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Using Personality Traits to Predict Pectoral Fin Contact Initiation Role in Bottlenose Dolphins (*Tursiops truncatus*)

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Using Personality Traits to Predict Pectoral Fin Contact Initiation Role in Bottlenose Dolphins (*Tursiops truncatus*)

by

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ABSTRACT

Contact with the pectoral fin facilitates formation and maintenance of social relationships between dolphins (Dudzinski & Ribic, 2017). Additionally, several studies have shown that bottlenose dolphins have distinct personalities that are consistent across time and situation (e.g., Highfill & Kuczaj, 2007; Kuczaj, Highfill, & Byerly, 2012), and it has been suggested that these individual differences (i.e., personality) may influence tactile behavior exchanges. The current study therefore aimed to determine if bottlenose dolphin personality traits predict whether and how dolphins initiate contact as a rubber or rubbee during pectoral fin contact exchanges, and to identify whether the effects of personality traits predicting initiator role varied across sex and age-class. Instances of pectoral fin contacts were selected from previously recorded underwater video observations of a bottlenose dolphin group under human care at the Roatan Institute for Marine Sciences (RIMS) between 2014 and 2017. Personality assessments were conducted by experienced trainers for dolphins using rating questionnaires that reflected the personality traits from the Five-Factor Model (i.e., Extraversion, Agreeableness, Openness to Experience, Conscientiousness, and Neuroticism; Goldberg, 1990). Multiple regression analyses suggested that personality traits do not fully predict initiator role; however, Conscientiousness and its interactions with sex and age may be important. Loglinear analyses showed Agreeableness affected the area of the body that was contacted when a rubbee initiated pectoral fin contact. This study demonstrates a first look at how personality influences the initiator side of pectoral fin contact exchange in bottlenose dolphins.

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Lastly, this thesis would not have been possible without the help and support of Teri and Eldon Bolton and the dolphin trainers at the Roatan Institute for Marine Sciences.

DEDICATION

I would like to dedicate this thesis to James Duggan and my parents, Rob Macgregor and Cheryl Heim.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ILLUSTRATIONS

CHAPTER I - INTRODUCTION

Bottlenose dolphins (*Tursiops truncatus)* are social mammals that maintain a complex social structure with dominance hierarchies and a fission-fusion pattern of individual movement (Conner, Wells, Mann, & Read, 2000; Samuels & Gifford, 1997). Like many animals, individual differences influence dolphin behavior and their interactions with conspecifics (Hill, Greer, Solangi, & Kuczaj, 2007; Lewis, Wartzok, & Heithaus, 2011). To overcome the demands of group living (e.g., travel, foraging, reproduction, parental care, social bonding), and maintain an intricate social structure, dolphins have evolved high levels of socio-cognitive abilities and a sophisticated communication system that aid social interaction and coordination between conspecifics (Conner, 2007).

Dolphins utilize multimodal communication in which signals are sent to a receiver through several sensory systems, such as acoustic, visual, and tactile. Communication can occur through one signal (e.g., one bubble trail), but more often occurs through complex signals via strings of units from multiple sensory systems (e.g., aggressive interactions have been observed to include s-posture, open mouth, bubble emissions, hitting, jaw claps, and vocalizations; Samuels & Gifford, 1997), either simultaneously or sequentially (Dudzinski & Gregg, 2017; Parten & Marler, 1999). Advanced technology (e.g., Dudzinski, Clark, Würsig, 1995) has allowed these types of complex signals to be observed and recorded in difficult-to-study species like bottlenose dolphins, thus facilitating research examining their species-specific functions.

Tactile Communication

Over the past two decades, there has been an abundance of underwater observational research on bottlenose dolphins, much of which has captured tactile exchanges between conspecifics. Touch is an important communicative outlet for dolphins, considering that their skin is highly innervated (Ridgway & Carder, 1990). It is similar in sensitivity to human finger tips, eye lids, and lips, with the rostrum, eyes, blowhole, and genital region being the most sensitive parts of the dolphin body (Ridgway & Carder, 1990). Due to their high skin sensitivity, even brief or low intensity contact may be meaningful in communicating a plethora of information. Dolphins are often seen in contact with one another (Dudzinski, 1998; Dudzinski, Danaher-Garcia, & Gregg, 2013), and use many parts of their body to perform tactile behaviors, including hits, rams, mounts, rubs, static touches, pectoral fin contact exchanges, and body rubs (Dudzinski & Gregg, 2017). Such exchanges can occur in many behavioral contexts but have primarily been observed during interactions characterized as agonistic, socio-sexual, affiliative, or play (Dudzinski & Gregg, 2017).

Pectoral fin contact is defined as static touch or movement between one dolphin's pectoral fin and another dolphin's body part (Dudzinski, Gregg, Ribic, & Kuczaj, 2009). This type of contact has been observed in numerous dolphin species, including: Atlantic spotted dolphins (*Stenella frontalis*; Dudzinski, 1998), Atlantic bottlenose dolphins (Dudzinski, Gregg, Paulos, & Kuczaj, 2010), Indo-Pacific bottlenose dolphins (*Tursiops aduncus*; Conner, Mann, & Watson-Capps, 2006; Dudzinski et al., 2009; Sakai, Hishii, Takeda, & Kohshima, 2006), Atlantic white-sided dolphins (*Lagenorhynchus acutus*; Nelson & Lien, 1994), Commerson's dolphins (*Cephalorhynchus commersonii;* Johnson

& Moewe, 1999; Sakai et al., 2013), and rough-toothed dolphins (*Steno bredanensis*; Kuczaj & Yeater, 2007). It has also been observed in other odontocetes, such as sperm whales (*Physeter microcephalus*; Whitehead & Weilgart, 2000), long-finned pilot whales (*Globicephala melas*; Aoki, Sakai, Miller, Visser, & Sato, 2013), and beluga whales (*Delphinapterus leucas*; Hill, Alvarez, Dietrich, & Lacy, 2016).

Pectoral fin contact behavior has had a range of suggested functions. Certain hypothesized functions, such as to elicit mating behaviors (Tavolga & Essapian, 1957), or to remove ectoparasites or old skin cells for hygiene purposes (reviewed by Dudzinski et al., 2009), are not strongly empirically supported. Most of the recent literature supports the notion that pectoral fin contact is a type of social affiliative behavior used primarily to form and maintain social bonds (Conner et al., 2006; Dudzinski et al., 2013, Dudzinski & Ribic, 2017; Kaplan & Conner, 2007; Sakai et al., 2006; Tamaki, Morisaka, & Taki, 2006), and decrease male harassment by signaling cooperation between females (Conner et al., 2006).

Two distinct pectoral fin contact behaviors have also been observed to reflect more specific functions within affiliative contexts. Petting is a pectoral fin contact behavior in which both dolphins involved in the exchange actively use their pectoral fins (Dudzinski et al., 2010; Dudzinski et al., 2013), and it appears to serve as a greeting among wild dolphins (Dudzinski, 1998; Dudzinski et al., 2009, 2010). Contact swimming (Conner et al., 2006), also termed contact position (Dudzinski, 1998) and bonding (Mann & Smuts, 1999), is a static pectoral fin contact behavior that consists of one dolphin placing its pectoral fin on another's lateral peduncle. This behavior has been observed in female bottlenose dolphins and Atlantic spotted dolphins, and is thought to communicate

association, cooperation, and support between the individuals (Conner et al., 2006; Dudzinski, 1998). In social species, it is highly beneficial to cooperate with conspecifics, and as a result, affiliative behavior may be evolutionarily conserved in such taxa (Harvey, Dudzinski, & Kuczaj, 2017).

