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Personality Traits as Predictors of Pair-housing Compatibility in Garnett's Greater Bushbabies (*Otolemur garnettii*)

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Personality Traits as Predictors of Pair-housing Compatibility in Garnett's Greater Bushbabies (*Otolemur garnettii*)

by

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Abstract

Continuously refining husbandry strategies to improve the welfare of captive primates is a research priority. A variety of enrichment strategies are employed to allow captive primates opportunities to exercise natural behaviors with the aim of maintaining their psychological health in environments different from those for which they evolved. Arguably the most important of these strategies is social housing, since primates are by definition social animals. Pair housing is often the most logistically feasible method; however, the process of introducing partners to each other comes with risks of stressful conflict that may result in injury, and the necessarily trial-and-error nature of finding matches can take considerable time. The present study assigned personality categories to individual Garnett's Greater Bushbabies (*Otolemur garnettii*) according to a battery of assessments. The subjects were assigned partners, and the pairs engaged in trials where they were in close contact, sharing a space separated by cage mesh; in the absence of aggression after a period of acclimation, the pairs were said to have passed, while persistently aggressive pairs failed the test. Statistical significance was not achieved, but similarity in one or more personality traits between partners seemed to predict success, as did low neophobia scores and high affiliative behavior towards human caretakers in one or both partners. Activity level and tendency to engage in stereotypic behavior did not indicate success or failure. Personality traits assigned by standardized behavioral tests may aid in predicting successful primate pairs, saving considerable time and stress and facilitating captive primate welfare.

Key Terms: Bushbaby, Social Interactions, Personality, Pair-housing

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Introduction and Literature Review

As our closest living relatives, non-human primates resemble us in many ways, genetically to psychologically. This makes them valued subjects across many different fields of scientific research. Some are studied in the wild, others in captivity. Captive situations vary; conditions may be as non-restrictive as free-range enclosures covering acres of land, or as confining as small cages with scheduled care regimens, with living spaces ranging in size on a spectrum between these two extremes. There is concern both within academia and beyond about the suitability of certain captive conditions to primate welfare, especially when the animals are housed in single cages, preventing them from socializing. Thus, substantial research is dedicated to improving the conditions of captivity and ensuring primates' welfare.

As surveyed by Coleman (2012), strategies to maintain a captive animal's psychological health fall under the category of behavioral management. Such strategies include social housing situations, enclosure design, and enrichment. Specific goals must be identified and articulated for these strategies to effectively address. Novak and Suomi (1988) explored ways of defining psychological health, identifying physical health, natural behaviors, competence in response to environmental challenges, and reaction to stress as possible metrics. Stress, the most intensely studied of these avenues, has been defined as "the biological response elicited when an individual perceives a threat to its homeostasis" (Moberg 2000, p. 1). Since stress, thus defined, is a regular aspect of any animal's life and not necessarily indicative of psychological suffering, *distress* is separately identified as a stress response that threatens an animal's health. The transition from regular stress to distress occurs when the stress response disrupts regular biological activities by directing resources away from them, leaving them vulnerable to disease

(Moberg 2000). On top of illness, itself an obvious concern, unusual behaviors may manifest. Stereotypy, characterized by Ödberg (1978), is behavior characterized by uniformity, repetition, and lack of obvious function; heavy stereotypy, while not intrinsically harmful to the animal, can confound the data it yields. Self-injurious behaviors, or SIBs, are more worrisome, requiring staff intervention to treat and prevent wounding. Stress management is thus of importance to concerns regarding both animal welfare and non-confounded data collection.

Primates are, without exception, social animals (see Kappeler & van Schaik 2002 for review). Even when not living in cohesive social units, they maintain social networks and regularly interact where territories overlap (Nekaris & Bearder 2013). When living in a social unit, they are immersed in contact with conspecifics from birth to death. Social housing is a strategy that attempts to use this part of the primate nature to mitigate stress in captive primates. Since logistics tend to discourage housing groups together, pair-housing is a popular social enrichment method.

The effectiveness of pair-housing is testified to in the literature. Weed (2003) examined attempts to pair-house six male rhesus macaques (*Macaca mulatta*) with histories of SIB, reporting that SIB occurrences were reduced in the new arrangement. Baker (2012) paired a diverse arrangement of rhesus macaques and found that subjects showed reduced levels of "abnormal" and "anxiety-related" behaviors, reinforcing Weed's findings with a larger and more demographically diverse sample size. Highfill (2008) went beyond macaques, examining Garnett's Greater Bushbabies (*Otolemur garnettii*). Bushbabies that were categorized as neurotic from coded behavioral observations showed less stereotypy upon introduction to a conspecific than did non-neurotic bushbabies. Social housing is considered so important to the welfare of

social animals such as primates that the *Guide for the Care and Use of Laboratory Animals* (National Research Council, 2011) requires it as the default housing condition for social animals.

Introducing animals to each other is not without risk, however. If they do not immediately take to each other, they may physically injure each other. A variety of methods are used for moving animals to paired housing, often in a series of steps so that the animals acclimate to each other (reviewed in Truelove et al. 2017). The most conservative method begins by separating the animals with a mesh so that they can see and perhaps touch each other, but are easily disentangled should aggression escalate. Even in these situations, however, injury is possible.

Personality and Compatibility

Assigning subjects to temperament, or personality, categories to estimate subject compatibility is a promising method of minimizing the injury risk. Personality is defined in Carter et al. 2013 (p.466) as the suite of "between-individual differences in behavior that persist through time." That is, the tendency of an individual to perform a specific behavior may differ from that of another; this difference would demarcate separate personalities. Experimental design can reveal these differences; for example, within a population, individuals will have different reactions to novelty. Experiments may exploit this using such paradigms as the open field test, in which the latency of an animal to enter a novel, empty area varies between individuals, and the novel object test, where the latency of an animal to investigate an unfamiliar item is the metric. These behavioral tendencies may be linked to other psychological traits, and thus may affect the way individuals interact with each other.

