



Fetal exposure to androgens, as indicated by digit ratios (2D:4D), increases men's agreeableness with women



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ABSTRACT

The ratio of the length of the second finger, or digit, to the fourth finger (2D:4D) is influenced by fetal exposure to androgens; a smaller ratio indicates greater androgen exposure. We used event contingent recording to investigate the relation between the 2D:4D ratio and social behavior. Participants completed multiple records of their behavior in events in naturalistic settings; records included information about situational features such as the gender of the person with whom the person was interacting. Men were more agreeable towards women than men; this effect was significantly greater in those with smaller 2D:4D ratios. Men with smaller 2D:4D ratios were also less quarrelsome towards women than towards men. The 2D:4D ratio did not influence social behavior in women. The hormonal environment in which the male fetal brain develops may influence adult social behavior in specific contexts.

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1. Introduction

Fetal exposure to androgens influences the ratio of the length of the second finger, or digit, to the fourth finger (2D:4D) with a larger ratio in women than in men (Manning, 2011). This ratio is associated with several sex-differentiated phenomena such as risk taking, with a smaller ratio associated with behavior more typical of men (Breedlove, 2010). The 2D:4D ratio is also associated with self-rated behavioral patterns, such as smiling and flirtation, which are intended to influence the social environment (Burton et al., 2011). However, many results related to the 2D:4D ratio have not replicated, and consequently, the 2D:4D ratio may not be reliably related to sex-differentiated characteristics (Putz, Gaulin, Sporter, & McBurney, 2004). Rather than focusing on traits, the present study considered the context-specific relation between the 2D:4D ratio and a major dimension of social behavior, agreeableness, which influences the social environment through its impact on others' interpersonal behaviors (Sadler, Woody, & Ethier, 2011) and thereby may be affected by characteristics of the other person in the situation.

Agreeableness can be conceptualized as one end of a broad dimension anchored at the extreme opposite end by aggression

(Moskowitz, 2010). Given gender differences in aggression (Hines, 2004), it might be expected that aggression would be associated with early exposure to androgens. However, findings have been mixed. A meta-analysis of the relation between the 2D:4D ratio and aggression (Hönekopp & Watson, 2011) concluded that there was no relation between the 2D:4D ratio and aggression in women and a very small negative correlation ($r = -0.06$) in men. The majority of the studies used questionnaires and may be limited by a methodology which relies on retrospective memories of a low base rate phenomenon.

Correlates of the 2D:4D ratio may be detected more easily with behaviors that are related to aggression but which have a higher base rate, such as low agreeableness and high quarrelsomeness (Moskowitz, 2010). One questionnaire study found a significant negative correlation between Five-Factor agreeableness and the 2D:4D ratio, but only in women (Fink, Manning, & Neave, 2004), while two other questionnaire studies found no correlation (Lippa, 2006; Luxen & Buunk, 2005). Thus, trait agreeableness measured using questionnaires has an inconsistent relation with the 2D:4D ratio.

Laboratory based studies have shown surprising relations between agreeable behaviors and the 2D:4D ratio. When participants engaged in a game in which they could make prosocial cooperative choices or egotistical choices, a smaller 2D:4D ratio was associated with more cooperative behavior (Millet & Dewitte, 2006), suggesting that early androgen exposure may be related to more agreeableness.

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Millet and Dewitte (2009) further demonstrated that participants with a smaller ratio were more prosocial than those with a larger ratio in a neutral situation, but were less prosocial after exposure to an aggression cue, suggesting that the relation between the 2D:4D ratio and agreeable behavior may be context specific. While there are no other findings about context specificity in the relation between the 2D:4D ratio and agreeable behavior, context specificity has been found in gender differences in agreeableness. Suh and colleagues found that women are more agreeable towards same-sex friends than men are, but that men are more agreeable towards romantic partners than women are (Suh, Moskowitz, Fournier, & Zuroff, 2004). These studies suggest that it may be informative to examine whether there are contextual moderators of the relation between the 2D:4D ratio and social behaviors.

Agreeableness is influential in shaping the social environment. Agreeable behaviors such as smiling and laughing with others, praising others, expressing agreement, and providing reassurance are likely to be reciprocated with agreeable behaviors by others, thereby shaping positive interpersonal encounters which forge and maintain social connections (Sadler et al., 2011). During evolution strong social connections may have increased reproductive success through a variety of mechanisms, including greater mating opportunities, shared child care and protection, and access to resources such as food and shelter. In the present, a smaller 2D:4D ratio in men has been associated with having more children (Manning & Fink, 2008).

