Published in final edited form as:

Pers Individ Dif. 2015 November 1; 86: 312–317. doi:10.1016/j.paid.2015.06.036.

Face Shape and Behavior: Implications of Similarities in Infants and Adults

Leslie A. Zebrowitz¹, Robert G. Franklin Jr.², and Jasmine Boshyan³

Leslie A. Zebrowitz: zebrowitz@brandeis.edu; Robert G. Franklin: rgfran@gmail.com; Jasmine Boshyan: jboshyan@brandeis.edu

¹Department of Psychology MS 062, Brandeis University, Waltham, MA 02454

²Department of Psychology, Anderson University, Anderson, SC 29621

³Department of Psychology MS 062, Brandeis University, Waltham, MA 02454

Abstract

We investigated conceptual overlap between literature demonstrating links between adult facial width-to-height ratio (FWHR) and behavior and that demonstrating links between infant FWHR and temperament by investigating whether babyfacedness is associated with FWHR and behavior at both ages. Babyfacedness was positively correlated with FWHR in both infants and adults. Babyfacedness also was correlated with an infant temperament that is a precursor of bolder behavior in childhood and adulthood, just as a broader infant FWHR was previously shown to be. These results call into question existing explanations for relationships between facial appearance and adult assertive or aggressive behavior. Previously, behavioral correlates of adult FWHR have been attributed to influences of pubertal testosterone, and correlates of adult babyfacedness have been attributed to compensation for undesirable stereotypes. Our findings indicate that the pre-natal developmental influences required to explain appearance-temperament relationships in infancy also should be considered as explanations for appearance-behavior relationships in adulthood.

Keywords

Face-width-height ratio; babyface; assertive/aggressive behavior; prenatal influences

1. Introduction

1.1. Facial width-to-height ratio (FWHR) and behavior

A burgeoning body of research has highlighted the role of facial width-to-height ratio (FWHR) as an accurate predictor of assertive personality traits in men. Men with relatively broader faces scored higher on laboratory and real-world measures of aggressiveness (Carré,

Correspondence to: Leslie A. Zebrowitz, zebrowitz@brandeis.edu.

Publisher's Disclaimer: This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

McCormick, & Mondloch, 2009; Carré & McCormick, 2008) and cheating (Jia, Van Lent, & Zeng, 2015; Haselhuhn & Wong, 2012; Stirat & Perrett, 2010). Broader faces further predicted men's dominance (Mileva, Cowan, Cobey, Knowles, & Little, 2014), US Presidents' achievement drive (Lewis, Lefevre, & Bates, 2012), performance during negotiation tasks (Haselhuhn, Wong, Ormiston, Inesi, & Galinsky, 2012), and CEOs' corporate success (Wong, Ormiston, & Haselhuhn, 2011).

1.2. Dominant explanation for FWHR effects

Most research on the link between FWHR and assertiveness attributes this relationship to the effect of pubertal testosterone to increase both facial masculinization and assertiveness. This explanation rests partly on evidence that pubertal sexual differentiation is associated with widening of the male jaw in many primate species, and human males show a larger FWHR than females (Weston, Friday, & Lio, 2007; but see Lefevre, Lewis, Bates, et al., 2012). Furthermore, testosterone is associated with assertive personality measures, such as physical aggression, reactive aggression, and social dominance (Mazur & Booth, 1998). Also supporting this link, FWHR is correlated with levels of circulating testosterone in men (Lefevre, Lewis, Perrett, & Penke, 2013). Based on the association between FWHR and increased testosterone and links between testosterone and aggressiveness, it is thought that FWHR may provide an honest signal of aggressiveness by indicating a man's level of pubertal testosterone (Carré et al., 2009).

1.3. Other possible mechanisms for FWHR effects

The large body of research investigating links between FWHR and aggressive or assertive behavior has neglected two related lines of research that suggest mechanisms for the relationship other than pubertal testosterone: 1) men judged as more babyfaced show more assertive, aggressive behavior; and 2) infants with a broader FWHR show a less shy and inhibited temperament in childhood and adulthood.