Personality and primate interaction is just beginning to be explored. In 2008, Weinstein & Capitanio examined peer relationships among a cohort of rhesus macaques that had been assigned personality profiles as part of a battery of tests conducted in their infancy. These tests exposed infant macaques to such situations as response to human intruders and playbacks of aggressive and affiliative macaque footage. Personality profiles were assigned based on their reactivity to these tests. The 2008 study found that high "Equability" scores—associated with low activity levels—predicted fewer relationships as measured by observation of proximity and social interaction among the juveniles. If the scores in equability and "Adaptability" were similar, however, between two macaques, they were more likely to have an observed relationship than if their scores were dissimilar. In 2014, Massen and Koski used personality profiles assigned to captive chimpanzees in previous studies to analyze friendships among the chimpanzees as evidenced by dyadic contact sitting behavior. Friendships were predicted by similarity, or homophily, in the traits of "Friendliness" and "Boldness." These findings suggest that homophily between partners, as well as perhaps high activity levels, predict affiliative association within a multi-member group setting.

These findings are similar to those in the pair-housing context. A 2003 study (McMillan et al.) examined rhesus macaques with a history of an attempt at pairing. An "Inhibition" score was assigned to each and their partner based on a novel object test. The successful pairs had more similar scores than the unsuccessful pairs. In 2017, the macaque cohort from the Weinstein & Capitanio study was again examined; those individuals that had undergone isosexual (same-sex) pairing attempts were analyzed regarding their assigned personality profiles (Capitanio et al., 2017). Personality predictors differed between sexes. For females, similarity in "Emotionality" predicted success. For males, success was high if both partners had low mean

"Gentleness" scores. Highfill (2008) also accounted for personality, but only in one partner. In this study, high "Neurotic" and "Agreeable" scores predicted reduction in stereotypy and benefit to the bushbaby. What this could mean for pairing success is unclear.

Subject Species

Garnett's Greater Bushbabies (*Otolemur garnettii*) are small (though large relative to other galagos) strepsirrhines native to east Africa. They are nocturnal, making extensive use of auditory and olfactory communication, and are rarely seen in the company of conspecifics (Nash & Harcourt, 1986). Where the ranges of adults overlap (with this overlap increasing with age disparity when the two parties are isosexual), both affiliative and agonistic encounters have been observed (Nash & Harcourt, 1986).

Nocturnal strepsirrhines are valued in evolutionary research due to their basal position on the primate phylogeny, offering unique insight into primate evolution. To ensure both the animals' welfare and the validity of the data they provide, it is in the best interest of caretakers to pursue promising enrichment options, including pair-housing. Highfill's relation of personality to pair housing success was limited by the larger context of the study (2008); she examined the effect of pair housing on the frequency of stereotypy, rather than the effect of stereotypy as personality trait on the success of pair housing. Thus, the question of whether the tendency to engage in stereotypic behavior predicts pair housing success remains unanswered.

In the present study, the personality profiles of both partners will be considered in light of the success of introductions. They will each be assigned a ranking (High or Low) in each of four personality metrics: Stereotypy, Activity, Neophobia, and Human-Friendliness, modified from Highfill's (2008) categories. Stereotypy substitutes "Neuroticism" because it is more specific to

the measurement taken, duration of stereotypy. Activity is left unmodified. Neophobia is modified from "Curious," as neophobia is the specific reaction (or lack thereof) to the novel object used in the test. Human-Friendliness is adapted from "Friendly," as Highfill's "Friendly" test assessed friendliness of the bushbabies specifically towards humans, not conspecifics; "Human-Friendliness" is thus more specific. These adapted personality traits were chosen and modified because they were not common human attributes projected onto the animals, but rather tendencies in response to a specific behavioral test. The aim of the decision is to reduce confusion introduced by vague terminology that may not be interchangeable if assessed using different tests (see Carter et al. 2013 for discussion). "Boldness" or "Curiosity," for example, may both describe the dimension measured by a novel object test; yet, "Boldness" could also describe an animal's performance in a risk/reward assessment, while "Curiosity" might not. Results from the two different tests might not be interchangeable simply because they both used the trait name "Boldness." The present traits are specifically named, can be easily and quickly assigned, and, if correlated with pair housing success, used as predictors in future pairing attempts.

Methods

Subjects

The University of Southern Mississippi's Primate Behavioral Research Center houses fifteen adult Garnett's Greater Bushbabies (*O. garnettii*). The bushbabies are singly housed in mesh cages measuring 77x77x152cm with two shelves and furnishings including plastic houses, blankets, large branches, water bowls, and a rotation of enrichment items such as wooden blocks, stuffed animals, and Wiffle® balls. The cages are distributed in three rooms containing five, six, and four cages each. The rooms are kept on a 12-hour light cycle, with red light during the day

and white light at night so that they are active during working hours. The rooms, cages, and enrichment are sanitized monthly. The cages and floors are swept and dishes cleaned every morning, and the floors are mopped every other day.

A diet of Purina® brand primate chow biscuits and rotation of fruits and vegetables is administered once daily, with the older individuals also receiving FreshPet® brand chicken flavored dog food and pulverized primate chow biscuits mixed with various flavors of Powerade® to supply electrolytes. Water is provided ad libitum through bowls and bottles mounted to the cage walls. Two bushbabies, Pebbles and Tiny Tim, receive daily 0.1 mL doses of gabapentin as treatment for anxiety tendencies. Other health problems of note are Moonstone's cataracts and arthritis and Brandine's history of breast cancer and seizures, though no symptoms were present at the time of study.

The present study was conducted before and during the process of transitioning the bushbabies to pair housing. Personality tests, which all took place in the home cage, were conducted before and during the initial phase of switching blankets and enrichments between paired individuals to introduce their partners' smells. The pairing trials were the next step, moving the cages together so that the bushbabies were in close proximity and could interact physically. More details on this protocol are provided below.

All husbandry and experimental procedures were in compliance with FDA guidelines and approved by the University's IACUC board (protocol #15111301).

Personality Assessments

Four personality dimensions were designated for the study (from the five dimensions and related tests in Highfill 2008). These dimensions were human-friendliness, neophobia, activity, and stereotypy.

