavior ratings over time. As with Crawford's behavior rating scale, Hebb's measure was highly reliable when animals were observed in similar circumstances some months after the initial testing. Even more notable is the

degree to which the animals' scores were stable: Approximately 8 years after the animals' first exposure to the object test, the apes' fear ratings to a different set of objects were remarkably similar to those of their first exposure.

Hebb would appear to have found the animal personality jackpot: a reliable measure of a variety of meaningful individual differences within a species that are stable across (at a minimum, a significant portion of) the lifespan. His post-hoc assignment of behaviors into human-like behavioral categories was, by his own admission (p. 197), something of an overreach. And yet, at that point in the history of animal personality research, such assignment was the only sensible way to analyze the data. Without the structure of a human-like framework for investigating individual differences in behavioral suites, "the investigator is left with an indigestible mass of facts without relation to one another, and with little value for the prediction of more complex aspects of behavior" (Hebb 1949, p. 196). [Of course, this remains one position in the ongoing contemporary debate regarding the merits of anthropomorphism in comparative research (e.g., Burghardt 2006).] On issues of emotion and temperament in animals, Hebb was pragmatic rather than dogmatic: "Whatever the anthropomorphic terminology may seem to imply about conscious states in the chimpanzee, it provides *an intelligible and practical guide to behavior*" (italics original, Hebb 1946, p. 88).

Nevertheless, animal personality research lacked anyone to follow that guide. Hebb left his position at Yerkes Laboratories before his animal personality research was published, and though he is ascribed as saying that "five years studying temperament in chimpanzees taught him more about human behavior than he learned in any other five years except his first" (paraphrased by Beach 1987, p. 187), he was not to return to Yerkes nor animal personality research. No researcher would immediately take up the mantle.

The Emotions Profile Index (1966, 1973, 1978)

A unique set of contributions to animal personality research comes from the collaborations of Peter Buirski, Robert Plutchik, and Henry Kellerman. From positions at the John Jay College of Criminal Justice at the City University of New York, Albert Einstein College of Medicine, and the Postgraduate Center for Mental Health, respectively, the authors developed and adapted a personality rating scale for use with humans, olive baboons, chimpanzees, and dolphins (Buirski et al. 1973, 1978; Kellerman 1966; Plutchik and Kellerman 1974). Whether by the unorthodox background of the authors or the changing landscape of psychology, work using the Emotions Profile Index (EPI) succeeded in pushing the boundaries of animal personality research.

Buirski, Plutchik, and Kellerman were unafraid of assuming, explicitly, that the same personality constructs applied equally well to all animal species. Indeed, the Emotions Profile Index was originally designed for use with humans on the basis of a general theory of human emotion advanced by Plutchik and Kellerman (1974). The central tenet of the theory was that all human personality is constructed from eight basic emotional states, the frequency and intensity of which can be quantified and understood as an individual personality profile. This profile might then be used as a diagnostic tool in clinical practice, counseling, education, or the workplace.

The version of the EPI for humans is a series of pairwise choices between two descriptive terms. Twelve terms were used in the scale, and all possible pairs of these 12 terms are included in the EPI for a total of 66 pairwise choices. These 12 terms (adventurous, affectionate, brooding, cautious, gloomy, impulsive, obedient, quarrelsome, resentful, self-conscious, shy, and sociable) were mapped onto the eight basic

emotional states (fear, anger, joy, sadness, acceptance, disgust, expectancy, surprise), presenting the individual who administered the EPI with an instant profile of an individual's personality.

To explore just how basic or fundamental the basic emotions that make up the EPI are, the same rating scale was then used by experienced observers to rate the personalities of animals. The first animals tested in such a way were dolphins housed at John Lilly's Communication Research Institute (Kellerman 1966). From a sample of only three dolphins, Kellerman identified both individual and species differences in the EPIs of the animals. Dolphins more generally, and two of Kellerman's subjects in particular, were understood to be playful, accepting, joyful, and primarily occupied with pleasure-seeking. More exceptional animals, like Kellerman's final dolphin subject, exhibited a wider range of personality expression. The normative pleasure-seeking may have been in conflict with more anxious or fearful personality dimensions. As can perhaps be deduced from these descriptions, Kellerman's interpretation of the dolphins' scores was distinctly psychoanalytic. Many unconscious motivations and states were presumed to combine so as to form the observed traits and behaviors on which the EPI is based, and the root cause of emotions and personality might, for any subject, be difficult to discern. For the most anxious animals, Kellerman recommended supportive psychotherapy.