1.3.1. Babyfacedness and assertive or aggressive behavior—Paralleling relationships between greater FWHR and more assertive or aggressive behavior is evidence that more babyfaced adolescent boys and young men show similar behavior. Babyfaced individuals are perceived as more naïve, honest, and warm than their more maturefaced peers. However, babyfaced males do not fit these stereotypes. Babyfaced adolescent boys showed more academic achievement than their more maturefaced peers, an effect mediated by their higher motivation (Zebrowitz, Andreoletti, Collins, Lee, & Blumenthal, 1998), and more babyfaced men were more likely to earn military awards (Collins & Zebrowitz, 1995). In addition, more babyfaced adolescents from lower socioeconomic status (SES) backgrounds, showed more criminal behaviors (Zebrowitz, Andreoletti, et al., 1998), and early measures of babyfacedness were associated with greater assertiveness and hostility at later ages in men, albeit not women (Zebrowitz, Collins, & Dutta, 1998). These effects parallel the behavioral correlates of higher FWHR discussed in section 1.1. Moreover, the facial qualities correlated with rated babyfacedness include a rounder face, as defined by relatively equal breadth and length, which is likely to share variance with a broader FWHR (Zebrowitz & Montepare, 1992).

In contrast to the argument that behavioral correlates of FWHR derive from pubertal testosterone levels, it has been suggested that the correlates of babyfacedness may reflect compensatory responses to the babyface stereotype. Indeed, more babyfaced young and middle-aged adults report more external constraints in their lives (i.e., external factors beyond their control that interfere with reaching goals; Andreoletti, Zebrowitz, & Lachman, 2001). One reason may be that babyfaced individuals are eschewed for jobs that value leadership and shrewdness, and favored for those that value the warmth and submissiveness associated with the babyface stereotype and that are assigned more often to women than men as well as more often to babyfaced than maturefaced men (Zebrowitz, Tenenbaum, & Goldstein, 1991). Since being viewed as warm and submissive conflicts with masculine ideals, it has been suggested that the more assertive and hostile behavior of more babyfaced men may reflect an effort to counter the babyface stereotype.

1.3.2. FWHR and Infant Temperament—Just as behavioral correlates of babyfacedness parallel correlates of FWHR in adulthood, so do temperament correlates of FWHR in infancy. Specifically, a landmark study by Arcus and Kagan (1995) found that low-reactive infants, who are developmentally prone to become more outgoing children, have higher FWHR than high-reactive infants, who are developmentally prone to be more shy and inhibited as children. Measures of infants' FWHR at 14 months (calculated as the ratio of face width at zygion to head height rather than to mid-face height, as in the adult literature) correlated with infant temperament categories determined at 4 months of age. Moreover, this infant reactivity measure continues to predict reactivity in childhood, adolescence, and even into adulthood (e.g., Hardway, Kagan, Snidman, & Pincus, 2013; Schwartz, et al., 2009; 2012).

In contrast to the suggestion that behavioral correlates of FWHR in adult men reflect the influence of pubertal testosterone or the suggestion that similar correlates of babyfacedness reflect a compensatory mechanism, another hormonal influence has been suggested to explain the behavioral correlates of infant FWHR. Specifically, Arcus and Kagan (1994) argued that this relationship may reflect increased prenatal exposure to glucocorticoids in infants with a smaller FWHR. Glucocorticoids are associated with inhibited growth of the palate in primate species (Hendrickx et al., 1975), which would lead to narrower faces and resultant smaller FWHR. Further, overexposure to glucocorticoids in prenatal development leads to increased stress responses as well as higher levels of anxiety (Seckl & Meaney, 2004), which could yield less assertive and aggressive behavior.

1.4 Research aims

The present study investigated the conceptual overlap between the literature demonstrating links between adult FWHR and behavior and that demonstrating links between infant FWHR and temperament. More specifically, we investigated whether babyfacedness is associated with FWHR at both ages. As further evidence of conceptual overlap, we also investigated whether babyfacedness is associated with early infant temperament, as it has been shown to be with behavior in adulthood. If babyfacedness shares variance with FWHR in both infancy and adulthood, this would implicate early developmental contributors to the assertive and aggressive behavior shown by young men high in babyfacedness or FWHR,

providing an alternative explanation to the influence of pubertal testosterone or compensatory motivation.

