STATUS RELEVANT SOCIAL CONTEXT, GROUP MEMBERSHIP, AND FINGER LENGTH RATIO (2D:4D) AS PREDICTORS OF ONLINE SOCIOECONOMIC BEHAVIOR

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DISSERTATION ABSTRACT

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Title: Status Relevant Social Context, Group Membership, and Finger Length Ratio (2D:4D) as Predictors of Online Socioeconomic Behavior

It is often argued that increased prenatal androgen exposure (as measured by the second-to-fourth-digit ratio, or 2D:4D) predicts increased aggression. Such simplified models may obscure subtler processes, however. Investigating moderating variables could elucidate more consistent results between these variables. Two moderators investigated here were status-relevant social norms and group membership. Aggression, as measured by the decision to reject an unfair offer in the ultimatum game (UG), was viewed as a context-dependent strategy of status acquisition dictated by social norms and driven by group membership.

Recent research suggests 2D:4D may be more associated with status acquisition motives than with aggression *per se*. It was hypothesized that lower 2D:4D would predict increased aggression when aggressive behavior was endorsed by group members for gaining/maintaining status. Conversely, lower 2D:4D would predict decreased aggression when aggressive behavior was proscribed by group members for gaining/maintaining status. Based on the Male Warrior Hypothesis, although it was hypothesized that out-group membership would predict aggressive behavior, it was also hypothesized that this

effect would be maximal among those with lower 2D:4D, particularly when an aggression-for-status norm was endorsed.

The data did not support the primary hypotheses. The digit ratio did not predict any DV. The norm manipulation did not affect UG decisions and there was a methodological issue with the group manipulation. The norm manipulation did affect secondary DVs, however. There were significant differences between the pro-, neutral, and anti-aggression groups regarding participants' endorsement of a fictional character's aggressive behavior to gain status. Those in the pro-aggression group endorsed it the most and those in the anti-aggression group endorsed it the least. Despite no effect of the norm manipulation on the decision in the UG, there was an effect of the manipulation on participants' confessed intent, with those in the pro-aggression condition rating their decision to reject as "aggressive" more so than those in the anti-aggression condition. The norm manipulation also influenced meta-perceptions of how participants thought their teammates viewed them based on their decision in the UG. Exploratory analyses modeled these effects. Reasons for the manipulations failing to produce an effect on the primary DV are discussed.

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CHAPTER I

INTRODUCTION

STATUS AND BEHAVIOR

Social hierarchy, defined as "an implicit or explicit rank order of individuals or groups with respect to a valued social dimension," is a persistent and salient feature of most human and nonhuman primate societies (Magee & Galinsky, 2008). One's position in that hierarchy (or one's status) is associated with the respect one receives and, to the extent that status is related to power, the control over resources one may have. Because of the potential reproductive benefits conferred by higher status, it is hypothesized that humans have evolved specific psychological mechanisms for signaling and competing for status (Cheng, Tracy, & Henrich, 2010). Indeed, people show preference and improved processing for socially hierarchical information (Zitek & Tiedens, 2012). They are also adept at perceiving their own status accurately, and are quick to locate and punish individuals who overestimate their respective status (Anderson, Ames, & Gosling, 2008). Individuals will put forth effort to gain status and even more effort to keep from losing it (Pettit, Yong, & Spataro, 2010). In short, processing, signaling, and maintaining status, and in some cases seeking to acquire it, are intrinsic components of the human experience (Anderson, Hildreth, & Howland, 2015).

Another important feature of status is its dynamic unfolding. Stratification to some degree is a constant across human organizations, and a given hierarchy may remain stable in its defined roles over a long period of time. However, which individual is assigned to a particular role at any given time can be a highly fluid process. One's status is often allocated based on their perceived suitability for, and performance in, reaching

the group's overall goals; therefore, if perceptions of one's competence changes, *or* the goals of the group change, then often so does one's status (Magee & Galinsky, 2008). It is at the cross roads of where these varied status-related psychological mechanisms collide with dynamic group norms that the utility of aggression can enter the discussion. Aggression is often defined as overt behavior that has the intention of inflicting harm on another individual who wishes to avoid that harm (Baron & Richardson, 1994). This definition is deceptively simple, as aggression may vary as a function of context and delivery. Contextually, *proactive* aggression is aggression used with little or no direct provocation, with minimal physiological arousal, and is often calculated with specific goals in mind (e.g., bullying to gain status, or a preemptive military strike), whereas *reactive* aggression is usually initiated in response to a direct threat or insult, is characterized by high physiological arousal, and is impulsive (Bobadilla, Wampler, & Taylor, 2012). With respect to delivery, *direct* aggression is most often characterized by intimidation, threat, and physical violence, whereas *indirect* aggression is characterized by behaviors such as spreading rumors, gossiping, and social exclusion (Archer & Coyne, 2005).

On the status-acquisition-strategy continuum, the aggression we may think of stereotypically—physical violence—is admittedly at an extreme end. Within the toolbox of dominance-based status-seeking behavior there are slightly subtler options in the form of confrontation, threats, and coercion. But individuals may also instead choose to pursue status through the acquisition, demonstration, and sharing of skills or expertise. This variety of status acquisition strategies has fueled debate about how social rank, or status, is generally attained among people—through threats and violent physical contests, or

though generosity and commitment to the group (Anderson et al., 2006). Henrich & Gil-White (2001) addressed this debate by answering: Both. Dominance is achieving status through force or threat of force, which is an ancient evolutionary inheritance observed in most nonhuman animals as well. Prestige is achieving status through the demonstration of knowledge or skill, which is thought to be a newer evolutionary adaptation specific to humans, and arose from the use of language and the cultural transmission of knowledge. Using dominance, status is taken; using prestige, status is conferred. Cheng and colleagues (2013) demonstrated that both strategies arise spontaneously and reliably, are judged quickly and accurately, and are successful pathways to status acquisition. It is important to note that individuals can adopt both strategies. When to use which strategy is thought to be a function of individual attributes and the social context (Cheng, Tracy, & Henrich, 2010). A small, timid, and physically weak individual is not advised to navigate a dominance pathway, due to personal attributes. But neither is a large, brash, and physically strong individual recommended to do so in a prestige-based hierarchy, due to social context. For example, there is evidence that demonstrates high levels of assertiveness, often interpreted as hostility, are predictive of status loss in a prestige-based environment (Ames & Flynn, 2007). At the extreme, one might imagine the results of applying judo in a lively debate at an academic conference. If there are many paths to status acquisition, ranging from prosocial (e.g., demonstrating and sharing knowledge or skill) to antisocial (e.g., using intimidation or violence) then a question arises: When is aggression useful?

At least as early as adolescence, individuals may choose any combination of the above types of aggression as a means to gaining and maintaining status. Sijtsema and

colleagues (2009) showed that, for example, the motivations of adolescent bullies are generally status related. Not only did bullies attach importance to status related goals, but also the victims attached significantly less value to such goals. There is also evidence that an aggression-based strategy for status acquisition can be relatively successful among adolescents. For example, Vaillancourt & Hymel (2006) demonstrated that among a large sample of adolescents, perceived popularity was highly associated with perceptions of dominance and power, and that directly and indirectly aggressive individuals were viewed as both popular and powerful. It is not entirely good news for the aggressors, however. Although aggressive individuals in both of the above examples were consistently rated as high in perceived popularity and power, they were also consistently rated lower on social preference. In addition, being a bully is predictive of many negative outcomes, including convictions of violent crime in early adulthood, self-reports of increased violent behavior, low job status, substance abuse, and an "unsuccessful life" in later adulthood (Farrington & Ttofi, 2011) as well antisocial personality and depressive and anxiety disorders (Sourander et al., 2007).

Although there is evidence to suggest that younger individuals tolerate aggressive behaviors within their hierarchies more so than adults (Savin-Williams, 1980; Hawley, 2002; Cheng, Tracy, & Henrich, 2010), one only need give the news a cursory glance to see evidence of aggression among adults that often results from initially trivial disputes. In fact, the highest rates of homicide offenses are for individuals between the ages of 18 to 34, with circumstances surrounding the homicide being an "argument" for 60.7% of offenders of the same age range (U.S. Department of Justice, 2011). Given the risks of injury, ostracism, incarceration, retaliation, and other negative outcomes associated with

aggression, one may wonder why anyone would choose to employ such a strategy for status acquisition. However, consider research on "cultures of honor". These are cultures that develop when the potential for theft of valuable resources is high and governing power is minimal or non-existent, in which an individual's reputation for toughness and retributive violence is the primary deterrent of theft (Shackelford, 2005). In other words, in such cultures status is commonly acquired and maintained through intimidation and reactive, direct aggression. Yet once these high stakes conditions are addressed, such that the threat of theft is mitigated and more formal, legal recourse can be taken, the violence-endorsing norms of the culture may persist.

The southern United States is argued to be one example of a culture of honor. It is a region of consistently high levels of violent crime, even when controlling for other factors such as urbanization and socioeconomic status (Erlanger, 1976; Nisbett, 1993). Individuals from the region, particularly males, have been shown to endorse violence for self-defense and in defense of one's honor more so than northerners (Cohen & Nisbett, 1994), to demonstrate increased reactivity, aggression, and behavioral dominance in response to an insult (Cohen et al., 1996), and were more likely to perceive their peers as endorsing aggression as well as to overestimate peer aggression (Vandello, Cohen, & Ransom, 2008). Interestingly, Cohen & Nisbett (1997) showed that employers from The South were more likely to respond in an understanding way to job applicants who had allegedly killed someone in an honor related conflict, and southern newspapers were more likely to cover favorably a stabbing that resulted from a family insult. At least in part, aggression persists in these regions because individuals and institutions endorse it as a legitimate means to acquiring and maintaining status.

In short, social norms dictate the efficacy of a given strategy for status acquisition. There is evidence to suggest people are quite sensitive to hierarchy-relevant contextual cues and will often adjust their behavior accordingly. Social complexity and behavioral flexibility of this magnitude are likely unique to humans. This may explain why nonhuman animal models of status and aggression do not consistently extend to humans. If a male rat encounters a rival, he cannot choose to barter for goods or engage in heroic altruism to climb the social ladder. He can threaten, fight, or flee. Humans are not thus constrained and therefore have increased options for attaining status. They can vary their status-oriented behaviors based on social context. In high risk or competitive social contexts, for example, an individual may acquire status more readily through aggressive behaviors (Fischer & Mosquera, 2001; Waasdorp, Baker, Paskewich, & Leff, 2012). In cooperative social contexts, the same individual may acquire status by curbing his or her aggressive tendencies or even by increasing pro-social behaviors (Hardy & Van Vugt, 2006). As such, it was hypothesized that when aggression was endorsed as a norm in the acquisition of status, then individuals would generally be more likely to engage in aggressive behavior. Conversely, to the extent that aggression was proscribed as a norm or led to status loss, then individuals would be less likely to engage in aggressive behavior. The extent to which another social variable, group membership, and a biological variable, 2D:4D, play roles in this behavioral plasticity will be discussed below.

GROUPS, SEXES, AND BEHAVIOR

From the earliest stages of human embryological development, the sexes are differentiated hormonally (for a review, see Knight & Mehta, 2014). Within the first few

weeks, androgens secreted from the testes facilitate the formation of internal and external male sex organs from previously undifferentiated tissues. In the absence of androgens female sex organs develop naturally. At puberty the pulsatile release of testosterone from the hypothalamic-pituitary-gonadal axis deepens the voice and increases muscle mass in males, and facilitates the growth of pubic hair in both sexes (though in females androgens are secreted primarily by the adrenal glands and ovaries). More relevant to this discussion is that androgens play an important role in mammalian brain development (Hines, 2006) and, consequently, in social behavior (Bos, Panksepp, Bluthé, & van Honk, 2012). As will be discussed in greater detail below, in humans specifically, normal variation in exposure to prenatal androgens has been linked to various postnatal sex differences (Hines, 2006). This prenatal exposure to androgens is also a contributing factor to the 2D:4D development, and sex differences on 2D:4D are robust (see 2D:4D AND BEHAVIOR, below).

However, among humans it is not clear to what extent these biological differences between sexes are associated with sex differences in social behavior. Indeed, regarding some social psychological phenomena, the extent to which there *are* sex differences is obscure. For example, having high status pays both immediate individual and long-term evolutionary dividends to males and females alike. As might be predicted, motivation to attain status has been observed in both sexes and is argued to be a universal human focus (Anderson, Hildreth, & Howland, 2015). But to say that both sexes are motivated to seek status does not inform us as to whether they are motivated equally so, nor does it inform us as to whether they acquire it in similar ways.

It is widely acknowledged that males have increased access to social power (Carli, 1999). In a meta-analysis, Eagly and Karau (1991) showed that, generally, males emerged as leaders more often than females. Yet it would be premature to assume that since men more frequently occupy positions of high status then men must therefore desire status more. It would further be a mistake to assume that this ostensible increased desire is due to aforementioned biological differences. One empirical reason these assumptions are at best questionable is that social variables do considerable work in the allocation of status. Sex stereotypes are argued to play an ongoing role in undermining female status acquisition (Heilman, 2001). For example, Heilman and colleagues (2004) showed that, when men and women were presented for evaluation under ambiguous conditions, participants rated women as less competent and less achievement-oriented than men. These differences vanished when competence was made unambiguous; yet even when demonstrated as competent, women were far more personally derogated and less likely to be recommended for increased salary or job opportunities than men of equal competence. This effect was driven by what participants perceived to be violations of sex-stereotypic norms, suggesting that even competent females can be denied higher status due to considerations of social perception. Some implications from this example could be that women's subjective desire for status is equal to men's, but they may be less likely to express it behaviorally due to potential social costs. Further, status is often conferred by others, so even if status-motivated behavior is expressed by women, successful acquisition could be undermined by other members of the social hierarchy due to perceived violations of sex-stereotypic norms. In either case, the extent to which women acquire high status is a poor proxy of their motivation to do so.

If status acquisition measures are not particularly informative then what about measures of how status is subjectively valued? Again, we find ourselves in muddy waters. Sometimes measures suggest men value status more than women, and sometimes they do not (Huberman, Loch, & Önçüler, 2004; cf., Schultheiss & Brunstein, 2001). These discrepancies may be due to sex differences, due to measurement differences, or both. Hays (2013) highlighted the importance of conceptual, and consequently, operational distinctions in investigating sex differences in social hierarchies. Arguing for a necessary distinction between *status*, i.e., the extent to which one is respected by others, and *power*, i.e., the control one has over valued resources, the author demonstrated that women valued status more than power and men valued power more than status. Further, men valued power more than women did, and women valued status more than men did. Future research highlighting such subtleties will hopefully elucidate any consistent sex differences in status valuation.

One sex difference that appears less obfuscated is regarding group biases. Males tend to consistently show biases both to the in-group, which they tend to treat particularly benevolently under conditions of intergroup competition (Yamagishi & Mifune; 2009), and to the out-group, which they tend to treat particularly malevolently (Yuki, Yokota; 2009). To account for these data, the Male Warrior Hypothesis (MWH) posits that evolutionary selection pressures on males have resulted in this increased likelihood of parochial altruism and coalitional aggression (Van Vugt, 2009; McDonald, Navarrete, & Van Vugt, 2012). Irrespective of sex, humans have a natural proclivity to categorize objects and individuals quite reflexively upon perception (Macrae & Bodenhausen, 2000). One of the "locations" other individuals are placed when using a categorizing

heuristics is in "group membership". Given the many survival-relevant benefits of living in groups, it is no wonder that humans have evolved to be intensely social, value our in-group, and have a strong need to belong (Baumeister & Leary, 1995). Although this accounts for a tendency to value our in-group, it does not address the tendency of hostility toward the out-group, nor does it address why male coalitions are extremely overrepresented in intergroup conflict. As with all organisms, human sex differences are largely a function of evolutionary history, and thus, the differential cognitive traits and behaviors are specific to the slightly differing evolutionary trajectories of males and females. To unpack this warrants a brief aside to look at sexual selection.