The second use of the EPI with animals involved a wild troop of olive baboons (Buirski et al. 1973). Compared with the previous use of the EPI with dolphins, this application to baboons was greatly expanded. Three observers, rather than one, completed EPIs for the seven animals that made up the baboon troop, and those ratings were then compared with observed behavioral markers of grooming and dominance. EPI scores were reliable across raters and were variable across animals (i.e., reliable individual differences were observed), taken by the authors as evidence for the validity of the EPI as a measure of animal personality. Animals that were scored as most sullen and jealous and least fearful (i.e., the dominant monkeys) were groomed the most by other animals. More subordinate animals were profiled as more affectionate and fearful. Although the authors noted that further analyses could not be made sensibly without adequate normative values for baboon EPI scores, they did offer that baboon scores were highly similar to those of humans for five of the eight emotional indices. Baboons, in comparison to humans, were more sociable and accepting.

The third use of the EPI with animals was with another wild primate troop: the groups of wild chimpanzees studied by Jane Goodall at the Gombe Stream National Park (Buirski et al. 1978). This application of the EPI, with seven raters of 23 animals, was another expansion of the method, and reliability scores remained high despite the greater numbers of raters and animals. And unlike the scores of dolphins and baboons, the scores of the chimpanzees were described with consideration to the specific life history and dynamics of the group. For example, one chimpanzee male with a physical impediment was nevertheless quite aggressive and impulsive when in the company of his dominant brother. Exhibition of these specific personality traits would have likely been significantly muted when the crippled chimpanzee was in a less supportive social environment. Another instructive example from the troop comes from the mother–daughter pair of Passion and Pom (Buirski and Plutchik 1991). The pair was highly deviant behaviorally, engaging in infanticide and cannibalism, and the aggressive, uncontrolled EPI profile of Passion contrasts sharply with female chimpanzee norms. More generally, chimpanzee scores and their relations to dominance rankings were similar to those of baboons. Dominant animals were aggressive and impulsive, whereas subordinates were more timid and sociable.

Issues with the use of the EPI with human subjects, much less with animals, are not difficult to identify. Applications of the EPI to animals were anthropomorphic in the extreme, explicitly assuming that biological similarities and common evolutionary heritage of humans and animals yielded common capacities for emotionality

and personality. The EPI itself was only completed by a small number of raters (as few as one in the case of Kellerman's investigation of dolphin personality) and for a small number of animals. Inter-rater reliability was high throughout (correlating the EPI scores of human adults, male baboons, and male chimpanzees yielded a correlation of 0.9), and the three primate species, graded on the exact same rating scale, present a strikingly similar range of individual personality profiles. Yet it can never be confidently stated that similarities within and between different species' EPI scores were the result of shared personality constructs or a demonstration of how consistently human raters can infer human-like mental states from a diversity of animal behavior.

The influence of the EPI cannot be denied, and the productivity of Buirski, Plutchik, and Kellerman makes the EPI among the most-used rating methods in comparative psychology (Gosling 2001). Although the EPI offered a standardized, cross-species method for personality research, something the field had never before boasted, fundamental issues with the scale's validity certainly reflected, and may well have contributed to, some bad habits of animal personality researchers and the generally poor reputation of the field that have been corrected only in recent decades. Though the EPI offered a way forward for the study of animal personality, it seems fortunate that other methodologies were developed concurrently.

