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Personality Assessment in African Elephants (*Loxodonta africana*)

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PERSONALITY ASSESSMENT IN AFRICAN ELEPHANTS

(*LOXODONTA AFRICANA)*

by

Kristina Marie Horback

Abstract of a Dissertation
Submitted to the Graduate School
of The University of Southern Mississippi
in Partial Fulfillment of the Requirements
for the Degree of Doctor of Philosophy

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ABSTRACT

PERSONALITY ASSESSMENT OF AFRICAN ELEPHANTS

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The following study assessed personality in twelve African elephants using both observational behavior coding and standardized trait rating methods, thus demonstrating consistent individual differences across time and contexts. During the summer of 2010 and 2011, over 640 hours of behavioral data were collected onsite at the San Diego Zoo Safari Park in Escondido, CA. Four coding-based personality traits were determined after analysis: PLAYFUL, CURIOUS, TOLERANT, and, AGGRESSIVE. This data was then compared to survey ratings completed by the animal keeper staff during both summers. Four rating-based personality traits resulted from this analysis: PLAYFUL, CURIOUS, TIMID, and, AGGRESSIVE. All eight composite personality traits were highly correlated ($p < 0.01$) from 2010 to 2011 for each individual elephant. In addition, the rated and coded traits were highly correlated ($p < 0.05$) among the individuals, demonstrating construct validity. Previous studies on personality in both humans and animals have found that individual differences in temperament are significantly related to immunity strength, breeding status, and stress response. This suggests that personality assessment in any species can be used to identify individuals that are more sensitive to environmental and social sources of stress, may help in determining inter-individual compatibility, and can shed light on personality-specific enrichment.

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CHAPTER I

INTRODUCTION

Individual Differences

Research on both mammalian and non-mammalian species has found that individuals of the same age and sex tend to display different behaviors given the same environmental context (cows: Boissy & Bouissou, 1995; fish: Budaev, 1997; Coleman & Wilson, 1998; Francis, 1990; ground squirrels: Coss & Biardi, 1997; cats: Feaver, Mendl, & Bateson, 1986; pigs: Forkman, Furuhaug, & Jensen, 1995; Lawrence, Terlouw, Illius, 1991; parakeets: Funk & Matteson, 2004; spotted hyenas: Gosling, 1998; dogs: Gosling & John, 1999; Murphy, 1995; Svartberg & Forkman, 2002; snakes: Herzog & Burghardt, 1988; quail: Jones, Mills, & Faure, 1991; goats: Lyons, Price, & Moberg, 1988; wolves: MacDonald, 1983; octopuses: Mather & Anderson, 1993; horses: Mills, 1998; deer: Pollard, Littlejohn, & Webster, 1994). In fact, research has shown that individuals vary their behavior in consistent trends across suites of functionally-distinct behavioral traits (Sih, Bell, & Johnson, 2004; Stamps & Groothuis, 2010). For example, animals that are more likely to explore novel environments (i.e., "bold") are also more likely to display hostile behaviors during social contexts (i.e., "aggressive") (rodents: Koolhaas et al., 2001; fish: Huntingford, 1976; birds: Verbeek, Boon, & Drent, 1996).

This variation in individual behavioral traits has been referred to as *coping styles* (Koolhaas et al., 1999), *temperaments* (Zuckerman, 1991), *behavioral profiles* (Carlstead, 1999a, b; Groothuis & Carere, 2005), *behavioral syndromes* (Sih et al., 2004) and *personalities* (Gosling, 2001; Highfill & Kuczaj, 2007). A general consensus of all terms is a consistent display of related behaviors, with varying degrees of intensity, across time

and contexts (Budaev & Zworykin, 2002; Dall, Houston, & McNamara, 2004; Gosling, 2001; Pervin, 1984; Vazire & Gosling, 2004). Each term describes individual differences in "patterns of responsiveness over time and situations, reactivity to novelty, the *flow* of behavior, and the intensity of actions and reactions*"* (Carlstead, 1999a, p. 19). Individual differences in humans, or *personalities*, are commonly assessed through self-reporting and cognitive tests (Gosling, 2001; Mather & Anderson, 1993; Pervin, 1984; Vazire & Gosling, 2004). *Temperament,* the biological foundation of future personality types, is assessed in non-verbal human infants via observable interactions with the environment (Buss et al., 1987). Recently, these observational methods have been modified to identify, and confirm, specific temperaments, or personalities, in animals as well (for review see Gosling, 2001). Knowledge of such individual differences in both domesticated and wild animals can help researchers determine appropriate husbandry practices, outline successful conservation biology methods, and identify potential cognitive abilities.

Animal Personality Research

The rise of *behaviorism* in the early 20th century proliferated the belief that psychological research should focus on observable animal behavior, rather than on inferred mental states (i.e., Hull, 1934; Skinner, 1931; Watson, 1913). Although this field assumed that all learning is a result of stimulus-response pairing, leading behaviorists did address the existence of individual differences. For example, Pavlov (1927) classified his canine subjects into four *humorism*-based temperaments while examining conditioned reflexes: angry dogs were choleric, sleepy dogs were phlegmatic, whimpering dogs were melancholy, and energetic dogs were sanguine. Both Skinner and Watson acknowledged the concept of personality but viewed it simply as a product of

genetics and one's personal history of reinforcement (Flett, 2008). Common methods used in assessing personality in both humans and animals relies upon observable and measurable behavior to provide insight into the biological, environmental, and social underpinnings which determine individual differences in behavior.

Personality Assessment Methods

Assessing personality in non-human animals can be accomplished through both (a) rating of specific traits, and (b) observational coding of specific behaviors (Highfill, Hanbury, Kristiansen, Kuczaj, & Watson, 2009; Mather, 1998; Vazire & Gosling, 2004). Rating personality traits in animals requires zookeepers, trainers, or animal owners use their intimate knowledge of each individual to rate the animal's placement on a continuum of a specific trait (i.e., 1 [timid] – 5 [bold]). The number and complexity of rated items varies according to the researcher's approach and the species of interest. For example, studies may try to adapt the Five Factor Model used in human personality research (OCEAN: Openness to Experience, Conscientiousness, Extroversion, Agreeableness, and Neuroticism) (Goldberg, 1990, 1993), or they may offer several diverse adjectives to be subsequently condensed into key traits following a factor analysis (i.e., Gosling, 1998; Svartberg & Forkman, 2002).

Observational coding of specific behaviors can be carried out through conducting specialized experiments (e.g., guppies: Budaev, 1997; horses: Le Scolan, Hausberger, & Wolff, 1997; pigs: Forkman et al., 1995; bushbabbies: Highfill et al., 2009), or by passively observing naturally occurring behavior (i.e., *ethological coding*: Vazire & Gosling, 2004). Behavioral ethograms used in ethological coding are generally created to be species-specific. Behavioral data is then collected using common scan sampling

techniques for either singular events and/or sustained states (i.e., Altmann, 1974). One of the first comprehensive examinations of individual differences in non-human animals was Adamec's study (1975) on behavioral traits between rat-killing and non-rat killing cats. Through a series of experimental trials examining novelty, response to live prey, human contact, and, fear-inducing auditory signals, Adamec found consistent and distinct differences in behavioral responses. The non-rat killing cats were found to be more reactive, highly aroused, and showed an increase sensitivity to external threats (Adamec, 1975).

A key component of personality is consistency of behavioral differences across time. Researchers assess this factor using the test-retest method. For example, Stevenson-Hinde, Stillwell-Barnes and Zunz (1980) rated individual rhesus macaques every November for four years in order to determine individual behavioral temperaments. After an extensive factorial analysis of behaviors observed, the authors determined three key behavioral traits for these rhesus macaques: confident, excitable, and sociable. Furthermore, maternal temperaments were found to greatly influence the temperaments of the developing offspring throughout the study (Stevenson-Hinde et al., 1980). While investigating the temporal consistency of personality traits following a major disruptive environmental event, Highfill and Kuczaj (2007) obtained ratings of individual bottlenose dolphins in the months preceding and following Hurricane Katrina. Remarkably, they found that the dolphins maintained distinct, stable personalities throughout major changes in their lives that resulted from Katrina.

Application of Animal Personality

Previous research on animal individual differences determined that personality traits are significantly related to immunity strength (Koolhaas et al., 1999; Segerstrom, 2000), rearing experience (Moberg, 1985), breeding status (Wielebknowski, 1999), genetics (Gentsch, Vichtsteiner, & Feer 1981; Mormede, Dantzer, Bluthe, & Caritez, 1984; Suomi, 1987), and stress response (i.e., cortisol levels: Sapolsky, 1987). For example, one way of categorizing animals into subgroups has been on the basis of their reaction to a variety of stressors: active or passive coping style (Benus, Bohus, Koolhaas, & van Oortmerssen, 1991). Animals which display shorter attack latencies to a threat (i.e., conspecific or human), high level of active avoidance and aggression are often labeled "active copers" (Bohus et al., 1987; Benus et al., 1991; Koolhaas et al., 1999). The passive coping style, or *reactive* behavioral syndrome, is associated with high hypothalamus-pituitary-adrenal axis responsiveness, and low sympathetic reactivity (Korte et al., 1992). Zoological facilities can use such knowledge to identify certain individuals (i.e., passive copers) which are vulnerable to environmental and/or social threats (Manteca & Deag, 1993), and may facilitate breeding programs (i.e., *Species Survival Plans* for endangered species) by pairing compatible individuals (Carlstead, Shepherdson, Sheppard, Mellen, & Bennet, 2000).

