Intern. J. of Research in Marketing 31 (2014) 117–121

Contents lists available at ScienceDirect

Intern. J. of Research in Marketing

journal homepage: www.elsevier.com/locate/ijresmar

Naturally designed for masculinity vs. femininity? Prenatal testosterone predicts male consumers' choices of gender-imaged products

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ARTICLE INFO

Article history:
First received in 2 March 2013 and was under review for 4 ½ month
Available online 6 October 2013

Replication Editor: Eric Bradlow

Keywords:
Digit ratio
Testosterone
Gender image
Masculinity
Femininity
Sex hormones
Consumption choices
Consumption preferences

ABSTRACT

In this paper, we find that a proxy of prenatal testosterone exposure (i.e., digit ratio) is a significant predictor of preferences for products that differ in perceived masculinity vs. femininity. A more masculine (feminine) digit ratio predicts choice of products that have an increasingly masculine (feminine) image. This relationship is statistically significant for male consumers, but not for females.

1. Introduction

People's sex-typed, or gender-related, characteristics and behaviors are influenced by sex hormones that are present during prenatal development (for a review, see Cohen-Bendahan, van de Beek, & Berenbaum, 2005). For instance, studies in psychology and biomedicine show that prenatal testosterone exposure influences one's sexual orientation and gender identity, as well as other physical, cognitive, and personality characteristics that are gender-related (for a review, see Hines, 2010). In this paper, we replicate these studies in the marketing/consumer domain and examine the link between prenatal testosterone exposure and preferences for gender-imaged products.

In particular, we investigate the link between consumer preferences and the "2D:4D digit ratio"—which refers to the ratio of the length of the index (2D) and ring finger (4D) and which is an established biomarker indicating the level of testosterone to which individuals were exposed before birth (McIntyre, 2006). The digit ratio reliably differs by sex, with males having a lower digit ratio. Moreover, studies find that individuals with lower (vs. higher) digit ratios display more pronounced masculine and less pronounced feminine behaviors than members of their sex typically display. Most relevantly for marketing, the digit ratio has also been shown to predict visual preferences for masculine vs. feminine toys within both genders in a laboratory setting (i.e., eye fixations on masculine vs. feminine toys) (Alexander, 2006). In the present conceptual replication, we investigate whether the digit ratio predicts actual product choices (beyond eye-tracking) in a real consumption environment (beyond laboratory).

2. Study

2.1. Study design, sample, and procedure

We observed consumers' purchases and usage of gender-imaged products at a shopping mall in Helsinki, Finland. In particular, we observed consumers who purchased a product from a vending machine (selling beverages or candy). To provide a robustness check for the results, we examine two different dependent variables: (1) the purchase choice of masculine- vs. feminine-imaged products and (2) the usage of masculine vs. feminine clothing colors (i.e., the main color of shirt/top worn by the individuals purchasing from the vending machines).

For the (1) purchase dependent variable, we have 588 observations of consumers (all ethnic Finns, 245 females, 343 males, age range = 13–54) who purchased cola beverages from the vending machine during 10 weeks in June–August 2010. Observations took place on weekdays (approximately 4 h/day) between lunch and evening rush hours. We focused on consumers purchasing one of the branded cola beverages (Regular Coke, Coke Zero, Diet Coke) (a) because they represented

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http://dx.doi.org/10.1016/j.ijresmar.2013.09.001

Table 1
Beverage choice (= increasingly masculine).

	Model with digit ratio only			Full model with all controls			Full model with all controls: winsorized[a]		
	b	(SE)	β[b]	b	(SE)	β[b]	b	(SE)	β[b]
Panel A: males									
Intercepts	6.86	(2.52)		7.16	(2.61)**		7.61	(2.83)**	
	7.60	(2.52)		7.91	(2.62)**		8.36	(2.83)**	
Demographic controls									
Age				−.03	(.02)†	−.12	−.03	(.02)	−.13
Age identity				.21	(.12)*	.15	.20	(.12)	.15
Affluence				−.02	(.10)	−.01	−.02	(.10)	−.02
Psychological gender identity									
BSRI				−.01	(.01)	−.07	−.01	(.01)	−.07
Explicit gender identity				−.02	(.03)	−.06	−.02	(.03)	−.06
Focal variable									
2D:4D digit ratio	−6.15	(2.62)**	−.18	−6.53	(2.66)**	−.20	−7.00	(2.88)**	−.19
Panel B: females									
Intercepts	.03	(2.75)		−.49	(2.82)		−.57	(3.13)	
	.57	(2.75)		.06	(2.82)		−.02	(3.13)	
Demographic controls									
Age				−.02	(.03)	−.06	−.02	(.03)	−.06
Age identity				.04	(.13)	.03	.04	(.13)	.03
Affluence				−.08	(.11)	−.06	−.08	(.11)	−.07
Psychological gender identity									
BSRI				−.01	(.01)	−.07	−.01	(.01)	−.07
Explicit gender identity				.05	(.04)†	.13	.05	(.04)	.13
Focal variable									
2D:4D digit ratio	.67	(2.83)	.02	1.56	(2.91)	.05	1.64	(3.25)	.04