2. Method

2.1 Participants

Child participants were drawn from a longitudinal sample of middle-class Caucasian children studied by Kagan and associates. Data used in the present study included a) temperament assessed at 4-months (Kagan, Reznick, & Snidman, 1988), b) FWHR at 14-months (Arcus & Kagan, 1995), and c) facial ratings made in the present study from videotapes during a follow up study of the children at ages 6 to 8.5 years (Kagan, Snidman, Zentner, & Peterson, 1999). The current sample was restricted to the 120 participants videotaped in childhood who had temperament ratings. Of these, 73 also had FWHR measures, a much smaller sample than the number for whom measurements were originally taken ($N = 284$). Of those with babyface ratings, 41 had been classified in infancy as low reactive and 37 as high reactive, the two temperament categories contrasted by Kagan. Of those with measured FWHR, 25 had been classified as low reactive and 21 as high reactive.

2.2. Stimulus Faces

2.2.1 Child participant faces—Thirty second clips of participants were taken from videotapes made during acclimation to the experimenter at the beginning of a long protocol of tests in the study by Kagan et al. (1999).

2.2.2 Adult faces—Thirty six faces were selected from a publicly available database (Minear & Park, 2004), with equal numbers of younger and older men and women (9 per group). Each photograph was stretched in Photoshop by 3% in either height or width, resulting in 3 versions of each facial identity (Figure 1), yielding 108 stimuli.

2.3 Raters

2.3.1 Child participant face raters—The videotape clips of the child participants were not publicly available. However, the first author and two graduate students with experience assessing babyfacedness from photographs were permitted to view them in Jerome Kagan's lab in order to make babyfacedness and attractiveness ratings.

2.3.2 Adult faces raters—Thirty two adults (16 women) aged 18–81 ($M=47$, $SD=27.86$) rated babyfacedness and attractiveness of the adult faces. Students received course credit; others were paid \$25.

3. Measures

3.1. FWHR of child participants

FWHR of participants at 14 months of age were taken from Arcus and Kagan (1995), who used calipers to measure the width between the left and right zygion and the height from the top of the head to the chin.

3.2. FWHR of adult faces

Two trained research assistants marked photographs of faces with 6 points (Figure 2a) from which three distances were calculated (Figure 2b). Using these distances, two measures of width to height ratio were calculated: 1) Face FWHR -- face width (distance between left and right zygion) divided by face height (distance between nasion and middle upper lip), the method used in the adult FWHR literature. 2) Head FWHR – face width divided by head height (distance between top of the head and bottom of the chin), calculated to see whether this would yield results better matching those found with the FWHR measure used for children. Inter-rater reliability was high for both ratios ($r_s = .946$ and $.989$, respectively).

3.3. Babyface and attractive ratings

Ratings of babyfacedness and attractiveness of the child participants, shown in a random order, were made using 5-point scales with points labeled ‘very maturefaced (unattractive), somewhat maturefaced (unattractive), neither mature nor babyfaced (unattractive nor attractive), somewhat babyfaced (attractive), and very babyfaced (attractive)’ We used more specific scales than for ratings of the adult faces to increase reliability given the small number of raters that had access to the videotapes and the greater difficulty of the task, as the children moved around and were not always looking at the camera. Babyface ratings showed acceptable inter-rater reliability ($\alpha = .71$) whereas attractiveness ratings showed lower reliability ($\alpha = .57$). Because removing one judge’s ratings of attractiveness increased agreement to $.70$, the attractiveness results reported below only include the judgments of two raters.

Ratings of the babyfacedness and attractiveness of the adult faces were made on 7-point scales with endpoints labeled ‘Not at all’ and ‘Very.’ Faces were blocked by age and sex, with the order counterbalanced across participants. All faces were rated on babyfacedness or attractiveness before any were rated on the other dimension. The order of the two ratings was counterbalanced across participants. Babyface ratings showed high reliability ($\alpha = .94$) as did attractiveness ratings ($\alpha = .98$).¹

3.4. Temperament Measures

Kagan & Snidman (1991) classified infants in the longitudinal study into one of four temperaments based on a battery of visual, auditory, and olfactory tests administered at 4 months of age: high reactive, low reactive, distressed, and aroused. Infants classified as high reactive showed a pattern of high distress and high motor activity; low reactive infants showed a pattern of low distress and low motor activity. Distressed infants were high in distress and low in motor activity whereas aroused infants were high in motor activity and low in distress.