Sexual selection is a specific case of natural selection. Whereas, in natural selection organisms are "competing" against the environment (e.g., Darwin's finches' beaks becoming specialized to their diet, or long necks being selected for in giraffes to reach food located higher in trees), sexual selection is when organisms compete against other members of their species for access to mates (e.g., male gorillas' larger size for competing against other males, or a peacock's tail being used in courtship displays to attract females). Sexual selection arises largely due to differential parental investment between males and females, and often plays out in the following manner: Males maximize their reproductive rate, and thus their potential reproductive success, by minimizing their investment in parental care; yet, females are necessarily more invested parentally via the biological burden of carrying the developing fetus and, in many species, via extended postnatal care (Clutton-Brock, 2007). This disparity in parental investment leads to females being particular about their mate choices, which in turn leads to increased variance in male breeding success and therefore increased competition

among males, ultimately selecting for traits that increase the likelihood of competitive success (Trivers, 1972; Kirkpatrick, 1982; Clutton-Brock, 2007). One trait germane to this discussion is a proclivity toward aggression aimed at other men, particularly if those men are from another group (i.e., not members of an individuals in-group). Such a tendency toward coalitional violence is thought to enhance male reproductive success by (potentially) providing increased access to out-group females or, more indirectly, increased survival success of relatives, the elimination of same-sex rivals, and increased access to other resources (food, territory, etc.) that may be converted into status or power which, again, increases reproductive success (McDonald, Navarrete, & Van Vugt, 2012). Interestingly, although putatively competing for access to females, men tend to be more concerned with the perspectives of other men regarding their perceived status, and less so with the perspectives of women (Fischer & Rodriguez-Mosquera, 2001; Griskevicius et al., 2009). This is likely an outcome arising from the aforementioned intrasexual competition in our evolutionary history.

As of now, the state of knowledge about sex differences in status acquisition makes predicting and interpreting possible sex differences in status-related behavior a notable challenge. Including both sexes in studies manipulating status-relevant context, one risks the sex differences obscuring any real effects that might otherwise be revealed by including males or females exclusively. Should certain effects be found in one sex but not the other then one's sample size is effectively cut in half. This is particularly crippling since effect sizes in social psychological studies tend to be smaller and many studies are already underpowered. As such, the current study focused on an exclusively male sample, using the MWH to inform potential interactions between 2D:4D (discussed in the

following section) and the effect of group membership on economic decision-making/aggressive behavior. That is, it was hypothesized that participants would generally behave more aggressively toward out-group members, and this effect would be most notable among those with more masculinized (lower) 2D:4D.

2D:4D AND BEHAVIOR

The road linking individual differences in prenatal brain androgenization to individual differences in human cognition and behavior is undoubtedly serpentine, often proving just consistent enough to be enticing. How psychologists measure prenatal brain androgenization in adults and our understanding of its role in development is thankfully a bit more consistent. An exhaustive list of the roles androgens play developmentally is beyond the scope of this paper, however a brief overview of some key details is necessary. As has been observed by many, nature's default setting when constructing an organism is female. Another way of saying this is that a hormonal "intervention" is required to get a male, and this is one of the first roles androgens accomplish: Once the testes develop from undifferentiated gonads, they secrete androgens that begin to masculinize undifferentiated tissues (Smith, Birnie, & French, 2013). That is, tissues that would naturally develop into labia in the absence of androgens, now in the presence of androgens develop into a scrotum instead; tissues that would naturally develop into a clitoris instead develop into a penis (Arnold, 2009). Yet in mammalian development androgens play a role beyond the differentiation of external genitalia, hence prenatal *brain* androgenization.

It is important to note that although early on the testes are the primary source of androgens in a developing male, they are not the only source. Nor are developing females

isolated from androgen exposure. In females the ovaries can secrete androgens and, in both males and females, androgens are also secreted by the adrenal glands. Further, in utero a developing organism may be exposed to other sources of androgens, such as those secreted by the mother or a twin, or those acquired from external environmental sources (Smith, Birnie, & French, 2013). These differences and dynamics play an important role in mammalian brain development (Hines, 2006) and, consequently, in social behavior (Bos, Panksepp, Bluthé, & van Honk, 2012). In both non-human and human primates, for example, there is a robust relationship between prenatal androgens and sexually differentiated behavior (Wallen, 2005; Cohen-Bendahan, van de Beek, & Berenbaum, 2005; Manson, 2008). In humans, normal variation in exposure to prenatal androgens has also been linked to postnatal sex differences in eye contact, vocabulary development, and sex-typed behavior such as toy preferences (Hines, 2006) and, though mixed, there is evidence for individual differences in aggression (Manson, 2008). One peculiar feature of differences in prenatal androgen exposure is their relationship to differences in finger length ratios—specifically, the ratio between the second digit (the index finger) and the fourth digit (the ring finger), also known as the 2D:4D ratio. Perhaps surprisingly, among psychologists this ratio has become a standard measure of exposure to prenatal androgens.

How this counterintuitive relationship was established is rather circuitous. In an early study, Manning and colleagues (1998) observed that the *Hox* gene family is requisite for limb, genital, and testes development and, citing previous animal studies associating digit abnormalities with genital abnormalities, they suggested that digit growth might be related to fertility. They highlighted the variability in the human 2D:4D

ratio and, in two studies, they presented evidence of sex differences in the 2D:4D ratio, showed that these sex differences were apparent in children as young as two years old, and demonstrated that in men a lower sperm count and lower sperm motility was associated with a higher (i.e., more feminine) 2D:4D ratio (Manning, Scutt, Wilson, & Lewis-Jones, 1998). Since previous evidence showed that androgen concentrations affect the rate of development (McEwen, 1981, MacLusky and Naftolin, 1981, Bardin and Catterall, 1981, Geschwind and Galaburda, 1985), and since hand asymmetry was correlated with testosterone levels in adult males (which themselves were associated with prenatal androgen levels; Jamison et al., 1993), and since evidence for sex differences in the 2D:4D ratio appeared so early on, Manning and colleagues argued the following: 1) The 2D:4D ratio was likely determined prenatally. 2) *Hox* gene-regulated androgens secreted by the testes starting at roughly 8 weeks until mid-gestation affect digit development. 3) Higher concentrations of fetal testosterone led to a low 2D:4D ratio. 4) Therefore, prenatal testicular activity (or perhaps more accurately, prenatal testosterone activity) is correlated with the 2D:4D ratio.

To be clear, Manning and colleagues' conclusions were that a lower 2D:4D ratio is associated with exposure to higher levels of prenatal androgens, whereas a higher 2D:4D ratio is associated with exposure to lower levels of prenatal androgens. Over time much evidence has accumulated in support of their conclusions. Indeed, sex differences in 2D:4D are one of the variable's most consistent features, such that males generally have lower 2D:4D ratios than females; these differences consistently appear early and are unaffected by pubertal growth; high amniotic testosterone-to-estradiol ratios predict low 2D:4D; and females affected by congenital adrenal hyperplasia (CAH; a condition in

which females are prenatally exposed to atypically high levels of androgens) have lower 2D:4D than control females (McIntyre, 2006). Further, males with androgen insensitivity syndrome (AIS) show a higher (feminized) 2D:4D relative to typical males (Berenbaum, Bryk, Nowak, Quigley, & Moffat, 2008), and 2D:4D has been correlated with sensitivity to testosterone via androgen receptors (Manning, Bundred, Newton, & Flanagan, 2003; although, admittedly this latter detail has come under notable scrutiny recently, Voracek, 2014).

There is a seemingly ever-growing consensus that 2D:4D is a proxy of prenatal androgen exposure, but admittedly it is not unanimous. Even in the above cited work showing supporting evidence for males with AIS having larger 2D:4D, Berenbaum and colleagues (2008) argued that the effect was small enough and the data was noisy enough that they were not convinced 2D:4D is a good marker of individual differences in exposure to prenatal androgens. Regarding mechanisms, although McIntyre (2006) provided evidence of how androgens *could* affect digit growth—via androgen receptors found in anlagen or metaphyseal tissue, for example—there is little direct evidence yet showing they do. Manning (2011) pointed out that this sex difference in 2D:4D exists across many mammalian species and also reviewed experimental evidence of the effect that the prenatal testosterone-to-estrogen ratio has on digit development in mice. In short, it seems that the 4th digit is particularly sensitive to this ratio, such that androgens increased growth while estrogen decreased growth, and similar to human results, this was most notable on the right paw (Zheng & Cohn, 2011). Again, there is a consensus that such a relationship between prenatal androgen exposure and 2D:4D exists, as well as some limited supporting evidence of mechanisms; but in candor, much of the evidence

supporting this relationship is indirect and leans on phenotypic patterns and peripheral markers of brain androgenization and sex differences, via associated traits and behaviors. So with what traits and behaviors is 2D:4D associated?

As mentioned, higher 2D:4D was associated with lower fertility in males (Manning, Scutt, Wilson, & Lewis-Jones,1998). It is frequently correlated with physical fitness in both males and females (Hönekopp, Manning, & Miller, 2006) and in males it has been linked to the number of sexual partners an individual has had (Hönekopp, Voracek, & Manning, 2005). It has shown (weak) associations with personality traits such as extraversion and openness to experience (Lippa, 2006) and it has also been correlated with attention deficit disorder, eating disorders, sexual orientation (in women but not in men), autism, risk taking, and aggression (Breedlove, 2010), as well as spatial navigation (Csatho, et al., 2003), verbal and numerical intelligence, and agreeableness (Luxen & Buunk, 2004). And this is a truncated overview. This bizarre laundry list of relationships appears nearly random, at a glance. However, there may be a theme to be extracted. As a reminder, 2D:4D is thought to be a proxy of exposure to prenatal androgens, and variance in exposure to prenatal androgens is a potent predictor of sex differences. Again, human sex differences are largely a function of our evolutionary history and thus, it is argued, 2D:4D is—or at least should be—associated with cognitive traits and behaviors specific to the slightly differing evolutionary trajectories of males and females discussed previously. With this in mind, and referring back to what larger amounts of prenatal androgens accomplish—namely, masculinizing a developing organism—then the swarm of relationships between 2D:4D and various traits begins to look like a pattern of relationships one might expect between prenatal androgenization

and male-typical traits. That is, it should not be as surprising to see lower 2D:4D associated with fertility, physical fitness, increased sexual partners, risk-taking, aggression, and so on.

Yet again it should be noted that although this interpretation represents the consensus it is not without issues, in part due to inconsistent data. For example, after reviewing the various findings associated with 2D:4D, Putz and colleagues (2004) looked at a total of 57 possible correlations between 2D:4D and relevant variables (e.g., number of sexual partners, social and physical dominance) and found only two significant correlations in the predicted direction. They also highlighted that previous significant results may not be as impressive as they appear at first glance due to the variability in measurement of 2D:4D. That is, across multiple studies, and often within the same study, both the left and right hand measurements are used in the analyses, in addition to the mean of the two, as well as the difference between the two (right minus left). Add another 5 or 6 variables of interest, as social psychologists are often wont to do, and one rapidly increases the likelihood of Type I errors (Putz et al., 2004). Yet, as of 2009 there were over 300 papers documenting relationships between 2D:4D and various traits and behaviors, with many going in predicted directions albeit sometimes inconsistently (Vorcek & Loibl, 2009). Methodological issues are always a legitimate concern, but it seems unlikely that the entirety of those studies plus those performed since 2009 all amalgamate to an embarrassing aggregate of Type I errors.

No doubt there are many factors leading to some of the inconsistencies in the 2D:4D literature, ranging from methodological muddiness to sample size issues, given the demonstrated small effect size estimates of 2D:4D on behavior (for example, see

Hönekopp & Watson, 2010). One factor may be more theoretical. Take for example a relationship relevant to this discussion, the one often found between 2D:4D and aggression. It has proven to be somewhat disorderly. 2D:4D has been correlated with aggression far more often in men but not women (Bailey & Hurd, 2005; Kuepper & Hennig, 2007; Hönekopp, 2011); however, it should be noted that at least once it has been correlated with reactive aggression in women but not men (Benderlioglu & Nelson, 2004), and it correlated with both sexes regarding retaliatory aggression (Ronay & Galinsky, 2011). Yet sometimes no relationship is found, particularly when using self-report measures of aggression.

One theoretical approach to make sense of inconsistencies in the literature comes from Millet (2010). Looking at nascent relationships between 2D:4D and economic decision making, Millet reviewed similar inconsistencies and suggested that 2D:4D is perhaps better thought of as being associated with *context-specific* behaviors, rather than as a stable trait producing predictable, homogenous behaviors across all situations. Drawing from empirical data, Millet makes a comparison to the narrative regarding testosterone. Once thought to be associated with aggression, testosterone (and particularly, testosterone dynamics) more recently has been found to be more strongly associated with status and status-seeking/maintaining behavior, rather than aggression *per se* (Mazur & Booth, 1998; Archer, 2006; Eisenegger, Haushofer, & Fehr, 2011; Carré & Olmstead, 2015). Similarly, Millet argues, low 2D:4D may be a biological marker of those motivated by status acquisition. The argument is supported by studies that show, for example, that low 2D:4D individuals are more likely to act prosocially under neutral conditions, but under conditions of threat they behave less prosocially, with the opposite

effect being true for high 2D:4D individuals (Millet & Dewitte, 2009). Low 2D:4D men show more aversion to risk than high 2D:4D men under conditions of high power (suggesting a preference for the *status quo*), whereas under conditions of low power, low 2D:4D men become more risk seeking (Millet & Dewitte, 2008). These are conditional behaviors contingent upon context, rather than rigid programs applied uniformly to all situations. As outlined above, humans use many tools for status acquisition. Aggression is one of them. So aggression may be associated with 2D:4D only insofar as aggression is being used under conditions relevant to status acquisition and maintenance.

Social psychology is the study of minds colliding with the environment, and the human social environment often consists of differing groups with differing norms, many of which we have to navigate daily. If successfully adhering to those differing norms is an essential feature of acquiring status, and if 2D:4D is a biological marker of status-motivation, then it stands to reason that 2D:4D would be associated with aggression (and other status-relevant behaviors) in a situation-contingent manner. As such, it was predicted that low 2D:4D individuals would be more sensitive to status-relevant cues and therefore more likely to adjust their behavior accordingly, such that they would comprise the most aggressive individuals under conditions in which their cohorts endorsed aggression as a means to gaining/maintaining status, but would comprise the least aggressive individuals under conditions in which aggression would result in status loss.

THE ULTIMATUM GAME AND AGGRESSION

The Ultimatum Game is broadly used as a social economic decision making task, particularly as it pertains to perceptions of unfair treatment (Crockett, Clark, Tabibnia, Lieberman, & Robbins, 2008; Sanfey, Rilling, Aronson, Nystrom, & Cohen, 2003;

Pillutla & Murnighan, 1996; Güth, Schmittberger, & Schwarze, 1982). Based on this, it could be rightly argued that the rejection of low offers is solely a rational reaction to perceived injustice. That is, participants may be saying, "My rejection is not meant to harm you. I simply require a 'fair' offer before I am willing to accept." It could also be argued, however, that rejection of the offer is a measure of aggression, *per se*. That is, participants may be saying, "My rejection of this offer is meant to harm you. If I do not get what I want then I will make sure no one gets anything." There is evidence to support this latter notion as well. High trait aggression has been associated with a higher rate of offer rejection (Mehta, 2007), and participants have reported feeling angry or insulted after receiving unfair offers (van't Wout, Kahn, Sanfey, & Aleman, 2006; Pillutla & Murnighan, 1996). This need not be an "either/or" scenario. It is possible that some people use rejection with aggressive intent and some people use it otherwise. Therefore, this study cast a broad net with respect to the dependent variable (i.e., social economic decision-making); however, in order to look at aggressive intent specifically, a series of questions were developed to ask participants after they had made their decision to accept or reject an offer. Answers to those questions were meant to provide data that help tease out aggressive intent from other intentions and provide a basis to understand what variables may influence aggression.