n (males) = 343, n (females) = 245.
Occasional missing values on control variables were substituted with variable means. If the participant had a missing value on the focal variable of right-hand digit ratio (due to a missing or bandaged finger), left-hand digit ratio measure was substituted.
[a] To provide a robustness check, delimiting the effect of outliers, the digit ratio variable was winsorized by setting values below the 5th percentile to the 5th percentile, and value above the 95th percentile to the 95th percentile.
[b] The β's are estimated standardized coefficients.
** Significant at $p = .01$ level.
* Significant at $p = .05$ level.
† Marginally significant at $p = .10$ level. One-sided.

Table 2
Clothing color (= increasingly masculine).

	Model with digit ratio only			Full model with all controls			Full model with all controls: winsorized[a]		
	b	(SE)	β[b]	b	(SE)	β[b]	b	(SE)	β[b]
Panel A: males									
Intercepts	2.86	(1.62)*		2.09	(1.68)		2.38	(1.82)†	
	3.46	(1.63)*		2.70	(1.68)†		2.98	(1.82)†	
Demographic controls									
Age				.05	(.02)**	.18	.04	(.02)**	.18
Age identity				.01	(.07)	.01	.01	(.07)	.01
Affluence				.02	(.06)	.02	.02	(.06)	.02
Psychological gender identity									
BSRI				−.00	(.01)	−.03	−.00	(.01)	−.03
Explicit gender identity				−.04	(.02)*	−.09	−.04	(.02)*	−.09
Focal variable									
2D:4D digit ratio	−2.60	(1.70)†	−.08	−2.84	(1.72)*	−.09	−3.13	(1.87)*	−.09
Panel B: females									
Intercepts	.74	(1.86)		1.16	(1.91)		1.17	(2.10)	
	1.40	(1.86)		1.82	(1.92)		1.83	(2.11)	
Demographic controls									
Age				−.01	(.02)	−.02	−.01	(.02)	−.02
Age identity				.07	(.08)	.05	.07	(.08)	.05
Affluence				−.09	(.07)	−.08	−.09	(.07)	−.07
Psychological gender identity									
BSRI				.00	(.01)	.02	.00	(.01)	.02
Explicit gender identity				−.01	(.02)	−.03	−.01	(.02)	−.03
Focal variable									
2D:4D digit ratio	−.46	(1.92)	−.01	−.65	(1.94)	−.02	−.66	(2.14)	−.02

n (males) = 588, n (females) = 431.
Occasional missing values on control variables were substituted with variable means. If the participant had a missing value on the focal variable of right-hand digit ratio (due to a missing or bandaged finger), left-hand digit ratio measure was substituted.
[a] To provide a robustness check, delimiting the effect of outliers, the digit ratio variable was winsorized by setting values below the 5th percentile to the 5th percentile, and value above the 95th percentile to the 95th percentile.
[b] The β's are estimated standardized coefficients.
** Significant at $p = .01$ level.
* Significant at $p = .05$ level.
† Marginally significant at $p = .10$ level. One-sided.

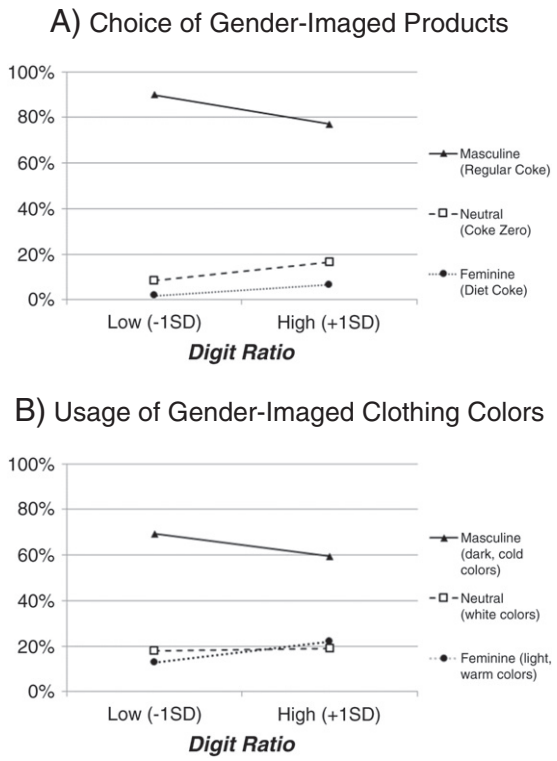

Fig. 1. Male consumers' choice shares by low vs. high digit ratio. Note. The figures depict actual, observed choice shares for participants whose digit ratio was 1 standard deviation or more below the mean digit ratio of participants of their sex (i.e., "low" digit ratio), vs. participants whose digit ratio was 1 standard deviation or more above the mean digit ratio of participants of their sex (i.e., "high" digit ratio).