3.5. Ethics

The protocol was approved by an institutional review board and conducted in accordance with provisions of the World Medical Association Declaration of Helsinki.

¹The faces also were rated on other traits in one of two orders: Aggressive, Manipulative, Trustworthy, Dominant, Angry, Masculine, Attractive, Babyfaced; or Dominant, Trustworthy, Manipulative, Aggressive, Masculine, Angry, Babyfaced, Attractive.

4. Results

4.1 Child participants

Infant FWHR was significantly correlated with childhood babyfacedness despite being measured at an interval of 5 to 7 years, $r(71) = .48, p < .001$. Infant FWHR was not correlated with childhood attractiveness $r(71) = .03, p = .78$. Both childhood babyfacedness and infant FWHR were associated with infant temperament. Low reactive infants were significantly more babyfaced in middle childhood ($M = 3.21, SE = .14$) than were high reactive infants ($M = 2.78, SE = .21$), $t(70) = 2.22, p = .029, d = .53$. Although the effect for FWHR was not significant when directly comparing high and low reactive children (low reactive: $M = .56, SD = .04, SE = .008$, high reactive: $M = .54, SE = .013$), $t(44) = 1.59, p = .12, d = .52$, this is likely due to lower power, as the means were very similar to those that differed significantly in the results reported by Arcus and Kagan (1995, Figure 2) for the much larger sample of 284 infants assessed at 14 months. Also, the effect size for FWHR in the current smaller sample is similar to that for babyfacedness, which had a larger sample size.

To increase power, infants who were classified as distressed (high distress -low motor activity) were added to the high reactive group (high distress -high motor activity), creating a set of infants who were high in distress ($N = 67$). Those classified as aroused (low distress - high motor activity) were added to the low reactive group (low distress - low motor activity), creating a set of infants who were low in distress ($N = 53$). Analyses comparing these combined groups revealed that infants low in distress at 4 months of age had higher FWHR at 14 months, (low distress: $M = .56, SE = .005$, high distress: $M = .54, SE = .007$) $t(72) = 2.07, p = .042, d = .57$, and also were significantly more babyfaced in middle childhood, (low distress: $M = 3.20, SE = .097$, high distress: $M = 2.83, SE = .013$), $t(117) = 2.43, p = .017, d = .44$.²

4.2 Adult faces

As shown in Table 1, the manipulation of FWHR was successful whether it was assessed as the ratio between face width and distance between top of head and chin (Head FWHR) or between face width and distance between the nasion and top of upper lip (Face FWHR). As predicted, FWHR was positively related to adult babyfacedness, just as it was for children. First, the unmanipulated male faces showed a positive relationship between babyfacedness and Face FWHR, $r(16) = .685, p = .002$, and this effect remained significant with face age controlled, $r(15) = .593, p = .012$. These correlations were not significant for Head FWHR or for unmanipulated female faces, $ps > .20$. Second, a $2(\text{face sex}) \times 2(\text{face age}) \times 3(\text{FWHR})$ ANOVA yielded a significant main effect for manipulated FWHR, $F(2,64) = 3.29, p = .044, \eta^2 = .093$, that was not moderated by face age or face sex, all $ps > .250$. Planned comparisons revealed that higher FWHR faces ($M = 3.30, SE = .12$) were judged significantly more babyfaced than the unmanipulated faces ($M = 3.18, SE = .13$), $p < .001$, and the lower FWHR faces ($M = 3.14, SE = .11$), $p = .043$, which did not differ from the

²The t-tests reported in this section use the Welch t-test to account for unequal variances, but all effects were the same using the Student's t-test. Relationships between FWHR and babyface ratings and between each of these facial qualities and temperament were unchanged with face sex controlled.

unmanipulated ones, $p > .250$. The FWHR manipulation had no significant effect on attractiveness, $F(2,64) = .185$, $p > .250$, $\eta^2 = .006$, and this null effect was not moderated by face age or sex, $ps > .250$.