The human-friendliness assessment involved interaction between a keeper and bushbaby. Each of two keepers ran a single trial with each bushbaby. The encounter was observed for one minute, during which the keeper stood outside the cage and held their hand in front of the mesh, mimicking an affiliative grooming-presenting gesture observed in the bushbabies. If the bushbaby presented its scruff for grooming by ducking the head and exposing the fur on the back of the neck, the individual was deemed High Human Friendly. If the bushbaby did not, it was deemed Low Human Friendly.

The neophobia assessment was a novel object test applied once to each bushbaby. A total of five unique novel objects were used: a plastic balancing bird toy with a wooden block as a base, a cat-sized stuffed African wild dog, a solid burgundy engineer's cap, a small plush orange bone with a squeaker, and a small, articulating wooden artist's model of a hand. Each object was only used once in one day for each of the bushbabies in a room. The item was hidden from the bushbaby's view until it was introduced, along with a familiar piece of cage enrichment, to the floor of the cage just behind the door. Latency to contact with the object was measured. A median split divided the latency values. Bushbabies above the median were High Neophobic, while bushbabies below the median were Low Neophobic. If the bushbaby did not contact the object within one minute of observation, the object was removed from the cage and 1:00 recorded for latency.

Activity and stereotypy levels were both obtained from an activity budget of each bushbaby constructed from five minutes of recorded footage. Coding began ten minutes after the

beginning of the footage, which was uniformly started with morning feeding, so that the bushbaby had time to finish eating its fill and the data would more accurately reflect its usual routine. High/Low Activity classifications were obtained from a median split of total locomotion duration, while High/Low Stereotypy classifications were obtained from a median split of total stereotypy duration.

Pairing Assessment

Six pairs of bushbabies were assigned for the study based on recommendations from the Aquarium and Zoological Association's Bushbaby Species Survival Plan (SSP): Emily and Chris, Moonstone and Heath, Houdini and Kyle, Pebbles and Simon, Brandine and Hercules, and Piper and Joey (see Table 1). Before the study commenced, their cages were rearranged such that the pairs were neighboring each other, at a distance of approximately six inches apart to preclude physical contact. Blankets and various cage enrichment were switched daily throughout the experiment, introducing each to the other's scent. For the trials, the cages were pushed together for a maximum of three minutes; these were conducted two days a week over roughly three weeks for a total of five trials per pair (n=30). Two observers monitored the bushbabies as they interacted (or did not); when conflict escalated to possible danger to a bushbaby, the cages were separated. Depending on the situation's severity, the cages were pulled five centimeters apart and observations continued, or to their original positions and observation halted. If either party showed signs of aggression on the final trial, the pairing was deemed unsuccessful for the purposes of the study. If there were no signs of aggression on the final trial or on two earlier trials, the pairing was deemed successful.

Moonstone	Heath
Joey	Piper
Brandine	Hercules
Houdini	Kyle
Chris	Emily
Pebbles	Simon

Table 1. Assigned bushbaby pairs.

Data Analysis

The number of data points did not permit a sufficient sample size for significant statistical analysis. The results of the pairing trials were examined from two perspectives. The first looked at the success and failure rates of the trials by the compositions of the trait matchups involved. The trial results associated with homophily—that is, where a trait is the same level (high or low) in each partner—were compared with those not associated with homophily. The other perspective examined success and failure rates according to the presence of each single trait category. Trends in the frequencies of success versus failure were identified and described.

Results

The results of the personality assessments and contact cage trials are summarized in Tables 1-6 below. Chris scored Low on Stereotypy, High on Activity, High on Human-friendliness, and High on Neophobia. His partner Emily scored High on Stereotypy, Low on Activity, High on Human-friendliness, and Low on Neophobia. They successfully completed the contact cage trials (Table 2).

Brandine scored High on Stereotypy, High on Activity, High on Human-friendliness, and High on Neophobia. Her partner Hercules scored Low on Stereotypy, Low on Activity, High on Human-friendliness, and High on Neophobia. They failed to satisfactorily complete the contact cage trials (Table 3).

Heath scored High on Stereotypy, Low on Activity, High on Human-friendliness, and Low on Neophobia. His partner Moonstone scored Low on Stereotypy, High on Activity, Low on Human-friendliness, and Low on Neophobia. They failed to satisfactorily complete the contact cage trials (Table 4).

Joey scored High on Stereotypy, Low on Activity, Low on Human-friendliness, and Low on Neophobia. His partner Piper scored Low on Stereotypy, Low on Activity, High on Human-friendliness, and Low on Neophobia. They successfully completed the contact cage trials (Table 5).

Kyle scored High on Stereotypy, High on Activity, Low on Human-friendliness, and Low on Neophobia. His partner Houdini scored Low on Stereotypy, Low on Activity, Low on Human-friendliness, and High on Neophobia. They failed to satisfactorily complete the contact cage trials (Table 6).

Pebbles scored Low on Stereotypy, High on Activity, High on Human-friendliness, and Low on Neophobia. Her partner Simon scored High on Stereotypy, High on Activity, High on Human-friendliness, and Low on Neophobia. They successfully completed the contact cage trials (Table 7).

62.5% of trials were passed when associated with a homophily, while 48.15% failed. When differing levels of traits were involved, 37.5% of trials passed while 51.86% failed (Figure 1).

59.26% of trials in which one or both bushbabies was High Human-friendly were successes, while 40.74% of such trials failed (Figure 2). When one or more bushbabies were Low Human-friendly, 35.71% of trials succeeded while 64.29% failed (Figure 3). 45.45% of trials succeeded when a High Activity bushbaby was present, while 54.55% of trials failed (Figure 4). 45.45% of trials succeeded when a Low Activity bushbaby was present, while 54.56% failed (Figure 5). When a High Neophobia bushbaby was present, 36.36% of trials succeeded while 63.63% failed (Figure 6). When a Low Neophobia bushbaby was present, 55.56% of trials succeeded while 44.44% failed (Figure 7). When a High Stereotypy bushbaby was present, the percentage of trials that both succeeded and failed was 50% (Figure 8). 47.82% succeeded when a Low Stereotypy bushbaby was present, while 52.17% of such trials failed (Figure 9).