Application of Personality Research in Zoos

In order to create a standardized behavioral evaluation procedure, the Institute of Museum and Library Services, Geraldine R. Dodge Foundation, and the Smithsonian Institution sponsored the "Methods of Behavioral Assessment Project" (Carlstead et al., 2000). Across twelve separate zoological facilities, this project used both rating and

coding techniques to examine individuality in four key species: cheetahs (*Acinonyx jubatus jubatus)*, black rhinoceros (*Diceros bicornis michaeli* and *minor)*, maned wolf (*Chrysocyon brachyurus)*, and great hornbill (*Buceros bicornis)*. By comparing behavioral profiles from 74 cheetahs across 16 zoos, this project found that there is a genetic predisposition for fear in this species; as all females were rated at higher levels, and siblings displayed more similar fear traits than non-siblings (Carlstead et al., 2000). Results from this project also indicate that more fearful cheetahs of both sexes are the least successful breeders; something that Wielebnowski (1999) also found in her study of individual differences in captive cheetahs. This cross-institutional project also found that keeping black rhinos in a small exhibit (< 4000 sq. m.), with concrete walls, multiple females and a large public access caused numerous stress-related behavior and reproduction problems (Carlstead, Fraser, & Kleiman, 1999a; Carlstead, Fraser, Bennett, & Kleiman, 1999b). From these studies, an instruction manual for appropriate data collection and analysis techniques was created in order to conduct behavioral profiling in all species.

The layout and structure of a zoological enclosure has also been found to affect the development of behavioral individual differences. For example, reduced exhibit size and complexity can result in sustained aggression and stereotypic behaviors (black rhinos: Carlstead et al., 2000; bears: van Keulen-Kromhout, 1978), which in turn greatly affects animal welfare. In their study of individual differences in gorillas (*Gorilla gorilla*), Miller-Schroeder and Paterson (1989) found that cage volume, complexity and the availability of privacy greatly affects long-term maternal styles and breeding success. For primates in particular, infant mortality has been shown to be a direct result of

deficient maternal styles due to the mothers' specific temperaments (Cleveland, Westergaard, Trenkle, & Higley, 2004; Fairbanks, 1996; Maestripieri, 1993).

The behavioral and physiological well-being of captive animals has been found to be directly related to the absence of abnormal or stereotypic behaviors (Dantzer, 1989; Hughes & Duncan, 1988; Mason, 1991), the ability to respond effectively to environmental change (Mendl, Zanella, & Broom, 1992; Novak & Suomi, 1988), and the presence of natural behaviors (i.e., rooting or nest-building in pigs, and scratching or dust-bathing in poultry: Bracke & Hopster, 2006) and positive behaviors (i.e., play: Boissy et al., 2007). Varying methods of animal management and husbandry techniques significantly shape individual differences in the ability to prosper in captivity. As Benus and colleagues (1987, 1990) found, certain individuals are better able to respond to environmental and social stress due to their temperament, or personality type. They selectively bred mice for aggressiveness and found that these individuals displayed less stress-indicating behaviors under stable contexts, whereas non-aggressive mice thrived under changing circumstances by showing greater flexibility in their behavior (Benus, den Daas, Koolhaas, & van Oortmerssen, 1990; Benus, Koolhaas, & van Oortmerssen, 1987). Personality assessments would allow animal caretakers to identify appropriate roles for certain individuals; such as those which are socially compatible for breeding, human-interaction (i.e., long or short training sessions), or transport to a separate facility (i.e., individuals with an active coping style).

Zoological African Elephants

African elephants have been in North American zoos for over 200 years (Schulte, 2000). The current AZA studbook, a computerized database of all captive animals, states

that there are approximately 126 female and 32 male African elephants being exhibited in the United States (International Species Information System, 2011). The vast majority of these adults were wild caught as juveniles during the ivory trade of the 1970s and 1980s (Olson & Wiese, 2000; Veasey, 2006). In 1981, the Association of Zoos and Aquariums began the *Species Survival Plan* for African elephants (AZA, 2007). This cooperative population management and conservation program carefully manages the breeding of zoological African elephants in order to maintain a healthy and self-sustaining population within zoos that is both genetically diverse and demographically stable.

The maintenance of elephants in zoological institutions is notoriously difficult due to the multifaceted requirements of adequate exhibit size, compatible social grouping, sheer physical management, and health care (Clubb & Mason, 2003; Mason & Veasey, 2010; Veasey, 2006). The attenuation of motor activity often seen in zoo elephants has resulted in elevated concerns regarding physical well-being (i.e., obesity, degenerative joint disease, foot health: Roocroft, 2005) and psychological welfare (Morgan & Tromburg, 2007; Shepherdson, 1999; Soltis & Brown, 2010). Zoological elephants have a reduced need to travel the long distances seen in the wild for resources, given that environmental and social variables are relatively static. Taking into account individual health, temperament, and age, researchers have reported similar walking rates for zoo-based animals compared to free-ranging populations (Leighty et al., 2009, 2010; Rothwell et al., 2011). The devoted matriarchal societies seen in the wild are rarely replicated in zoos. The natural family units range from 10 to 12 closely related adult females and their offspring (Estes, 1991; Vidya & Sukumar, 2005). Subadult males leave their natal group between nine and 18 years of age, occasionally forming bachelor groups

when not in *musth*, but become solitary as adult bulls (Vidya & Sukumar, 2005). Maintaining complex social grouping in zoological institutions is most likely difficult due to limited accessibility and appropriate enclosure size.

CHAPTER II

METHODS

Focal Subjects

The subjects for this study were 12 of the 17 African Elephants (*Loxodonta africana*) held at the San Diego Zoo Safari Park in Escondido, California (Table 1). From May 2010 through January 2011, this herd consisted of one adult male, six adult females, one male sub-adult, two female juveniles, two males juveniles, and three male calves (age class according to based on Sukumar, 1988). In January 2011, another male calf was born into the herd and a second bull male was given access to certain females and their corresponding offspring. The date of birth for all adults is estimated, as this wild herd was transferred from Kruger National Park in South Africa to Swaziland in 1994, before being rescued from a scheduled cull and finally transferred to North America in August 2003.

Facility

The elephant enclosure at the San Diego Zoo Safari Park contains two indoor barns, and a 1.3 ha outdoor exhibit of various topography (dirt, rock, mud, grass) and includes accessories of trees, shade structures, and a bathing pool. The herd social grouping ranges from all 15 individuals present in the same large outdoor exhibit, to smaller subgroups of a single adult female and her offspring. Animal keeper staff interacted with the herd during daily medical checks and routine operant behavior training. Behavior data were not collected during this interaction time period.

Table 1

Gender, Date of Birth, and Lineage of the African Elephants Observed

Elephant	Sex	DOB	Sire	Dam
E1*	M	est.1/1/1990	unknown	unknown
E2*	F	est.1/1/1990	unknown	unknown
E3*	F	est.1/1/1990	unknown	unknown
E4*	F	est.1/1/1991	unknown	unknown
E5*	F	est.1/1/1990	unknown	unknown
E6*	F	est.1/1/1990	unknown	unknown
E7*	F	est.1/1/1990	unknown	unknown
E8*	M	2/23/2004	unknown	E5
E9*	F	9/11/2006	E1	E6
E10*	M	3/11/2007	E1	E3
E11*	F	9/19/2007	E1	E7
E12*	M	3/13/2009	E1	E6
E13	M	2/14/2010	E1	E5
E14	M	4/12/2010	E1	E2
E15	M	5/12/2010	E1	E7
E16	M	12/27/2010	E1	E3
E17	M	est. 1/1/1990	unknown	unknown

Note*:* * indicates individual analyzed for this study.

Data Collection

Behavior Coding

Onsite behavioral data were collected for approximately 12 weeks throughout late May to early August during the summer of 2010 and 2011. Observations were recorded in the perimeter section of the elephant exhibit, which is closed off to the public. This enabled the observer to follow and track each individual when they travel out of public view. Behavioral events were recorded using an all-occurrence focal sampling technique, while the behavioral state of the focal individual was recorded using a one minute scan sampling method (Altmann, 1974). These 15-minute focal follows entailed recording every behavior displayed during each minute, and the behavioral state at the end of each minute (i.e., instantaneous method) (see Appendix A for operational definitions). Each subject was observed for 30 minutes (two separate observation periods), once during the morning and evening hours. The morning shifts occurred from 0500-0900 and 1100-1500 while night shifts were from 1700-2100 and 2100-0100.

The shift schedule alternated as follows: eight morning shifts cut in half by two days off (with two days off in the middle), then eight night shifts separated by two days off. This pattern repeated for a total of 20 days of each morning and night shift observations for each summer. A total of 640 hours of behavioral data were collected between both summers, with 320 hours of behavioral data during the daylight hours and 320 hours of behavioral data during the night. The order in which the subjects were observed was determined prior to the data collection period using a randomized computer sequence using the Excel® program.

Behavioral data were recorded on a specifically created datasheet, using a stop watch to designate the beginning of each minute. Solitary behaviors (feed, drink, dust, wallow, bathe, dig, rub, manipulate object/enrichment, sway, and other) were recorded in Section I of the datasheet by tallying each occurrence of the behavior in the corresponding row. Sections II and III referred to positive (approach, body touch, social play, leave, share food, share object) and negative social behaviors with conspecifics (charge [mock and real], head shake, alert posture, pursue, throw, bite, head butt, spar) (Ross, Ross, & Lukas, 2002; Tresz, Roocroft, Wright, Wright, & Koyle, 2005). When applicable, the *other* individual involved in the behavior with the focal subject was also recorded in the corresponding row. Section IV was for recording the instantaneous sampling of behavioral state each minute.

Due to the long hours necessary for data collection, and the limited access to the non-public viewing areas, all onsite data were collected by a single observer. A second observer recorded one hour of observational data for each member of the herd, resulting in 15 hours of behavioral data analyzed for reliability (*inter-observer agreement* on 2.3% of data: *Pearson's r* > 0.90). Intra-observer reliability was assessed through repeated coding of two 20-minute video segments of the herd filmed in the spring of 2011 (*intra-coder agreement*: *Pearson's r* > 0.95). This method was done in order to verify that behaviors were being coded on a consistent level throughout the summer (i.e., no coder-fatigue).