Studying several dolphin groups over more than a decade, Dudzinski and colleagues (i.e., Dudzinski et al., 2009, 2010, 2012, 2013; Dudzinski & Ribic, 2017) examined four descriptors related to participants involved in pectoral fin contact exchanges: initiator, receiver, rubber, and rubbee. The initiator and receiver are self-explanatory while, by definition, the rubber is the dolphin whose pectoral fin is involved in the exchange whereas some part of the rubbee's body is involved. Therefore, the rubber or rubbee can initiate or receive contact, although, it was found in several social groups that rubbers initiate pectoral fin contact exchanges more often than rubbees (Dudzinski et al., 2013). During these exchanges one or more different body parts are contacted. When rubbers initiate pectoral fin contact, the lateral side of the receiver is contacted most often, and for initiating rubbees, contact to the rostrum, face, and lateral side is often solicited (Dudzinski et al., 2013).

Apart from mother-calf dyads, pectoral fin contact exchanges mostly occur between dolphins of the same sex and same age (Conner et al., 2006; Dudzinski, 1998; Dudzinski et al., 2013; Dudzinski & Ribic, 2017; Kaplan & Conner, 2007; Sakai et al., 2006). For male bottlenose dolphins, tactile interactions with same sex partners during their juvenile period may establish future associations (Dudzinski & Ribic, 2017; Mann, 2006), as some adult male bottlenose dolphins form long-term alliances (Conner et al., 2000). Female juvenile bottlenose dolphins do not appear to have any sex preference

when exchanging pectoral fin contact (Dudzinski & Ribic, 2017), which is consistent with the lack of strong alliances between adult females, although as adults, they do engage in more same-sex affiliation and pectoral fin contact (Dudzinski & Ribic, 2017; Kaplan & Conner, 2007). While much research has examined sex- and age-related patterns of tactile behaviors, little attention has been paid to the potential role of individual differences. Personality, as manifested in differences in behavioral tendencies between individuals of a species, seems likely to affect the extent to which individuals exchange pectoral fin contacts.

Personality

Personality is a unique concept that has been difficult to define. For non-human animals, personality is a term often used interchangeably with temperament or behavioral syndrome; a general definition relates to individual differences in behavior that are consistent across time and context (Gosling, 2001). In recent years, personality research with non-human animals has flourished, and has demonstrated that personality is not bound by taxa. Numerous species have shown individual differences, including but not limited to, ants (*Myrmica ruginodis*; Chapman, Thain, Coughlin, & Hughes, 2011), cuttlefish (*Sepia officinalis*; Carere et al., 2015), three-spined sticklebacks (*Gasterosteus aculeatus*; Bell, 2005; Harcourt, Sweetman, Johnstone, & Manica, 2009), great tits (*Parus major*; Aplin et al., 2013), chimpanzees (*Pan troglodytes;* King & Figueredo, 1997; Koski, 2011; Massen & Koski, 2013), Asian elephants (*Elephas maximus*; Yasui et al., 2013) and African elephants (*Loxodonta Africana*; Horback, Miller, & Kuczaj, 2013; Yasui et al., 2013), and bottlenose dolphins (Highfill & Kuczaj, 2007; Kuczaj, Highfill, & Byerly, 2012; Frick, 2016; Moreno, Highfill, & Kuczaj, 2017).

Two approaches are common when investigating personality in non-human animals: bottom-up and top-down. The bottom-up approach focuses on species-specific measures designed to capture traits relevant to the study species (Weiss & Adams, 2013). For example, behavioral coding is a predominantly bottom-up method in which patterns of behavior that are specific to the studied species are identified, quantified, and observed. Using this methodology, recorded behaviors are compiled into trait factors unique to the individual(s) in the study group and/or the species (de Vere, Lilley, & Highfill, 2017; Feaver, Mendl, & Bateson, 1986; Frick, 2016; Horback, et al., 2013; Koski, 2011). Bottom-up approaches have the benefit of finding factors specific for the species and minimizing anthropomorphic influences. However, the species-specific nature of these approaches can make it difficult to compare personality factors across species.

Conversely, top-down approaches use existing personality measures or frameworks and tailor them to the focal species (e.g., Five-Factor Model; Goldberg, 1990; King & Figueredo, 1997). The rating method tends to be predominantly top-down, and involves human judges rating individual animals on various personality traits. Typically, ratings are completed by individuals with prior experience working with the animals, such as animal care staff (Freeman, Gosling, & Schapiro, 2011). One of the scales successfully applied in multiple non-human animal personality assessments is the human Five-Factor Model (Goldberg, 1990). This model contains the five trait dimensions of: Extraversion, Agreeableness, Openness to experience, Conscientiousness, and Neuroticism (Goldberg, 1990). Extraversion is related to being active, assertive, and sociable. Agreeableness is associated with being affiliative, cooperative, and trustworthy.

Openness to Experience is related to curiosity and creativity. Conscientiousness reflects an individual who is dependable, alert, and dutiful. Neuroticism is linked to aggressiveness, anxiousness, and stress. Since the Five-Factor Model is originally a framework for human personalities, it must be tailored for applications to non-human animal species, to reflect the behavior and characteristics of the focal species in a research study. Though applying this model to non-humans has the potential to include traits that may not be relevant for the focal species, it works well for cross-species comparisons. Additionally, personality ratings have been shown to have good reliability (Gosling, 2001; Gosling, Kwan, & John, 2003; Gosling & Vazire, 2002; Morton, Weiss, Buchanan-Smith & Lee, 2015), and predictive validity, as ratings are generally consistent with results obtained from observational and experimental assessments (Highfill, Hanbury, Kristiansen, Kuczaj, & Watson, 2010; Horback, et al., 2013).

Linking Pectoral Fin Contact and Personality

It may seem intuitive that people differ in the extent to which they seek out and enjoy social contact and affiliative interaction, but this topic has been the subject of substantial research. For example, high Agreeableness and Openness were strong indicators of positive perceptions of touch from others (Dorros, Hanzal, & Segrin, 2008), and high Neuroticism has been associated with touch avoidance (Deethardt & Hines, 1987). High Conscientiousness, Extraversion, Agreeableness, and low Neuroticism related to greater satisfaction between friends (Wilson, Harris, & Vazire, 2015), and adolescents tend to choose friends who have similar levels of Openness, Extraversion, and Agreeableness (Selfhout et al., 2010). Those individuals who seek out people to befriend tend to have higher Extraversion scores, while the people chosen as friends were

often high in Agreeableness (Selfhout et al., 2010). It has also been suggested that higher Conscientiousness and lower Neuroticism may contribute to friendship maintenance between two people, rather than to the initial formation of their friendship (Selfhout et al., 2010).

Non-human research has also considered the potential role of both personality and tactile behaviors in the formation and maintenance of social relationships. Chimpanzees exhibit contact sitting, an affiliative tactile behavior, which reflects relationship quality; individuals with greater similarity in personality traits sat in contact more frequently than those with dissimilar personalities (Massen & Koski, 2013). For example, for non-kin contact sitting, partners were similar in the personality dimensions of Boldness and Grooming Equity (Massen & Koski, 2013). Another social species in which touch is salient and varies between individuals is Asian elephants. Observations and analyses of tactile behaviors indicate that individual differences in tactile behaviors may be important to the type of social interactions and how often they occur (Makecha, Otto, & Kuczaj, 2012). Elephants were observed initiating and receiving contact with preferred individuals of the social group (Makecha et al., 2012). Differences in the frequency of initiated and received contacts were identified between individuals, which the authors note that some of the differences may be due in part from the influence of rank in the dominance hierarchy (Makecha et al., 2012).