5. Discussion

This study is the first to examine conceptual overlap between the literature demonstrating links between adult FWHR and behavior and that demonstrating links between infant FWHR and temperament. Evidence that these literatures are tapping the same construct is provided by significant correlations between babyfacedness and both infant and adult FWHR as well as between babyfacedness and infant temperament. The fact that infant temperament shows stability through adolescence and into early adulthood bolsters the argument that the prediction of a bolder temperament from a larger FWHR in infancy captures the same phenomenon as the prediction of assertive and aggressive behavior from a larger FWHR or babyfacedness in adult men.

Additional support for the overlap between the babyface and FWHR literatures was provided by positive correlations between babyfacedness and adult FWHR only when the latter was computed using Face FWHR, as is conventional in adult FWHR research. Although one might suggest that Head FWHR is more comparable to the measure used with infants, the fact that 14 month old infants have not yet shown pubertal growth of the jawbone that is independent of the skull renders the Arcus & Kagan (1995) infant measure more equivalent to adult Face FWHR. The finding that the correlation between adult babyfacedness and Face FWHR in the unmanipulated faces was limited to male faces is consistent with evidence that the documented effects of each of these facial qualities on behavior is largely limited to men. This sex difference also is consistent with the fact that other childlike features also contribute to babyfacedness, and some of these differ for female and male faces. For example, Zebrowitz & Montepare (1992) found that nose bridge size was a significant predictor of the babyfacedness of female, but not male faces.

Our results indicate that relationships between behavior and the facial qualities of FWHR and babyfacedness occur earlier in development than is suggested by research investigating behavioral correlates of these facial qualities in adolescents and adults. This casts doubt on attributions of the relationships to variations in pubertal testosterone levels or compensation for stereotypes. Since Arcus and Kagan (1995) assessed temperament at 4 months and FWHR at 14 months, their results suggest an influence of prenatal hormone exposure or other prenatal factors on future behavior. As suggested by those authors, glucocorticoid exposure provides one possible mechanism linking FWHR (and, by extension, babyfacedness) to temperament in infancy. The same mechanism could also account for the evidence for relationships between facial morphology and behavior in adults, since longitudinal research has shown that infant temperament predicts behavior in adolescence and adulthood (e.g., Hardway et al., 2013; Schwartz, et al., 2009; 2012).

Another possible mechanism is prenatal testosterone exposure. However, a meta-analysis showed no evidence for a relationship between adult aggressiveness and the 2D to 4D finger ratio, a proxy for prenatal testosterone exposure (Honekopp & Watson, 2011). Also, studies

investigating whether the 2D:4D finger ratio is associated with facial masculinity have yielded mixed results (Burriss, Little, & Nelson, 2007; Fink, Grammer, Mitteroecker, 2005; Koehler, Simmons, & Rhodes, 2004; Meindl, Windhager, Wallner & Schaefer, 2012), and none has specifically assessed FWHR. The implications of these results are unclear, since a meta-analysis found no relationship between finger ratios and androgen receptors, as assessed by genetic polymorphisms (Vorachek, 2014). Thus, the 2D:4D ratio may not be a good proxy for prenatal testosterone exposure, reflecting the balance of prenatal testosterone and estrogen rather than testosterone alone (Manning, 2011). A more valid index of prenatal testosterone exposure may well provide evidence that it contributes to the associations between face shape and assertive or aggressive behavior.