PASSED	Chris	Emily
Stereotypy	Low	High
Activity	High	Low
Human-friendliness	High	High
Neophobia	High	Low

Table 2. Chris and Emily results.

FAILED	Brandine	Hercules
Stereotypy	High	Low
Activity	High	Low
Human-friendliness	High	High
Neophobia	High	High

Table 3. Brandine and Hercules results.

FAILED	Heath	Moonstone
Stereotypy	High	Low
Activity	Low	High
Human-friendliness	High	Low
Neophobia	Low	Low

Table 4. Heath and Moonstone results.

PASSED	Joey	Piper
Stereotypy	High	Low
Activity	Low	Low
Human-friendliness	Low	High
Neophobia	Low	Low

Table 5. Joey and Piper results.

FAILED	Kyle	Houdini
Stereotypy	High	Low
Activity	High	Low
Human-friendliness	Low	Low
Neophobia	Low	Low

Table 6. Kyle and Houdini results.

PASSED	Pebbles	Simon
Stereotypy	Low	High
Activity	High	High
Human-friendliness	High	High
Neophobia	Low	Low

Table 7. Pebbles and Simon results.

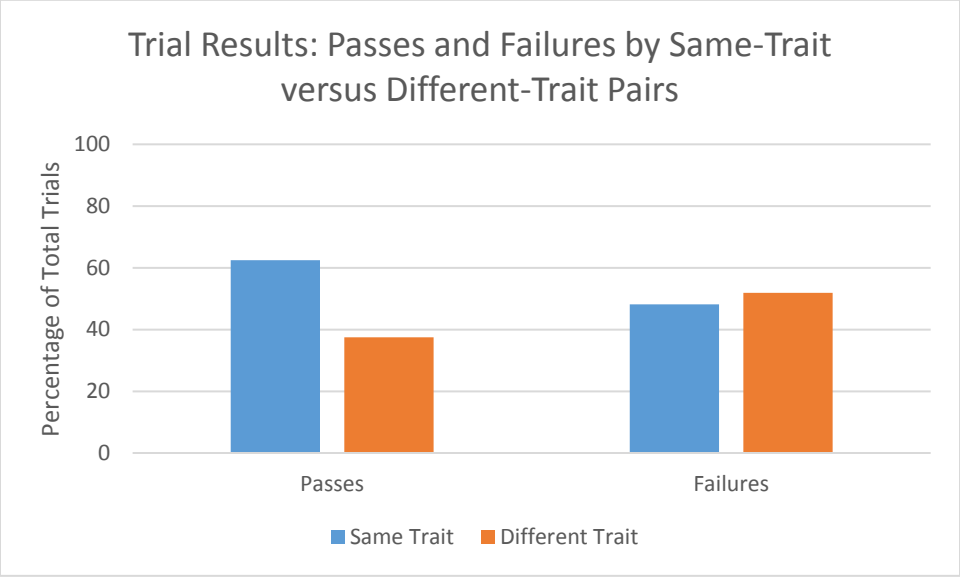

Figure 1. Frequency of failures and successes in the pairing trials, according to whether or not a homophily in one trait was present.

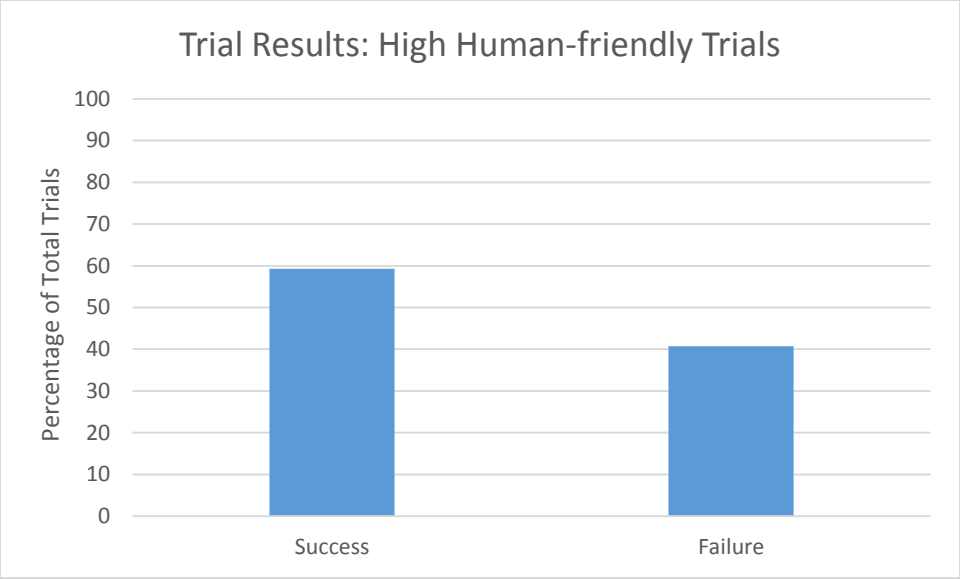

Figure 2. Frequency of successes and failures of trials involving one or both High Human-friendliness bushbabies.