Rated Surveys

Previous studies have found that raters spend less concentrated time and give less accurate responses when questionnaires are too complex or time-consuming (Carlstead et

al., 2000). Therefore, the survey used in the present study was constructed with particular attention to clarity and minimal effort required. The elephant care staff of the Safari Park were not trained to rate the elephants in a uniform fashion. Previous studies on the use of subjective ratings to determine animal temperament have found that high inter-observer reliability can be attained with untrained, inexperienced observers (Carlstead, 1999a; Feaver et al., 1986; Wemelsfelder, Hunter, Mendl, & Lawrence, 2000; Wielebnowski, 1999). In addition, animal caretakers can demonstrate high levels of agreement when rating personality traits in their animals depending on the length of their association with the animals (Feaver et al., 1986; Martau, Caine, & Candiand, 1985). Each of the twelve members of the elephant keeper staff of the San Diego Wild Animal Park (mean acquaintance with these elephants = 4.2 years) completed personality rating questionnaires for each individual elephant. Each keeper was asked to list the number of years they have worked with the herd, as well as the number of years they have worked with the individual elephant in order to assess bias (i.e., Highfill et al., 2009).

The animal care staff rated each elephant in terms of specific behavioral tendencies. Each tendency was rated on a 1-7 scale, with 4 being neutral (e.g., 1 [timid] – 7 [bold]). In addition, the keepers were given the option to place "don't know" when rating a specific tendency. A total of 35 tendencies were separated into three sections: I. Interactions with the Physical World, II. Interactions with other Elephants, and, III. Interactions with Humans (see Appendix B for example survey).

CHAPTER III

RESULTS

Behavior Coding

Behavior Event Rates

Recorded behavior events were summed for each individual and were then divided by the total number of minutes each individual was available for observation (based on the 1-minute behavior state scan). This procedure was completed separately for both years, giving each individual one score (i.e., number of events per hour) for 2010 and one score for 2011.

Correlation Matrix

Individual behavior rates from each year were summed to give each individual an overall score for each behavior event. The resulting dataset violated some assumptions for bivariate Pearson's correlation (i.e., normality, skewness, and kurtosis); therefore, a Spearman's correlation coefficient was then calculated for each of the 18 behaviors recorded (see Table 2). The behavior events found to be correlated with an alpha less than 0.01, and had closely related operational definitions, were then clustered to create composite behavior groups. The composite trait groups did not cluster in a random pattern which as would be expected of multiple Type I errors. In the end, four composite groups were created: (1) PLAYFUL (Approach, Rub, Social Play, Spar, Wallow); (2) CURIOUS (Manipulate Enrichment, Manipulate Object, Throw); (3) TOLERANT (Body Touch, Share Food); and (4) AGGRESSIVE (Charge, Head Shake).

Composite Group Score

Each individual was given a score for the four composite groups for each year of observation. These scores were based on the sum of weighed behavior events that define each composite group. For example, the male calf (E12) received a "PLAYFUL" behavior score of 17.26 for the 2010 data. This means that, on average, he engaged in approach, rub, social play, spar, and wallow 17.26 times per hour in 2010.

The composite group score for each individual in 2010 was compared to the scores determined for 2011 in order to establish consistency across time. Each individual displayed a consistent trend in behaviors based on highly correlated scores for each composite group: PLAYFUL ($r_s(10) = 0.91$, $p < 0.001$), CURIOUS ($r_s(10) = 0.85$, $p = 0.001$), TOLERANT ($r_s(10) = 0.68$, $p = 0.02$), and AGGRESSIVE ($r_s(10) = 0.9$, $p < 0.001$) (Figures 1–4).

Table 2

Spearman's Rank Correlation Matrix for Behavior Events Coded

Behavior	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. Dust	0.07	0.43	0.42	-0.2	0.23	0.21	0.06	-0.4	0.13	-0.2	**0.54***	0.01	0.2	-0.1	0.26	0.18	0.26
2. Wallow	-	0.47	0.13	**0.56***	0.38	0.14	**0.59***	**0.64***	**0.81****	**0.52***	0.28	0.01	-0.4	0.09	0.37	0.28	**0.56***
3. Bathe	-	-	0.23	0.12	**0.69****	0.49	0.34	-0.2	**0.56***	-0.3	0.49	0.20	-0.07	0.22	**0.79****	**0.57***	0.41
4. Dig	-	-	-	0.10	0.28	0.44	0.30	0.09	0.20	0.41	0.20	-0.30	-0.32	-0.45	0.13	0.23	0.14
5. Rub	-	-	-	-	0.45	0.07	**0.85****	**0.57***	**0.71****	0.30	0.04	0.01	-0.62	0.17	-0.10	0.24	**0.55***
6. Manip. Obj.	-	-	-	-	-	**0.74****	**0.63***	-0.01	**0.71****	-0.01	0.43	-0.40	-0.25	0.43	**0.58***	**0.75****	**0.58***
7. Manip. Enr.	-	-	-	-	-	-	0.35	-0.11	0.41	0.13	0.45	**-0.66****	-0.24	0.25	**0.55***	**0.65****	**0.52***
8. Approach	-	-	-	-	-	-	-	0.43	**0.86****	-0.32	0.43	-0.06	-0.41	0.37	0.10	**0.53***	**0.76****
9. Body Touch	-	-	-	-	-	-	-	-	0.47	**0.66****	-0.24	-0.16	**-0.57***	0.02	-0.19	-0.10	0.18
10. Social Play	-	-	-	-	-	-	-	-	-	0.34	0.43	-0.18	-0.46	0.44	0.43	**0.65****	**0.83****
11. Share Food	-	-	-	-	-	-	-	-	-	-	0.02	0.02	0.20	-0.21	-0.08	0.06	0.22
12. Share Obj.	-	-	-	-	-	-	-	-	-	-	-	0.02	0.20	0.40	0.21	0.38	**0.53***
13. Charge	-	-	-	-	-	-	-	-	-	-	-	-	**0.65****	**0.53***	-0.07	-0.10	-0.10
14. Head Shake	-	-	-	-	-	-	-	-	-	-	-	-	-	0.22	-0.03	0.07	-0.24
15. Alert Posture	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.20	**0.55***	0.49
16. Pursuit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**0.62***	0.41
17. Throw	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**0.65****
18. Spar	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Note: *$p < 0.05$, **$p < 0.01$

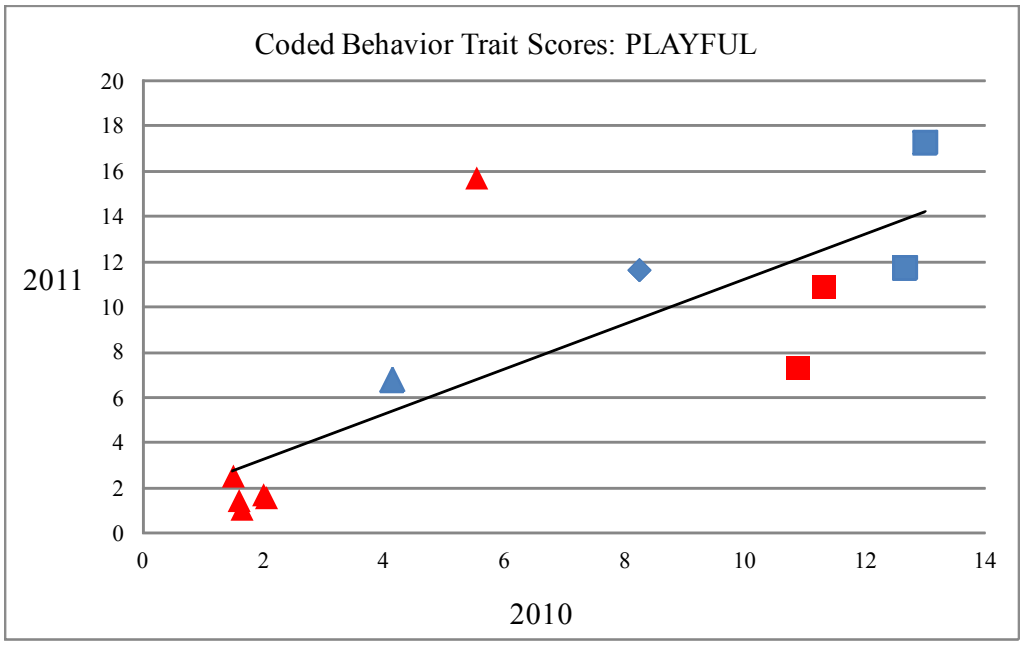


Figure 1. Individual scores for 2010 and 2011 based on the coded trait PLAYFUL. Red markers indicate female, blue indicate male. Triangle markers indicate adult, diamond sub-adult, and square markers indicate juvenile. Scores were highly correlated across the years ($r_s(10) = 0.91$, $p < 0.001$).