Personality in Monkeys: Factor Analyses of Rhesus Social Behavior (1973)

In contrast to the approach of finding ways to measure individual differences on classes of behavior that seem important for theoretical or even face-valid reasons, some researchers have employed a strategy of casting a wide net of measures and looking subsequently for underlying patterns like personality factors or latent variables. Factor analysis, a statistical sorting technique often applied in the study of human personality, was not used in animal personality research until the publication of "Personality in Monkeys: Factor Analyses of Rhesus Social Behavior" (Chamove et al. 1972), although Van Hooff (1970) did use principal component analysis for a similar purpose to understand social behaviors of captive chimpanzees. This innovation emerged from the collaboration of clinical psychologist Arnold Chamove and two giants of psychology, personality theorist Hans Eysenck and comparative psychologist Harry Harlow, at Harlow's primate research facility. Ten behaviors of 168 juvenile rhesus macaques were recorded as the animals were exposed to different social and experimental settings including interactions with three groupmates, exposure to an infant conspecific, and exposure to a docile adult male conspecific. The behaviors were coded by the duration in which the monkey engaged in them, and included social and nonsocial versions of play, fear, and avoidance behaviors.

Once analyzed, the animals' behaviors during their interactions with three groupmates clearly loaded onto three factors: hostile, fearful, and social behaviors. A possible analogy between these factors and Eysenck's three major personality factors (neuroticism-stability, extraversion-introversion, and psychoticism) was dutifully noted by the authors (Eysenck and Eysenck 1968). They were also careful to note that similarities in the factor loadings of different species may be illusory. In spite of the superficial similarity in the factors, it was concluded that "It would be premature to seek to prove the identity of the factors in these different species; no acceptable method exists at the moment for any such proof" (Chamove et al. 1972; p. 502). Critically, animal personality research was regarded as worth pursuing, and even as a construct that was both critically important and strikingly underrepresented in comparative psychology. Such a line of inquiry was not impossible; the interpretive framework was simply incomplete.

Madingley Questionnaire (1978–Present)

A landmark series of studies on animal personality was published by Joan Stevenson-Hinde and colleagues beginning in the latter part of the 1970s (Stevenson-Hinde et al. 1980a, b; Stevenson-Hinde and Zunz 1978). Her work on individual differences in rhesus macaques carried with it no assumption that all animals experienced the same basic emotions, as in work with the EPI. Stevenson-Hinde was trained as an experimental psychologist in the Skinnerian tradition, and this training, combined with her interest in variables outside of the immediate stimulus environment and an eye to developing theories of human personality, allowed for the development of a new tool for the study of animal personality (Stevenson-Hinde and Hinde 2011).

In truth, Stevenson-Hinde's work is not different in kind from what has already been reviewed. The development of the scale that would eventually become the Madingley Questionnaire was strikingly similar to that of Crawford's behavior rating scale, with terminology from Sheldon's *Scale for Temperament* (1942), and analysis via factor analyses of the kind used by Chamove, Eysenck, and Harlow (see previous section; Stevenson-Hinde and Hinde 2011). Nevertheless, the combined effects of her commitment to her scale (she used it across multiple years and multiple publications) and its relative adaptability (the experimenter is afforded a certain degree of flexibility in changing the scale) presented a substantive contribution to animal personality research (Stevenson-Hinde and Hinde 2011). Initial versions of Stevenson-Hinde's rating scale included 33 items that were to be rated on a seven-point scale by three observers. This version of the scale loaded the ratings of the rhesus macaques into two factors, one a spectrum from "Confident" to "Fearful" and the other, a spectrum from "Active" to "Slow". Later versions removed unreliable items from the initial set and replaced them with ones of a more social nature. The new set of items loaded onto a third factor and included items related to sociality on a spectrum from "Sociable" to "Solitary". These ratings and loadings were highly consistent over multiple years for adult animals, with juveniles' scores more irregular.

A novel and important approach of Stevenson-Hinde was the standardization of individual animals' scores relative to population means for each component. In this way, she could derive a truly individual profile for each of the animals based on their specific deviations from the norms of the species. Whether it was for this unique element or another reason, Stevenson-Hinde is regarded as a pioneer in the study of personality research (Gosling et al. 2003). Indeed, so impactful were her early works that they are sometimes erroneously cited as being the first studies of animal personality (e.g., Clarke and Boinski 1995). Although it is impossible to say with any certainty what precipitated the boom in animal personality research that occurred at the conclusion of the twentieth century and into the twenty-first century, Stevenson-Hinde offered an attractive corpus of scholarship that synthesized the strongest ideas from previous animal personality research just as a generation of animal personality research began. Her influence cannot be understated, and the Madingley questionnaire remains an invaluable tool for the study of animal personality (e.g., Freeman et al. 2013).