CURRENT STUDY

The human brain is the most complicated structure in the known universe, so it is not surprising that human behavior is some of the most complex, variable, and unpredictable behavior among all known species. Social behavior is the collision of two or more human brains within a highly dynamic environment of resources and context.

Add in evolutionary history, hormones, developmental diversity, sociological influences, biological/environmental interactions, etc., and understanding human social behavior quickly starts to look like an overwhelmingly intimidating and perhaps impossible task. Extreme complexity is not a problem specific to social science. Historically, one way in which philosophers and scientists have managed complexity is to "carve nature at its joints", making demarcations within the chaos. These demarcations are sometimes arbitrary or artificial. Even so, they are useful and even necessary to lay a foundation of assumptions on which to build structures of knowledge. Simple, distinct variables are laid out and basic relationships between those variables are observed and defined. More complicated models come later and, occasionally, a more sophisticated understanding is used to reinterpret previous "fundamental" assumptions. Sometimes these fundamental assumptions do not survive the reinterpretation, and the scaffolding is removed while the structure yet remains.

The relationship between an individual's aggressive behavior and an individual's second-to-fourth digit ratio typifies the aforementioned complexity of human social behavior and associated biological variables. Two variables were carved at the joints and tentative, simple, and even surprising relationships between them have been explored. However these relationships have proven inconsistent, perhaps owing to methodological issues but also perhaps owing to oversimplified models of human behavior. Like testosterone, 2D:4D may be a correlate of aggressive behavior but not in a linear fashion (i.e., lower 2D:4D always equals more aggression). Instead, there may be moderating effects of context. The goal of this study was to propose and test such a model. So far we have reviewed the tools for gaining status, with a particular focus on aggression; the

effects of norms on status acquisition and maintenance; male biases with regards to intra- and intergroup dynamics; and the 2D:4D measurement as a proxy of exposure to prenatal androgens. The current study attempted to place all these variables into a model predicting the rejection rate in the Ultimatum Game, with an eye on that rejection as an act of aggression. As such, there are multiple *a priori* hypotheses to test.

In this study we measured participants' 2D:4D. We then assigned them to teams and led them to believe they were interacting with teammates. Those teammates either endorsed aggression as a means to gaining status, were neutral about aggression as a means to gaining status, or proscribed aggression as a means to gaining status. This is the aggression-for-status norm manipulation. After meeting their teammates and being exposed to their group norms, participants were told they would be interacting with either one of those teammates, or with a member from a rival team (against whom they would allegedly be competing later). This was the in-group vs. out-group manipulation. The interaction was one round of the Ultimatum Game. This was the dependent variable. After the round of the Ultimatum Game, participants were asked a variety of questions in an attempt to unpack their reasoning and intent behind their decision to accept or reject the unfair offer. For main effects, it was hypothesized that 1) individuals in the pro-aggression condition would be more likely to reject the unfair offer than those individuals in the neutral or anti-aggression condition, and 2) individuals interacting with a rival would be more likely to reject an unfair offer than individuals interacting with a teammate.

However, hypotheses regarding interactions are at the heart of this study. 1) If 2D:4D denotes a predisposition toward status concerns then lower 2D:4D individuals

should be more sensitive to such information and more likely to adjust their behavior accordingly. Therefore it was hypothesized that individuals with low 2D:4D would be the most likely to reject unfair offers when in the pro-aggression condition, but the least likely to reject unfair offers in the anti-aggression condition. 2) As per the MWH (that is, in times of out-group threat—the pending competition—males tend to engage in out-group aggression and in-group cooperation), it was predicted that low 2D:4D individuals would be more likely to reject an unfair offer from a rival, and more likely to accept an unfair offer from a teammate, than high 2D:4D individuals. 3) The potential interaction between the aggression-for-status norm variable and the in-group vs. out-group variable was less clear. It could be that endorsing aggression as a means for gaining status implied a *carte blanche* application. That is, being aggressive was interpreted as good both when interacting with teammates as well as interacting with rivals. Here we might think of a team or business in which competition for positions or status is intense among teammates as well as competition being intense between teams or businesses. However, it might be interpreted as only applicable to interacting with rivals. A more cohesive and stable group that only reacts aggressively to outside threats might capture this latter response. Although agnostic about this interaction, I leaned toward the latter outcome being most likely—individuals in the pro-aggression condition would be particularly likely to reject an unfair offer when interacting with a rival than those individuals in the anti-aggression condition. That is, any effect of aggression endorsement would be maximal, or perhaps even only visible, among those interacting with a rival. 4) There is also a possibility of a three-way interaction. If 2D:4D is a measure of both a masculinized brain as well as an indication of status-orientation, then according to the MWH a masculinized brain should

be particularly aggressive toward out-group individuals and particularly prosocial toward in-group members, and status-oriented individuals should be most in tune to, and most likely to adjust their behavior to, status-relevant context. It was therefore hypothesized that low 2D:4D individuals in the pro-aggression condition, interacting with a rival, should be among the most likely to reject an unfair offer in the Ultimatum Game; whereas, low 2D:4D individuals in the anti-aggression condition interacting with a teammate should be among the least likely to reject an unfair offer.

CHAPTER II

METHODS

Participants: 609 male participants were recruited from Amazon Mechanical Turk and were paid $3.00 for 20-30 minutes of their time. Ages ranged from 18-65 (M = 30.25, SD = 9.24). The demographic information breaks down as follows: Reported ethnicities were 64.5% European American, 10.0% Hispanic Latino, 8.2% African American, 7.1% Asian Pacific Islander, 1.1% Native American, 10.0% Other. Reported native languages were 95.9% English, 1.6% Spanish, 0.3% French, 0.2% Chinese, 2.0% Other. Reported sexual orientation was 86% heterosexual, 7.9% homosexual, 4.8% bisexual, 1.3% Other.

Materials and Procedure:

Recruitment, 2D:4D, and Demographics: Participants were recruited from Amazon Mechanical Turk. They were paid $3.00 for 20-30 minutes of their time. Once accepting the job, participants were directed to Qualtrics and filtered for biological sex. The first question they encountered asked their sex. If they answered “female” then they were redirected to a prompt thanking them for their time but informing them they were not eligible to continue. (IP addresses were checked for redundancy to ensure individuals were not returning, changing their response, and thus faking their sex in order to participate.) If they answered “male” then they were presented with a screen briefly describing the demands of the study and requesting they set aside the requisite time to complete everything without disturbance. They were then presented with a consent form. Once they read the form and agreed to participate in the study, they were asked to upload pictures of both their right and left hands (individually). The process required that they hold their hands up horizontally in front of a unique background on the computer screen.

They then took a picture of their hand with their smartphone, sent the picture to their email, downloaded the file to their desktop, and then uploaded the picture to the Qualtrics survey. Though measures of 2D:4D acquired via smartphone are not yet "standard", there is precedent for acquiring measures in this way (Huang, Basanta, & Sandnes, 2015).

Following the pictures, participants took the Dominance-Prestige survey (Cheng, Tracy, & Henrich, 2010) and were then asked to respond to a variety of demographic questions. Upon completion of the questions, participants then read a more detailed overview of the study and were told they were part of a study investigating the nature of online, indirect interactions and how the indirect nature of interactions affects the ability of individuals to form and function as a team. They were told they would be connected to the study's online network, placed on a team based on a software algorithm, and then they would get to know their teammates in indirect ways. They were told that eventually they and their teammates would compete against another team in an (undisclosed) online competition. Once the "familiarizing" process was completed, they were told that they would interact with either a randomly selected teammate or a randomly selected member of the rival team. The results of those interactions, they were told, would be made visible to their teammates. They were told that these results should be used to inform them as to whom they would like to elect as team leader. They were informed that the team leader would decide how to allocate the winnings acquired in the team-on-team competition, should their team win, and that would be the end of the study.

Much of this was not true, however, and was a cover story intended to achieve many experimental goals. The other teammates were not real and instead were predetermined responses. This was necessary for the "aggression-for-status" norm

manipulation, ensuring teammates were either pro-aggression, neutral about aggression, or anti-aggression. The other rival members were not real and the online competition never took place. This was the cover story necessary to generate the need for teams. That is, it created the incentive to care about what others thought ("my teammates" as opposed to interacting with random internet strangers), allowed the possibility of manipulating group norms, and it facilitated the in-group/out-group manipulation (that is, everyone is an "out-group" member in the absence of teams). The team leader election never took place, either. This deception was also used to accomplish a couple ends. First, it created a drive for status since all individuals felt they had an opportunity to become leader (if they wanted). By telling participants that the leader would decide how winnings would be shared, any potential status jostling was enhanced by further incentivizing the team leader position. Second, it ensured that participants' felt their behavior in the interaction would be observed by group members and (presumably) evaluated based on group norms. That is, manipulating group norms to observe their potential effects on behavior would make no sense if that behavior was believed to be confidential and had no possible repercussions within the group.

Aggression-for-Status Norm Manipulation: Upon being told about the overview of the (alleged) procedure of the study, participants were placed on a team. A screen came up that told them that their team placement was decided by a computer algorithm and was based on their geographic location combined with their demographics. They were then given directions about how they would get to know their teammates indirectly by first reading some vignettes and then responding to some follow-up statements about the vignettes. Unbeknownst to them, participants were randomly assigned (via Qualtrics

software) to either a pro-aggression condition, in which the participant's teammates appeared to endorse aggressive behavior as a means to gaining status; a neutral condition, in which teammate's appeared ambivalent about aggression as a means to gaining status; or an anti-aggression condition, in which teammate's appeared to reject aggressive behavior as a means to gaining status.

The vignettes were identical for all groups (pro, neutral, and anti). Each vignette consisted of a fictional "John" character interacting with other individuals (John's friends and others) in a hypothetical situation that ultimately resulted in him engaging in aggressive behavior in a social setting (see supplemental materials for all vignettes). The vignettes were designed from scratch and were intentionally constructed to convey acts of aggression in varying social contexts. That is, an act of in-group aggression, which is to say status jostling between members of an in-group (vignette 1); an act of out-group aggression, which is to say coalitional aggression between two explicit rival groups (vignette 2); and aggression in a situation absent any salient in-group/out-group cues, which is to say an act of aggression toward a "random" stranger not explicitly thought to be in a rival out-group (vignette 3). After each vignette, participants in all three groups were exposed to the same three statements:

1) "If John wanted his friends to respect him then his behavior would work."

2) "If John wanted his friends to like him then his behavior would work."

3) "If John wanted his friends to view him as a leader then his behavior would work." These three statements were meant to capture status-relevant details in a broad manner, as status may consist of social preference, respect, and/or leadership. Participants were eventually asked to select from answers that were on a 7-point Likert scale, ranging

from “Completely Agree” to “Completely Disagree”. In the pro-aggression norm group, the participant’s teammates responded with either “Mostly Agree” or “Completely Agree”. In the neutral group, the teammates responded with “I am undecided”, “Somewhat Agree”, or “Somewhat Disagree”. In the anti-aggression norm group, the teammate’s responded with “Mostly Disagree” or “Completely Disagree”. However, there was concern that by allowing participants to answer first (i.e., before their teammates), they may be more inclined to “dig in” and defend their perspective if it differed from their teammates. That could create an artificial barrier to normative influence on behavior later in the UG. Whereas, if they answered last then there may be more variability in their responses and, perhaps, in their subsequent behavior, which would better facilitate measuring the effect that aggression-for-status relevant group norms have on behavior (if any). Therefore, just prior to reading the vignettes and responding to the aforementioned statements, participants were told they were randomly selected to respond last. There were three vignettes total with a series of three subsequent statements (see above) following each vignette.

The participant response to the vignette also serendipitously provided another dependent measure. While the primary dependent measure was behavior in the UG, the participant’s response to the statements following the vignette allowed investigation into whether the participants’ evaluation of John’s behavior would vary as a function of the team to which they were assigned. If there were no influence of team norms, via their teammate responses, then there should not be any differences in the participants’ responses between the conditions since the vignettes were identical across groups and only the team norms differed. However, if the team norms influenced the participants

(irrespective of whether such norms later influenced participant behavior in the UG) then participant responses should follow the pattern of team assignment. That is, participants in the pro-aggression-for-status norm condition should be more likely to respond in a way that approves of John's aggressive behavior and those in the anti-aggression-for-status norm condition should respond in a way that proscribes John's aggressive behavior. Pilot data consisting of 100 participants did indeed yield significant differences in responses to these statements based on norm condition, implying a potentially successful manipulation.

Group Manipulation: After being exposed to the team norms regarding aggression for status acquisition, participants then engaged in one round of the Ultimatum Game (UG). They were told, "Now you will be randomly connected with either a fellow teammate or a rival from another team that you will compete against later." (Qualtrics randomly assigned them to either the teammate or rival condition.) After a moment, participants were told, "You have been connected to a Rival." (Or in the case of being assigned to a teammate: "You have been connected to a Teammate".)

Primary Dependent Variable: Participants then went through the UG instructions and answered some follow-up questions to ensure they understood the procedure. They were told that they would be looking to acquire tickets and the more tickets they acquired, the more likely they would be to win a $50.00 gift card. Once the directions were read and participants were told with whom they would be interacting, either a teammate or a rival made an offer that consisted of 2 out of 10 possible tickets (i.e., if the participant accepted then they would receive two tickets and the teammate/rival would keep 8 tickets). Participants were then asked to make their decision to accept or reject.

Manipulation and Suspicion Checks. Participants were asked a series of questions throughout the procedure that were meant to be manipulation checks for the norm manipulation. After the vignettes, but before the UG interaction, participants were asked whether they felt their teammates valued dominance, compassion, fairness, aggression, or compliance, in order to increase status (again, answers were on a 7-point Likert scale). These questions were meant to ensure participants understood their team's norms regarding status acquisition. Separately, there was the possibility that, in seeing their teammates' responses to the statements following the vignettes, participants might feign agreement with John's aggressive behavior, for example if they were in the pro-aggression condition, but still not behave aggressively later in the UG. This might be due to a willingness to signal acquiescence to group norms while not necessarily agreeing with them, which could in turn affect one's willingness to let such norms affect one's actual behavior in a more applied setting when stakes are higher (i.e., regarding their decision to accept or reject the UG offer). To address this, participants were also asked the extent to which they related to their teammates. This was hoped to help interpret null results. That is, if the norm manipulation failed to affect behavior in the UG, might it be due to participants' inability to relate to their teammates (or at least their team's norms)?

Following their decision in the UG, participants were asked a variety of questions about their perception of the offer they received (was it fair/unfair? Respectful/disrespectful? Generous/greedy? Friendly/aggressive?), questions about their decision (same as above: Was it fair/unfair, respectful/disrespectful, generous/greedy, friendly/aggressive?), as well as questions about their affect: Did the offer make them feel calm/bothered, upbeat/dejected, friendly/angry? All answers were also on a 7-point

Likert scale (e.g., 1 = friendly, 7 = aggressive). These questions were asked in anticipation of "unpacking" any effects on the DV. That is, what about the offer contributed most to their decision to accept/reject? For example, did they reject more so because they perceived the offer as unfair, or rather did they reject more so because it was perceived as intentionally aggressive or disrespectful? Ultimately, why did they accept/reject the offer? Was it that they felt, for example, to reject an unfair offer was the fair thing to do, irrespective of the intent of the person making the offer? Or rather did they intentionally mean their rejection to be an act of aggression? The affective state of the participant might be informative as well. For example, we might expect those who rejected due to issues of "fairness" to perhaps rate their feelings as less "angry" than individuals who rejected due to issues of "aggression" or "disrespect", etc. All of these worked together as a way to probe whether rejection of an unfair offer in the UG can be considered an act of aggression.