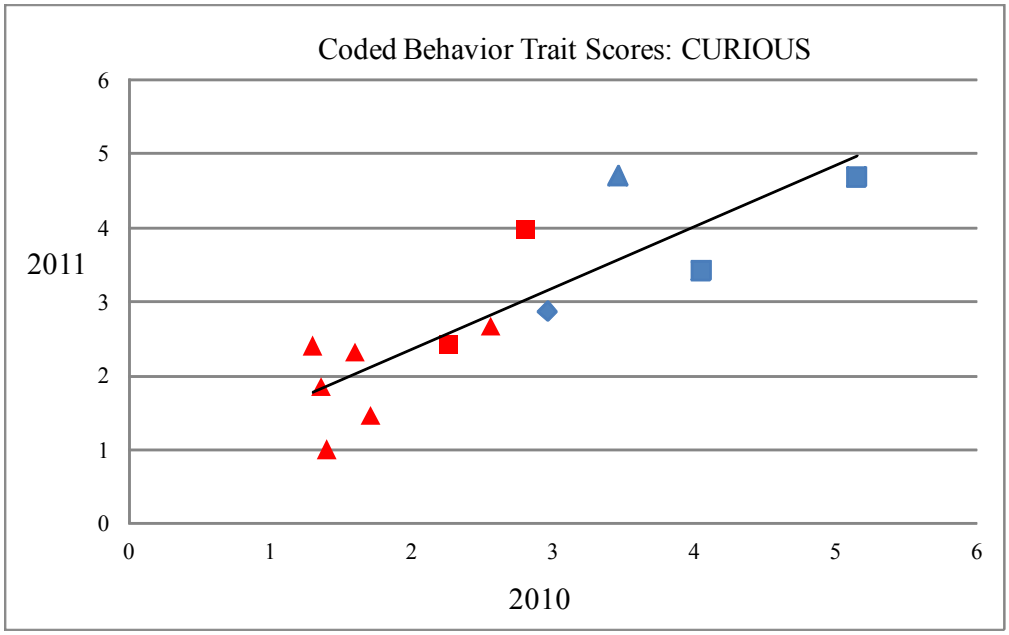


Figure 2. Individual scores for 2010 and 2011 based on the coded trait CURIOUS. Red markers indicate female, blue indicate male. Triangle markers indicate adult, diamond sub-adult, and square markers indicate juvenile. Scores were highly correlated across the years ($r_s(10) = 0.85$, $p = 0.001$).

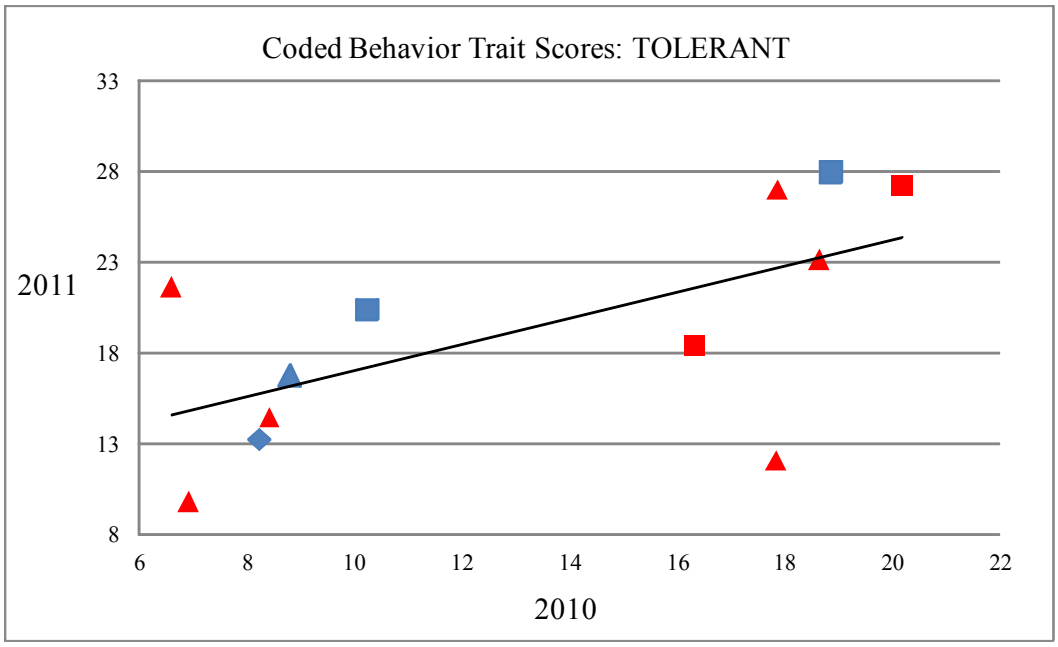


Figure 3. Individual scores for 2010 and 2011 based on the coded trait TOLERANT. Red markers indicate female, blue indicate male. Triangle markers indicate adult, diamond sub-adult, and square markers indicate juvenile. Scores were highly correlated across the years (r_s (10) = 0.68, p = 0.02).

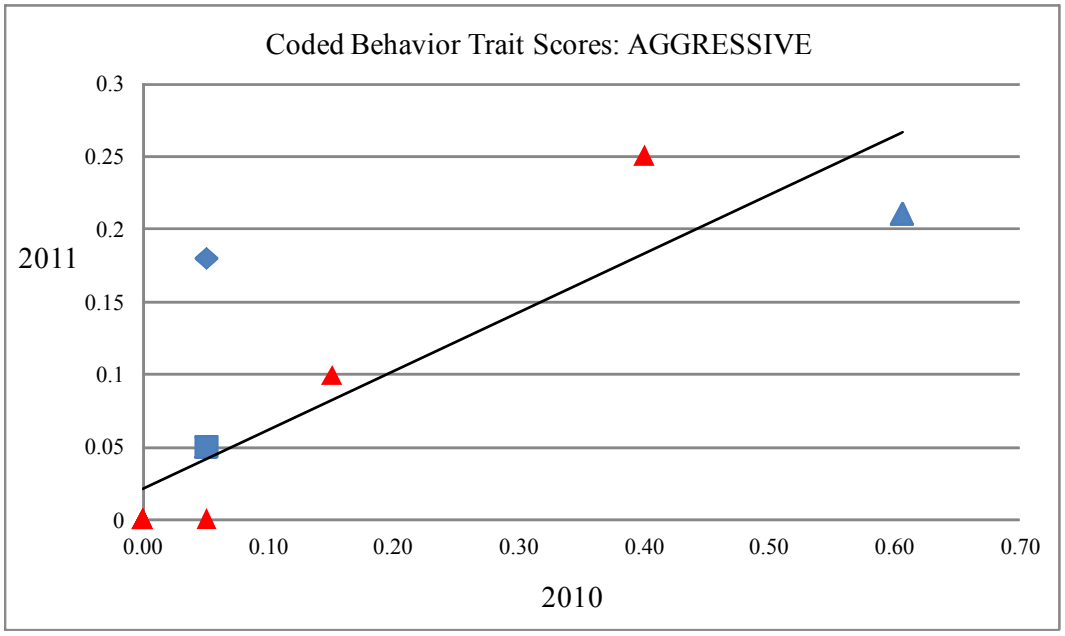


Figure 4. Individual scores for 2010 and 2011 based on the code trait AGGRESSIVE. Red markers indicate female, blue indicate male. Triangle markers indicate adult, diamond sub-adult, and square markers indicate juvenile. Scores were highly correlated across the years (r_s (10) = 0.9, p < 0.001).

Item Rating

Inter-Rater Reliability

Intraclass Correlation Coefficients (ICC) were calculated for each of the 33 personality survey items in order to determine inter-rater reliability among the keeper staff. The Spearman-Brown correction was applied to each ICC in order to calculate the average level of agreement (Li, Rosenthal, & Rubin, 1996). ICC average can be interpreted as follows: 0-0.2 indicates poor agreement; 0.3-0.4 indicates fair agreement; 0.5-0.6 indicates moderate agreement; 0.7-0.8 indicates strong agreement; and >0.8 indicates almost perfect agreement (Shrout & Fleiss, 1979). Composite traits with less than almost perfect relative agreement (ICC < 0.80) were eliminated from further analysis (Table 3).

Correlation Matrix

Due to the rating dataset violating bivariate assumptions, a Spearman's rank correlation coefficient was calculated between each of the 18 items with the highest level of average agreement (see Table 4). The rated items with correlations at the 0.01 level were then clustered to create composite rated groups. Those correlations which were at the 0.05 level mirrored the overall trend of the 0.01 level item correlates. In the end, four composite groups were created (E = Environment, C = Conspecific, and, H = Human): PLAYFUL (E-Playful, C-Playful, C-Tolerant, H-Playful); CURIOUS (E-Curious, E-Energetic, E-Observant, H-Observant); TIMID (E-Timid, C-Shy, H-Gentle, H-Shy); and, AGGRESSIVE (C-Aggressive, C-Confident, C-Dominant, H-Aggressive).

Table 3

Intraclass Correlation Coefficients for Rated Items

Rated Traits	Intraclass Correlation	
	2010	2011
Section I: Interaction with Environment		
CURIOUS	0.87	0.81
CONFIDENT	0.87	0.84
OBSERVANT	0.87	0.85
PLAYFUL	0.89	0.83
CREATIVE^{+}	0.84	0.78
ENERGETIC	0.93	0.94
TIMID	0.86	0.81
Section II: Interaction with Conspecifics		
PLAYFUL	0.94	0.93
OBSERVANT^{+}	0.78	0.71
TOLERANT	0.84	0.86
SOLITARY	0.84	0.82
GENTLE^{+}	0.75	0.90
CURIOUS^{+}	0.66	0.82
DOMINANT	0.97	0.96
CONFIDENT	0.89	0.85

Table 3 (continued).

Rated Traits	Intraclass Correlation	
	2010	2011
Section II: Interaction with Conspecifics		
AGGRESSIVE	0.86	0.94
SHY	0.90	0.86
COOPERATIVE^{+}	0.69	0.75
Section III: Interaction with Humans		
GENTLE	0.84	0.88
COOPERATIVE^{+}	0.65	0.72
OBSERVANT	0.84	0.83
PLAYFUL	0.86	0.90
CURIOUS^{+}	0.88	0.76
AGGRESSIVE	0.87	0.87
SHY	0.88	0.84

Note: $^{+}$Indicates items which were eliminated from further analysis due to low agreement ($p > 0.01$).

Composite Group Score

Each individual was given a score for the four composite traits for each year of observation. These scores were based on the sum of rated items that define each composite group. For example, in 2010 the male calf (E12) received a "CURIOUS" trait

score of 23.56. This score is the sum of the average rated items E-Energetic, E-Curious, E-Observant, and H-Observant.

The composite group score for each individual in 2010 was compared to the scores determined for 2011 in order to establish consistency across time. Each individual was rated in a consistent trend based on highly correlated ratings: PLAYFUL ($r_s(10) = 0.85$, $p < 0.001$), CURIOUS ($r_s(10) = 0.95$, $p < 0.001$), TIMID ($r_s(10) = 0.88$, $p < 0.001$), and, AGGRESSIVE ($r_s(10) = 0.93$, $p < 0.001$) (Figures 5 – 8).