Whatever factors in early development contribute to relationships between face shape and assertive or aggressive behavior, various moderators of these effects suggest that developmental influences in addition to prenatal hormone influences are at play. In particular, higher SES, IQ and height decrease the likelihood that babyfaced boys will show more anti-social behavior, like delinquency, and increase the likelihood that they will show more assertive behavior, like high achievement motivation (Zebrowitz et al., 1998). Similarly, research reveals that the positive relationship between FWHR and aggression is moderated by objective and subjective measures of social status, with a significant relationship only for men with relatively low status (Goetz, Shattuck, Miller, Campbell, Lozoya, Weisfeld, & Carre, 2013). There is also evidence that self-fulfilling prophecy effects may contribute to less pro-social behavior in men with a higher FWHR (Haselhuhn, Wong, & Ormiston, 2013). Furthermore, sex-role socialization may contribute to the fact that, with one exception (Lefevre, Etchells, Howell, Clark, & Penton-Voak, 2014), a relationship between FWHR or babyfacedness and aggressive or assertive behavior is more reliable for men than women (Carre & McCormick, 2008; Geniole, Keyes, Carre, & McCormick, 2014; Mileva et al., 2014; Zebrowitz et al., 1998), with these results leading many researchers to study only men. Among the children born with a predisposition toward assertive or aggressive behavior, girls may experience stronger social pressure to subdue this tendency. It is also possible that the babyfaced appearance of boys with greater FWHR may motivate them to counter the infantilizing stereotypes, augmenting their early tendencies toward assertive, aggressive behavior. The influence of testosterone at puberty may also augment these tendencies in boys more than girls.

6. Conclusions

Our results suggest that not only is there an early developmental cause for the relationship between infant FWHR and temperament, as Kagan and his associates previously demonstrated, but also that this causal variable is likely to contribute to the documented relationships between FWHR or babyfacedness and assertive or aggressive behavior in adolescence and adulthood. Such early developmental influences warrant additional consideration in research examining the relationship between facial breadth and behavior.

Acknowledgments

This work was supported by the National Institute on Aging [AG38375]. The authors would like to thank Jerome Kagan and Nancy Snidman for allowing us to make babyface ratings from the videotapes of the child participants

and later providing us with the FWHR measurements and temperament scores for these participants. We also thank Carrie Andreoletti and Jason Maurice for help rating the children's faces, Jessica Neary and Melany Vidret for help measuring FWHR of adult faces, and Jerome Kagan for his comments on the manuscript.