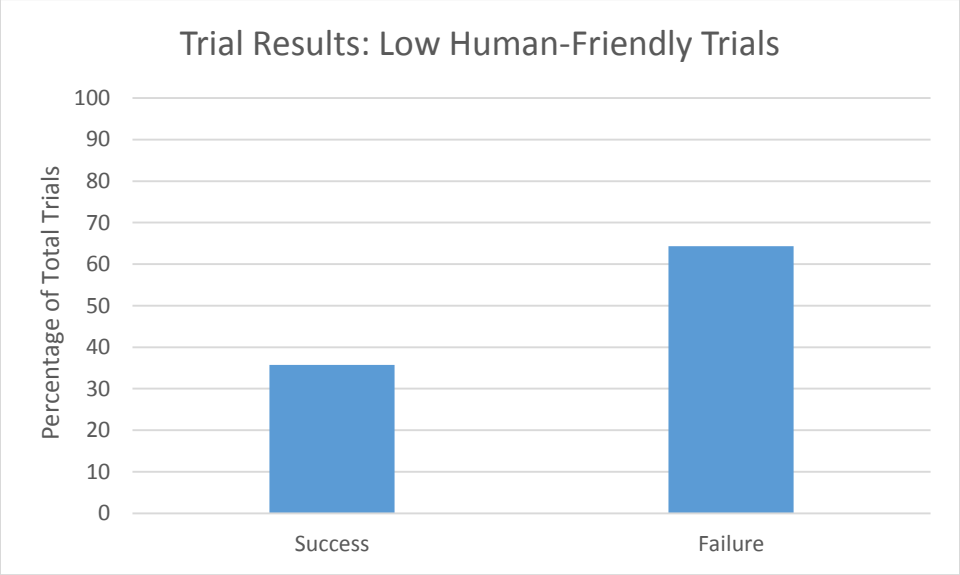

Figure 3. Frequency of successes and failures of trials involving one or both Low Human-friendliness bushbabies.

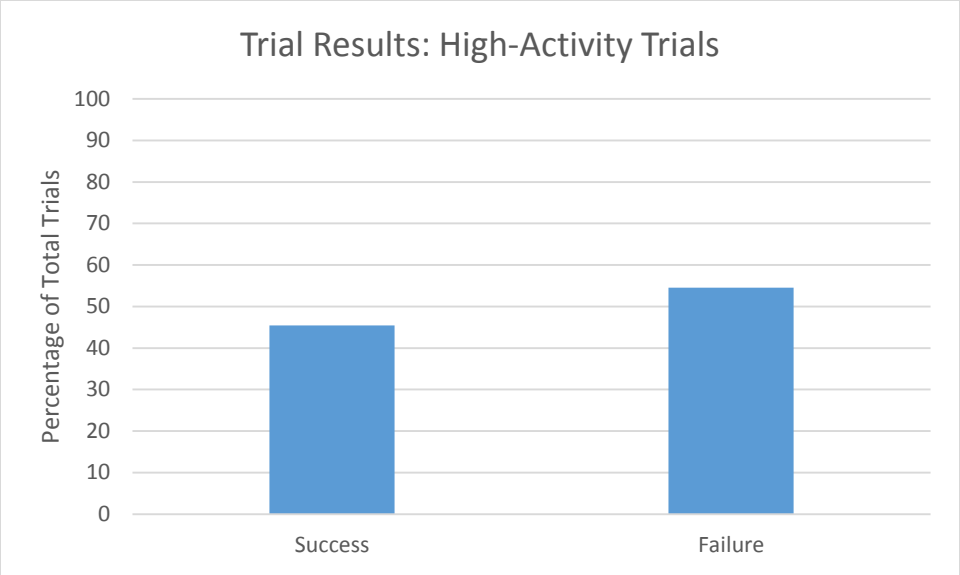

Figure 4. Frequency of successes and failures of trials involving one or both High Activity bushbabies.

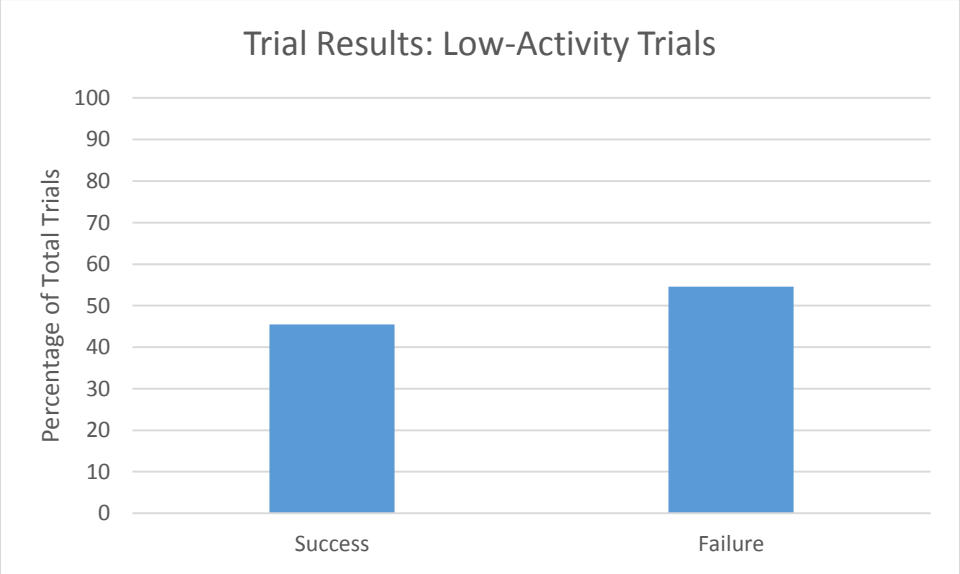

Figure 5. Frequency of successes and failures of trials involving one or both Low Activity bushbabies.

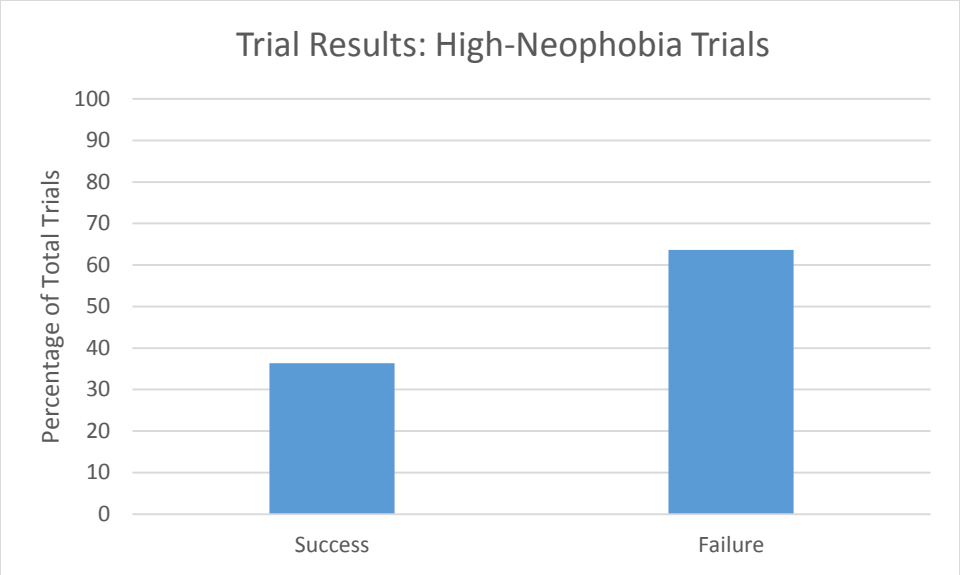

Figure 6. Frequency of successes and failures of trials involving one or both High Neophobia bushbabies.