Previous studies conducted with dolphins in managed care have loosely considered the role of personality in social touch behavior. Assessing social behavior in the presence of enrichment objects and without, Caffery (2013) found that a group of captive rough-toothed dolphins exhibited more behaviors when enrichment objects were

present in their enclosure. However, the frequency of affiliative tactile behaviors was not different between conditions. Individual differences were observed in number of social behaviors and type of behaviors, as well as the initiation of affiliative tactile behaviors in both conditions. It was also identified that individual dolphins who exhibited more object play behaviors also engaged in more affiliative tactile behaviors, which may suggest that extraverted dolphins involve themselves in many pro-social situations (Caffery, 2013). Bottlenose dolphins have been confirmed to possess distinct personalities (Highfill & Kuczaj, 2007; Kuczaj et al., 2012), including the proposed study group (Frick, 2016; Moreno et al., 2017). Using behavioral coding, Frick (2016) demonstrated the intricate relationship between dolphin social status and personality. It was found that in hierarchies separated by sex, males on the lower end of the hierarchy were higher in the traits characterized as Sexual and Contact-seeking, while males at the high end of the hierarchy were low on these two traits and higher in Camaraderie than the low-ranking males. Camaraderie included pectoral fin rubs in the composite of correlated behaviors, while Contact-seeking included rubs not specific to the pectoral fin and touches. For females, Playful was correlated with higher social rank, and Evasive was correlated with lower social rank. Neither of the two traits comprised of tactile behaviors. In general, dolphins at the high and low ends of the social hierarchy exhibited a stronger relationship between personality and dominance, particularly for males. However, for individuals in the middle of the hierarchy, other components (e.g., age, maternal style, and associations) also contributed to the relationship between personality and dominance. In the same population, Moreno et al. (2017) assessed the effect of personality on social bonds. Components of relationship quality were categorized as Affiliative Support (which

included all affiliative tactile behaviors), Socio-sexual, and Conflict Play. They found that Conscientiousness, Extraversion, and Neuroticism predicted the occurrence and quality of social bonds. The greater the similarity in Conscientiousness scores, the stronger the association observed between pairs of dolphins, and higher levels of bonding were observed between pairs of dolphins with contrasting ratings on Extraversion and Neuroticism. This contrasts with findings in capuchin monkeys (*Sapajus* sp.), for whom stronger affiliative relationships are seen between individuals who are more similar in Neuroticism (Morton et al., 2015). Harvey et al. (2017) also noted that affiliative behaviors play a key role in maintaining dyad associations within the proposed study group. Given that personality is related to the performance of affiliative behaviors in various non-human species, including bottlenose dolphins, and that pectoral fin contact behaviors are known to facilitate the formation and maintenance of bonds between dolphins (Dudzinski & Ribic, 2017), personality may therefore play an important role in determining which dolphins who initiate pectoral fin contact take the role of rubber or rubbee during an exchange. This study sought to fill in the empty space on what we know about pectoral fin contact exchanges.

Current Study

The aim of the current study was to investigate whether aspects of bottlenose dolphin personality predicted an initiators' role as either rubber or rubbee during pectoral fin contact exchanges. Pectoral fin contact data were coded using behavioral observations made from underwater video recordings collected at the Roatan Institute for Marine Sciences (RIMS). Personality was quantified using trait ratings for this population of bottlenose dolphins completed by experienced trainers.

Hypothesis 1

It was hypothesized that dolphin personality would predict whether an initiator acts more often as a rubber or rubbee in pectoral fin contact exchange events. Specifically, dolphins rated as higher on Agreeableness were predicted to be more likely to assume the role of rubbee than rubber when initiating pectoral fin contact exchange. Agreeableness is associated with being trustworthy, friendly, and cooperative. Individuals assuming the rubbee role are soliciting contact from a specific other individual whom they trust and want to cooperate with to establish or build on their relationship.

Hypothesis 2

Differences in personality ratings ability to predict rubber versus rubbee role of the initiator were expected between sexes. Specifically, Extraversion was expected to more strongly predict the role (rubber versus rubbee) of female compared to male initiators in pectoral fin contact exchanges, Male dolphins are known to establish and maintain strong social bonds, and do so through repeated interactions with other males; they also spend an exceptional amount of time social-sexual interactions with other males (Botero-Acosta, 2015) and actively pursue females for mating. As male dolphins engage in such high frequencies of contact behaviors, the variability in the frequency of male pectoral fin contact exchanges is expected to be lower than that of females.

Hypothesis 3

Differences in personality ratings ability to predict rubber versus rubbee role of the initiator were expected between age-classes. Specifically, personality factors for older dolphins (i.e., sub-adults and adults) were expected to predict their role as rubber versus rubbee more when initiating pectoral fin contact as compared to younger dolphins (i.e.,

calves and juveniles). Young dolphins are curious and exploratory as they are developing and learning about the world around them, as well as how to function appropriately within their social group (Kuczaj & Winship, 2015). Therefore, the behavior of younger dolphins was likely to be more variable than that of older dolphins, including the role they assume in initiated pectoral fin contact exchanges.

Hypothesis 4

It was predicted that if the initiating rubbee scores high on Agreeableness and/or low on Neuroticism, this dolphin would be more likely to be rubbed by a rubber on its face and rostrum. Prior literature has demonstrated that initiating rubbees often solicit rubs to the face (Dudzinski et al., 2013). Since the face and rostrum are more sensitive parts of the body, it is likely that friendlier or more affiliative rubbees would initiate contact to these areas. It was therefore predicted that initiating rubbees who were high in Agreeableness were more likely to be rubbed on the face and rostrum. Additionally, dolphins low in Neuroticism were also more likely to be rubbed on the face and rostrum, as a dolphin who is highly neurotic and more fearful would be less willing to expose sensitive areas as a rubbee.

CHAPTER II – MATERIALS & METHODS

Subjects and Facility

Subjects for the current study were a group of Atlantic bottlenose dolphins housed at RIMS, located along the northwest side of Roatan Island, north of the Honduran coast. The dolphins reside in a natural lagoon contiguous to Bailey's Key (Figure 1). The enclosure has approximately 8,000m² of surface area that is characterized by a sandy sea floor with natural coral and sea grass. Depth ranges from zero to eight meters (Dudzinski et al., 2010). For the duration of the study between 2014 and 2017, the population consisted of 26 dolphins (13 males and 13 females). For the duration of this study, four individuals died, and four calves were born. Dolphins were categorized as "young" and "old" using age-class information based on the year each dolphin was born (K. Dudzinski, personal communication, August 2017); calves and juveniles were categorized as young, while sub-adults and adults were classed as old. Only two dolphins transitioned from young to old during the study period but were placed in the young category because most of their initiation events occurred when they were juveniles

Figure 1. Aerial view of dolphin sea pen at Roatan Institute for Marine Sciences.

Retrieved from www.cetabase.org/captive/cetacean/roatan-institute-marine-sciences

Materials and Procedure

Pectoral Fin Contact Behaviors

Behavioral data were collected between 2014 and 2017 by Dolphin Communication Project (DCP) using a mobile video/acoustic system (MVA; Dudzinski et al., 1995). Data were collected in 30-minute sessions, typically in the early morning when all dolphins were housed together in the main lagoon. Focal animal follow and all-occurrence sampling (Altmann, 1974; Mann, 1999) were used to collect behavioral data. Focal follows were initiated when a dolphin came into view of the observer's camera and finished when the dolphin swam out of view (Dudzinski, et al., 2009). There was an attempt to record all individuals equally during focal follows.