References

- Andreoletti C, Zebrowitz LA, Lachman ME. Physical appearance and control beliefs in young, middle-aged, and older adults. *Personality and Social Psychology Bulletin*. 2001; 27:969–981.
- Arcus D, Kagan J. Temperament and Craniofacial Variation in the First Two Years. *Child Development*. 1995; 66:1529–1540. [PubMed: 7555228]
- Berry DS, McArthur LZ. Perceiving character in faces: The impact of age-related craniofacial changes on social perception. *Psychological Bulletin*. 1986; 100:3–18. [PubMed: 3526376]
- Berenbaum SA, Bryk KK, Nowak N, Quigley CA, Moffat S. Fingers as a marker of prenatal androgen exposure. *Endocrinology*. 2009; 150:5119–5124. [PubMed: 19819951]
- Burriss RP, Little AC, Nelson EC. 2D:4D and sexually dimorphic facial characteristics. *Archives of Sexual Behavior*. 2007; 36:377–384. [PubMed: 17203400]
- Carre JM, McCormick CM, Mondloch CJ. Facial structure is a reliable cue of aggressive behavior. *Psychological Science*. 2009; 20:1194–1198. [PubMed: 19686297]
- Carre JM, McCormick CM. In your face: Facial metrics predict aggressive behavior in the laboratory and in varsity and professional hockey players. *Proceedings of the Royal Society of Science: B*. 2008; 275:2651–2656.
- Collins M, Zebrowitz LA. The contributions of appearance to occupational outcomes in civilian and military settings. *Journal of Applied Social Psychology*. 1995; 25:129–163.
- Fink B, Grammer K, Mitteroecker P, Gunz P, Schaefer K, Bookstein FL, et al. Second to fourth digit ratio and face shape. *Proceedings of the Royal Society B-Biological Sciences*. 2005; 272:1995–2001.
- Geniole SN, Keyes AE, Carré JM, McCormick CM. Fearless dominance mediates the relationship between the facial width-to-height ratio and willingness to cheat. *Personality and Individual Differences*. 2014; 57:59–64.
- Gitau R, Adams D, Fisk NM, Glover V. Fetal plasma testosterone correlates positively with cortisol. *Arch Disease Children Fetal and Neonatal Edition*. 2005; 90:F166–F169. [PubMed: 15724043]
- Goetz SMM, Shattuck KS, Miller RM, Campbell JA, Lozoya E, Weisfeld GE, Carre JM. Social status moderates the relationship between facial structure and aggression. *Psychological Science*. 2013; 24:2329–2334. [PubMed: 24068116]
- Hardway C, Kagan J, Snidman N, Pincus DB. Infant reactivity as a predictor of child anxiety, social ease, and parenting behavior in middle childhood. *Journal of Psychopathology and Behavioral Assessment*. 2013; 35:531–539.
- Haselhuhn MP, Wong EM. Bad to the bone: Facial structure predicts unethical behavior. *Proceedings of the Royal Society B: Biological Sciences*. 2012; 279:571–576. [PubMed: 21733897]
- Haselhuhn MP, Wong EM, Ormiston. Self-fulfilling prophecies as a link between men's facial width-to-height ratio and behavior. *PLOS ONE*. 2013; 8:1–7. e72259.
- Haselhuhn MP, Wong EM, Ormiston ME, Inesi ME, Galinsky AD. Negotiating face-to-face: Men's facial structure predicts negotiation performance. *The Leadership Quarterly*. 2014; 25(5):835–845.
- Hendrickx AG, Sawyer RH, Terrell TG, Osburn BI, Hendrickson RV, Steffek AJ. Teratogenic effects of triamcino-lone on the skeletal and lymphoid systems in non-human primates. *Federal Proceedings*. 1975; 34:1661–1665.
- Hönekopp J, Watson S. Meta-analysis of the relationship between digit-ratio 2D:4D and aggression. *Personality and Individual Differences*. 2011; 51:381–386.
- Jia YP, Van Lent L, Zeng YC. Masculinity, testosterone, and financial misreporting. *Journal of Accounting Research*. 2015; 52:1195–1246.
- Kagan J, Snidman N. Infant predictors of inhibited and uninhibited profiles. *Psychological Science*. 1991; 2:40–44.
- Kagan J, Reznick JS, Snidman N. Biological bases of childhood shyness. *Science*. 1988; 240:167–171. [PubMed: 3353713]