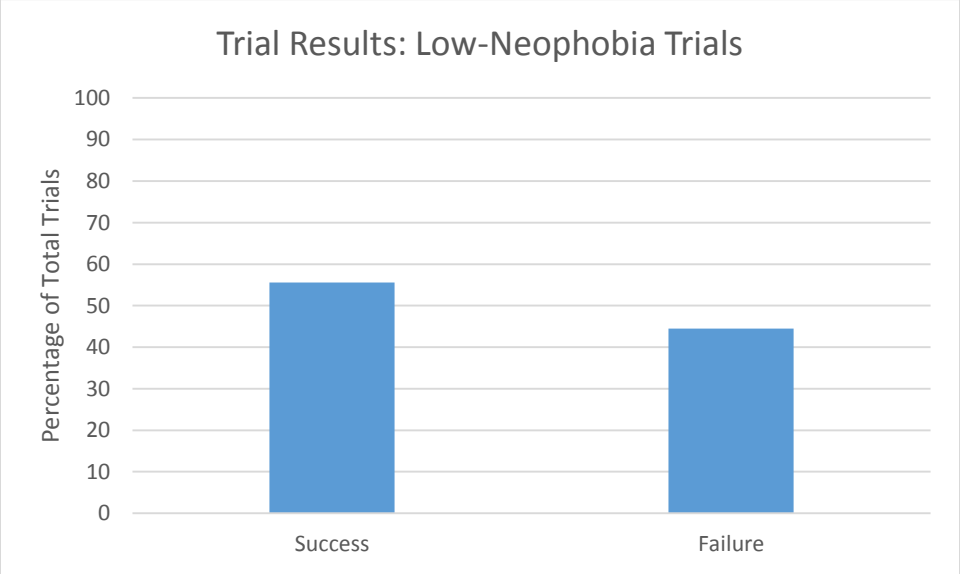

Figure 7. Frequency of successes and failures of trials involving one or both Low Neophobia bushbabies.

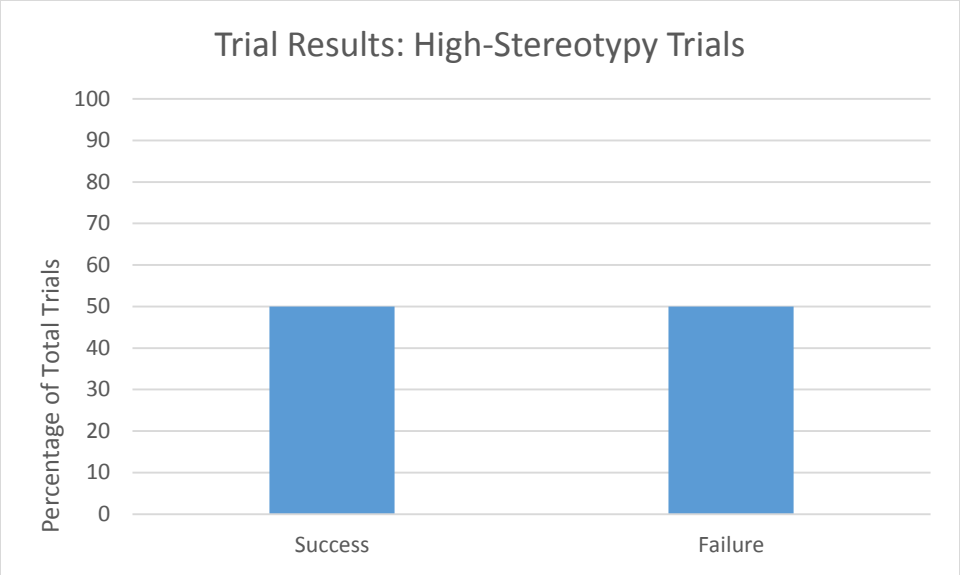

Figure 8. Frequency of successes and failures of trials involving one or both High Stereotypy bushbabies.

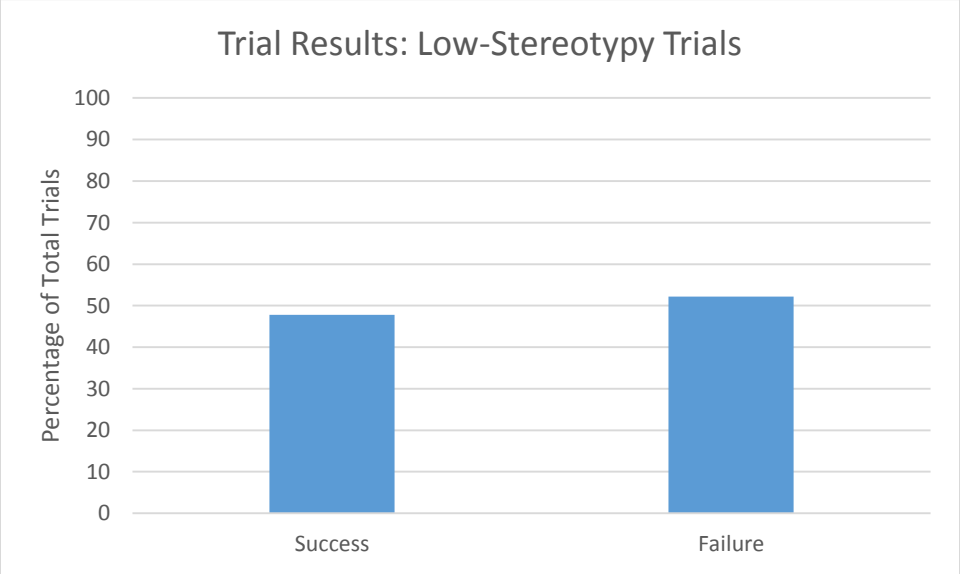

Figure 9. Frequency of successes and failures of trials involving one or both Low Stereotypy bushbabies.