Video footage totaled 20 hours and 56 minutes, with 997 pectoral fin contact exchanges event sampled. Pectoral fin contact exchanges were coded for identification of the dolphins involved (rubber and rubbee), their sex, age-class, and body part contacted. All dolphins were individually identified using characteristic body features such as permanent scars or marks and were confirmed through comparison of temporary rake marks apparent during data collection periods. A pectoral fin contact exchange began when one dolphin initiated contact (initiator) with a second dolphin (receiver; Dudzinski et al., 2009). Because the current study is focused specifically on the initiator role, no data about the receiver role were included in analysis. The initiator could be either a rubber or rubbee (Dudzinski et al., 2009). The body part contacted by a rubber's pectoral fin during an exchange was coded using a diagram that divides the dolphin body surface into 11 parts. Before statistical analyses could be run, body parts were collapsed into three main sections, face, mid-body and posterior-end, due to low occurrence of contact

to some body parts. Previous research found that the body parts contacted most by initiating rubbees included the rostrum, face, and lateral side, and initiating rubbers often contacted the lateral side and face (Dudzinski, et al., 2013). Thus, the three body sections were chosen to include body parts most often contacted and their surrounding parts for ease of analyses

Personality Assessment

To assess dolphin personality, a personality questionnaire based on the human Five-Factor Model of personality, verified in past research with this population (e.g., Moreno, Highfill, & Kuczaj, 2017), was completed. The questionnaire used in the present study was completed by animal care trainers at RIMS who had worked daily with the dolphins for a minimum of six months. For one questionnaire, the trainer had been working with the focal dolphin for two months. This questionnaire was still included because the trainer spent a lot of time interacting and observing the dolphin and the effect of familiarity may have minimal effects (Martau, Caine, & Candland,1985); however, influence of acquaintanceship on personality rating needs to be further studied. Additionally, the trainer rated them self as very confident in their assessment. Trainers indicated their confidence in rating the focal dolphin using a seven-point Likert scale. Four questionnaires were completed with a neutral confidence rating (i.e., four). The remaining questionnaires were completed with confidence ratings above neutral (i.e., five, six, seven), indicating high confidence.

Each dolphin was rated on several traits that capture components of each of the five personality factors (i.e., Extraversion, Agreeableness, Openness to experience, Conscientiousness, and Neuroticism; Table 1).

Table 1

List of Traits in Questionnaire for Each Personality Factor

Factors	**Traits**
Extraversion	Active
	Playful
	Timid (Reverse)
Agreeableness	Affiliative
	Friendly
	Demanding (Reverse)
Openness	Curious
	Creative
	Not Exploratory (Reverse)
Conscientiousness	Alert
	Careful
	Undependable (Reverse)
Neuroticism	Aggressive
	Relaxed (Reverse)
	Tolerant (Reverse)

Within the questionnaire, each trait description related to only one of the personality factors. All traits were accompanied by an operational definition to reduce variability between raters' own concepts of each trait (e.g., Demanding: requires much effort or attention from other dolphins and/or humans). A seven-point Likert scale was used to score each trait, seven represented "very accurate description" while one represented "very inaccurate description." These traits were chosen by Moreno et al. (2017) to represent the most informative traits from the personality questionnaire to assess bottlenose dolphin personality, first implemented by Highfill and Kuczaj (2007), which made it more opportune for responders because the reduction in questions reduced the amount of time trainers needed to spend on completing it. The questionnaire was

given in either English and Spanish, for responder convenience. Trainers completed questionnaires individually and were asked not to share their ratings. Questionnaires collected during this study were used in conjunction with those collected by Moreno et al. (2017), with the goal of extending individual personality data to include a minimum of three completed questionnaires for each dolphin housed at RIMS between 2014 and 2017. However, there were five dolphins who were only rated by two trainers due to time constraints at the facility. The youngest calf also was unable to be rated during this study.

Data Analysis

Three dolphins were excluded from analyses for not having initiation events during the study period. To establish a value for all five factors individually, trait descriptions that had been written in a negative direction were reverse scored and all responses from raters were averaged for each dolphin. Intra-class correlation coefficients (ICCs) were used to determine inter-rater reliability for each personality factor and for each dolphin. ICCs are widely used reliability tests that are helpful when testing more than two raters (McGraw & Wong, 1996). Model one ICCs were used for this study because each subject was not always rated by the same trainers, and the trainers who completed questionnaires were a sample of the population of potential raters (Koo & Li, 2016; Strout & Fleiss, 1979). The average measure ICC was utilized (ICC (1, 3)), as the average rating of each personality factor was germane for analyses. The five dolphins who were rated by two raters were analyzed with the same ICC model with one fewer rater (ICC (1, 2)). Criteria to determine the level of reliability were derived from Cicchetti (1994), an ICC estimate lower than 0.40 is “poor”, between 0.40 and 0.59 is “fair”, between 0.60 and 0.74 is “good”, and between 0.75 and 1.0 is “excellent”.

ICC estimates for dolphins (Table A1) showed that one dolphin received a negative ICC estimate (ICC (1, 2,) = -0.429), indicating that raters disagreed significantly, and was therefore removed from further analyses. The remaining dolphins had ICC estimates ranging from fair to excellent (Table A1) and were retained for analyses.

Reliability was also assessed for each personality factor using the average measure of a model one ICC. Estimates indicated that Agreeableness (ICC (1, 3) = 0.256) and Conscientiousness (ICC (1, 3) = 0.376) were "poor", while Extraversion (ICC (1, 3) = 0.884), Openness (ICC (1, 3) = 0.777), and Neuroticism (ICC (1, 3) = 0.813) were "excellent." All five factors were kept for analyses to maintain the full Five-Factor Model personality profile; however, the low ICCs for Agreeableness and Conscientiousness indicate that these scores are somewhat below acceptable criteria for reliability.

Multiple regression analyses were used to test hypotheses one through three because regression analyses are useful when predicting the probability of a future event using several variables in the model (Field, 2013). Since each dolphin had an equal chance of being the rubber or rubbee initiator in a given pectoral fin contact exchange, the percentage of time spent in the rubber role was used as the outcome variable to ensure the variable was continuous and therefore appropriate for regression analyses.

Loglinear analyses were utilized to test hypothesis four, whether proportions of touch to specific sections of the body were moderated by role and Agreeableness, as well as role and Neuroticism. This kind of analysis requires only categorical predictors, so continuous Agreeableness and Neuroticism scores were median split. This yielded resulting models with body section, role, and personality factor (low and high).

Subsequent χ^2 tests were run for significant interactions containing two variables. All analyses were conducted using IBM SPSS 20.0 for Windows.

CHAPTER III - RESULTS

Before analyses were conducted, personality factors were mean centered, and sex and age were dummy coded so that the group with the highest frequency was embedded in the constant. For sex, female was coded as 0 and male was coded as 1, and for age, older dolphins were coded as 0, and younger dolphins were coded as 1.

Correlations were calculated between the outcome variable (percentage of events initiated as a rubber) and predictor variables (sex, age, and all personality factors; Table 2). Results showed that several factors were significantly correlated with one another, which is a common occurrence in research utilizing the Five-Factor Model (e.g., Musek, 2007).

Table 2

Correlations Between Variables

	% Rubber	**Sex**	**Age**	**E**	**A**	**O**	**C**	**N**
% Rubber	1	0.14	0.24	-0.02	0.24	0.02	0.27	0.08
Sex		1	-0.06	0.32	0.32	0.06	-0.24	0.31
Age			1	0.41†	-0.16	0.41†	-0.10	0.10
E				1	0.39†	0.87***	0.15	-0.23
A					1	0.31	0.48*	-0.54*
O						1	0.29	-0.23
C							1	-0.52*
N								1
M	76.04	0.48	0.43	5.50	4.61	5.40	5.32	3.52

Table 2 (continued).