Suomi's Laid-Back, Uptight, and Jumpy Monkeys (1989–Present)

As noted above, some of the earliest attempts to describe individual differences in animal personality were focused on the organisms' responsiveness to novel or threatening stimuli. Assessments of individual differences in fearfulness, timidity, anxiety, shyness, or hypervigilance in response to such situations appear to be stable within individuals and across contexts, and predictive with respect to a wide range of behavioral outcomes. Over the last three decades, Steve Suomi and his collaborators have examined the biological basis and social–behavioral consequences of variations in behavioral

reactivity as a personality trait in monkeys (e.g., Higley and Suomi 1989; Schneider et al. 1991; Suomi 2001; Suomi et al. 2011). Suomi and his colleagues have focused on three subgroups of monkeys within these variations in reactivity. About 20% of the monkeys respond consistently and characteristically to environmental stressors with fear, stress, and avoidance. These animals, dubbed "uptight" (or fearful, or anxious) by Suomi's team, respond behaviorally and physiologically with stress responses to even mild challenges—the kinds of things that would produce curiosity and exploration in other ("laid-back") members of the same species and group. The third group of monkeys of interest to these researchers is the 5–10% of animals that are reliably impulsive, showing poor behavioral inhibition in a wide range of environments. Unlike the uptight and laid-back animals, these monkeys are much more likely to behave in inappropriate and maladaptive ways, for instance by moving repeatedly between a dominant male and a desired food, or between a high-ranking mother and her infant. These aggressive, jumpy monkeys also show neurobiological markers that correspond to the stable behavioral patterns. Suomi and collaborators have also shown that the traits that underlie these three groups are highly heritable but modifiable by early experience, that the distributions of these groups are consistent across laboratory and naturalistic settings, and that the behavioral types correspond to adjective-rating assessments of personality like those discussed in the previous section (Bolig et al. 1992). Further, the temperament differences recorded in these rhesus monkeys appear to map onto variations that are observed in human children (i.e., with parallels between uptight monkeys and anxious or fearful children, and between jumpy monkeys and aggressive children). Without suggesting that reactivity and behavioral inhibition capture all of the variability in personality differences for animals, Suomi and colleagues have shown powerful predictive relations between this trait and a wide range of important social and behavioral competencies and problems such as affiliation or social isolation, reproductive success or sexual impairment, and longevity versus premature death from violence (Higley et al. 2011).

The Five-Factor Model Plus Dominance in Chimpanzee Personality (1997–Present)

The final case study included in this review is the Five Factor Model + Dominance for chimpanzees (FFM + D; King and Figueredo 1997). In most ways, the work of King and Figueredo reflected the natural evolution of the various adjective-based personality ratings that preceded them. For example, Figueredo et al. (1995) had compared the personality structure of macaques and zebra finches using a modified version of the Madingley Questionnaire. Like the research with the EPI and earlier versions of the Madingley Questionnaire discussed above, the FFM + D was based on rating scales originally designed for use with humans. In this case, the model was Goldberg's (1990) taxonomy of the "Big-Five" factor framework, in which human personality can be measured with adjectives selected to reflect five latent factors or dimensions: Surgency (Extraversion/Introversion), Agreeableness, Emotional Stability (or its reverse, Neuroticism), Intellect (Openness), and Conscientiousness. King and Figueredo (1997) selected 40 adjectives from Goldberg's inventory (and added three words: clumsy, autistic, manipulative) for use with chimpanzees. A total of 100 chimpanzees from 12 zoological parks were rated for each adjective on a 7-point scale by a total of 53 raters (averaging about four raters per chimpanzee, with high observed inter-rater reliability). Principal axis factor analysis of these ratings revealed six factors. The first and largest of the factors, accounting for about 21% of the variability, did not correspond to any of the factors in either Goldberg's (1990) analyses or the FFM more generally. The highest-loaded adjectives on this factor were dominant and submissive, and all of the adjectives that loaded on this factor suggested a Dominance dimension. The other five factors revealed in the King and Figueredo analysis corresponded rather directly with the