Table 4

Composite Personality Traits determined from Correlated Observed Behaviors and Rated Items

Personality Traits	Coded Behaviors and Rated Items
PLAYFUL	Approach, Rub, Social Play, Spar, Wallow
CURIOUS	Manipulate Enrichment/Object, Throw
TOLERANT	Body Touch, Share Food
AGGRESSIVE	Charge, Head Shake
PLAYFUL	E-Playful, C-Playful, C-Tolerant, H-Playful
CURIOUS	E-Curious, E-Energetic, E-Observant, H-Observant
TIMID	E-Timid, C-Shy, H-Shy
AGGRESSIVE	C-Aggressive, C-Confident, C-Dominant, H-Aggressive

Note*:* E = Environment, C = Conspecific, and, H = Human

Table 5

Spearman's Rank Correlation Matrix for Rated Items

Item	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Environment																	
1. Curious	0.65*	0.87**	0.60*	0.88**	-0.56	0.77**	0.57	-0.57	-0.28	0.17	-0.48	-0.26	-0.08	0.88**	0.56	0.14	-0.33
2. Confident	-	0.63*	0.12	0.48	-0.83**	0.36	0.33	-0.60*	0.45	0.75**	-0.08	-0.80**	-0.48	0.55	-0.07	0.50	-0.80**
3. Observant	-	-	0.25	0.76**	-0.48	0.46	0.52	-0.29	-0.21	0.13	-0.39	-0.15	-0.04	0.87**	0.34	0.14	-0.32
4. Playful	-	-	-	0.46	0.05	0.95**	0.74**	-0.35	-0.57	-0.27	-0.75**	-0.02	0.42	0.49	0.88**	-0.47	0.22
5. Energetic	-	-	-	-	-0.47	0.60*	0.34	-0.61	-0.34	0.06	-0.40	-0.25	-0.15	0.71**	0.50	0.21	-0.24
6. Timid	-	-	-	-	-	-0.13	0.06	0.53	-0.49	-0.76**	-0.23	0.83**	0.63*	-0.40	0.20	-0.60*	0.84**
Conspecific																	
7. Playful	-	-	-	-	-	-	0.81**	-0.52	-0.49	-0.11	-0.77**	0.02	0.24	0.65*	0.84*	-0.25	0.06
8. Tolerant	-	-	-	-	-	-	-	-0.16	-0.48	-0.22	-0.92**	0.17	0.52	0.64*	0.72**	-0.50	0.15
9. Solitary	-	-	-	-	-	-	-	-	-0.16	-0.44	0.41	0.54	0.54	-0.24	-0.22	-0.54	0.34
10. Dominant	-	-	-	-	-	-	-	-	-	0.88**	0.72**	-0.81**	-0.72**	-0.41	-0.84**	0.65*	-0.75**
11. Confident	-	-	-	-	-	-	-	-	-	-	0.48	-0.96**	-0.80**	-0.05	-0.58*	0.74**	-0.92**
12. Aggressive	-	-	-	-	-	-	-	-	-	-	-	-0.45	-0.64*	-0.58*	-0.82**	0.57	-0.39
13. Shy	-	-	-	-	-	-	-	-	-	-	-	-	0.72**	-0.04	0.46	-0.65*	0.93**
Human																	
14. Gentle	-	-	-	-	-	-	-	-	-	-	-	-	-	0.21	0.59*	-0.97**	0.67*
15. Observant	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.58*	-0.09	-0.18
16. Playful	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-0.56	0.50
17. Aggressive	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-0.63*
18. Shy	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Note: *$p < 0.05$, **$p < 0.01$

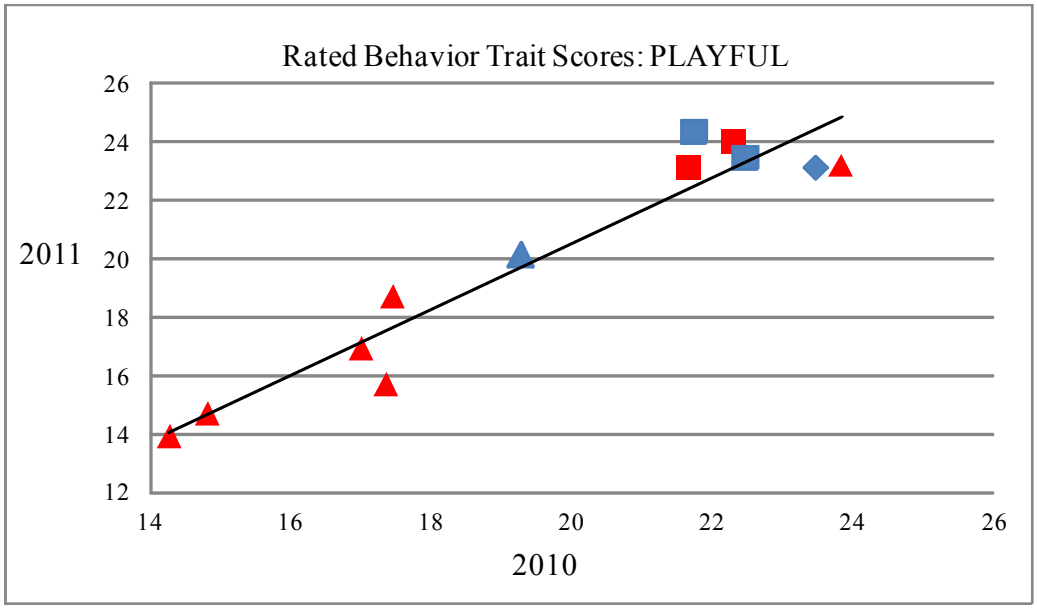


Figure 5. Individual scores for 2010 and 2011 based on the rated trait PLAYFUL. Red markers indicate female, blue indicate male. Triangle markers indicate adult, diamond sub-adult, and square markers indicate juvenile. Scores were highly correlated across the years ($r_s(10) = 0.85$, $p < 0.001$).

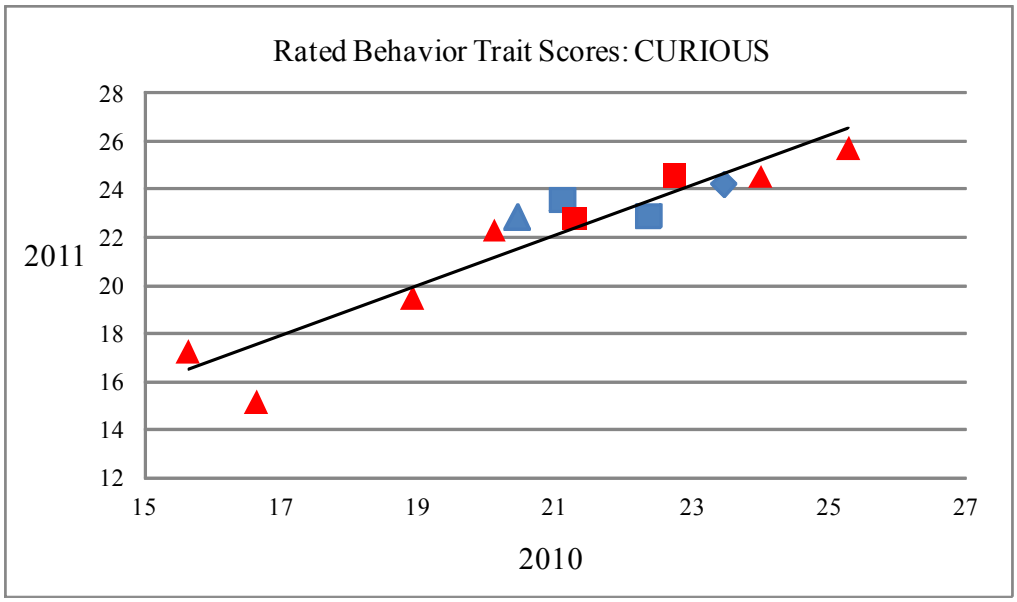


Figure 6. Individual scores for 2010 and 2011 based on the rated trait CURIOUS. Red markers indicate female, blue indicate male. Triangle markers indicate adult, diamond sub-adult, and square markers indicate juvenile. Scores were highly correlated across the years ($r_s(10) = 0.95$, $p < 0.001$).

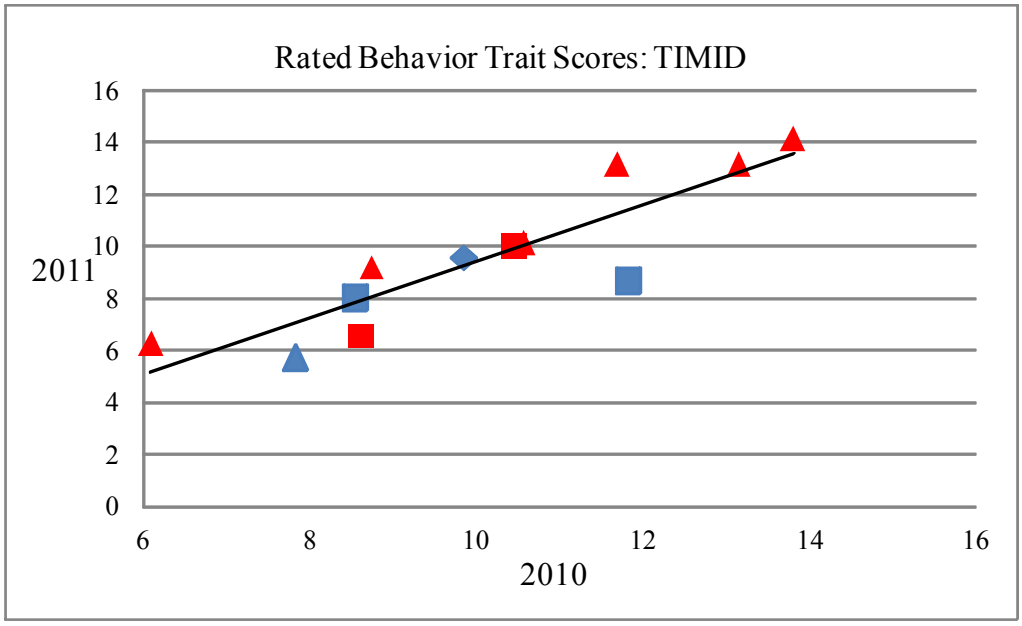


Figure 7. Individual scores for 2010 and 2011 based on the rated trait TIMID. Red markers indicate female, blue indicate male. Triangle markers indicate adult, diamond sub-adult, and square markers indicate juvenile. Scores were highly correlated across the years ($r_s(10) = 0.88$, $p < 0.001$).