SD	15.37	0.51	0.51	1.05	0.55	0.87	0.61	1.05

Note. † $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Hypothesis 1

Multiple regression analyses were conducted to test whether personality factors would predict whether dolphins initiating pectoral fin contact would assume one role more than the other by using percentage of events spent in the rubber role. In essence, a higher score (e.g., 70) would indicate a dolphin initiated pectoral fin contact exchanges more often as a rubber (70% initiated as rubber, 30% as rubbee). In the first regression model, sex and age were entered as simultaneous predictors to determine whether general demographics could predict the outcome variable. Results indicated the model was not significant (R^2=0.08, F(2,18)=0.77, p=0.476), nor were the variables within the model. In a second regression model, the five personality factors were added with sex and age as simultaneous predictors. Results indicated this model was not significant (R^2=0.38, F(7,13)=1.12, p=0.410; Table 3). Within the model, a marginal effect of age occurred, which suggested that younger dolphins were 15.10% more likely to initiate pectoral fin contact as a rubber (vs. rubbee) compared to older dolphins. This marginal effect should be interpreted tentatively as the model did not reach significance.

Table 3

Linear Model of Predictors of Percentage of Time Spent in Rubber Role

Model 1: Demographics	***b* (SE)**	**β**	***t***	***p***
Constant	70.71 (5.63)	-	12.56	0.00
Sex	4.45 (6.80)	0.15	0.66	0.52
Age	7.50 (6.87)	0.25	1.09	0.29

Table 3 (continued).

Model 2: Demographics plus Factors				
Constant	66.92 (7.52)	-	8.89	0.00
Sex	5.57 (10.83)	0.19	0.52	0.62
Age	15.10 (8.10)	0.50	1.86	0.09
Extraversion	-7.23 (8.58)	-0.50	-0.84	0.42
Agreeableness	11.40 (10.16)	0.41	1.12	0.28
Openness	1.28 (9.29)	0.07	0.14	0.89
Conscientiousness	9.26 (7.45)	0.37	1.24	0.24
Neuroticism	4.20 (5.11)	0.29	0.82	0.43

Note. R^2 = .08 (p = .48) for Model 1; R^2 = .38 (p = 0.41) for Model 2

Hypothesis 2

To test whether sex moderated the relationship between personality and the percentage of events initiated in the rubber role, the next analysis employed hierarchical regression. Model 2 above was treated as the first block. Interaction variables were created by multiplying sex by each factor and were added in block 2. Results for block 2 indicated the model was not significant (R^2=0.76, F(12,8)=2.12, p=0.147), nor did it improve upon Model 2 (ΔF(5,8)=2.575, p=0.113; Table 4). Within the model, a Sex × Conscientiousness interaction significantly predicted the outcome variable, which suggested females who were more conscientious were likely to initiate 19.42% *more* pectoral fin contact exchanges as rubbers. This pattern was reversed for males, with greater conscientiousness predicting a 24.17% *lower* percentage of pectoral fin contact exchanges as rubbers. This effect should be interpreted cautiously, as the model did not reach significance.

Table 4

*Linear Model of Predictors of Percentage of Time Spent in Rubber Role Using Hierarchical Sex*Factor Interactions*

Step 2	***b* (SE)**	**β**	***t***	***p***
Constant	66.12 (8.44)	-	7.83	0.00
Sex	16.08 (12.13)	0.54	1.33	0.22
Age	18.05 (7.21)	0.60	2.51	0.04
Extraversion	-4.71 (11.64)	-0.32	-0.41	0.70
Agreeableness	12.25 (24.53)	0.44	0.50	0.63
Openness	-2.90 (13.62)	-0.17	-0.21	0.84
Conscientiousness	19.42 (7.95)	0.77	2.44	0.04
Neuroticism	8.17 (10.41)	0.56	0.79	0.46
Sex*E	-31.50 (17.85)	-1.16	-1.77	0.12
Sex*A	2.38 (28.70)	0.06	0.08	0.94
Sex*O	14.58 (16.78)	0.45	0.87	0.41
Sex*C	-43.59 (15.07)	-0.94	-2.89	0.02
Sex*N	-25.39 (15.02)	-0.97	-1.69	0.13

Note. R^2 = .38 for Step 1; ΔR^2 = .39 for Step 2 (p = 0.15).

Hypothesis 3

A similar procedure was used to test whether age moderated the relationship between personality and percentage of time spent in the rubber role. As with sex, the main effect only model (Model 2) was treated as a first block and interactions were added in a second block. Results for block 2 indicated the model was not significant (R^2=0.68, F(12,8)=1.39, p=0.328, ΔF(5,8)=1.481, p=0.296; Table 5).

Table 5

*Linear Model of Predictors of Percentage of Time Spent in Rubber Role Using Hierarchical Age*Factor Interactions*

Step 2	***b* (SE)**	**β**	***t***	***p***
Constant	61.14 (7.79)	-	7.85	0.00
Sex	13.00 (11.78)	0.43	1.10	0.30
Age	16.47 (9.00)	0.54	1.83	0.11
Extraversion	-4.23 (8.87)	-0.29	-0.48	0.65
Agreeableness	9.19 (10.65)	0.33	0.86	0.41
Openness	-7.11 (10.73)	-0.40	-0.66	0.53
Conscientiousness	27.01 (10.12)	1.07	2.67	0.03
Neuroticism	4.87 (5.44)	0.33	0.89	0.40
Age*E	-12.16 (17.39)	-0.36	-0.70	0.50
Age *A	20.56 (22.58)	-0.28	-0.91	0.39
Age *O	17.80 (16.91)	0.49	1.05	0.32
Age *C	-29.06 (15.39)	-0.76	-1.89	0.10
Age *N	-10.85 (13.03)	-0.27	-0.83	0.43

Note. R^2 = .38 for Step 1; ΔR^2 = .30 for Step 2 (p = 0.33).

Hypothesis 4

To determine whether Agreeableness influenced the body section that was contacted on a rubbee, a loglinear analysis was run using the variables of initiator role (rubber and rubbee), body section, (face, mid-body, posterior-body), and Agreeableness (low and high). The three-way loglinear analysis produced a final model that retained the three-way interaction (Table 6).

Table 6

Loglinear Partial Associations

Effect	df	Partial Chi-Square	*p*
Role*Body Section	2	36.58	0.00
Role*Agreeableness	1	0.003	0.95
Body Section*Agreeableness	2	5.30	0.07

Table 6 (continued).

Role	1	316.20	0.00
Body Section	2	300.10	0.00
Agreeableness	1	29.61	0.00

Note. Likelihood ratio of this model was $\chi^2(0) = 0$, $p = 1$.

This indicated that the highest-order interaction (Agreeableness × role × body section) was significant, $\chi^2(2) = 13.08$, $p = 0.001$. To break down this effect, separate chi-square tests on Agreeableness and body section variables were performed separately for rubbers and rubbees. There was no association between Agreeableness and body section contacted for rubbers $\chi^2(2) = 1.54$, $p = 0.464$; however, for rubbees there was a significant association between Agreeableness and the body section contacted $\chi^2(2) = 12.53$, $p = 0.002$ (Table 7). Rubbees high in Agreeableness preferred face over posterior-body contact, and mid-body over posterior-body, but there was only a slight preference for face over mid-body contact. Most notably, there was zero out of 54 contacts made to the posterior-body when highly Agreeable rubbees initiated a pectoral fin contact exchange. Rubbees low in Agreeableness preferred mid-body over face contact (38:25), and an over 2:1 preference for face over posterior-body contact. Between dolphins of low and high Agreeableness, highly agreeable dolphins had more contact to the face, while dolphins lower in agreeableness had more contacts to their mid-body and posterior-body.

Table 7

Crosstabulation of Rubbee Agreeableness and Body Section Contacted

	Body Section			
	Face	Mid-body	Posterior-body	Total

Table 7 (continued).

Agreeableness	Low	Count	25	38	12	75
		Expected Count	32.0	36.0	7.0	75.0
	High	Count	30	24	0	54
		Expected Count	23.0	26.0	5.0	54.0
Total		Count	55	62	12	129
		Expected Count	55.0	62.0	12.0	129.0

To also see whether Neuroticism influenced the body section that was contacted on a rubbee, a similar loglinear analysis was run using the variables of initiator role (rubber and rubbee), body section, (face, mid-body, posterior-body), and Neuroticism (low and high). The contingency table confirmed that no expected counts were less than one, nor were there any counts less than five. The three-way loglinear analysis produced a final model that was not significant (p=0.18) but retained the initiator role × body section and Neuroticism × body section interactions (Table 8).