Also after their decision to accept or reject, they were asked with whom did they just compete, to ensure they understood whether it was a teammate or a rival. They were also asked three questions about whether they thought their teammates would approve of their decision. Specifically, they were asked, "If you wanted your teammates to respect you then your decision to accept/reject would work," "If you wanted your teammates to like you then your decision to accept/reject would work," and, "If you wanted your teammates to view you as a leader then your decision to accept/reject would work". This was meant to estimate whether the effect, if any, of the aggression-for-status norm manipulation was still having an effect this late into the experiment. They were also asked about how many tickets they expected to be offered. The scale of answers to this

question was the only one that deviated from a 7-point Likert scale. It ranged from 0 to 10, capturing all possible offers of 10 available tickets.

The final questions before the study concluded were opportunities for participants to provide any feedback or observations about the study. Specifically, it was an opportunity for participants to express any suspicions they might have had about the procedure. They were asked to, “Please briefly share any interesting thoughts/observations/experiences you may have had while participating in this study thus far.” Then they were asked, “What did you think of the Proposer-Responder interaction?” (The “Proposer-Responder interaction” was the Ultimatum Game.)

CHAPTER III

RESULTS

Quality Control: Data was acquired from 609 males. Of those, participants who showed skepticism in the outgoing survey questions were removed prior to analyses. Additionally, some individuals did not provide pictures of their hands, one individual wore gloves (making 2D:4D measurement impossible), and a few individuals provided double pictures of one hand (two lefts or two rights), and were therefore excluded. These exclusions resulted in 572 participants. These participants were used in all subsequent analyses unless otherwise noted. Digit ratios for the left and right hands were significantly correlated ($r = 0.54$, $p < 0.001$). Further, digit ratios for both hands were normally distributed (right hand: Mean = 0.98, $SD = 0.06$; left hand: Mean = 0.98, $SD = 0.07$). Despite pictures being acquired online, the aforementioned data suggested acceptable quality of 2D:4D data. (See Table 1 for descriptive statistics and Table 2 for intercorrelations between study variables.) Regarding overall ultimatum game results, 262 participants (45.8%) accepted the offer of two tickets, while 310 participants (54.2%) rejected it.

Table 1. Descriptive statistics for study variables

Variables	Mean (*SD*)	Minimum	Maximum
Age	30.14 (*9.07*)	18.00	65.00
Prestige	46.59 (*7.90*)	9.00	63.00
Dominance	28.09 (*7.28*)	8.00	50.00
Right 2D:4D	0.98 (*0.06*)	0.70	1.23
Left 2D:4D	0.98 (*0.07*)	0.70	1.26

Team values dominance	3.98 (*2.33*)	1	7
Team values compassion	3.78 (*1.96*)	1	7
Team values fairness	4.03 (*1.82*)	1	7
Team values aggression	4.03 (*2.34*)	1	7
Team values compliance	3.76 (*1.77*)	1	7
Relate to team	4.13 (*1.90*)	1	7
Team respect me for my decision	4.76 (*1.71*)	1	7
Team like me for my decision	4.42 (*1.86*)	1	7
Team view me as a leader for my decision	4.81 (*1.73*)	1	7
Vignette 1, endorse aggression	3.47 (*1.83*)	1	7
Vignette 2, endorse aggression	2.66 (*1.67*)	1	7
Vignette 3, endorse aggression	3.11 (*1.84*)	1	7
Offer was fair vs. unfair	5.98 (*1.22*)	1	7
Offer was respectful vs. disrespectful	5.84 (*1.66*)	1	7
Offer was generous vs. greedy	6.32 (*0.89*)	1	7
Offer was friendly vs. aggressive	5.83 (*1.10*)	1	7
Decision was fair vs. unfair	2.24 (*1.46*)	1	7
Decision was respectful vs. disrespectful	3.06 (*1.72*)	1	7
Decision was generous vs. greedy	3.07 (*1.69*)	1	7
Decision was friendly vs. aggressive	3.68 (*2.00*)	1	7

Table 2. Zero-order correlations between study variables

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1. Age	-																								
2. Prestige	-0.13*	-																							
3. Dominance	-0.01	0.02	-																						
4. Right 2D4D	0.15**	0.05	0.03	-																					
5. Left 2D4D	0.11	0.02	0.06	0.61**	-																				
6. Team: Dominance	0.01	-0.06	-0.01	0.04	0.06	-																			
7. Team: Compassion	-0.12*	0.09	0.03	-0.07	-0.05	-0.72**	-																		
8. Team: Fairness	-0.13*	0.06	-0.04	-0.08	-0.04	-0.52**	0.68**	-																	
9. Team: Aggression	0.02	-0.05	0.03	0.03	0.02	0.92**	-0.72**	-0.55**	-																
10. Team: Submission	-0.12*	0.08	0.06	-0.10	-0.05	-0.51**	0.61**	0.50**	-0.50**	-															
11. Relate to Team	-0.14*	0.12*	-0.10	-0.05	-0.01	-0.44**	0.56**	0.55**	-0.46**	0.37**	-														
12. Team Respect	0.07	0.12*	0.05	-0.05	-0.02	0.01	-0.02	0.05	0.02	-0.08	0.07	-													
13. Team Like	0.03	0.03	-0.01	-0.02	0.03	0.02	-0.01	0.06	0.04	-0.01	0.12*	0.42**	-												
14. Team Leader	0.09	0.18**	0.08	-0.01	-.010	0.11	-0.05	-0.01	0.11	-0.07	-0.01	0.65**	0.44**	-											
15. Offer Unfair	-0.01	0.21**	0.03	0.03	0.08	0.03	-0.01	-0.01	0.01	0.07	0.08	0.12*	0.07	0.20**	-										
16. Offer Disrespectful	-0.03	0.13*	0.10	-0.05	-0.03	0.03	0.01	-0.01	0.04	0.03	-0.02	0.11*	0.03	0.18**	0.51**	-									
17. Offer Greedy	-0.03	0.07	0.06	-0.03	0.01	0.08	-0.06	-0.10	0.08	-0.01	-0.04	0.15**	0.03	0.12*	0.49**	0.58**	-								
18. Offer Aggressive	0.01	0.09	0.06	0.01	-0.04	0.10	-0.09	-0.10	0.09	-0.08	-0.11	0.17**	0.01	0.14*	0.31**	0.42**	0.38**	-							
19. Decision Unfair	0.05	-0.10	0.01	0.01	0.09	0.09	-0.06	-0.06	0.10	0.01	-0.02	-0.19**	-0.07	-0.20**	-0.20**	-0.24**	-0.22**	-0.23**	-						
20. Decision Disrespectful	-.062	-0.05	0.11	-0.07	0.01	0.07	0.04	-0.06	0.05	0.04	-0.02	-0.10	-0.05	-0.09	-0.03	0.07	0.04	0.04	0.27**	-					
21. Decision Greedy	-0.06	-0.03	-0.02	0.01	0.06	0.01	-0.03	-0.05	0.05	-0.09	-0.05	-0.03	-0.08	-0.08	-0.13*	0.03	-0.03	-0.01	0.13*	0.38**	-				
22. Decision Aggressive	-0.07	0.03	0.02	-0.04	-0.01	0.13*	-0.11	-0.06	0.09	-0.06	-0.09	0.05	-0.13*	-0.01	0.01	0.18**	0.14*	0.24**	-0.01	0.36**	0.30**	-			
23. Endorsement V1	0.01	-0.01	0.12*	0.07	0.05	0.44**	-0.29**	-0.22**	0.46**	-0.12*	-0.11	0.07	0.09	0.13*	0.12*	0.11	0.16**	0.12*	0.06	0.07	0.12*	0.18**	-		
24. Endorsement V2	-0.08	0.11	-0.02	-0.01	-0.02	0.30**	-0.14*	-0.09	0.30**	-0.03	0.04	-0.07	0.07	0.07	0.08	0.06	-0.04	-0.01	0.08	0.06	0.09	0.11	0.46**	-	
25. Endorsement V3	-0.10	0.10	0.07	0.07	0.08	0.40**	-0.21**	-0.12*	0.42**	-0.04	-0.03	-0.03	0.03	0.08	0.01	0.06	0.07	-0.05	0.10	0.10	0.15*	0.10	0.65**	0.38**	-

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

Manipulation Checks:

Aggression-for-Status Norm Manipulation: If there were an effect of this manipulation then it might be that the pro-aggression condition drove the rejection rate up, or that the anti-aggression condition drove the rejection rate down, or a combination of both. To unpack this, Helmert contrasts were created. These planned contrasts allowed investigation into whether the pro-aggression condition differed from the neutral and anti-aggression conditions (Helmert 1 contrast coefficients: 1, -0.5, -0.5) and whether the anti-aggression condition differed from the neutral condition (Helmert 2 contrast coefficients: 0, 1, -1). A series of ANOVAs, using the Helmert contrasts to predict participant ratings of perceived teammate values, revealed that the primary manipulation check questions significantly varied as a function of aggression endorsement condition (all ps < 0.001, *partial* η^2 ranged from 0.16 to 0.76). Summary statistics for these Helmert contrasts are shown in Table 3. Participants in the pro-aggression condition rated their teammates as valuing dominance and aggression more than participants in the neutral and anti-aggression conditions. Further, participants in the neutral condition rated their teammates as valuing dominance and aggression more than participants in the anti-aggression condition. Conversely, participants in the pro-aggression condition rated their teammates as valuing compassion, fairness, and compliance less than participants in the neutral and anti-conditions. Participants in the neutral condition rated their teammates as valuing these variables less than participants in the anti-aggression condition.

Table 3. Summary statistics for Helmert contrasts comparing aggression-for-status norm manipulation group ratings of teammates' values

Variables	Mean Difference	*p*	*Cohen's d*
Pro vs. Neutral & Anti			
Dominance	3.68	< 0.001	2.35
Aggression	3.64	< 0.001	2.28
Compassion	-2.28	< 0.001	-1.40
Fairness	-1.64	< 0.001	-0.99
Submissiveness	-1.26	< 0.001	-0.75
Neutral vs. Anti			
Dominance	2.42	< 0.001	1.86
Aggression	2.69	< 0.001	2.16
Compassion	-1.89	< 0.001	-.140
Fairness	-1.53	< 0.001	-1.07
Submissiveness	-0.93	< 0.001	-0.63

Interestingly, the extent to which participants stated that they related to their teammates also varied according to condition, $F(2, 569) = 108.06$, $p < 0.001$, *partial* $\eta^2 = 0.28$. Participants in the pro-aggression condition reported that they related to their teammates less than those in the neutral and anti-aggression conditions (Mean difference = -1.40, $p < 0.001$, $d = -0.78$). Further, participants in the neutral condition reported that they related to their teammates less than participants in the anti-aggression condition (Mean difference = -1.83, $p < 0.001$, $d = -1.23$).

After their decision in the UG, participants were asked whether they thought their teammates would respect them/like them/view them as a leader based on their decision to

accept or reject. These functioned as manipulation checks in that, presumably, if the aggression-for-status manipulation were successful then there would be differences in responses between groups. For example, those in the pro-aggression condition would assume their teammates would respect them more if they behaved aggressively (i.e., rejected the offer), whereas the reverse would be true in the anti-aggression condition. So in this case both responses (accept and reject) were meaningful. Significant differences were found for two of the three questions.

For the question regarding gaining the respect of their teammates, a 3x2 ANOVA was performed using the aggression-for-status norm manipulation (with the Helmert contrasts described above) and UG decision (accept or reject) as independent variables. Differences across groups were expected—even for those who chose to accept—if the manipulation was salient enough. For example, those who accepted the unfair offer would seem more likely to assume their teammates would respect them if in the anti-aggression condition than those who accepted in the pro-aggression condition. There was a main effect of response (i.e., the decision to accept or reject), $F(1, 566) = 27.77$, $p < 0.001$, *partial* $\eta^2 = 0.05$. There was also a significant interaction between the aggression condition and the response, $F(2, 566) = 4.64$, $p = 0.01$, *partial* $\eta^2 = 0.02$). A simple-effects analysis revealed that those in the pro-aggression condition who accepted felt their teammates would respect them less than those who rejected ($p < 0.001$, $d = -0.70$). Similarly, there were differences in team-respect ratings in the neutral condition between those who chose to accept vs. those who chose to reject ($p = 0.004$, $d = -0.43$). There were no significant differences in the anti-aggression condition.

Regarding the participants' perspective on whether their teammates would view them as a leader based on their decision in the UG, a similar set of relationships were found. A 3x2 ANOVA again revealed a main effect of response, $F(1, 566) = 33.64$, $p < 0.001$, *partial* $\eta^2 = 0.06$ and a significant interaction between decision and aggression-for-status condition, $F(2, 566) = 6.91$, $p = 0.01$, *partial* $\eta^2 = 0.02$). A simple effects analysis showed that those participants who rejected the unfair offer in the pro-aggression-for-status condition rated their teammates as significantly more likely to view them as a leader than participants in the pro-condition who accepted ($p < 0.001$, $d = -0.86$). Similarly, there were differences in team-leader ratings in the neutral condition between those who chose to accept vs. those who chose to reject ($p = 0.002$, $d = -0.46$). There were no significant differences in the anti-aggression condition, and there were no significant results to report regarding the question about whether their teammates would like them based on their decision to accept or reject.

Group Manipulation: There was a concerning issue with the group manipulation. After interacting in the UG, and after the follow-up questions, participants were asked to report with whom they just competed. This was a manipulation check to ensure the participants understood with whom they were interacting (teammate or rival). A large number of participants ($N = 129$, or 22.6%) answered this incorrectly. It also appeared that the majority of those who answered incorrectly were in the "rival" condition. It was hypothesized that the length of the UG directions, procedure, and subsequent questions was long enough that participants may have forgotten with whom they were interacting and used the offer they received (which was encountered more recently and likely more emotionally salient) as a heuristic. That is, if they could not remember with whom they

were interacting but the offer was considered particularly low or unfair, then perhaps participants assumed they must have been interacting with a rival since only a rival would provide such a low offer. If true, then presumably there would be a relationship between the condition to which they were assigned (teammate or rival) and the likelihood of incorrectly reporting the condition to which they were assigned, with those who incorrectly reported their interlocutor being more likely to be in the teammate condition.

A Chi-square analysis revealed a statistically significant relationship (χ^2 (1, 559 = 95.59, $p < 0.001$); see Figure 1) between the team condition and the likelihood of a correct answer on the follow up question (Who did you just interact with: Teammate or Rival?). Specifically, of the 129 individuals who answered incorrectly, 114 of them (or 88%) were in the "team" condition but reported being in the "rival" condition. This is not conclusive evidence of the mechanism that led to the incorrect answers (i.e., the heuristic mentioned above), however it nonetheless revealed a notable confound in the group manipulation.