We used an intensive repeated measures method in which data were collected in naturalistic settings. Event-contingent recording was used. Participants completed a report after engaging in a substantial interpersonal interaction defined as an interaction lasting more than five minutes (Moskowitz & Sadikaj, 2011). Participants reported whether they engaged in specific behaviors representing four dimensions of social behavior: agreeable, quarrelsome, dominant, and submissive. Participants also reported about situational characteristics of the event such as the other person's sex and the other person's role relationship to the participant. This method permits the examination of situational cues that affect behavior, as well as the examination of multiple instances of situational cues that should increase the sensitivity of the analyses.

We first considered it possible that the relation between the 2D:4D ratio and behavior would correspond to sex differences in behavior such that greater disagreeableness would be related to a smaller 2D:4D ratio. We also considered the possibility that the associations between social behavior and the 2D:4D ratio would be specific to interactions with opposite sex interaction partners. We predicted that men with smaller 2D:4D ratios, compared to men with larger 2D:4D ratios, would be more agreeable towards women than towards men. Given inconsistencies in the literature about women, we did not make a prediction about the association between agreeableness and the 2D:4D ratio among women.

2. Method

2.1. Participants

After the study was approved by the Research Ethics Board of McGill University, men and women were recruited in couples from the community using advertisements in local newspapers and free online classifieds (e.g., Craigslist.ca). For the purposes of another study, selection criteria specified that participants had to be in a heterosexual relationship and to have been employed in the preceding 6 months. There were 155 individuals (78 men and 77 women) who provided usable event-contingent recording data and a readable scan of at least one hand. Participants ranged in age between 18 and 54 years of age ($M = 28.7$; $SD = 7.3$); men

($M = 29.9$; $SD = 7.6$) were approximately 2.5 years older than women ($M = 27.4$; $SD = 6.7$), $F(1,153) = 4.84$, $p = .029$.

Of the participants, 68.9% identified as Caucasian; the other 31.1% identified with a range of ethnic backgrounds including 9.3% Hispanic, 5.3% Black, 3.3% East Asian, 4.6% Southeast Asian, and 1.3% West Indian. Participants varied in level of education: 0.4% did not graduate high school; 13.8% were high school or trade school graduates; 36.4% reported one or more years of college or university; 34.6% were university graduates; and 14.8% had a post-graduate degree.

2.2. Procedure

Prospective participants attended an initial session where they were briefed on the procedure, consented to participate, and provided demographic information. Participants were asked to complete an event contingent recording form following each social interaction lasting 5 min or more for 20 days and to mail the forms on the day following their completion. We examined the forms upon arrival to ensure that they were completed correctly and mailed in a timely fashion. Participants completed an average of 126 forms, about 6 per day.

Following this procedure, participants returned and consenting participants had their left and right hands scanned by a research assistant. Participants were then debriefed and received compensation for their participation (CAD\$160).

2.3. Measures

2.3.1. 2D:4D ratio

Finger length measurements were taken from high-resolution scans by two coders using the freeware program AutoMetric. Coders followed the procedure described by Voracek and Offenmüller (2007) in which each digit was measured from the midpoint of the ventral basal crease to the fingertip.

Inter-rater reliability was calculated using ICC (2,2) (Shrout & Fleiss, 1979) in which raters are assumed to be a random sample, and reliability is provided for the average of the raters. The ICCs for the average of the two raters exceeded .99 for both men and women for both the left and right hands. Scores from the two raters were averaged.

There was a significant difference in men's and women's left 2D:4D ratios, $F(1,152) = 4.25$, $p = .040$. Men's ratios ($M = .95$; $SD = .03$) were smaller than women's ratios ($M = .96$, $SD = .02$). For the right hand, men's 2D:4D ratios ($M = .96$; $SD = .03$) were again smaller than women's 2D:4D ratios ($M = .97$, $SD = .02$), but the difference was not statistically significant, $F(1,153) = 2.32$, $p = .130$. The correlation between the left and right ratios was similar for men, $r(75) = .72$, $p < .001$, and women, $r(75) = .73$, $p < .001$.

2.3.2. Event contingent recording measures of social behavior

For each reported interaction event, participants recorded the gender and the role relationship of the primary person with whom they were interacting. The social roles were supervisor, co-worker, supervisee, parent, sibling, friend, acquaintance, and romantic partner.

Social behaviors representing the four poles of the interpersonal circumplex model of interpersonal behavior were measured: agreeable, quarrelsome, dominant and submissive (Moskowitz, 1994). Participants were instructed to check behaviors in which they had engaged on the record form for each event.

There were 12 items for each of the four scales (Moskowitz, 1994). Examples of items were "I smiled and laughed with others" (agreeableness), "I made a sarcastic comment" (quarrelsomeness), "I asked the other to do something" (dominance), and "I gave in" (submissiveness).

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