- Kagan J, Snidman N, Zentner M, Peterson E. Infant temperament and anxious symptoms in school age children. *Development and Psychopathology*. 1999; 11:209–224. [PubMed: 16506531]
- Koehler N, Simmons LW, Rhodes G. How well does second-to-fourth digit ratio in hands correlate with other indications of masculinity in males? *Proceedings of the Royal Society of London, Series B*. 2004; 271:s296–s298. [PubMed: 15503999]
- Lefevre CE, Etchells PJ, Howell EC, Clark AP, Penton-Voak IS. Facial width-to-height ratio predicts self-reported dominance and aggression in males and females, but a measure of masculinity does not. *Biology letters*. 2014; 10(10):20140729. [PubMed: 25339656]
- Lefevre CE, Lewis GJ, Perrett DI, Penke L. Telling facial metrics: facial width is associated with testosterone levels in men. *Evolution and Human Behavior*. 2013; 34(4):273–279.
- Lefevre CE, Lewis GJ, Bates TC, et al. No evidence for sexual dimorphism of facial width-to-height ratio in four large adult samples. *Evolution and Human Behavior*. 2012; 33:623–627.
- Lewis GJ, Lefevre CE, Bates TC. Facial width-to-height ratio predicts achievement drive in US presidents. *Personality and Individual Differences*. 2012; 52:855–857.
- Manning JT. Resolving the role of prenatal sex steroids in the development of digit ratio. *Proceedings of the National Academy of Sciences*. 2011; 108:16143–16144. 39.
- Meindl K, Windhager S, Wallner B, Schaefer K. Second-to-fourth digit ratio and facial shape in boys: the lower the digit ratio, the more robust the face. *Proceedings of the Royal Society. B*. 2012; 279:2457–2463. [PubMed: 22337693]
- Mazur A, Booth A. Testosterone and dominance in men. *Behavioral and Brain Sciences*. 1998; 21:353–397. [PubMed: 10097017]
- Mileva VR, Cowan ML, Cobey KD, Knowles KK, Little AC. In the face of dominance: Self-perceived and other-perceived dominance are positively associated with facial width-to-height ratio in men. *Personality and Individual Differences*. 2014; 69:115–118.
- Miner M, Park DC. A lifespan database of adult facial stimuli. *Behavior Research Methods, Instruments, & computers*. 2004; 36:630–633.
- Schwartz CE, Kunwar PS, Greve DN, Kagan J, Snidman NC, Bloch RB. A phenotype of early infancy predicts reactivity of the amygdala in male adults. *Molecular psychiatry*. 2012; 17:1042–1050. [PubMed: 21894151]
- Schwartz CE, Snidman N, Kagan J. Adolescent social anxiety as an outcome of inhibited temperament in childhood. *Journal of the American Academy of Child & Adolescent Psychiatry*. 1999; 38:1008–1015. [PubMed: 10434493]
- Seckl, JR.; Meaney, MJ. Glucocorticoid programming. In: Yehuda, R.; McEwen, B., editors. *Biobehavioral stress response: Protective and damaging effects*. New York: Academy of Sciences; 2004. p. 63–84.
- Stirrat M, Perrett DI. Valid facial cues to cooperation and trust. *Psychological Science*. 2010; 21:349–354. [PubMed: 20424067]
- Voracek M. No effects of androgen receptor gene CAG and GGC repeat polymorphisms on digit ratio (2D:4D): a comprehensive meta-analysis and critical evaluation of research. *Evolution and Human Behavior*. 2014; 35:430–437.
- Weston EM, Friday AE, Lio P. Biometric evidence that sexual selection has shaped the hominin face. *PLoS*. 2007; 2:e710.
- Wong EM, Ormiston ME, Haselhuhn MP. A face only an investor could love: CEOs' facial structure predicts their firms' financial performance. *Psychological Science*. 2011; 22:1478–1483. [PubMed: 22042727]
- Zebrowitz LA, Andreoletti C, Collins MA, Lee SY, Blumenthal J. Bright, bad, babyfaced boys: Appearance stereotypes do not always yield self-fulfilling prophecy effects. *Journal of Personality and Social Psychology*. 1998; 75:1300–1320. [PubMed: 9866189]
- Zebrowitz LA, Collins MA, Dutta R. Appearance and personality across the lifespan. *Personality and Social Psychology Bulletin*. 1998; 24:736–749.
- Zebrowitz LA, Montepare JM. Impressions of babyfaced males and females across the lifespan. *Developmental Psychology*. 1992; 28:1143–1152.

Zebrowitz LA, Tenenbaum DR, Goldstein LH. The impact of job applicants' facial maturity, sex, and academic achievement on hiring recommendations. *Journal of Applied Social Psychology*. 1991; 21:525–548.

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Highlights

- FWHR in infancy predicts same personality qualities as FWHR and babyfacedness in adulthood. (79)
- Prenatal factors influence relationship of adult FWHR or babyfacedness to behavior. (83)
- Pinpointing the prenatal influences we found will elucidate impactful individual differences. (83)

Figure 1.

Sample stimuli of adult faces in 3 conditions: unmanipulated, stretched by 3% in height to be longer, and stretched by 3% in width to be wider.

Figure 2.

a) Points marked. 1: top of head; 2: bottom of chin; 3: nasion; 4: middle upper lip; 5 and 6: left and right zygion.

b) Three distances calculated from the 6 points. H1: distance between 3 and 4; H2: distance between 1 and 2; W: distance between 5 and 6.

Table 1

FWHR computed two ways for unmanipulated faces and those made longer or wider.

	Head FWHR ^a		Face FWHR ^b	
	Mean	SD	Mean	SD
Longer	0.57	0.03	1.82	0.12
Unmanipulated	0.61	0.03	1.94	0.14
Wider	0.66	0.04	2.08	0.14

^a - facial width divided by head height.

^b - facial width divided by mid-face height

Note: All means within both Head FWHR and Face FWHR were significantly different from each other, $ps < .001$.