Table 8

Loglinear Partial Associations

Effect	df	Partial Chi-Square	*p*
Role*Body Section	2	37.24	0.00
Role*Neuroticism	1	0.40	0.53
Body Section*Neuroticism	2	7.61	0.02
Role	1	316.20	0.00

Table 8 (continued).

Body Section	2	300.10	0.00
Neuroticism	1	3.64	0.06

Note. Likelihood ratio of this model was $\chi^2(3) = 3.79$, $p = 0.29$.

The initiator role × body section interaction was significant, $\chi^2(2) = 36.84$, $p < 0.001$. This interaction indicated that the ratio of contact to the face, mid-body, and posterior-body was different between rubber contact initiation and rubbee contact initiation. In particular, rubbers compared to rubbees had an over 6:1 preference for mid-body contact and an almost 7:1 preference against posterior contact (12:88), but a less than 2:1 preference for contacts to the face (Table 9). Specifically, for rubbees, mid-body contact was preferred slightly more over face contact, and an over 4:1 preference for face contact to posterior-body contact and an over 5:1 preference for mid-body to posterior body contact occurred. In contrast, rubber initiators had a market preference for mid-body contact over both face and posterior-body contact, and a small preference for face contact over posterior-body contact.

Table 9

Crosstabulation of Initiator Role and Body Section Contacted

			Body Section			
			Face	Mid-body	Posterior-body	Total
Role	Rubbee	Count	55	62	12	129
		Expected Count	27.8	83.2	18.0	129.0
	Rubber	Count	99	399	88	586
		Expected Count	126.2	377.8	82.0	586.0
Total		Count	154	461	100	715

Table 9 (continued)

	Expected Count	154.0	461.0	100.0	715.0

The Neuroticism × body section interaction was also significant, $\chi^2(2) = 7.20$, $p < 0.05$ (Table 10). This interaction indicates that the ratio of contact to the face, mid-body, and posterior-body was different for dolphins with low Neuroticism compared to dolphins with high Neuroticism. Dolphins who were low in Neuroticism initiated more contact to the face compared to dolphins high in Neuroticism. Dolphins high in Neuroticism initiated more contact to the mid-body and posterior-body, with the mid-body having the greatest difference between low and high Neuroticism for the three body parts. In general, mid-body contacts was initiated the most, followed by face, then posterior-body.

Table 10

Crosstabulation of Neuroticism and Body Section Contacted

			Body Section			
			Face	Mid-body	Posterior-body	Total
Neuroticism	Low	Count	86	200	46	332
		Expected Count	71.5	214.1	46.4	332.0
	High	Count	68	261	56	383
		Expected Count	82.5	246.9	53.6	383.0
Total		Count	154	461	100	715
		Expected Count	154.0	461.0	100.0	715.0

CHAPTER IV – DISCUSSION

The goals of the current study were to (1) determine if bottlenose dolphin personality predicts whether dolphins initiating pectoral fin contact assume one role (i.e., rubber) more than the other (i.e., rubbee), (2) identify whether personality traits predicting initiator role vary across sex and age groups, and (3) determine if personality factors, particularly Agreeableness and Neuroticism, influence which area of the body is contacted when initiators assume the rubbee versus rubber role. The hypotheses were partially supported by results of the current study.

Hypothesis 1

It was hypothesized that personality traits would have an effect on the role of an initiating dolphin, but this hypothesis was not supported. General personality traits did not predict whether an initiating dolphin assumed the role of rubber or rubbee more when exchanging pectoral fin contact with a conspecific. This result was surprising given that personality often shapes behavioral tendencies in both humans and non-human animals. Still, it is possible that the regression model utilized in analyses did not reach significance due to the large number of predictor variables that were included (e.g., sex, age, Extraversion, Agreeableness, Openness, Conscientiousness, Neuroticism), in addition to a low sample size.

Although it should be interpreted cautiously, a marginally significant effect of age was observed. Specifically, younger dolphins were more likely to initiate more pectoral fin contact exchanges as a rubber compared to older dolphins. Pectoral fin contact exchanges are important for young dolphins as they need to learn and develop the skills

to appropriately interact with others in their social group (Kuczaj & Winship, 2015). Within the first year or so of life, calves maintain close proximity to their mother to receive locomotor support, obtain nutrients from their mother's milk, and receive protection from predators and aggressive conspecifics (Gubbins, McCowan, Lynn, Hooper, & Reiss, 1999). During this time, mothers and their calves frequently exchange pectoral fin contact to form and maintain a strong bong (Dudzinski, et al., 2013). As calves physically develop and acquire behavioral skills, they become increasingly less dependent on their mother (Gubbins, et al., 1999). Because social interactions with conspecifics are necessary for survival and reproduction, young dolphins often practice pectoral fin contact as a social tool and use it to begin building relationships with other individuals (Dudzinski & Ribic, 2017). One possible explanation for why young dolphins initiate pectoral fin contact more as a rubber could be attributed to their exploration of potential social bond partners. Initiating rubbees often solicit contact to the face and rostrum (Dudzinski, et al., 2013) which are considered sensitive parts of the dolphin body (Ridgeway & Carder, 1990). Dolphins may solicit contact to these body parts from individuals with whom they have an established relationship. Older dolphins have more established relationships and may already have an idea of who they could approach as an initiating rubbee for a successful exchange of pectoral fin contact.

Hypothesis 2

The second hypothesis that differences between the sexes would be present for personality factors predicting the initiator role was not fully supported. Extraversion did not predict initiation role more strongly for females compared to males. The full model was not conventionally significant, but there was still a significant effect that can

(cautiously) be interpreted. Though it was not anticipated, female dolphins who were higher in Conscientiousness were more likely to be rubbers, but males with high Conscientiousness, were less likely to be rubbers. In humans, high Conscientiousness can be considered a positive personality trait for maternal parenting (Bornstein, Hahn, & Hayes, 2011). For dolphins, females are the primary caregivers of their offspring, and high Conscientiousness may positively influence females' maternal style and the subsequent success of calf-rearing. Aspects of high Conscientiousness, such as being alert and careful, may be positive traits for dolphin mothers because being highly aware of environmental surroundings would help protect both the mom and the calf form potential predators. Also, a mother who knows where her calf is located would be able to act quickly if the calf required care or attention. Being dependable is another helpful trait for calf-rearing because mothers need to provide many necessary resources for their calf's survival (Kuczaj & Winship, 2015). Mothers engage in a lot of pectoral fin contact with their calves (Dudzinski et al., 2013), which helps build and maintain their relationship, and through social learning, calves learn how to use this behavior as a social tool (Kuczaj & Winship, 2015). It could be that females high in conscientiousness are more biologically biased toward assuming the initiating rubber role more often to build relationships with calves and with other individuals who could potentially help their future calves through alloparental care.

For males, it is possible that they are likely to initiate more pectoral fin contacts as rubbees as a tactic to reduce tension when interactions have the potential to become aggressive. Dudzinski and Ribic (2017) briefly discussed the possibility that a dolphin presenting a more sensitive/vulnerable part of the body as a rubbee could reduce tension

as a submissive signal, but this notion would need be explored further in future research. Tamaki, et al. (2006) investigated tension reduction through pectoral fin rubbing between three bottlenose dolphins residing in managed care and found that this type of contact increased the latency between episodes of conflict observed for the focal dyad. Because two of the three dolphins in the study were females, more research on conflict and reconciliation is necessary to determine if soliciting pectoral fin contact as a rubbee influences tension reduction between male dolphins.