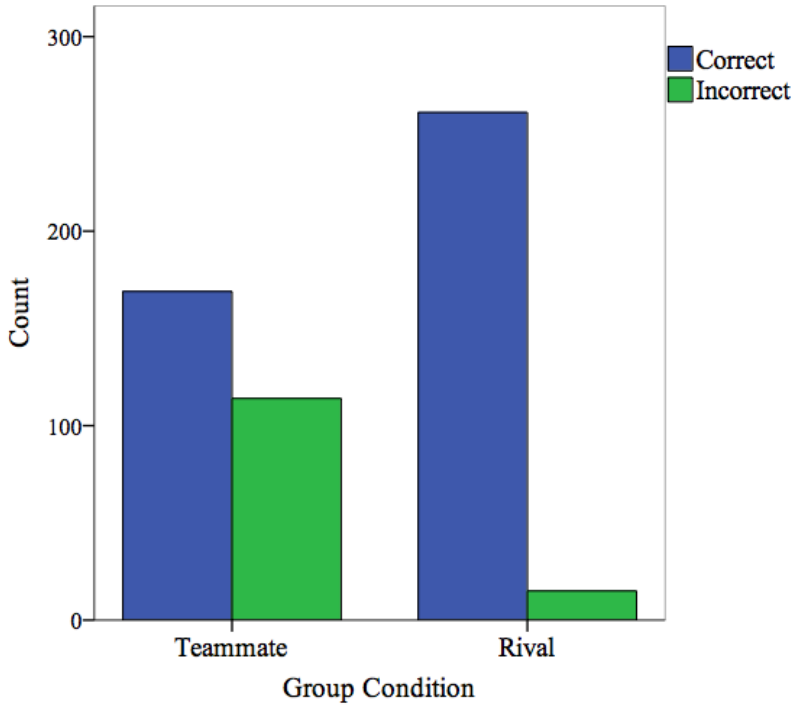

Figure 1. Chi-square results showing systematic error in teammate condition

Primary analyses: By way of reminder, the primary hypothesis were as follows:

H1: The aggression-for-status norm manipulation would predict the decision to accept or reject the offer in the UG (main effect), with those in the pro-aggression condition rejecting more than those in the anti-aggression condition.

H2: The group manipulation would predict the decision to accept or reject the offer in the UG (main effect), with those in the rival condition rejecting more than those in the teammate condition.

H3: The above effects would be maximal among those with low 2D:4D (interaction). That is, if 2D:4D is associated with status acquisition and maintenance rather than aggression *per se*, then low 2D:4D will be associated with the most rejection when aggression is good for status and the least rejection when aggression is bad for status. Further, if 2D:4D is a proxy for an androgenized, or "masculinized", brain, then low 2D:4D will predict the least

amount of rejection when interacting with a teammate and the most amount of rejection when interacting with a rival.

As mentioned, there was a notable methodological problem with the group manipulation. Because of this, the group manipulation condition was dropped from the models regarding the primary DV. Stepwise binary logistic regression analysis was conducted to predict the decision to accept or reject the offer in the UG, with the following predictors: the aggression-for-status norm Helmert contrasts, the continuous 2D:4D variable, and their interaction terms (Helmert I x 2D:4D, Helmert II x 2D:4D). Separate analyses were performed for both the right and left digit ratios. The predictors did not account for a significant portion of variance in the behavior in the UG, either in the model with the right digit ratio (χ^2 (4) = 4.92, p = 0.30), or in the model with the left digit ratio (χ^2 (4) = 5.9, p = 0.21). The addition of the two-way or the three-way interactions did not improve model fit, all ps > 0.24. Models for both right and left hands were run excluding the group condition and, similarly, the predictors did not account for a significant portion of the variance in behavior in the UG (right hand: χ^2 (3) = 2.94, p = 0.40; left hand: χ^2 (3) = 4.00, p = 0.26). Further, models were run for both the left and right hands including the group condition but excluding those participants who answered incorrectly regarding with whom the interacted. These models did not account for any significant portion of the variance in behavior in the UG, either (right hand: χ^2 (4) = 8.30 , p = 0.08; left hand χ^2 (4) = 8.12, p = 0.07). Inclusion of interaction variables did not significantly improve the models (all ps > 0.05). A summary of the results with respect to the primary hypotheses can be seen in Table 4.

Table 4. Summary of primary hypotheses and results.

Hypothesis	Support
H1: Main effect of aggression-for-status norm manipulation—pro-aggression = more rejection; anti-aggression = less rejection.	Did not receive support from any models tested.
H2: Main effect of group manipulation—rival condition = more rejection; teammate condition = less rejection.	Did not receive support from any models tested.
H3: Interaction between 2D:4D and above variables—low 2D:4D = most rejection in pro-aggression and rival conditions; low 2D:4D = least rejection in anti-aggression and teammate conditions.	Did not receive support from any models tested.

As a note, other than left and right 2D:4D being correlated with each other, 2D:4D showed no significant relationship with any other measure in any analysis performed, including zero-order correlations, as well as tests of main effects and interactions. However, both the group manipulation and the aggression-for-status manipulation were explored and found to have effects worth noting. These will be discussed below.

Exploratory Analyses:

Aggression-for-Status Norm Manipulation: As mentioned, in addition to demographic questions, participants filled out the Dominance-Prestige scale prior to all other procedures. These are important variables with regards to aggressive behavior. Although the aggression-for-status norm manipulation did not significantly predict the decision to accept or reject the UG offer, it could be that age or dominance did, or that they might have interacted with the norm manipulation in some meaningful way. Thus, another binary logistic regression was run, using age, dominance, the aggression-for-status norm manipulation, and all their consequent interaction terms to predict the decision to accept

or reject the UG offer. None of the aforementioned variables significantly predicted the decision to accept or reject (χ^2 (4) = 7.97, p = 0.09), and the addition of the interaction terms did not significantly improve the model ($p > 0.05$).

Following each vignette participants were asked to respond to three statements rating whether John's behavior was good or bad for status (i.e., If John wanted his friends to like him/respect him/view him as a leader then his behavior would work). Before responding, however, they were asked to read their teammates' responses. Participant responses to these statements therefore functioned as secondary DVs in that it could be seen if their ratings of John's behavior (i.e., their endorsement of aggression as a means to status acquisition and maintenance) would vary as a function of their group's norms, as implied by their teammate's responses. The "facets" of status (respect, like, view as a leader) were highly correlated within each vignette (all rs > 0.74, ps < 0.001) and they were therefore aggregated for each vignette. That is, "John's friends would respect him," "John's friends would like him," and "John's friends would view him as a leader," were all averaged for a single "endorsement of aggression for status" score for vignette 1, vignette 2, and vignette 3. Further, to the extent that an effect of the norm manipulation was found, it was necessary to better understand the effect by exploring any possible moderating variables. For example, the severity of conflicts appears increased when young males are involved (Mesquida & Wiener, 1996; Mesquida & Wiener, 1999). Young males also tend to engage in more violent and risky behavior (e.g., Turner & McClure, 2003 and Wilson & Daly, 1985). Younger people generally also seem to be more susceptible to peer influence (Albert, Chein, & Steinberg, 2013). To the extent that the norm manipulation was resulting in participants endorsing or rejecting John's

aggressive behavior, these effects might have been driven entirely by younger participants. Therefore, age was included in the model as a predictor. It was also important to ask to what extent did dominance (or prestige, for that matter) drive any of these significant effects? Might they be interacting with the manipulation in some way? For example, it is possible that the pro-aggression-for-status condition might have an effect solely on those high in dominance.

The two primary claims of the MWH are that males have a proclivity toward in-group favoritism and a proclivity toward out-group aggression (McDonald, Navarrete, & Van Vugt, 2012). By way of reminder, vignette 1 was meant to capture aggression-for-status within the in-group, vignette 2 was meant to capture aggression-for-status between two explicit rival coalitions, and vignette 3 was meant to capture a moment of "random" aggression toward a stranger who is not an in-group member but who is also not a member of an explicit rival out-group. Therefore, referring to the MWH, I hypothesized an interaction between the vignettes and the aggression-for-status norm manipulation. The pro-aggression condition would drive participant endorsement of aggression higher in vignette 2 (and perhaps 3) than in vignette 1, and/or the anti-aggression condition would attenuate participant endorsement of aggression in vignette 1 more so than in vignettes 2 and 3.

With respect to age, the MWH has made no qualifications to date. That is, according to the MWH, males of all ages are presumably equally likely to engage in parochial altruism. Therefore, the MWH might not predict an effect of age. However, as outlined here repeatedly, large amounts of extant data demonstrate age to be negatively associated with aggressive behavior (e.g., Buss & Shackelford, 1997; Mesquida &

Wiener, 1999; U.S. Department of Justice, 2011; Wilson & Daly, 1985). As such, one might expect the same relationship between age and the *endorsement* of aggressive behavior (the younger the individual male, the more they will endorse aggression for status). Therefore it was hypothesized that there would be a main effect of age, with younger males generally endorsing aggression more than older males across all vignettes and aggression-for-status conditions. No interactions were predicted.

Prestige shared no first order correlations with any variables of interest (see below), so it was left out of all subsequent models. Dominance, as an approach to status acquisition, is largely defined by acquiring status through acts of coercion, threat, violence, etc. It therefore might be that individuals high in dominance would display higher endorsement of aggression for status acquisition across the board. However, dominance was only positively correlated with endorsement of aggression for vignette 1. Individuals are known to apply dominance and prestige strategies variably depending on context (McDonald, Navarrete, & Van Vugt, 2012). Therefore, it could be that dominance interacted with the vignettes due to contextual considerations, which is why it was only correlated with endorsement of aggression on a single vignette. The current state of the literature on the dominance-prestige scale leaves it difficult to articulate with any specificity what those considerations might be, so I remained agnostic about the role dominance might be playing.

To investigate these hypotheses, a repeated-measures ANOVA was performed, using age, dominance, and the aggression-for-status norm manipulation to predict participants' aggregated endorsement of aggression for status across the three different vignettes. The same Helmert contrasts used in the primary analyses were also used in the

repeated measures, comparing the pro-aggression condition to the neutral and anti-aggression conditions (contrast coefficients: 1, -0.5, -0.5) and comparing the neutral and anti-aggression conditions (contrast coefficients: 0, 1, -1). Interaction terms were created for the Helmert contrast codes, dominance, and age (Helmert I x dominance, Helmert II x dominance, Helmert I x age, Helmert II x age, age x dominance). Given dominance showed neither a significant main effect nor any significant interactions with any other variables in the model, dominance was dropped from the subsequent model for the sake of parsimony. The model was run again, this time using age, both Helmert contrasts, and their interaction terms to predict participants' endorsement of aggression for status across the three different vignettes. The summary statistics for this analysis are shown in Table 5.

Table 5. ANOVA results for participants' aggregated endorsement of aggression for status across the three different vignettes.

	F	*df*	*p*	*partial* η^2
Age	9.93	1, 565	0.002	0.02
Vignette	4.49	2, 1130	0.01	0.01
Pro vs. Neutral & Anti	165.26	1, 565	< 0.001	0.23
Neutral vs. Anti	87.06	1, 565	< 0.001	0.13
Age x Pro vs. Neutral & Anti	0.02	1, 565	0.90	0.01
Age x Neutral vs. Anti	2.75	1, 565	0.10	0.01
Age x Vignette	4.00	2, 1130	0.02	0.01
Vignette x Pro vs. Neutral & Anti	8.02	2, 1130	< 0.001	0.01
Vignette x Neutral vs. Anti	8.63	2, 1130	< 0.001	0.02

There was a significant main effect of age, a significant difference in the endorsement of aggression for status between the pro-aggression condition and the neutral and anti-aggression conditions, and a significant difference between the neutral and anti-aggression conditions. There were also multiple significant interactions. Vignette interacted with age, and a simple effects analysis showed that younger people endorsed John's behavior more so in vignettes 2 ($p = 0.001$, $d = -0.29$) and 3 ($p = 0.001$, $d = -0.24$), though there was no effect of age for vignette 1 (see Figures 2-4).

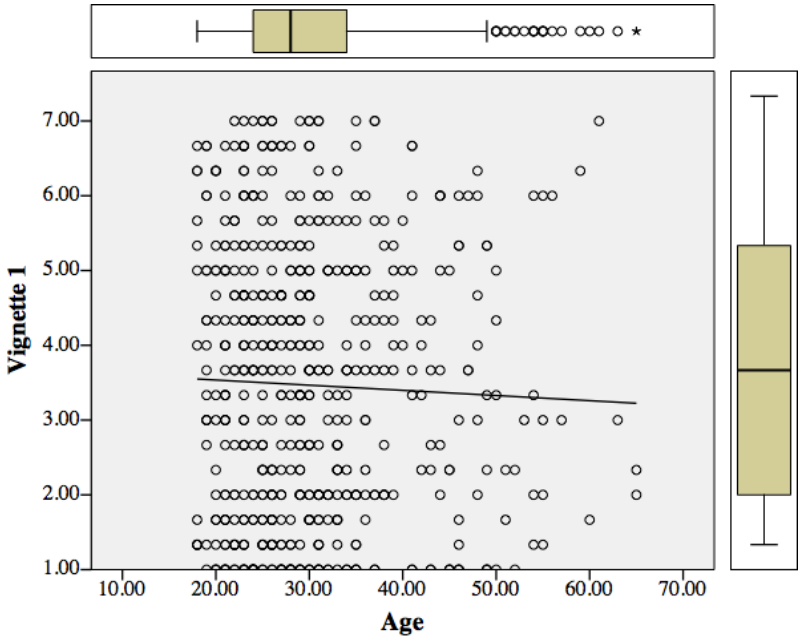

Figure 2. Vignette x age interaction (no effect of age for vignette 1).

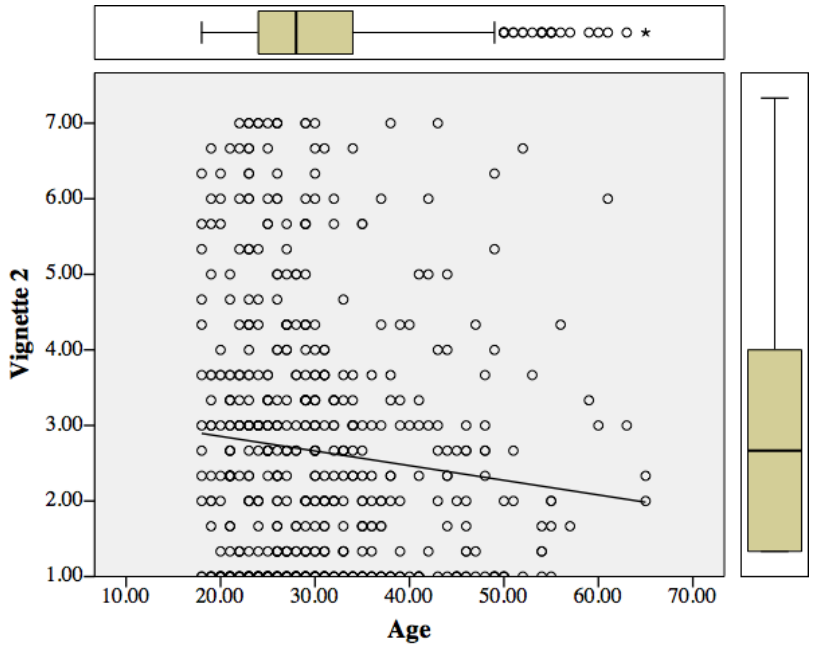

Figure 3. Vignette x age interaction (significant effect of age for vignette 2)

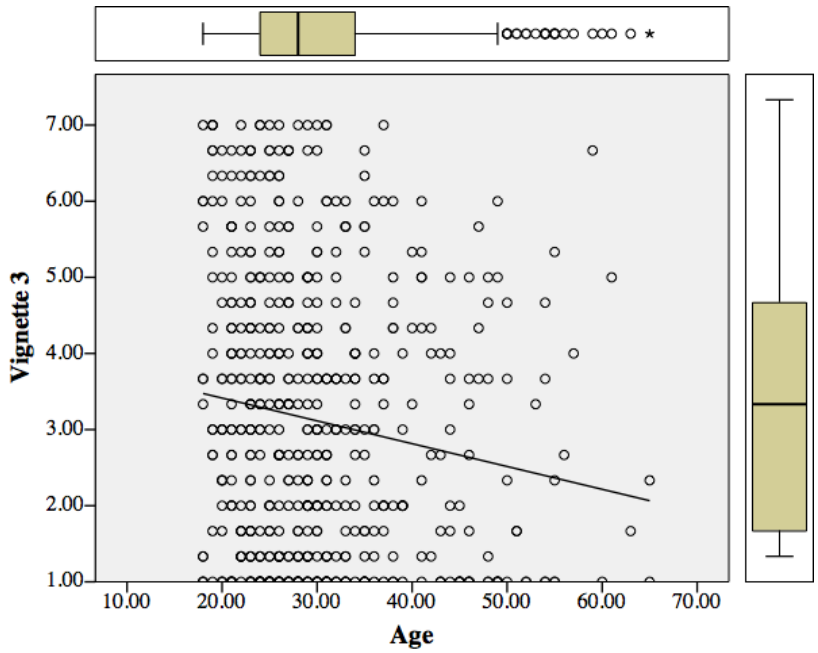

Figure 4. Vignette x age interaction (significant effect of age for vignette 3)

Vignette also interacted with the aggression conditions (i.e., both Helmert contrasts). A simple effects analysis revealed that participant endorsement of John's aggressive behavior significantly varied by each vignette for both the pro- and neutral

conditions of the aggression-for-status norm manipulation. That is, in the pro-aggression condition there were significant differences in endorsement of John's aggressive behavior between vignettes 1 and 2 ($p < 0.001$, $d = 0.61$), between vignettes 1 and 3 ($p < 0.001$, $d = 0.20$) and between vignettes 2 and 3 ($p < 0.001$, $d = -0.41$). In the neutral condition there were likewise significant differences in endorsement of John's aggressive behavior between vignettes 1 and 2 ($p < 0.001$, $d = 0.73$), between vignettes 1 and 3 ($p < 0.001$, $d = 0.32$) and between vignettes 2 and 3 ($p < 0.001$, $d = -0.41$). For the anti-aggression condition, vignette 1 significantly differed from vignette 2 ($p < 0.047$, $d = 0.19$) and from vignette 3 ($p < 0.02$, $d = 0.18$), but the latter two did not significantly differ from each other ($p < 0.96$, $d = 0.01$; see Figure 5).