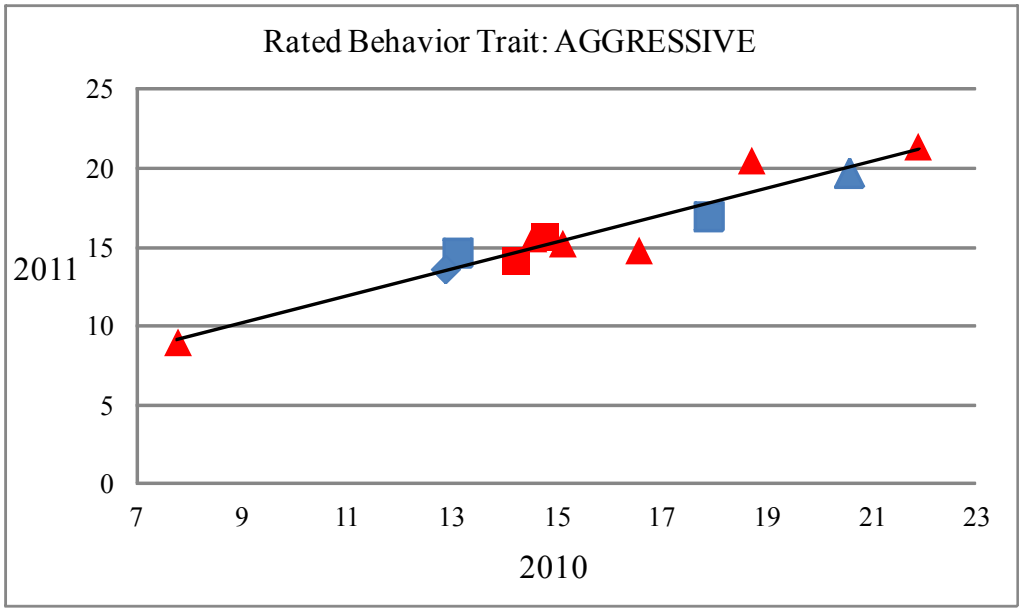


Figure 8. Individual scores for 2010 and 2011 based on the rated trait AGGRESSIVE. Red markers indicate female, blue indicate male. Triangle markers indicate adult, diamond sub-adult, and square markers indicate juvenile. Scores were highly correlated across the years ($r_s(10) = 0.93$, $p < 0.001$).

Comparing Behavior Traits to Rated Traits

All eight composite personality traits were highly correlated ($p < 0.05$) from 2010 to 2011 (see Table 4 for elements of each trait). In order to accurately compare coded personality traits to rated traits, data from "Section III: Interaction with Humans" from the raters' survey was removed from further analysis. This data was removed because the behavior data from onsite coding did not record human interaction and therefore was not comparable. After averaging scores from 2010 and 2011 for each individual, a Spearman's rank correlation coefficient was calculated for each coded-rated trait pair (Table 6). The coded personality trait PLAYFUL had a significantly strong, positive relationship with the rated trait PLAYFUL ($r_s(10) = 0.71$, $p < 0.01$), and the rated trait CURIOUS ($r_s(10) = 0.67$, $p < 0.05$). The coded personality trait CURIOUS was significantly related to rated PLAYFUL ($r_s(10) = 0.75$, $p < 0.01$), and the coded trait TOLERANT was positively correlated to the rated trait TIMID ($r_s(10) = 0.81$, $p < 0.01$) and negatively correlated to the rated trait AGGRESSIVE ($r_s(10) = -0.79$, $p < 0.01$). Finally, the coded trait AGGRESSIVE was significantly related to both rated AGGRESSIVE ($r_s(10) = 0.83$, $p < 0.01$) and rated TIMID ($r_s(10) = -0.82$, $p < 0.01$).

Table 6

Spearman's Correlation Coefficient between each Coded and Rated Trait

	Rated			
Coded	PLAYFUL	CURIOUS	TIMID	AGGRESSIVE
PLAYFUL	0.71**	0.67*	-0.31	-0.21
CURIOUS	0.75**	0.46	-0.08	-0.03
TOLERANT	0.53	-0.33	0.81**	-0.79**
AGGRESSIVE	-0.23	-0.38	-0.82**	0.83**

Note: *$p < 0.05$, **$p < 0.01$; Section III: *Interaction with Humans* rated data removed.

Individual Behavior Profiles

Individual coded and rated trait scores (with Section III: Interaction with Humans rated data removed) from 2010 were added to individual scores earned from 2011. From this dataset of combined scores, the quartile rank of each trait was calculated. In order to create a behavior profile for each elephant, individuals were labeled as either "high", "medium-high", "low-medium", or "low" for each trait (Table 7). An individual was labeled as "high" for particular trait if their combined trait score was between the third and fourth quartile, "medium-high" if it was between the second and third quartile, "low-medium" if the combined trait score was between the first and the second quartile, and "low" if it was less than the first quartile value.

Table 7

Behavior Profiles: Individuals are labeled as High, Medium-High, Low-Medium, or Low for each Coded and Rated Trait

Elephant	Coded Traits				Rated Traits			
	PLAYFUL	CURIOUS	TOLERANT	AGGRESSIVE	PLAYFUL	CURIOUS	TIMID	AGGRESSIVE
E1	Low-Medium	High	Low-Medium	High	Low-Medium	Low-Medium	Low	High
E2	Low-Medium	Low	Low	High	Low	Low	Low-Medium	High
E3	Low	Low-Medium	Medium-High	Low	Low	Low	High	Low
E4	Medium-High	Medium-High	Low-Medium	Low	High	High	High	Low
E5	Low	Low	High	Low-Medium	Low-Medium	High	Low	High
E6	Low	Low-Medium	Low	Medium-High	Low-Medium	Low	High	Low-Medium
E7	Low-Medium	Low	Medium-High	High	Low-Medium	Low-Medium	Medium-High	Medium-High
E8	Medium-High	Medium-High	Low	Medium-High	Medium-High	Medium-High	Low-Medium	Low
E9	High	Medium-High	Medium-High	Low	Medium-High	Low-Medium	Medium-High	Low-Medium
E10	High	High	Medium-High	Medium-High	High	Medium-High	Low-Medium	Medium-High
E11	Medium-High	Low-Medium	High	Low-Medium	High	High	Low	Medium-High
E12	High	High	High	Low	Medium-High	Medium-High	Medium-High	Low-Medium

CHAPTER IV

CONCLUSION

The goals of this study were to: (1) identify personality traits based on both observational behavior coding and standardized trait ratings for African elephants, and, (2) assess consistent individual differences among the traits across time and contexts. In using both methods (coding and rating) of personality assessment, this study examined the construct validity of behavior profiles in terms of their associations with overt, observationally-coded behaviors. In addition, a high level of convergent validity was found based on the significant association of rating-based personality traits to behaviors that are assumed to demonstrate those traits (i.e., Pederson, King, & Landau, 2005).

Consistency across Time and Contexts

All eight composite coding and rating-based personality trait scores for each individual in 2010 were highly correlated ($p < 0.05$) to the trait scores of 2011. This significant, positive relationship between the years demonstrates that each individual was consistent in its behavioral tendencies over time, which is a key element in determining personality. Five of the 12 subjects examined in this study were under the age of eight years, and were thus observed during key biological and social developmental stages (Lee & Moss, 1986; Soltis & Brown, 2010). Although this is a potentially large extraneous variable, all juveniles and calves retained consistent personality trait scores. For example, the sub-adult male appeared to be more solitary and less playful during the second year of observation. This trend is expected given that sub-adult males reach sexual maturity and leave their natal group starting at nine years old (Vidya & Sukumar, 2005). Nonetheless, he maintained consistent levels in each personality trait across the

years. In addition, the wide range in trait scores for the coded trait TOLERANT and the rated traits CURIOUS and TIMID among the six adult females demonstrates that age and gender alone cannot explain personality. If the interaction of biology and environment solely determined behavioral plasticity, then each of the cows should have relatively the same trait score for each trait.

In order to demonstrate consistency across contexts, individuals must behave on the same level in the presence of at least two different sets of external stimuli. This stimuli may be biotic (e.g., conspecifics) or abiotic (e.g., structure of the exhibit, temperature) features of the external environment. Previous animal personality studies have examined correlations between behaviors expressed in the presence of food competitors (*aggressiveness*) and behaviors in the presence of a novel object or setting (*boldness*) (Huntingford, 1976). Ethological coding methods were used in this study because experimental trials were logistically impossible, and natural behaviors were of interest. This ecological approach to personality research provides a diversity of social and environmental contexts to observe behavior. In addition, the keepers' ratings were based on long-term, accumulated judgments of three broad contexts (*environment, conspecifics,* and *humans*) for each individual elephant. The keepers were not asked to rate an individual based on a single context (i.e., bold – timid when with others of the same age), but were asked to give an overall assessment of each elephant. Consistency of the coded and rated personality traits were analyzed during feeding contexts, novel contexts (e.g., feral deer running into elephant exhibit), and changing social contexts. Therefore, each individual was measured by the objective observer and animal keeper staff in the presence of at least two different sets of external stimuli throughout this study.