Hypothesis 3

The results show that in general, personality traits are not more predictive of initiator role for older dolphins compared to younger dolphins; hypothesis 3 was not supported. Though the model was not significant, it is worth noting that, Conscientiousness predicted higher percentage of initiations in the rubber role, and it was the most influential variable in the model. Although not significant, this pattern suggests that Conscientiousness predicted higher percentage of events as a rubber for younger dolphins but a lower percentage of events as a rubber for older dolphins. Investigating personality and friendships in human adolescents, Jensen-Campbell & Malcolm, (2016) found that students with high Conscientiousness had greater quality peer friendships. The authors also noted that the self-control aspect of Conscientiousness is essential for building and maintaining successful relationships. A similar reason could provide an explanation for why high Conscientiousness predicted more pectoral fin contact initiations in the rubber role for dolphins in the current study. It's possible that the initiating rubber had more control over the contact exchange. Therefore, dolphins who are high in Conscientiousness may assume the rubber role more often because they are

better able to regulate their contact using their pectoral fin to touch another conspecific's body part.

Hypothesis 4

Hypothesis 4 was partially supported. Initiating rubbees that were high in Agreeableness were more likely to be contacted on the face as well as their mid-body rather than their posterior-end. This supports the idea that friendly and affiliative dolphins will more often solicit contact to sensitive parts of the body, such as the face. These effects are similar to those found in humans, for whom agreeableness predicts positive perceptions of contact from other people to body areas characterized as initiate and nonintimate (Dorros, et al., 2008), as well as increased prosocial behaviors (Jensen-Campbell, Gleason, Adams, & Malcolm, 2003).

There was no relationship between Neuroticism and initiator role; however, overall it was observed that dolphins low in Neuroticism initiated contact to the face about 1.25 times more frequently than dolphins rated high in Neuroticism. Because there was no relationship between Neuroticism and initiator role, it is therefore possible that dolphins who are highly neurotic are less likely to initiate pectoral fin contact because they may be more fearful or anxious about initiating contact. This would make them less willing to expose sensitive areas to other conspecifics. Neuroticism is negatively associated with positive perceptions of contact to intimate body areas in humans (Dorros, et al., 2008). It is likely that this is also the case in non-human animal species, such as bottlenose dolphins.

Limitations

There were several limitations to the current study, most notable was the number of dolphins. Oftentimes research involving animals is limited in the number of individuals easily accessible to the researchers, particularly when using animals residing in managed care. While research on captive delphinids typically has a sample size of one to four individuals, this population offered more than 20 dolphins in a dynamic social setting akin to that of several groups of wild dolphins (Conner, et al., 2006). While the population size is larger than normally represented in the literature, it was limited with respect to applying regression analyses with numerous predictor variables. Typically, when using regression analyses, at least 10 participants per predictor variable is ideal (Wilson, Voorhis, & Morgan, 2007). After the first regression model assessing sex and age, remaining models were analyzed with more than two predictor variables, while having only 21 dolphin subjects. Still, regression analyses were chosen for analysis in the current study because regression is a common statistical method utilized in personality trait research. A strength of using this type of analysis is that it controls for multiple variables all in one model. In the current study, regression models with trending patterns may have reached significance if a larger sample size was available. Although, given lower power, it is also possible that observed effects may be Type 1 error due to sampling variability. Future research would be required to determine whether these effects observed in this study are in fact robust.

Another limitation to this study was low interrater reliability for some dolphins. For the type of ICC model that was used to assess interrater reliability in this study (ICC(1, k)), error between ratings can occur through rater error, the interaction between

rater and subject, and random error (Strout & Fleiss, 1979). Thus, there are several potential reasons why several dolphins' ratings resulted in lower reliability, and one dolphin's ratings were deemed unreliable (i.e., Stan). It is most likely that error accumulated from the interaction between rater and dolphin. Animal personality trait ratings are dependent on the rater's personal experiences and observations of behavior in the focal animal. Stan was one of the five dolphins who was rated by only two trainers, one being the director of training at RIMS. These two raters could have observed different behaviors during their past interactions with Stan that resulted in characterizing his personality differently. Some trainers worked during more sessions or for a longer period of time with the focal dolphin they rated. Still, an understanding of whether level of acquaintance improves reliability of trait ratings has not been conclusively determined (Gosling, 2001; Martau, et al., 1985). Additionally, some dolphins may exhibit more varied behavior leading to another possible explanation for why some dolphins were less reliably rated between trainers. Overall reliability between personality rating scores would likely improve with an increased number of raters per animal, as well as having an equal number of raters for all dolphins.

Out of all five personality factors, Agreeableness and Conscientiousness presented relatively low reliability overall. It is possible that reliability for these two factors could improve with a greater number of trait ratings per factor, but Agreeableness and Conscientiousness could potentially be traits that are more inconsistent in their expression due to external factors (e.g., affiliative behaviors may vary widely because of context, previous interactions between individuals, etc.) Nonetheless, the results in the current study are consistent with previous literature, as Agreeableness often has a lower

interrater reliability for both humans and animals (Gosling, 2001). Because Conscientiousness is often theorized as including aspects of higher cognition (e.g., planning, self-regulation), it is considered a more difficult factor to rate in non-human animals and thus receives lower reliability between raters (Gosling & John, 1999). In contrast, Extraversion has the highest reliability of all five traits because of the many directly observable (e.g., assertive, social, active) behaviors associated with this trait (Gosling & John, 1999).

Future Research

Research on dolphin pectoral fin contact exchange has spanned almost 20 years, adding important information to our current knowledge on dolphin communication signals and social bonds. Still, there is much to learn about the intricacies of this type of communicative contact. Because the present study focused on sex, age, and personality traits from the Five-Factor Model of initiator dolphins, a natural extension of this research would be to examine these same components in receivers, as the dynamics between initiators and receivers may ultimately determine the success of a pectoral fin contact exchange.

Looking closer at the personality traits of pairs of dolphins that are known to have a strong social bond would give us more detail on the dynamics of pairs of dolphins that maintain bonds through pectoral fin contact exchanges. In some communities, male bottlenose dolphin pairs form strong alliances that are characterized by frequent contact, synchrony, and close proximity (Conner, 2007). A good first step in assessing strongly bonded males would be to identify if they share similar scores of personality traits, or if their trait scores complement each other. Comparisons could then be made across

different allied pairs to identify whether more contacts are observed in bonded pairs who share similar levels of personality traits or bonded pairs who have differing levels of traits.

It would also be informative to assess individual differences between strongly associated pairs in the stability of their pectoral fin contacts and the roles that they assume (i.e., initiator-rubber, initiator-rubbee, receiver-rubber, receiver-rubbee) over time. It is currently unknown whether the number of pectoral fin contacts between two individuals is consistent over time. It is possible that they are; however, if the nature of relationships changes between a pair of dolphins then tactile communication may change as well. Additionally, it would be interesting to know if the roles dolphins assume during contact exchanges vary over time or if one individual initiates more frequently than the other, and if they initiate as a rubber or rubbee more often than the other. This information would provide further details on the maintenance of social bonds through pectoral fin contact exchanges.

It is possible that use of trait rating Five-Factor Model to assess personality may not capture all of dolphin personality, and this could be a reason for the null results found in the current study. Future research could use behavioral coding to supplement dolphin personality data. A behavioral coding method to assess the five factors of personality traits has not been applied to cetacean species; however, a previous assessment of personality through bottom-up behavioral coding was successfully conducted on the dolphins residing at RIMS (Frick, 2016). The benefit of using behavioral coding is that traits manifesting from clustered behaviors would directly reflect the personality of the

species, rather than trying to map dolphin personality onto a common set of traits like those in the Five-Factor Model.