Discussion

The results presented here come from a dataset far too small to be statistically significant, but some trends are still apparent. In three of the cited studies (Weinstein & Capitanio 2008, Massen & Koski 201, McMillan et al. 2003), similarity in a trait between partners predicted

successful pairing or friendship with a conspecific. In the present study, pairings with trait homophily involved succeeded on average almost twice as often as pairings without, which correspondingly failed more often (Figure 1). Weinstein and Capitanio (2008) also found that high "Equability" scores, associated with low activity levels, predicted fewer relationships between juvenile macaques. Pairing trials in the present study involving one or both bushbabies displaying Low Activity failed slightly more often than succeeded. However, this was also true for High Activity, so it is especially unclear what role Activity scores played in the pairing results.

Though not examined beyond homophily, traits relating to affiliative tendencies would seem to predict success in pairing, as an affiliative individual by definition would be less likely to instigate conflict. Due to the sensitivity of the pairing protocol, experimentation to assess affiliative tendencies toward conspecifics was not possible in the present study. Singly housed bushbabies were being slowly exposed to a single individual, based on age, sex, and genetic distance, and any intrusion of another individual would upset the process. The interaction of the pairs was used to measure their compatibility, not the personality traits of the bushbabies, and in any case, the affiliative nature of one would have been influenced by the behavior of the other, so such a methodology would not necessarily have yielded an accurate conclusion. Instead of conspecifics, a subject was exposed to a human caretaker for a measure of affiliative tendencies—operationally, the tendency to approach and present for grooming, as has been observed between successful pairs such as Pebbles and Simon. This test's results might not be communicable with those using conspecific interactions, however, as noted by Highfill's (2008) observation of the late bushbaby Marie. Marie was extremely friendly towards caretakers, but did not tolerate the company of other bushbabies. Despite this possible discrepancy, in the

present study, High Human-friendliness in one or both bushbabies yielded more successes on average than failures (Figure 2). Low Human-friendliness resulted in almost twice as many failures as successes (Figure 3). Bushbabies that were more affiliative with human caretakers seemed to be more tolerant of their partners in the pairing trials. Non-contact interactions with caretakers may be an easy way to test for affiliative tendencies in general, pending further examination of the correlational relationship between human-friendliness and conspecific-friendliness.

Neophobia may also have promise as a predictive trait. When High Neophobia was represented, twice as many trials failed as succeeded on average (Figure 6). Conversely, slightly more trials succeeded than failed when Low Neophobia was involved (Figure 7). Neophobia as revealed by novel object tests may signify a cautious, distrustful temperament more given to agonistic than affiliative behavior, as passing and failing were determined not by consistent avoidance but by outright aggression. Novel object tests are common, simple procedures used often in personality assessment and can be easily administered by staff in constructing personality profiles.

Tendency to perform stereotypic behaviors did not seem to have any effect on pairing success. The numbers of successes and failures when a High Stereotypy bushbaby was present were equal (Figure 8); Low Stereotypy bushbabies yielded slightly more failures on average (Figure 9). Stereotypic tendencies were a proxy for what was described by Highfill (2008) as a "Neurotic" temperament, which in turn may signify more consistently present personality traits that might make an animal more prone to stereotypy. It is possible, however, that there is a disconnect between the behavior and its risk factors such that the behavior is not a reliable indicator of those factors. An animal that has such a personality may not ever develop stereotypic

behaviors because of various environmental factors, as well as other psychological factors. Predisposition does not guarantee the development of a resulting pathology, no matter how closely the two are linked. It is still useful to note stereotypic and other neurotic tendencies, however. As demonstrated by Highfill (2008), pair housing may be an effective remedy for such behaviors if they become problematic to the animal's health, whether or not those behaviors predict success or failure with a partner. Here is where assessment of other personality traits might prove useful.

Also of note is the stage in the transition protocol that was used for experimentation. The success or failure of a pairing was determined by the presence of aggression during the last of five trials in which the bushbabies' cages were pushed against each other to allow for contact. This gave them some time to get acquainted with each other, but did not permit prolonged interaction in a shared space. Such interaction may be the true proving ground of a dyadic relationship, where partners must determine how they are going to share resources such as space and food. Contact aggression was not permitted, so contests to establish dominance relationships were not possible. Personality traits would likely affect all of these processes, and may affect them differently than those permitted by the trials conducted in this study. Here, personality's effect on first impressions was examined; further investigation would be appropriate to link these results with those of prolonged contact in shared space, where pairs that tolerated each other from either side of a barrier may fall apart.

In conclusion, the trend of homophily as a predictor of pairing success that is apparent in previous studies continued in the present study. Activity and Stereotypy levels did not seem to indicate success or failure either way, but Neophobia and Human-friendliness did. The data used to draw these conclusions were frequencies derived from a very limited set of data and are not

statistically significant, so this study's findings should only be taken as suggestions for further research, particularly into homophily, general neophobia, and affiliative tendencies and pair-housing success.

References

Baker, K.C., Bloomsmith, M.A., Oettinger, B., Neu, K., Griffis, C., Schoof, V., Maloney, M. (2012). Benefits of pair housing are consistent across a diverse population of rhesus macaques. *Applied Animal Behaviour Science,* 137: 148-156.

Carter, A.J., Feeney, W.E., Marshall, H.H., Cowlishaw, G., & Heinsohn, R. (2013). Animal personality: what are behavioural ecologists measuring? *Biological Reviews, 88,* 465-475.