Big Five from Goldberg and many other studies (see, for example, reviews by Digman 1990; McRae 2009). The second factor included variables like solitary, active, playful, sociable, and friendly, and was interpreted as Surgency (Extraversion). The third factor (including impulsive, defiant, reckless, erratic) suggested Dependability or Conscientiousness, whereas the fourth factor (including sympathetic, helpful, sensitive, protective) was interpreted as Agreeableness. Stable, excitable, and unemotional appeared to form an Emotional Stability factor, whereas inventive and inquisitive loaded together in a factor interpreted as Openness. More than 72% of the total variability was accounted for by the six-factor solution.

The general correspondence between the Big Five personality traits and factors two through six of the King and Figueredo data was impressive, although the authors acknowledged that some of the items had their strongest loadings for the chimpanzees in a different factor than what Goldberg (1990) found for humans. Nevertheless, the report provided impressive evidence both for the existence of apparent personality traits in these animals, and also for the utility of assessment strategies for understanding animal personality that are comparable to those used for humans.

A Recent History of Animal Personality Research

The animal personality area has been definitively reviewed and summarized by Samuel Gosling and his collaborators (e.g., Freeman and Gosling 2010; Gosling 2001, 2008; Gosling and John 1999; Jones and Gosling 2005). These reviews illustrate the commonalities and differences in findings about animal personality across studies. They also serve to document the tremendous increase in interest in the topic in the last two decades, at least to the degree that scholarly output is an indicator of interest. Figure 1.1 updates the publication counts reported by Freeman and Gosling (2010), including conservative projections of the number of empirical, theoretical, and review publications that should be in print by the end of the present decade. To highlight the recent surge of interest, note that of the 468 articles and chapters that have been published to date on primate personality, 75% have appeared in the two decades since King and Figueredo (1997). It seems likely that PsycINFO will index more articles and chapters on animal personality (with animals as the subject population) between 2010 and 2019 than in all of the previous decades combined.

In addition to chronicling the change in interest in the topic, the highly cited reviews of animal personality research by Gosling (2001) and Gosling and John (1999) likely contributed to the start of the surge in interest. Attempts to synthesize the contributions of scholars like Crawford and Hebb indicate a self-awareness about the field that animal personality research had previously lacked; that is, there seems to be a tacit acknowledgment that although no single work of those authors had birthed a multi-faceted program of animal personality research, the combined efforts across investigators might have done just that. The reviews also inevitably evaluated the current climate in which questions of animal personality might be studied and found it to be quite a bit more forgiving than in Crawford's or Hebb's time. Gone was much of the behaviorist dogma that may have otherwise stifled the growth of animal personality research, without abandoning the methodological behaviorism that elevates the enterprise from speculation to science. The language of psychology had loosened, and loosened enough that the exploration of the individual characters of a diverse array of animals was no longer verboten.

The methodological innovations discussed in the present chapter remain important: the EPI, Madingley Questionnaire, and Chimpanzee Personality Questionnaire were used in two-thirds of the animal personality studies reviewed by Freeman et al. (2011). More broadly, the general use of subjective personality ratings (ideally anchored by specific behaviors) followed by analysis of factor structure has become conventional, with the specific assessment methods and latent variables being continually refined and described