Conclusion

The current study presented an initial look at the potential effect of personality on a specific communicative behavior, pectoral fin contact exchange, which is shared often between individuals in several dolphin species. Pectoral fin contact behavior is salient for the development and preservation of social relationships in dolphins. Past research demonstrated that personality can influence behavior and, given the nature of the traits making up the Five Factor Model and the roles dolphins assume when initiating pectoral fin contact exchange, we expected that personality traits would influence these roles and also interact with sex and age. Results showed little support that personality predicts the role (rubber or rubbee) assumed by dolphins when initiating pectoral fin contact exchanges, although the trait of Agreeableness seemed moderately related to the area of the body contacted on a rubbee. Though trait ratings of the five factors were not a conclusive predictor of the initiator role assumed by dolphins in this social group, more research on this topic may elucidate details with respect to how dolphin personality may influence social contact behavior and ultimately the formations of social bonds in bottlenose dolphins.

APPENDIX A – Dolphin ICC Estimates

Table A1.

Intra-class Correlation Coefficient Estimates by Subject

Dolphin ID	**ICC (1, 3)**	**Level**
Alita	0.680	Good
Bailey	0.408	Fair
Mrs. Beasley	0.632	Good
Calli	0.606	Good
Carmella Cedena		
Elli	0.694	Good
Maury	0.936	Excellent
Mika	0.906	Excellent
Poli	0.869	Excellent
Tilly	0.686	Good
Bill	0.532	Fair
Champ	0.813	Excellent
Han	0.773	Excellent
Hector	0.869	Excellent
Lenca	0.766	Excellent
Mac	0.816	Excellent
Paya		
Ritchie	0.766	Excellent
Ronnie	0.816	Excellent
Tank		
	ICC (1, 2)	
Dory	0.586	Fair
Gracie	0.921	Excellent

Table A1 (continued).

French	0.630	Good
Shawn	0.916	Excellent
Stan	-0.429	Very Poor

APPENDIX B – Personality Questionnaire

Dolphin Name: _____ Date: _____

Rater's Name: _____ Years with Animal: _____

How confident are you in rating this animal?

Very Confident	Somewhat Confident	Slightly Confident	Neutral	Slightly Unsure	Somewhat Unsure	Very Unsure

Please circle the dimension which best describes the target animal.

1. Curious: Appears to be interested in new situations or objects.

Very Curious	Somewhat Curious	Slightly Curious	Neutral	Slightly Uninterested	Somewhat Uninterested	Very Uninterested

2. Demanding: Requires much effort or attention from other dolphins and/or humans.

Very Demanding	Somewhat Demanding	Slightly Demanding	Neutral	Slightly Undemanding	Somewhat Undemanding	Very Undemanding

3. Alert, Vigilant: Ready, attentive, watchful, appears to pay attention to surroundings.

Very Alert	Somewhat Alert	Slightly Alert	Neutral	Slightly Oblivious	Somewhat Oblivious	Very Oblivious

4. Aggressive: Threatens or causes harm, high frequency of raking, biting or hitting other animals and/or humans.

Very Aggressive	Somewhat Aggressive	Slightly Aggressive	Neutral	Slightly Unaggressive	Somewhat Unaggressive	Very Unaggressive

5. Affiliative, companionable: Agreeable and sociable. Appears to like the company of others. Seeks out social contact with another animal or person.

Very Affiliative	Somewhat Affiliative	Slightly Affiliative	Neutral	Slightly Solitary	Somewhat Solitary	Very Solitary

6. Creative, imaginative: Approaches situations and addresses problems in novel, creative ways. (E.g. finds various ways to play with a toy)

Very Creative	Somewhat Creative	Slightly Creative	Neutral	Slightly Uncreative	Somewhat Uncreative	Very Uncreative

7. Friendly, gentle: Friendly, amicable, and congenial toward other animals and humans. Responds to others in an easy, kind, manner.

Very Friendly	Somewhat Friendly	Slightly Friendly	Neutral	Slightly Unfriendly	Somewhat Unfriendly	Very Unfriendly

8. Undependable, unreliable: Not easily relied or depended on. Not a "go-to" animal.

Very Undependable	Somewhat Undependable	Slightly Undependable	Neutral	Slightly Dependable	Somewhat Dependable	Very Dependable

9. Relaxed, calm: Assured or at ease. Not tense or highly sensitive.

Very Relaxed	Somewhat Relaxed	Slightly Relaxed	Neutral	Slightly Tense	Somewhat Tense	Very Tense

10. Careful, cautious: Animal exhibits caution in its actions.

Very Careful	Somewhat Careful	Slightly Careful	Neutral	Slightly Careless	Somewhat Careless	Very Careless

11. Active, Energetic: Moves around a lot. Locomotion can include swimming normally, swimming quickly, surface behavior, diving, playing, active exploration, etc.

Very Active	Somewhat Active	Slightly Active	Neutral	Slightly Inactive	Somewhat Inactive	Very Inactive

12. Timid: Hesitant, apprehensive, and tentative.

Very Timid	Somewhat Timid	Slightly Timid	Neutral	Slightly Bold	Somewhat Bold	Very Bold

13. Tolerant and easy-going: Inclined to be relaxed and tolerant.

Very Tolerant	Somewhat Tolerant	Slightly Tolerant	Neutral	Slightly Irritable	Somewhat Irritable	Very Irritable

14. Playful: Engages in play behavior.

Very Playful	Somewhat Playful	Slightly Playful	Neutral	Slightly Unplayful	Somewhat Unplayful	Very Unplayful

15. Not exploratory or inquisitive: Does not seek out nor investigate novel situations or objects.

Very Unexploratory	Somewhat Unexploratory	Slightly Unexploratory	Nutral	Slightly Exploratory	Somewhat Exploratory	Very Exploratory

APPENDIX C – IRB Approval Letter

THE UNIVERSITY OF
SOUTHERN MISSISSIPPI

INSTITUTIONAL REVIEW BOARD
118 College Drive #5147 | Hattiesburg, MS 39406-0001
Phone: 601.266.5997 | Fax: 601.266.4377 | www.usm.edu/research/institutional.review.board

NOTICE OF COMMITTEE ACTION

The project has been reviewed by The University of Southern Mississippi Institutional Review Board in accordance with Federal Drug Administration regulations (21 CFR 26, 111), Department of Health and Human Services (45 CFR Part 46), and university guidelines to ensure adherence to the following criteria:

- The risks to subjects are minimized.
- The risks to subjects are reasonable in relation to the anticipated benefits.
- The selection of subjects is equitable.
- Informed consent is adequate and appropriately documented.
- Where appropriate, the research plan makes adequate provisions for monitoring the data collected to ensure the safety of the subjects.
- Where appropriate, there are adequate provisions to protect the privacy of subjects and to maintain the confidentiality of all data.
- Appropriate additional safeguards have been included to protect vulnerable subjects.
- Any unanticipated, serious, or continuing problems encountered regarding risks to subjects must be reported immediately, but not later than 10 days following the event. This should be reported to the IRB Office via the "Adverse Effect Report Form".
- If approved, the maximum period of approval is limited to twelve months.
  Projects that exceed this period must submit an application for renewal or continuation.

PROTOCOL NUMBER: 18061301
PROJECT TITLE: Is Personality a Factor when a Dolphin Initiates Pectoral Fin Contact as a Rubber or Rubbee?
PROJECT TYPE: Master's Thesis
RESEARCHER(S): Riley Macgregor
COLLEGE/DIVISION: College of Education and Psychology
DEPARTMENT: Psychology
FUNDING AGENCY/SPONSOR: N/A
IRB COMMITTEE ACTION: Exempt Review Approval
PERIOD OF APPROVAL: 06/22/2018 to 06/21/2019
Edward L. Goshorn, Ph.D.
Institutional Review Board

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