Capitanio, J.P., Blozis, S.A., Snarr, J., Steward, A., & McCowan, B.J. (2017). Do "birds of a feather flock together" or do "opposites attract"? Behavioral responses and temperament predict success in pairings of rhesus monkeys in a laboratory setting. *American Journal of Primatology, 79.*

Coleman, K. (2012). Individual differences in temperament and behavioral management practices for nonhuman primates. *Applied Animal Behaviour Science, 137,* 106-113.

Highfill, L.E. (2008). The use of personality assessments in designing environmental enrichment for Garnett's bushbabies (Otolemur garnettii) (doctoral thesis). Retrieved from Aquila dissertation archive database. (UMI No. 3329739)

Kappeler, P.M. & van Schaik, C.P. (2002). Evolution of primate social systems. *International Journal of Primatology,* 23: 707-740.

Massen, J.J.M. & Koski, S.E. (2014). Chimps of a feather sit together: chimpanzee friendships are based on homophily in personality. Evolution and Human Behavior, 35: 1-8.

McMillan, J., Maier, A., Tully, L., & Coleman, K. (2003). The effects of temperament on pairing success in female rhesus macaques. *American Journal of Primatology* 60, 95 (abstract.).

Moberg, G.P. (2000). Biological response to stress: Implications for animal welfare. In Moberg, G.P. & Mench, J.A. (Eds.), *The Biology of Animal Stress: Basic Principles and Implications for Animal Welfare* (pp. 1-21). Wallingford, UK: CABI.

Nash, L.T. & Harcourt, C.S. (1986). Social organization of galagos in Kenyan coastal forests: II. *Galago garnettii*. *American Journal of Primatology*, 10: 357-369.

National Research Council. 2011. *Guide for the Care and Use of Laboratory Animals: Eighth Edition*. Washington, DC: The National Academies Press. doi:https://doi.org/10.17226/12910.

Nekaris, K.A.I, & Bearder, S.K. (2013). The lorisiform primates of Asia and mainland Africa: Diversity shrouded in darkness. In Campbell, C.J., Fuentes, A., MacKinnon, K.C., Bearder, S.K., & Stumpf, R.M. (Eds.), *Primates in Perspective* (pp. 34-54). Oxford, UK: Oxford University Press.

Novak, M.A. & Suomi, S.J. (1988). Psychological well-being of primates in captivity. *American Psychologist*, 43: 765-773.

Ödberg, F.O. (1978). Abnormal behaviours: stereotypies. Proc. 1st World Congress on Ethology Applied to Zootechnics. Madrid: 475-480.

Truelove, M.A., Martin, A.L., Perlman, J.E., Wood, J.S., & Bloomsmith, M.A. (2017). Pair housing of macaques: A review of partner selection, introduction techniques, monitoring for compatibility, and methods for long-term maintenance of pairs. *American Journal of Primatology*, 79: e22485.

Weed, J.L., Wagner, P., Byrum, R., Parrish, S., Knezevich, M., & Powell, D.A. (2003). Treatment of persistent self-injurious behavior in rhesus monkeys through socialization: A preliminary report. *Contemporary Topics*, 42: 21-23.

Weinstein, T.A.R. & Capitanio, J.P. (2008). Individual differences in infant temperament predict social relationships of yearling rhesus monkeys (Macaca mulatta). Animal Behavior, 76, 455-465.

Appendices

A) Ethograms

Individual

Locomote **L**

Walk or run, leap, or climb; translocate

Scan **Sc**

Look about environment, ears erect, head moving or still with eyes focused, body is still

Rest **R**

No movement or active scanning; sitting or lying down, eyes closed

Forage **F**

Reaching for, manipulating, or eating food; drinking water from bowl or bottle

Groom **G**

Licking fur or scratching with grooming claw

Interact with enrichment **E**

Yawn **Y**

Open mouth widely but briefly and close eyes

Sneeze **Sn**

Rapid expulsion of air from nasal cavity

Scent-marking

Rubbing body part on substrate

Chest **ScC**

Cheek **ScCh**

Foot-rub **FR**

Call

Contact call **VL**

Clicking **VC**

Grunting **VG**

Barking **VB**

Stereotypy **ST**

Any uniquely patterned movement typically repeated for at least three loops; may include wheeling, pacing, head-twirling

Pairing

Approach **AP**

Move toward conspecific

Attack **AT**

Aggressive physical contact such as bite or grab, accompanied by shrieking

Head-cock **HC**

Tilt head sideways with ears erect while facing conspecific

Lunge **LU**

Launch self at individual

Retreat **RE**

Move away from individual

Ear tuck **ET**

Tuck ears against skull

Allogroom **AG**

Lick conspecific's fur

Sniff **SN**

Nudge conspecific with nose, nostrils quivering

Present **P**

Look down near conspecific, baring scruff; alternatively, extend arm toward conspecific

Threat **TH**

Arched-back posture: on all four limbs with at least two limbs rigidly extended and the back or rump pronouncedly arched

Bipedal: standing on hind limbs, arms outstretched, teeth bared

Follow **FO**

Locomote alongside conspecific

Call

Contact call **VL**

Clicking **VC**

Grunting **VG**

Barking **VB**

Flutter-hum **VF**

B) IACUC Approval Form

THE UNIVERSITY OF
SOUTHERN MISSISSIPPI

INSTITUTIONAL ANIMAL CARE AND USE COMMITTEE

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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 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 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:	**15111301 (modification dated 05/14/17)**
PROJECT TITLE:	**Examining the Health and Wellbeing of Captive Housed Otolemur garnetti**
PROPOSED PROJECT DATES:	**11/2015 – 09/2018**
PROJECT TYPE:	**Modification**
PRINCIPAL INVESTIGATOR(S):	**Katie Smith**
DEPARTMENT:	**Anthropology and Sociology**
FUNDING AGENCY/SPONSOR:	**N/A**
IACUC COMMITTEE ACTION:	**Full Committee Approval**
PROTOCOL EXPIRATON DATE:	**September 30, 2018**

Jake Schaefer, PhD
IACUC Chair

05/18/2017
Date