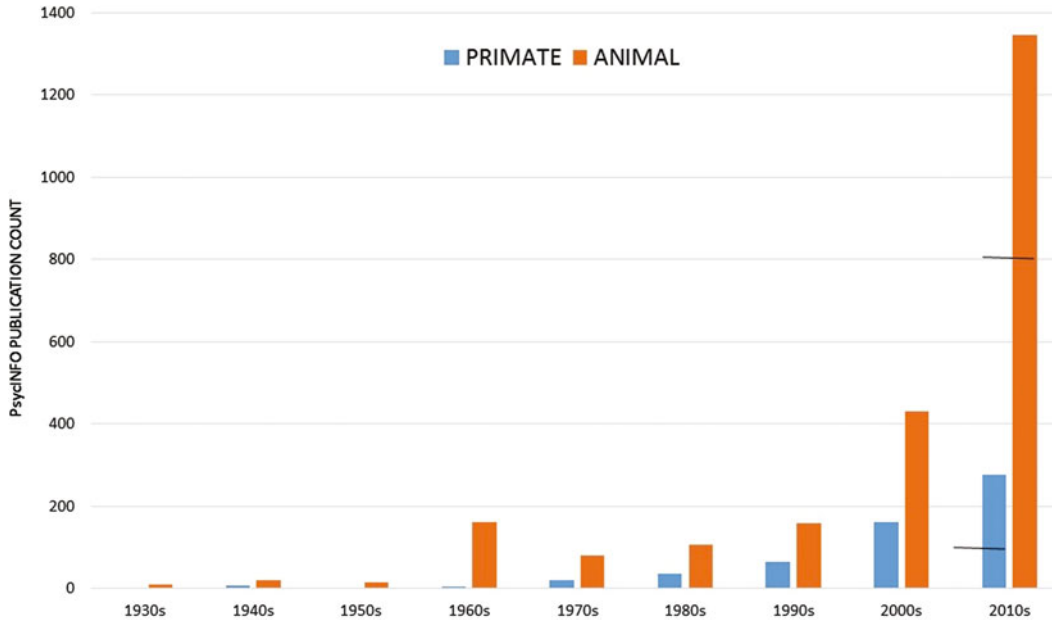

Fig. 1.1 PsycINFO publication counts by decade for "primate and personality" or "animal and personality" (population = animals). The *bars* in the 2010s column represent projections for the 2010–2019 decade, based on publications to date (marked by the *horizontal lines* in this column)

(e.g., Freeman et al. 2013). Nonhuman primates remain popular subjects of these studies, but personality research is being conducted with a growing number of other animal species. Within the last year, for example, there have been published reports of personality research with fish, birds, spiders, lizards, and wild boars, among other species. As is the case for other topics within comparative cognition, there has been a surge of research on personality of canines—bringing the field full circle, in a sense, from the early musings of Pavlov discussed above. Although there remains much to learn about the nature, causes, and implications of individual and species differences in personality among nonhuman animals, the field is much more empirically grounded and much more theoretically cohesive, compared to the broad early descriptions of savage rats (Utsurikawa 1917), gregarious pigeons (Taylor 1932), negative dogs (Pavlov and Petrova 1934), unsociable cats (Romanes 1912), and confident chimpanzees (Yerkes 1939).

That said, this overview of the history of the research area serves to highlight that there remain concerns and problems within the field, even after these many decades of research on personality in animals, and in the midst of this tremendous surge in interest and scholarly activity. The challenges that characterize other areas of inquiry within comparative cognition—from anthropomorphism to uncontrolled sources of error—plague animal personality researchers as well, who must also wrestle with issues (e.g., the circularity of inferring traits that presumably explain behavior from subjective ratings of similar behaviors) faced by scientists who study personality in humans. In part because of this, it could be claimed that the hundreds of discrete steps the field has taken since the 1970s have advanced our knowledge less than those two or three leaps reflected in the seminal studies reviewed in this chapter. The other contributions to this volume seek to remedy this, illuminating the relation between evolution, heredity, biology, experience, development, cognition, social variables, temperament, and behavior.

It seems that comparative psychology is at the brink of a big change, in which individual differences become as interesting and important as group (e.g., species, or mother-reared versus

nursery reared, or laboratory-housed versus free-range) similarities and differences have been. Future histories of comparative psychology will indicate whether this statement is true; but if individual differences are indeed to become an increasing focus of comparative psychology, it seems likely that the struggles and successes that have characterized the study of animal personality will lead the way.

Acknowledgements Preparation of this chapter was supported by Grant HD-060563 from the National Institute of Child Health and Human Development, and by Georgia State University. For more information, contact the authors at wwhitham1@student.gsu.edu or dwashburn@gsu.edu.

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