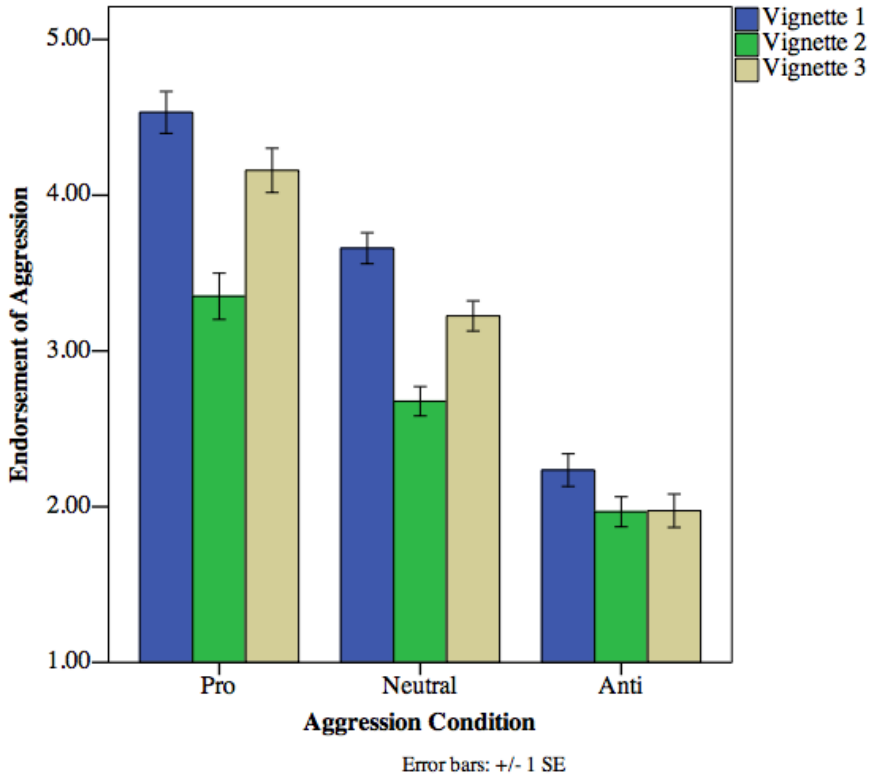

Figure 5. Vignette x Aggression Condition interactions.

As a reminder, after the UG the participants were asked a series of questions. The first 4 questions were about the participant's perception of the offer (whether it was fair/unfair, respectful/disrespectful, generous/greedy, or friendly/aggressive). There were another 4 questions about the nature of their decision to accept or reject (again, whether it was fair/unfair, respectful/disrespectful, generous/greedy, or friendly/aggressive). A series of one-way ANOVAs revealed that none of these significantly varied as a function of aggression-for-status condition except one. The extent to which individuals rated that their acceptance/rejection of the offer was friendly/aggressive significantly varied according to aggression-for-status condition, $F(1, 570) = 4.22$, $p = 0.02$. It looked as though the participants in the pro-aggression condition reported their decision as aggressive more so than participants in the anti-aggression condition. A confounding issue in these results was, of course, their actual decision (accept vs. reject). There is no conceivable reason why someone who accepted an offer would rate it as aggressive and indeed there appeared to be no variability in this question among those who accepted. However, those who rejected an offer are likely to vary in their intent. That is, the decision to reject could be intended to "harm" the person who made the unfair offer (and is therefore more aggressive), or the decision to reject could be an impersonal rejection of an offer not perceived to be fair (and is therefore less aggressive). Limiting the one-way ANOVA to individuals who rejected the offer, there were significant differences between the endorsement of aggression for status conditions, $F(2, 309) = 5.97$, $p = 0.003$. A Bonferroni corrected post hoc analysis showed that those in the pro-aggression condition

and those in the neutral condition both rated their decision to reject as aggressive more so than those in the anti-aggression condition ($p = 0.003$, and $p = 0.04$, respectively)[1].

Using available measures, I wanted to explore possible moderators of this effect, looking again at age and dominance. Might those high in dominance be more likely to report their rejection of the offer as aggressive, irrespective of aggression condition (i.e., a main effect)? Or might the pro-aggression condition maximize this interpretation through teammate endorsement among those high in dominance, while the anti-aggression condition attenuates this interpretation (i.e., an interaction). Again, the subtleties of social context that drive individuals to vacillate between approaches of dominance and prestige for status acquisition and maintenance have yet to be articulated with any specificity. This makes informed hypothesizing about possible interactions challenging. Therefore, I predicted a main effect of dominance, such that those high in dominance would rate their decision to reject as "aggressive" across all conditions of the norm manipulation. This was a single question (and therefore not a repeated measure), so a linear regression was used to explore the possible mechanisms. Only participants who rejected the offer were part of this analysis. Age, dominance, and the previously described Helmert contrasts, as well as all two-way interaction terms, were used in a stepwise regression to predict participant rating of their decision to reject as aggressive.

[1] To be comprehensive, a 3x2 ANOVA was performed, using "decision was friendly/aggressive" as a dependent variable and the aggression condition and UG decision as independent variables. Analysis revealed a trending main effect for the aggression condition, $F(2, 567) = 2.87$, $p = 0.06$, and a trending interaction, $F(2, 567) = 2.93$, $p = 0.05$. A simple effects analysis showed that individuals who accepted did not vary in their aggression rating across groups, as would be expected. Of those who rejected, the individuals in the pro-aggression condition ($M = 5.03$, $SD = 1.58$; $p = 0.001$) and in the neutral condition ($M = 4.82$, $SD = 1.59$; $p = 0.01$) reported their decision to reject as aggressive significantly more so than individuals in the anti-aggression condition ($M = 4.25$, $SD = 1.82$).

Age and dominance were added to the model first, and then the Helmert contrasts, and finally the interactions were added in the third step. The results of this regression analysis are summarized in Table 6. Neither age nor dominance explained a significant portion of variance in participant interpretation of their decision to reject as aggressive, $R^2 = 0.01$, F (2, 307) = 0.71, $p = 0.49$. The addition of the aggression conditions significantly contributed to the model, $\Delta R^2 = 0.04$, F (2, 305) = 6.18, $p = 0.002$. Participants in the pro-aggression condition rated their decision as more aggressive than participants in the neutral and anti-aggression conditions, and participants in the neutral condition rated their decision as more aggressive than those in the anti-aggression condition. The addition of the interaction terms did not significantly contribute to the model, $\Delta R^2 = 0.02$, F (5, 300) = 1.40, $p = 0.27$.

Table 6. Summary of the regression analysis for variables predicting ratings of decision to reject as aggressive (n = 309).

Variable	Model 1				Model 2			
	B	*SE B*	*β*	*p*	*B*	*SE B*	*β*	*p*
Age	-0.01	0.01	-0.07	0.25	-0.01	0.01	-0.08	0.18
Dominance	0.01	0.01	0.02	0.78	0.01	0.01	0.02	0.77
Helmert I					0.33	0.13	0.14	0.01
Helmert II					-0.30	0.12	-0.14	0.01
					Model 3			
Age x Dominance					0.01	0.01	-0.33	0.26
Age x Helmert I					0.01	0.01	0.12	0.35

Age x Helmert II					0.01	0.01	0.05	0.40
Dominance x Helmert I					-0.01	0.02	0.08	0.71
Dominance x Helmert II					-0.02	0.02	-0.22	0.35

Group Manipulation: Despite the methodological confound of the group manipulation, further analyses were conducted in order to explore, understand, and improve it for future investigations. Because one original goal was to investigate possibly differing rates of rejection when interacting with a teammate vs. a rival, it was reasoned that it might be useful to look at the belief participants had about the person with whom they were interacting (did they *think* it was a teammate, or a rival?) instead of looking at the condition to which they were assigned (were they *actually* interacting with a teammate, or a rival?). A Chi-Square analysis did yield marginally significant differences, with those who reported they were interacting with a rival being more likely to reject an offer compared to those who reported they were interacting with a teammate (χ^2 (1, 559) = 3.99, p = 0.046). This differed from the Chi-Square analysis using the actual condition (i.e., the condition to which they were assigned, rather than the condition they reported), which yielded no significant differences.

Seeing the interaction (reported above) between age and vignette (older participants being less inclined to endorse aggression for status in conditions of conflict with a non-in-group member), I decided to reinvestigate the effect of the group belief on the primary DV (i.e., the decision to accept or reject the unfair offer in the UG). Again, when using what participants reported (i.e., with whom they thought they were interacting, instead of the condition to which they were actually assigned), a Chi-square

analysis showed that when participants reported to be interacting with a rival they were significantly more likely to reject the unfair offer. Performing the same analysis, but this time limiting the sample to participants below the age of 30, the results showed an increased effect size (Cramer's V = 0.09 vs. Cramer's V = 0.12). Performing this analysis but limiting the sample to participants 30 years of age and over, there was no significant effect.

Ultimatum Game: Given the debate about what the UG is measuring—rational responses to unfair behavior, or aggression *per se*—a series of questions followed participants' decision in the UG. They were asked four questions about how they perceived the offer: Was it fair vs. unfair, respectful vs. disrespectful, generous vs. greedy, and friendly vs. aggressive? They were also asked four questions about how they perceived their decision to accept or reject: Again, was it fair vs. unfair, respectful vs. disrespectful, generous vs. greedy, and friendly vs. aggressive? Finally, they were asked three questions about their feelings upon seeing the offer: Did you feel calm vs. bothered, upbeat vs. dejected, and happy vs. angry? A series of independent samples t-tests were performed to better understand the differences between those who chose to accept the unfair offer, vs. those who chose to reject the unfair offer. Regarding the perceptions of the offer, there were significant differences between those who chose to accept and those who chose to reject, for all four questions, with those who chose to reject rating their perception of the offer more negatively (e.g., more unfair, more disrespectful). For the questions pertaining to perception of their own decision to accept or reject, there were also significant differences but only for three of the four questions. Participants rated their decision to accept or reject as equally fair. There were also significant differences in the rating of

their emotions upon seeing the unfair offer, with those rejecting rating their emotions as more negative. See Table 7 for full results.

Table 7. Independent samples t-tests for perceptions of offer, decision, and affect

	t	*P*	95% CI		Cohen's d
			Lower	Upper	
Offer: Fair vs. Unfair	-7.88	<0.001	-0.96	-0.58	-0.66
Offer: Respectful vs. Disrespectful	-6.17	<0.001	-0.77	-0.41	-0.52
Offer: Generous vs. Greedy	-5.98	<0.001	-0.58	-0.3	-0.51
Offer: Friendly vs. Aggressive	-4.97	<0.001	-0.63	-0.27	-0.42
Decision: Fair vs. Unfair	-0.67	0.51	-0.32	0.16	-0.06
Decision: Respectful vs. Disrespectful	-8.37	<0.001	-1.41	-0.87	-0.71
Decision: Generous vs. Greedy	-14.05	<0.001	-1.95	-1.47	-1.18
Decision: Friendly vs. Aggressive	-16.44	<0.001	-2.54	-2.01	-1.38
Calm vs. Bothered	-4.62	<0.001	-0.99	-0.41	-0.39
Upbeat vs. Dejected	-4.08	<0.001	-0.66	-0.23	-0.34
Friendly vs. Angry	-5.75	<0.001	-0.77	-0.38	-0.48

Table 8. Descriptive statistics for offer, decision, and affect

	Accept		Reject	
	M	SD	M	SD
Offer: Fair vs. Unfair	5.56	1.40	6.33	0.92
Offer: Respectful vs. Disrespectful	5.53	1.25	6.11	1.01
Offer: Generous vs. Greedy	6.09	1.00	6.52	0.74
Offer: Friendly vs. Aggressive	5.59	1.19	6.03	0.98
Decision: Fair vs. Unfair	2.20	1.45	2.28	1.46

Decision: Respectful vs. Disrespectful	2.44	1.58	3.58	1.46
Decision: Generous vs. Greedy	2.14	1.44	3.85	1.46
Decision: Friendly vs. Aggressive	2.45	1.61	4.72	1.68
Calm vs. Bothered	4.19	1.79	4.88	1.81
Upbeat vs. Dejected	4.93	1.25	5.37	1.33
Friendly vs. Angry	4.76	1.22	5.33	1.17

CHAPTER IV

DISCUSSION

The primary goal of this study was to investigate potential moderating variables between 2D:4D and aggressive behavior, by exploring the conditional nature of aggressive behavior based on social norms pertaining to status. Given the inconsistent nature of previous results tentatively linking the 2D:4D and aggression, it was posited that, instead of 2D:4D predicting aggression *per se*, perhaps 2D:4D is associated with status acquisition/maintenance and would only be associated with aggression when aggression was perceived to be good for status (Millet, 2010). Status is primarily allocated by others based on their perceptions of one's adherence to group norms and usefulness in accomplishing group goals (Magee & Galinsky, 2008). Therefore, the utility of aggression as a means to acquiring status was manipulated across three groups by changing the group norms associated with aggression. In one group aggression was endorsed as a legitimate means to gaining status, in a control group aggression-for-status was left ambiguous, and in a third group aggression was proscribed as a means for gaining status. Low 2D:4D individuals (i.e., presumably status-oriented individuals) were hypothesized to be most sensitive to this and most likely to adjust their behavior accordingly. It was consequently predicted that low 2D:4D individuals would be the most likely to reject an unfair offer in the Ultimatum Game in the pro-aggression condition and least likely to reject an unfair offer in the anti-aggression condition (Millet & Dewitte, 2008; Millet & Dewitte, 2009). Further, the MWH predicts that in times of potential conflict males will demonstrate parochial altruism, favoring in-group members and expressing coalitional aggression toward out-group members (Van Vugt, 2009;

McDonald, Navarrete, & Van Vugt, 2012). To the extent that 2D:4D is a proxy of exposure to prenatal androgens, and hence, androgenization or "masculinization" of the human brain in development, then lower 2D:4D should predict increased hostility toward out-group members and, at the very least, diminished hostility toward in-group members. Finally, given the above rationale, a three-way interaction was predicted such that low 2D:4D individuals would be the most aggressive when in the pro-aggression condition and interacting with a rival, and the least aggressive when in the anti-aggression condition and interacting with a teammate.