Construct Validity

The coded and rated personality traits were significantly correlated across the years for each individual, confirming that the long-term, intimate knowledge of animal caretakers is a reliable source in verifying behavior profiles. The pattern of significant and non-significant correlations among the coded behaviors and rated items were consistent with the construct validity of the personality traits. The composite trait groups did not cluster in a random pattern which as would be expected of multiple Type I errors (Pavur, 1988). Previous critics of personality assessment based on human ratings have argued that any validity based on behavior correlations is limited because the ratings were no more than inferences based on summed memories of previous animal behaviors (Davis, 1997; Heyes, 1998). Given that humans are unaware of non-verbal animals' thoughts or feelings, overt behaviors are the basis of both ratings and behavioral coding. With that said, the personality ratings of more abstract items contained reliable information about the elephants as well. For example, the rated items *confident, observant,* and *tolerant* are not adjectives for which obvious behavior examples come to mind. Nevertheless, all of these items were rated consistently among the keeper staff for both years and were highly correlated with corresponding coded personality traits.

Limitations

Seasonal Influence

A potential source of bias is the fact that all behavioral data was taken during the summer seasons. Elephants are polyestrous breeders (Heistermann, Trohorsch, & Hodges, 1997); therefore, during the summer data collection period four of the six adult females may have been influenced by their estrous cycles (two cows were pregnant

during the data collection period). The timing of male elephant *musth*, the surge in testosterone and aggressive behavior, depends on age, nutrition and the availability of females in estrus, has been reported to occur during the months of maximum rainfall (i.e., winter) (Eisenberg, McKay, & Jainudeen, 1971), generally occurs once a year, and can last anywhere from one day to three months (Brown, 2000; Poole, 1987). Consequently, the one adult male elephant analyzed may have displayed spurts of highly aggressive activity due to hormonal bias. In addition, research shows that although the average age for *musth* to begin in wild male elephants occurs after 25 years, yet there have been reports of zoo elephants entering *musth* from ages 10-15 years old (Cooper et al., 1990).

Aggression Trait

The majority of subjects in this study received a coded AGGRESSIVE trait score of zero due to the lack of recorded *charges* or *head shakes* for those individuals. Throughout the 640 hours of observation, there were no recorded events of overt aggression. In addition, all individuals were recorded to be in the behavior state of *negative social* less that 0.01% of all observation time. Throughout the behavior data collection time frame, anecdotal reports of extreme aggression were made to the animal keeper staff. These rare interactions, however, often did not occur during a focal subject's recorded session and were thus not included in the behavior data analyzed.

As stated before, the ethological coding method was necessary in this study as experimental methods were logistically impossible, and natural behaviors were of interest. This purely observational approach is limited in its inability to observe each individual's response to an aggressive situation. Maintaining exotic and domestic animals under human care requires certain restrictions on allowing aggressive

interactions to occur in order to ensure safety. The personality traits based on coding methods, therefore, did not fully assess aggressive levels in all individuals. The animal care staff, however, relied on personal memory and individual interaction to base their ratings of *aggressiveness.* This, therefore, suggests that future studies should rely on standardized, experimental tests (i.e., measure latency to approach a novel object, or, latency to attack threatening object/conspecific) in order to determine individuals which tend to display higher aggression level across time and contexts.

Future Directions

Previous studies on personality in both humans and animals have found that individual differences in temperament are significantly related to immunity strength, breeding status, and stress response. For example, individuals which are labeled as *reactive*, or those having passive coping styles, are more likely to have elevated stress response (HPA axis), and a lower threshold for "fight/flight" behavioral responses (Korte et al., 1992). Therefore, personality assessment in any species can be used to identify individuals that are more sensitive to environmental and social sources of stress. In addition, distinguishing personality profiles for zoological and domestic animals may help in evaluating personality-appropriate enrichment techniques. An individual labeled "high" in curiosity and boldness (i.e., quick to explore novel environments and approach novel conspecifics/objects) may require a variable interval schedule for training and enrichment in order to maintain stimulation. The opposite may be true for an individual labeled "low" in curiosity or boldness; they may require a more fixed, non-random schedule of reinforcement and prefer more stable enrichment (i.e., favorite item/smell always in the same location).

The primary objectives of enrichment for animals are to avoid undesirable behavior associated with stress (i.e., stereotypic behavior and high aggression: Mason, 1991; Mason, Clubb, Latham, & Vickery, 2007) and to encourage species-typical behavior (Boissy et al., 2007; Bracke & Hopster, 2006; Shepherdson, 1998). Studies have reported significant reduction in stress after environmental enrichment (Carlstead & Shepherdson, 2000; Fairhurst et al., 2011), but few considered how this enrichment could interact with personality (i.e., Highfill, 2008). Ensuring inter-individual compatibility in group housing, as well as personality-specific enrichment, may enhance not only the physical safety of the group, but also the psychological well-being of each individual.

APPENDIX A

BEHAVIORAL ETHOGRAM

SECTION I: Interactions with Physical World

Behavior	Operational Definition
Dusting	Throwing browse, dirt, dung, hay, mud, or sand on self.
Wallowing	Laying down and wiggling in mud, dirt or sand.
Bathing	Individual lying, standing in the pond or under the shower.
Digging	Use trunk and foot movements to stab into ground.
Rubbing	Rub head or body against a wall, tree or object.
Manipulate object	Individual moves, pushes, tosses or picks up objects within its environment such as grass, rocks, sticks, dirt, etc.
Manipulate enrichment	Individual moves, pushes, tosses, or picks up enrichment provided including toys, logs, etc.
Sway	Move body side to side repeatedly. Usually with all four feet on the ground. May lift one forefoot at a time.
Other	Individual is engaging in a behavior not mentioned in the ethogram descriptions above.

SECTION II: Interactions with Conspecifics

Positive Behavior	Operational Definition
Approach	One elephant walks toward another elephant.
Body touch	Initiation of head or body contact with another elephant.
Social play	Trunk wrestling, shoving, butting, bullying each other.
Sharing food	Eating from the same food pile, simultaneously.
Sharing objects	More than one elephant simultaneously handling the same object (e.g., rope or tree branch).

SECTION II: Interactions with Conspecifics

Negative Behavior	Operational Definition
Charge	Rapidly approach another animal with trunk tucked under head, head up, and chin tuck. Attempts to contact target. Often a "silent" charge, without trumpeting. Ears usually close to the head. Often has an ear fold.
Head shake	An abrupt shaking of the head that causes ears to flap; can also be used in play.
Alert posture	Standing with the head raised, ears spread with bottom part of ear folded back so that a prominent horizontal ridge appears, tail raised, trunk raised or turned in a "Sniff" position.
Pursuit	One elephant runs after another. The pursuer is attempting to reduce the separation between animals. The elephants may be moving at a fast walking space.
Throwing	Lifting or uprooting objects and throwing them in the general direction of an opponent.
Bite	The aggressor puts the tail or other body part of another elephant in its mouth.
Head butt	The aggressor charges/rams another elephant with its head. The aggressor may hit the recipient on its side, hind legs, and front legs. This is a side-on hit, not a hit from above.
Sparring	Head to head contact between two elephants. Pushing trunks, tusking, shove, wrestle or trunk entwine with another elephant.

SECTION III: Behavioral State

Behavior State	Operational Definition
Feed/Drink	Engaging in behaviors related to feeding and/or drinking
Self-Maintenance	Engaging in behaviors related to wallowing, bathing, dusting, digging, rubbing, etc. of body with environment.
Rest	Engaging in behaviors related to lying or standing.
Positive Social	Engaging in behaviors related to positive social events.
Negative Social	Engaging in behaviors related to negative social events.
Locomotion	Engaging in behaviors related to walking, trotting, etc.
Out of View	Individual is not in view for the minute.

APPENDIX B

ELEPHANT PERSONALITY SURVEY

Elephant Name: _____
Rater: _____
Number of years working with elephants:_____
Number of years working with this elephant:_____
Facility: _____
Date: _____
Please note that this questionnaire is divided into <u>3 sections</u>. Please follow the instructions carefully for each section. Thank you!

Please indicate the answer that you think best describes this elephant for each set of adjectives (mark or circle).

Cooperative ◄——————————————————————► **Competitive**

Extremely Cooperative	Quite Cooperative	Slightly Cooperative	Neutral	Slightly Competitive	Quite Competitive	Extremely Competitive
				X		

If you are unable to make a judgment about a particular adjective, please write "DK" to signify "don't know" next to the adjectives.

Example:

Energetic ◄——————————————————————► **Lethargic**

Extremely Energetic	Quite Energetic	Slightly Energetic	Neutral	Slightly Lethargic	Quite Lethargic	Extremely Lethargic	DK

Thank you very much for your help with evaluating elephant personalities!

SECTION I: ***Interactions With Physical World***

For this section, we are concerned with how elephants interact with their physical environment, including objects. Interactions with other elephants should NOT be considered in this section. So please rate this elephant on each of the following adjectives based on how the elephant deals with its physical environment.

Curious ◄——————————————————————► **Not Curious**

Extremely Curious	Quite Curious	Slightly Curious	Neutral	Slightly Not Curious	Quite Not Curious	Extremely Not Curious

Confident ◄——————————————————————► **Not Confident**

Extremely Confident	Quite Confident	Slightly Confident	Neutral	Slightly Not Confident	Quite Not Confident	Extremely Not Confident

Observant ◄——————————————————► **Not Observant**

Extremely Observant	Quite Observant	Slightly Observant	Neutral	Slightly Not Observant	Quite Not Observant	Extremely Not Observant

Playful ◄——————————————————► **Not Playful**

Extremely Playful	Quite Playful	Slightly Playful	Neutral	Slightly Not Playful	Quite Not Playful	Extremely Not Playful

Creative ◄——————————————————► **Not Creative**

Extremely Creative	Quite Creative	Slightly Creative	Neutral	Slightly Not Creative	Quite Not Creative	Extremely Not Creative

Energetic ◄——————————————————► **Lethargic**

Extremely Energetic	Quite Energetic	Slightly Energetic	Neutral	Slightly Lethargic	Quite Lethargic	Extremely Lethargic

Timid ◄——————————————————► **Fearless**

Extremely Timid	Quite Timid	Slightly Timid	Neutral	Slightly Fearless	Quite Fearless	Extremely Fearless

If you have any questions or comments concerning elephants' interactions with the physical world, please note them here. Then go on to Section II.

SECTION II: Interactions With Other Elephants

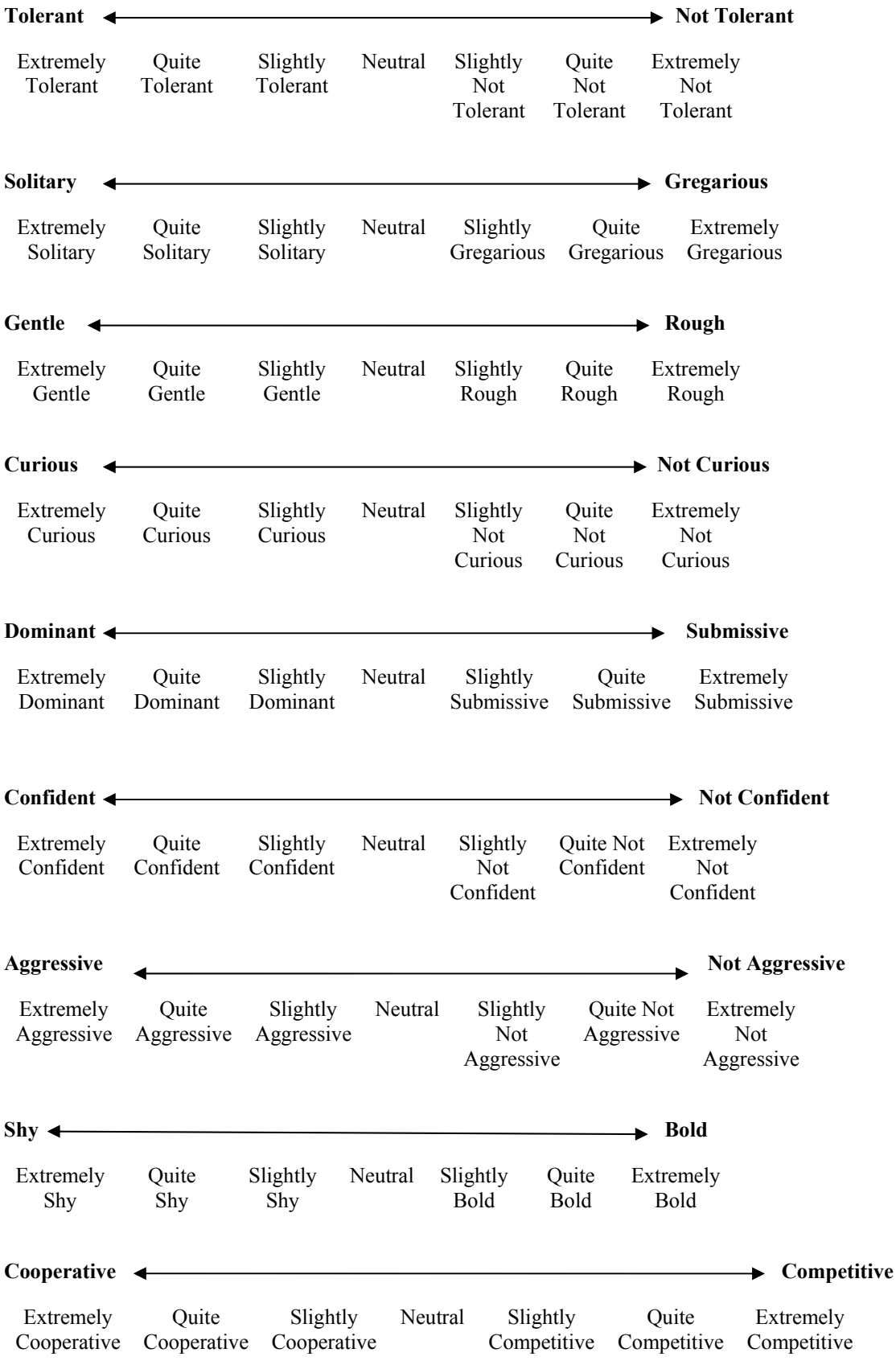
For this section, we are concerned with how elephants behave towards other elephants. Please rate this elephant on each of the following adjectives based on how the elephant interacts with other elephants.

Playful ◄——————————————————► **Not Playful**

Extremely Playful	Quite Playful	Slightly Playful	Neutral	Slightly Not Playful	Quite Not Playful	Extremely Not Playful

Observant ◄——————————————————► **Not Observant**

Extremely Observant	Quite Observant	Slightly Observant	Neutral	Slightly Not Observant	Quite Not Observant	Extremely Not Observant


Tolerant
Not Tolerant
Extremely Tolerant
Quite Tolerant
Slightly Tolerant
Neutral
Slightly Not Tolerant
Quite Not Tolerant
Extremely Not Tolerant
Solitary
Gregarious
Extremely Solitary
Quite Solitary
Slightly Solitary
Neutral
Slightly Gregarious
Quite Gregarious
Extremely Gregarious
Gentle
Rough
Extremely Gentle
Quite Gentle
Slightly Gentle
Neutral
Slightly Rough
Quite Rough
Extremely Rough
Curious
Not Curious
Extremely Curious
Quite Curious
Slightly Curious
Neutral
Slightly Not Curious
Quite Not Curious
Extremely Not Curious
Dominant
Submissive
Extremely Dominant
Quite Dominant
Slightly Dominant
Neutral
Slightly Submissive
Quite Submissive
Extremely Submissive
Confident
Not Confident
Extremely Confident
Quite Confident
Slightly Confident
Neutral
Slightly Not Confident
Quite Not Confident
Extremely Not Confident
Aggressive
Not Aggressive
Extremely Aggressive
Quite Aggressive
Slightly Aggressive
Neutral
Slightly Not Aggressive
Quite Not Aggressive
Extremely Not Aggressive
Shy
Bold
Extremely Shy
Quite Shy
Slightly Shy
Neutral
Slightly Bold
Quite Bold
Extremely Bold
Cooperative
Competitive
Extremely Cooperative
Quite Cooperative
Slightly Cooperative
Neutral
Slightly Competitive
Quite Competitive
Extremely Competitive

If you have any questions or comments concerning elephants' interactions with other elephants, please note them here. Then go on to Section III.

SECTION III: Interactions with Humans

For this section, we are concerned with how *elephants* behave towards humans. Please rate this elephant on each of the following adjectives based on how the elephant interacts with humans.

Gentle ⟷ **Rough**

Extremely Gentle	Quite Gentle	Slightly Gentle	Neutral	Slightly Rough	Quite Rough	Extremely Rough

Cooperative ⟷ **Competitive**

Extremely Cooperative	Quite Cooperative	Slightly Cooperative	Neutral	Slightly Competitive	Quite Competitive	Extremely Competitive

Observant ⟷ **Not Observant**

Extremely Observant	Quite Observant	Slightly Observant	Neutral	Slightly Not Observant	Quite Not Observant	Extremely Not Observant

Playful ⟷ **Not Playful**

Extremely Playful	Quite Playful	Slightly Playful	Neutral	Slightly Not Playful	Quite Not Playful	Extremely Not Playful

Curious ⟷ **Not Curious**

Extremely Curious	Quite Curious	Slightly Curious	Neutral	Slightly Not Curious	Quite Not Curious	Extremely Not Curious

Aggressive ⟷ **Not Aggressive**

Extremely Aggressive	Quite Aggressive	Slightly Aggressive	Neutral	Slightly Not Aggressive	Quite Not Aggressive	Extremely Not Aggressive

Shy ⟷ **Bold**

Extremely Shy	Quite Shy	Slightly Shy	Neutral	Slightly Bold	Quite Bold	Extremely Bold

If you have any questions or comments concerning elephants' interactions with humans, please note them here.

APPENDIX C

INSTITUTIONAL ANIMAL CARE AND USE COMMITTEE APPROVAL FORM

The University of Southern Mississippi

Institutional Animal Care and Use Committee

118 College Drive #5147
Hattiesburg, MS 39406-0001
Tel: 601.266.6820
Fax: 601.266.5509
www.usm.edu/spa/policies/animals

INSTITUTIONAL ANIMAL CARE AND USE COMMITTEE
NOTICE OF COMMITTEE ACTION

The proposal noted below was reviewed and approved by The University of Southern Mississippi Institutional Animal Care and Use Committee (IACUC) in accordance with regulations by the United States Department of Agriculture and the Public Health Service Office of Laboratory Animal Welfare. The project expiration date is noted below. If for some reason the project is not completed by the end of the three year approval period, your protocol must be reactivated (a new protocol must be submitted and approved) before further work involving the use of animals can be done.

Any significant changes (see attached) should be brought to the attention of the committee at the earliest possible time. If you should have any questions, please contact me.

PROTOCOL NUMBER: **10051301**
PROJECT TITLE: **Assessing Elephant Personality**
PROPOSED PROJECT DATES: **05/20/2010 to 08/31/2010**
PROJECT TYPE: PRINCIPAL INVESTIGATOR(S): **Stan Kuczaj, Ph.D.**
COLLEGE/DIVISION: **College of Education & Psychology**
DEPARTMENT: **Psychology**
FUNDING AGENCY/SPONSOR: **Departmental**
IACUC COMMITTEE ACTION: **Full Committee Review Approval**
PROTOCOL EXPIRATION DATE: **09/30/2012**

Robert C. Bateman, Jr., Ph.D.
IACUC Chair

5-13-10
Date

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