None of the primary hypotheses received support from the data. 2D:4D was unrelated to any measured variable. Further, there was a problem with the group manipulation that made a proper analysis, and hence, a proper test of these hypotheses, problematic. A notable subset of participants responded incorrectly to a question about whom they were interacting with during the Ultimatum Game. Specifically, a large proportion of individuals in the teammate condition incorrectly reported as having interacted with a rival. However all is not lost and, in fact, some useful information may still be gleaned from the data.

GROUP MANIPULATION

It is important to note that the errors participants made regarding the group manipulation were systematic. Of the 129 individuals who answered incorrectly, 114 of them were in the team condition but reported being in the rival condition. The source of this bias is unclear. It was hypothesized that perhaps individuals, after having been told who their interlocutor was, simply forgot when asked due to too much time having passed and too much information having been processed. They then may have used the

offer as a heuristic since it was more recent and probably more salient. If one cannot remember with whom they were interacting then it makes sense to use the offer, which was low, to assume it must have been a rival since a teammate presumably would not do such a thing. There is evidence that people can use heuristics in their decision to accept or reject an offer (Stephen & Pham, 2008). However, currently there is no research suggesting that the offer amount can be used as a heuristic when attempting to recall details about those who made the offer, so this interpretation is necessarily speculative. Another possibility is that this question is an unintentional suspicion check. That is, perhaps participants could accurately remember who they were told they were interacting with but, since the offer was low, they assumed they were being "tricked" by researchers. They may have perceived the question as implying, "You were told with whom you would be interacting. Now that the interaction is over, with whom do you think you were *really* interacting?" Unfortunately it is impossible to test either of these hypotheses with the current data since it was an unintended and unforeseen outcome. It also could be due to an error in the way the information was conveyed to the participants, leaving many of them truly unsure about with whom they were interacting. Yet such error would presumably be random, which was not the case.

Despite the group manipulation being confounded, to the extent that participants reported they were interacting with a teammate or a rival did relate to their decision to accept or reject the offer in the Ultimatum Game. That is, using participant reports on who they were interacting with, instead of which condition they were actually assigned to, showed that those who reported as interacting with a rival rejected the offer disproportionately to those who reported as interacting with a teammate. This is a

methodological failure but perhaps nonetheless implies a (flawed) conceptual success, since the ultimate goal was to see how individuals treated others based on what they *believed* about their group membership. Still, this made the primary model problematic to analyze since the group manipulation was not methodologically sound, and any attempts to do so in spite of this failure yielded null results regarding the primary hypotheses, anyway.

AGRESSION-FOR-STATUS NORM MANIPULATION

The group manipulation confound made other analyses challenging as well. Of those in the pro-, neutral, and anti-aggression conditions, half of each group would have also been assigned to the teammate condition, which was problematic due to the large amount of participant error. Ignoring this source of error and keeping all participants in the analysis, there was no difference in rejection rates between the pro-, neutral, or anti-aggression conditions. Excluding all participants in the teammate condition, since that is where the error seemed to reside, also yielded no differences in rejection rate between the aggression conditions. This latter analysis also severely reduced the sample size, which may also have obscured any possible effects. In summary, all analyses of the aggression condition yielded no observable effects on the primary DV, which was the decision to accept or reject the unfair offer in the UG. It still may be premature to discount the manipulation.

There were many significant effects of the manipulation on the secondary DVs. For example, the extent to which participants endorsed John's actions as likely to earn his friends' respect, liking, or perceptions of being a leader all varied as a function of the condition to which they were assigned for every single vignette. Participants in the pro-

aggression condition endorsed John's aggressive behavior for the acquisition of status significantly more so than those in the neutral condition, who in turn endorsed John's aggressive behavior more than those in the anti-aggression condition. This is despite the fact that all participants read identical vignettes. The only difference was their teammates' reports on John's behavior, which participants read before giving their own answer. The sizes of these effects were not trivial (*partial* η^2 ranging from medium (0.13) to large (0.23). So why might the norm manipulation affect participant endorsement of aggressive behavior for status, but not affect their behavior in the UG?

One interpretation is that participants were simply subject to social pressure. That is, individuals felt pressure to adjust their answers to their teammates' answers since participants were outnumbered (Asch, 1951). This pressure might account for the fact that participant's answers varied as a function of aggression condition, yet so did the extent to which participants reported that they related to their group, with people in the pro-aggression condition relating to their team the least and people in the anti-aggression condition relating their team the most. In short, perhaps they did not agree with, and thus did not relate to, their teammates but they nonetheless adjusted their answers to match their teammates because they felt outnumbered. A more distal evolutionary explanation of the above effect is that acquiescence to group norms is a way of signaling the potential of cooperative behavior. Mathematical models have shown that signaling, even if costly, is a way for an individual to display his or her quality as a mate, coalition partner, or competitor (Gintis, Smith, & Bowles, 2001), and that strong reciprocity—one side of which is a proclivity to cooperate with in-group members—may be an evolutionarily selected trait that facilitates cooperation among non-kin (Gintis, 2000; Bowles & Gintis,

2004). Displaying agreement with group norms, even if one does not actually agree, could be a quick and clear signal in otherwise ambiguous situations that an individual is a worthy, i.e., a cooperative, teammate.

Further, there is evidence to suggest that distance, both psychological and physical, can moderate susceptibility to social influence. Ledgerwood and Callahan (2012) reasoned that, "The social norm today is likely to be the same as the social norm next year and will be relevant across a wide range of contexts. Thus, if psychological distance truly increases the extent to which evaluations incorporate information relevant for relating to an object across contexts, it should strengthen the tendency for a person's opinions to align with those of his or her group," and they found evidence supporting this. The psychological distance that strangers have when interacting online should result in increased susceptibility to social influence when it comes to evaluating normative information, and the results of the current study support this notion. As such, many possible psychological phenomena may account for the effects of normative information influencing participant endorsement of John's behavior despite them concurrently reporting their ability to relate to their teammates least in the pro-aggression condition. Whether they actually endorsed John's behavior privately cannot be ascertained by the current measures, however, so future research might attempt to disentangle public vs. private conformity.

Yet there is more to the story here. Of those who rejected the offer, participants in the pro-aggression condition rated their rejection as "aggressive" significantly more so than those who rejected in the anti-aggression condition. Participants also rated their teammates as more likely to respect them and view them as a leader based on which

aggression condition they were in, depending on how the behaved in the UG. Those who rejected the offer rated their teammates as more likely to respect them and view them as a leader when in the pro-aggression condition than when in the anti-aggression condition. Those in the pro-aggression condition who rejected also felt their teammates would respect them and view them as a leader when they rejected more so than when they accepted.

Given that most of the secondary DVs suggested the aggression-for-status norm manipulation affected participants in a variety of arguably intuitive ways, why then were there no differences in the rejection rate of the offer, which after all was the primary DV? There are many possibilities. The first and most obvious conclusion is that the manipulation affected social signaling; however, the inability to relate to such norms in the pro-aggression condition, as captured by participant ratings, impeded the influence on behavior in the UG (as outlined above). That is, there may not be a behavioral effect, which is why one was undetected. In seeing their teammate's values on display, participants may have been willing to "play along" by giving lip service in order to appear as a cooperative teammate, which would account for the differing responses to the vignettes between the aggression groups. Yet when it was (allegedly) time to acquire tickets for a chance at winning a gift card they defaulted to more self-oriented behavior. In short, in this specific context group norms may not affect an individual's behavior as soon as any kind of resource is at stake for that individual.

Conflicts between the interests of the self and that of the group can play out in complex ways (Bornstein, 2003). This may be an instance of that, no doubt influenced by the *ad hoc* nature of group formation in this study. Again, there was an effect of the norm

manipulation on participants' evaluation of John's behavior, but no effect on participants' decision to accept or reject an unfair offer. Given the former, the latter may be an informative null result. Nearly everyone wants to feel like a valued member of one's group (Anderson, Hildreth, & Howland, 2015). Valuation by the group is often determined by the adherence to and the expression of group norms, and these norms are often derived from group goals (Magee & Galinsky, 2008). However, when a proximate group goal is "conflict with another group", or even when an individual faces interpersonal conflict that will knowingly be perceived by group members and filtered through the lens of group norms, some individuals can feel psychologically and/or physically unsuited for the task. After all, be it physical or otherwise, be it personal or group-oriented, conflict is risk. This puts one in a quandary: "I want my group to value me. Members allocate my value based largely on my perceived suitability for accomplishing group goals and my adherence to group norms. However, the current situation is one in which I find myself hard pressed to adhere to group norms. What do I do?"

One solution to such a dilemma, though itself not without risk, is so simple and common as to be trite. Aggression and conflict can indeed be costly, but talk is cheap. During times of threat one can signal one's adherence to the group and its norms by verbally endorsing behaviors that one may have no intention to carrying out personally. After all, the pending conflict may never actually come to fruition. An individual's bluffing or saber rattling may not be solely serving the function of (hopefully) intimidating the opponent(s). It may also preserve or even be an opportunity to improve the individual's status within the group during this transient time of interpersonal or

intergroup tension—again, even if that individual has no intent to act upon their norm-driven proclamations. There are many terms and phrases for this type of behavior: False bravado, bluster, "all bark and no bite", a paper tiger, or in the case of pending violent military conflict, a chicken hawk.

When asked about their decision to accept or reject the unfair offer in the UG, and whether their teammates would respect them or view them as a leader based on that decision, participants reflected and reported, with their responses breaking down based on the aggression condition to which they were assigned. This is informative. At the very least, it suggests their continued awareness of their teammates' values (i.e., their group's norms) throughout the experiment. This further suggests that, to the extent that there was no effect of the norm manipulation on the DV, this was not because they had forgotten their group's norms (at least when asked). If this is the case then the fact that the norm manipulation affected participant endorsement of aggression yet did not affect their decision to accept or reject the unfair offer is meaningful. Again, it could be that individuals were signaling their adherence to group norms but nonetheless unwilling to let such norms dictate their behavior because of their disagreement with such norms (i.e., based on their reported ability to relate to their teammates). That is, this could be a "paper tiger" phenomenon in which individuals endorse aggression for social reasons but fail to act aggressively due to personal risk. This notion of a paper tiger may be best interpreted in light of a dual-process theoretical perspective on moral judgment (Greene et al., 2004).

Of those who rejected the unfair offer, participants in the pro-aggression condition of the norm manipulation rated their rejection as "aggressive" more than those in the anti-aggression condition. This is curious because these are identical responses

from participants (rejection of unfair offer) being interpreted differently (more or less aggressive) based on the aggression condition of the norm manipulation. According to dual-process theory, reasoning can be conceived of as being executed by two separate systems, with on system being automatic, associative, and often emotionally driven, while the second system is slower, deliberate, and potentially rule-governed (Kahneman, 2003; Greene, et al., 2004). Given that it is the least resource intensive, the automatic system is what individuals generally rely on. They only transition to the second system when engaged in more demanding tasks. It could be that participants sensed potential loss or personal risk and reacted emotionally to the low offer in the UG. They therefore defaulted to the automatic, emotionally driven system in their decision to accept or reject. Presumably a reflexive response would not be influenced by the inputs of norms recently gathered from a newly formed group, and hence there would be no effect of the norm manipulation on the decision to accept or reject. However, the second, more deliberative, system might be required to articulate the intent behind one's decision, in which case participants might then cognitively reflect on group norms and use them to justify their decision *post hoc*. In short, group norms—in this case particularly those of an impromptu, *ad hoc* group—may not influence an individual's behavior, particularly when norm-consistent behavior results in notable personal risk; yet, they may nonetheless influence an individual's interpretation of his (or her?) behavior after the fact when doing so is advantageous.

Even with a "paper tiger" interpretation in hand, it is still not the whole picture. Exploratory analyses showed that there was a main effect of age, with younger males generally endorsing aggressive behavior for status more so than older males. This general

tolerance of, or even support for, aggression among younger males is not entirely surprising, however, given that young males are primary drivers of violent crime, for example (U.S. Department of Justice, 2011). There was also an interaction between age and vignette regarding the endorsement of John's aggressive behavior. Specifically, there was no effect of age in the rating of John's behavior in vignette 1, but there was an effect of age in the rating of John's behavior in vignettes 2 and 3. In vignettes 2 and 3 exclusively, older participants endorsed John's aggressive behavior significantly less than younger participants. Again, vignette 1 was meant to capture aggression-for-status within the in-group, vignette 2 was meant to capture aggression-for-status between two explicit rival groups, and vignette 3 was meant to capture a moment of "random" aggression toward a stranger who is not an in-group member but who is also not a member of an explicit rival out-group. It would seem that older males are less inclined to endorse aggression as a means to status acquisition and maintenance in contexts of out-group conflict (or conflict with an non-in-group member).

To bolster this notion further, when looking at with whom participants reported they were interacting during the UG, a teammate or a rival, participants did reject an unfair offer more when they reported as having interacted with a rival; however, the effect size of this phenomenon was larger when looking at only those individuals under 30 and vanished when looking at individuals 30 and over. Should results like these be replicated consistently, perhaps the Male Warrior Hypothesis should be renamed the Young Male Warrior Hypothesis. Conceptually, this observation is not unique (*see* Mesquida & Wiener, 1996 *and* Mesquida & Wiener, 1999). It also suggests that while the proclivity to endorse coalitional aggression as a means to gaining/maintaining status may

attenuate with age, the endorsement of aggression for gaining/maintaining status within one's in-group does not necessarily. Again, this may not be terribly surprising given the intrinsic and far-reaching human concern with status within one's group (Anderson, Ames, & Gosling, 2008; Anderson, Hildreth, & Howland, 2015; Magee & Galinsky, 2008; Pettit, Yong, & Spataro, 2010; Zitek & Tiedens, 2012).

Another important consideration gleaned from the current study is the importance of context outside of group norms. That is, the aggression-for-status norm manipulation affected participant endorsement of John's aggressive behavior across all vignettes, but not equally so. Only in the anti-aggression condition did each vignette not significantly differ in participant endorsement of aggressive behavior, and that lack of difference might be due to a "floor effect", in that participant endorsement of aggression in that condition was so low that it may not have generated enough variability for differences between all vignettes to be detected. Even so, in the anti-aggression condition vignette 1 received more endorsement of aggression that both vignettes 2 and 3. In fact, vignette 1 received the strongest endorsement of John's aggressive behavior across the board. This is interesting because it is also the only condition in which there is in-group aggression taking place and the MWH hypothesis would seem to suggest that males should engage in more favoritism (i.e., less aggression) toward in-group members (McDonald, Navarrete, & Van Vugt, 2012). In this vignette John was shoved first, so it may be that participants perceived him as being provoked. However provocation took place in all vignettes. In vignette 2 John was provoked verbally, but he escalated the situation to one of potential physical violence. Perhaps that is why vignette 2 received the least amount of endorsement across all conditions. In vignette 3 John was the "victim" in that a careless

driver cut him off, yet he also may have been perceived as escalating the situation by rolling down the window and retaliating verbally, but not physically, which may be why endorsement of vignette 3 fell in between 1 and 2. In short, in vignettes 2 and 3 John may be perceived as escalating a confrontation to varying degrees, but vignette 1 may be perceived as a more justified "tit-for-tat" response, and this perception of escalation might have attenuated participant endorsement of his behavior despite the "teammate endorsement" not wavering.

2D:4D

The measurement of 2D:4D appeared sound, with the left and right hands being correlated well and the distributions of both hands appearing normal. This is despite it being an online measurement of pictures uploaded by participants, as opposed to the more traditional in-person measurements taken in a laboratory environment. However, 2D:4D showed no significant effects with any measured variable; again, the only exception being the correlation between the right and left hands of participants, suggesting it was measured adequately. This may not be entirely surprising given the inconsistency with which 2D:4D yields significant relationships in general (e.g., Putz et al., 2004), however one of the primary goals of this study was to address that very inconsistency theoretically (Millet, 2010). Despite the lack of evidence, concrete success or failure in this regard cannot be determined with any confidence due to previously discussed methodological issues with the group manipulation and the inability to detect behavioral differences on the dependent variable in the aggression manipulation.

It may be telling, however, that even when significant relationships were found with other variables, 2D:4D still played no role. For example, if 2D:4D is associated with

status acquisition and maintenance, then presumably it should be associated with increased ability to detect a group's status-relevant norms. After completing the vignette questions and seeing what their team values were with regards to aggression and status acquisition, when participants were asked what their group valued (aggression, compassion, fairness, etc.), there were no significant differences in ratings between high and low 2D:4D participants based on the aggression condition to which they were assigned. Nor were there any interactions between aggression conditions and 2D:4D regarding whether one's teammates would respect them or view them as a leader based on their decision to accept or reject. It could be that the aggression manipulation was strong enough to provide a ceiling effect (or floor effect, depending on the condition) that would obscure differences between high and low 2D:4D. That is, the team's values were so explicit that anyone could perceive them equally well, irrespective of status orientation. Of course, if the aggression manipulation was this strong, then this begs the question of why did it not interact with 2D:4D to affect behavior in the UG?

Again, effects of 2D:4D are notoriously inconsistent and generally small when present (e.g., Putz et al., 2004; Vorcek & Loibl, 2009; Hönekopp & Watson, 2010). Further, many studies include measurements of both the left and right hand, the mean of the two, and the difference between the two, in addition to including a variety of other trait and behavioral variables of interest (Putz et al., 2004). As mentioned above, as of 2009 there were over 300 papers documenting relationships between 2D:4D and various traits and behaviors, and there are certainly more now, many with results hinting at a narrative. Yet although it was stated at the outset that it seems unlikely the entirety of the literature on 2D:4D is an aggregate of Type I errors, given its context, the file drawer

effect, and recent concerns with replication in social psychology (Ioannidis, 2005; Open Science Collaboration, 2015), this may not be outside the realm of possibility. In fact, it is a legitimate concern in this case particularly since small effect sizes are even more demanding of large sample sizes for dependable results, requiring many hundreds of participants (Schönbrodt & Perugini, 2013). To put it clearly, with a history of inconsistent and small effect sizes, questionable statistical power, and a large set of variables from which to cherry pick a statistically significant relationship, the importance of 2D:4D as a viable biological variable within psychology requires some serious and honest scrutiny[2].

For 2D:4D to stand uncontested as a variable associated with multiple human traits and behaviors, more research needs to be performed using larger sample sizes and consistent measures. To the extent that any remotely consistent results already exist, they seem to point at the right hand as being the most common suspect and, combined with animal studies suggesting the same (Manning, 2011; Zheng & Cohn, 2011), future studies would do well to limit their primary analyses to the right hand only. More importantly, this should be combined with having theoretically driven *a priori* hypotheses with an upward limit on variables included in the analyses so as to attenuate the likelihood of Type I error.

ULTIMATUM GAME

The UG did not reveal consistent differences in behavior based on the primary manipulations in the current study. However, questions posed to participants following

[2] Indeed, after the current study was completed but before it was written, Turanovic, Pratt, and Piquero (2017) provided meta-analytic evidence that places the alleged relationship between 2D:4D and aggressive behavior in serious doubt.

their decision in the UG revealed potentially interesting insights. That there were differences between those who accepted and those who rejected regarding their perceptions of their decision to accept or reject is not entirely surprising. People who accept are not likely to rate their acceptance as "aggressive". People who reject are not likely to rate their rejection as "generous". Interestingly though, whether participants accepted or rejected, they rated their decision as "fair" roughly equally. This may not be surprising when interpreted through the lens of how they perceived the offer.

Those who rejected the offer rated their perception of it as more unfair, greedier, more disrespectful, and more aggressive than those who accepted. They also rated themselves as having more negative affect upon seeing the offer (i.e., more bothered, more dejected, and angrier), relative to those participants who accepted. If one perceives an offer as particularly unfair, aggressive, disrespectful, etc., then they are likely to view their rejection as "fair", in a tit-for-tat sense; however, if one is less negatively affected by their perceptions of the offer then they may perceive their acceptance of the offer as "fair" in spite of, or perhaps even because of, it being a low offer. If we consider the largest effect sizes of the mean differences among these various ratings, then the picture we are left with is that participants who rejected the offer perceived it as particularly unfair, were particularly angered by this, and therefore rejected the offer with the intent to harm (i.e., aggressive intent). Do these data then suggest that the UG is a legitimate measure of aggression and not simply a measure of broader socioeconomic behavior? This is a false dichotomy, of course, because aggression can be part of socioeconomic behavior. Given that participants in the pro-aggression condition rated their rejection as more aggressive than those in the anti-aggression condition, it would seem that rejection

in the UG *can* be an act of aggression, but only for some people and only some of the time.

At worst this suggests that the UG is not a particularly clean measure of aggressive behavior. At best, however, to the extent that the UG does capture a modicum of aggression, it may be a particular kind of aggression. Altruistic punishment is when individual punish despite the fact that the punishment is costly to them and yields no gain (Fehr & Gächter, 2002). Again, looking at the effect sizes of the follow up questions, participants who rejected were the most angered, and with regards to the perceived unfairness of the offer. This is in line with aggressive behavior. Yet keeping in mind that rejection of the offer guarantees that no one gets anything, rejection in the UG may be a specific manifestation of altruistic punishment. There is intent to punish (or harm, i.e., aggression) but at the cost of one's forsaken gains. This is a subtle but important detail for those contemplating use of the UG in the context of broader aggressive behavior. Another subtlety not addressed in the current study is that of implicit motives. The self-report measures in the current study addressed only explicit motives, yet it is known that implicit motives are associated with dominance and other status relevant variables, such as testosterone, gaze aversion, and even implicit learning in contest situations (Schultheiss, Campbell, & McClelland, 1999; Schultheiss & Rohde, 2001; Terburg, Hooiveld, Aarts, Kenemans, & van Honk, 2011). Future studies exploring the UG may consider investigating the role such implicit motives may play in the decision to accept or reject an unfair offer.

Nonetheless, in hindsight it would seem that other measures of aggression might yield greater insight than the UG for the purposes of this study. For example, the

aggression manipulation consisted of vignettes that primarily focused on reactive, physical aggression. This was to ensure the aggression manipulation was salient, but such direct aggression may not translate behaviorally to the less explicit aggression inherent in rejecting an unfair offer in the Ultimatum Game. Using a measure such as the Taylor Aggression Paradigm (TAP), which is more associated with physical aggression (Giancola & Parrott, 2007), might provide more insight about the aggression-for-status manipulation. That is, a better match between the type of aggression in the manipulation and the type of aggression in the dependent variable may work to maximize differences in behavior between the groups. The TAP has the added benefit of measuring three different types of aggressive responses: Unprovoked, retaliatory, and extreme (Giancola & Parrott, 2008). In the first round of the reaction time competition within the TAP, the participant is often predetermined to "win", thus allowing them to determine the magnitude and length of the "punishment" without having received it themselves. As such, this is a measure of their tendency to aggress without having been provoked. After the trials continue and the participant loses a round and are "punished", researchers can see how the participant's future punishments change. That is, how the participant aggresses in retaliation to the punishment they received. Finally, researchers can look at the overall magnitude and length of punishment each participant engaged in, giving a measure of "extreme" aggression for those who selected higher magnitudes and greater durations of punishment on average over the course of the procedure. To the extent that status-relevant normative information might affect these different factors at all, it may do so differentially. Due to various logistic considerations, such as sample size, the length of

the study, attrition, and the rate of data acquisition, utilizing the TAP was not possible in this study but future investigations using similar manipulations may benefit from its use.

SUMMARY AND FUTURE DIRECTIONS

The current study encountered a methodological obstacle, but it nonetheless revealed some useful information. Group norms pertaining to status did affect the extent to which individuals publicly endorsed aggressive behavior. Group norms affected participants' metacognition about how their group members would allocate them status based on their behavior. Group norms affected the extent to which individuals interpreted their behavior as an act of aggression after the fact, and despite these norms not affecting their actual behavior. Questions about participants' perceptions of the UG offer and of their subsequent decisions highlighted the applications and limitations of the UG as a measure of aggression. Responses to these questions also provided a more detailed and empirical insight into the nature of the decision to accept or reject. The "paper tiger" phenomenon highlighted the collision of personal interests vs. group interests—the Me vs. Us dilemma of social animals—and showed that although individuals may default to more self-interested behavior when at personal risk, they may interpret that self-interested behavior through the lens of group norms or demands, *post hoc*. Further, the endorsement of aggression varying by vignette highlighted that there is important context beyond group norms that goes into evaluating the "appropriateness" of aggressive behavior.

The immediate goal of this study was to investigate specific hypotheses surrounding 2D:4D, status, and aggressive behavior. However, the meta-goal was to construct a more complicated model needed to outline contextually dependent human social behavior more effectively. This meta-goal may be the study's undoing. With so

many variables being measured and manipulated, issues ranging from curious to confounding compromised testing the overall model. Conceptually this is a model worth testing, however. Understanding the mechanisms of aggressive behavior alone is worth pursuing. Status is a highly pursued resource and dominance (of which aggression is a tool) is one pathway to its successful acquisition, but there are more peaceful ways to acquire status as well, such as prestige, and people vary between these approaches readily (Cheng et al., 2013). This is useful knowledge, yet it is but the broadest outline. When and why to people change strategy? Successful behavioral strategies for acquiring status are largely constrained by group norms and norms can vary wildly between human groups, ranging from hyper-cooperative to internecine (Anderson, Hildreth, & Howland, 2015). Are there individual differences in the ability to detect normative cues? If so, are these differences rooted in a biological proclivity or are they simply a matter of better or worse social cognition?

Results in this study suggested that people are at least willing to signal their endorsement of status-relevant norms. After all, talk is cheap. The potency of norms to affect behavior in this study is nonetheless ambiguous. Failure to generate behavioral changes might be a methodological issue; however, it may be something else. People presumably choose their groups based on personal interests and values, so it may be naïve to think they would alter their behavior based on the values of a temporary *ad hoc* group they were thrust into, as was the case in this study. Yet that does not mean that group norms about aggression as a means to status acquisition are irrelevant. It simply means that such norms may be second to individual beliefs, and these beliefs may be less pliable. Beliefs are levers to action, so aggressive behavior as a means to status

acquisition may be less variable within an individual across contexts. Another way of thinking about this is to conceive of everyone's "baseline" proclivity toward aggressive behavior as a means to status acquisition as being different, and there may be a certain amount of variance around that baseline depending on the context. If this is the case then a measure of the beliefs one has about the efficacy of aggression specifically as a means to gaining and maintaining status would prove useful.

One obstacle to such a measure is the confounding factor of social desirability. Individuals may be hesitant to convey their honest beliefs about aggression for acquiring and maintaining status because they fear such a confession could undermine their status. This might be addressed with an indirect approach, by asking participants to rate other individuals' behaviors in specific social contexts (e.g., via vignettes, similar to the aggression manipulation in this study) instead of being asked to disclose their personal beliefs explicitly. However we saw in this study that responses in such an approach can be "pushed around" by group member responses. Another option could be modifying the implicit association test to measure implied beliefs about aggression and status (Greenwald, McGhee, & Schwartz, 1998). In addition, creating factors within the measure that capture direct and indirect aggression distinctly would be necessary given their different applications across contexts (and between sexes, e.g., see MacAndrew, 2014).

Social psychology is the study of minds colliding with the environment. For example, the current study showed not only differences in the endorsement of aggression based on the normative condition to which participants were assigned, but also differences in endorsement of aggression based on the vignette. It is speculated above

that the differences in rating between the vignettes may be due to participant perceptions of provocation, or a lack thereof, with respect to John. However, this is necessarily speculative. What precisely *are* the conditions that led to these differences in ratings? What situational cues were most salient and useful for participants when making their decisions? This is important in understanding aggressive behavior, given that its efficacy for status acquisition and maintenance is situationally contingent. But it also important because it is a testable idea, assuming a measure exists to quantify such contextual details. Speculation need not persist where science can be done. Therefore, in addition to a measure of individuals' subjective psychological mechanisms associated with aggression and status jostling—the "psychology" part of social psychology—it would also be useful to have a reliable and objective measure of situational cues—the "social" part of social psychology. Rauthmann and colleagues (2014) have developed a candidate measure that, though still nascent, has shown promise in both reliability and predictive power. Described as a taxonomy of "major dimensions of situation characteristics", the measure purports to function similarly to personality measures (e.g., Big Five) but for psychologically salient features of a given situation (Rauthmann et al., 2014). The measure is an abbreviated version of the Riverside Situational Q-Sort (RSQ; Sherman, Nave, & Funder, 2010, 2012, 2014; Wagerman & Funder, 2009) and is said to capture eight dimensions of situational characteristics: Duty, Intellect, Adversity, Mating, pOsitivity, Negativity, Deception, and Sociality (DIAMONDS).

Using this measure, one might investigate whether challenges to status are comprised of a relatively specific and consistent constellation of these dimensions, or whether various dimensions are particularly salient to status-motivated individuals.

Further, the extent to which an individual believes aggression is endorsed for gaining status among their cohorts is presumably driven by the social feedback the individual receives and interprets. That is, beliefs about norms must be largely derived from the group's expression of those norms—but norms are not always expressed explicitly. Having an objective taxonomy of psychologically salient situational features might help elucidate which of those features an individual uses to infer ambiguous normative information. Such situational information could be applied not just to an understanding of aggression and status specifically, but to human social behavior more generally. It could also be used to increase efficacy when manipulating social variables in the laboratory, improving the "signal" in the signal-to-noise ratio of often-ambiguous social interactions.

Given the complexity of this study and the challenges encountered, future endeavors may yield greater success by first breaking the investigation into pieces, establishing whether there are consistent effects and what the mechanisms might be, and then putting it back together (with some necessary methodological modifications to increase clarity and preserve results). For example, a study (or many studies) investigating the aggression manipulation alone (perhaps using the TAP instead) might provide greater insight as to whether there is a behavioral effect without the confounding issues that came with the team manipulation. Using subtler aggression cues in the vignettes might increase the chances of finding differences in sensitivity to status-relevant cues, with regards to 2D:4D for example. The in-group/out-group contingency is no doubt important to understanding aggressive behavior as well. Do individuals interpret in-group norms about aggression as applying only to interactions with out-group members? Or do such norms also apply to interactions with in-group members? It is also

important to note that the role group norms play in social aggression as a means to gaining status, in the end, may not be linked to 2D:4D, or any biological variable. Perhaps the 2D:4D variable should be jettisoned altogether. Reactivity to norms may be purely a function of social learning. Yet norms about aggression and personal beliefs pertaining to them almost assuredly play *some* important role in social interactions. Investigating this notion further would surely yield insight into the highly complicated ways in which individuals navigate the social labyrinth of status acquisition, irrespective of biological correlates.

APPENDIX

VIGNETTES

Vignette 1:

John is out with a new group of friends. John gets along with almost everyone, except for one guy, Brian, who occasionally makes rude comments to John. Later in the evening while John is waiting for a drink at the bar, Brian walks past and rudely shoves John while giving him a dirty look. John notices that the rest of his new friends are watching, so he decides to shove Brian back.

Vignette 2:

John is with his friends at his university's football game and is seated close to the opposing team's cheering section. When the opposing team scores a touchdown, one of their fans who is seated close to John makes a rude gesture towards him and then verbally taunts him and his friends. John then tosses his drink in the fan's face and challenges him to a fight, which the fan declines.

Vignette 3:

John is driving in his car with a few of his friends. Another car swerves in front of him and cuts him off almost resulting in a car accident. John pulls up alongside the car at a stoplight, rolls down his window, and yells, "Learn how to drive, asshole!"

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