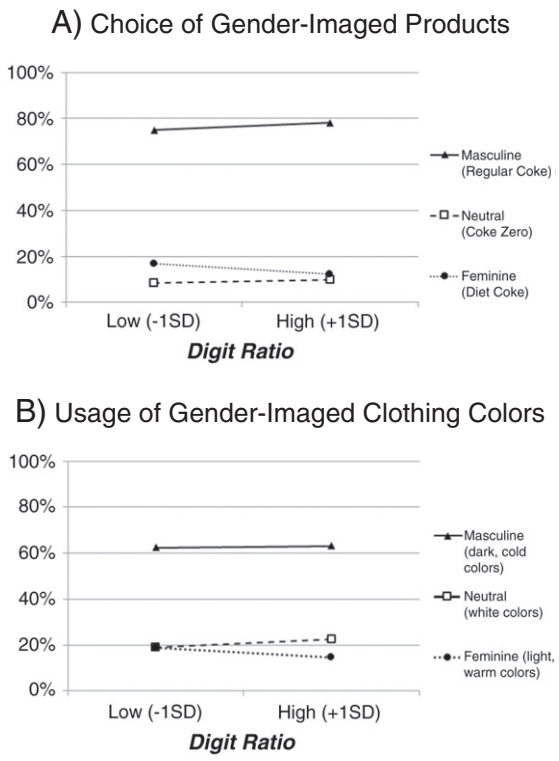

Fig. 2. Female consumers' choice shares by low vs. high digit ratio. Note. The figures depict actual, observed choice shares for participants whose digit ratio was 1 standard deviation or more below the mean digit ratio of participants of their sex (i.e., "low" digit ratio), vs. participants whose digit ratio was 1 standard deviation or more above the mean digit ratio of participants of their sex (i.e., "high" digit ratio).

the vast majority (>85%) of the beverages sold through the beverage vending machine; (b) because they constitute a coherent, realistic choice set of comparable alternatives; and most importantly, (c) because a survey among an independent sample of consumers indicated that the colas are reliably associated with distinct gender images (see Appendix A, Table A.1): Regular Coke has a masculine image, Diet Coke[2] a feminine image, and Coke Zero a neutral image (i.e., not masculine, nor feminine). On the same grounds, we ignore purchase data from the candy vending machine (n = 477) because a test with an independent sample of consumers indicated that the candies of the vending machine were ambiguous in terms of gender image. Thus, there was no theoretical basis to expect the digit ratios to affect candy purchases.

Both the beverage and candy buyers were included in observations for the (2) second dependent variable, clothing color. The total number of observations for clothing color was 1019 (all ethnic Finns; 431 females, 588 males, age range = 13–54).[3] A survey among an independent sample of consumers indicated that colors are reliably associated with gender images (see Appendix A, Table A.2). Dark and cold colors (gray, brown, black, green, blue) are rated towards the masculine pole, while light and warm colors (red, yellow, orange, purple, light blue, light red) are rated towards the feminine pole. We classified white as having a neutral gender image, because its rating was not significantly different from the midpoint of the scale.

After a product was purchased from a vending machine, the consumer was approached by a research assistant who had observed the purchasing process from a distance. The research assistant promised a reward (€5 or a movie theater gift certificate) when consumers would participate in a hand measurement study and complete a short questionnaire. Nearly all individuals (~98%) agreed to participate.

The product purchased by the participant was observed and registered by the research assistant before the participant was approached. After participants agreed to participate, hands were scanned by the research assistant, after which the participant was asked to fill in a questionnaire (control measures). While participants were completing the questionnaire, the research assistant carefully registered the main color of their shirt/top.

2.2. Measures

Index and ring fingers of the right hand were measured from digital scans with image-processing software. The variable entered into the analyses was the median of five measurements by five independent raters. The measures exhibited high inter-rater reliability (pairwise correlations across measurers in the range of .96–.98). The main control variables in the survey were psychological gender identity (i.e., short form of the widely-used Bem's Sex Role Inventory [BSRI]), explicit gender identification (i.e., how much participants identify with adjectives "masculine" and "feminine"), and demographics (i.e., age, age identity, and affluence).

2.3. Results

Because both dependent variables have three, ordered levels (in the order of increasing masculinity: *Feminine → Neutral → Masculine*), we employ ordered probit regressions. We estimate the ordered likelihood

[2] The exact brand name for Diet Coke in the study country is "Coca-Cola Light". However, we refer to "Diet Coke" for reasons of brevity, and for the familiarity of the "Diet Coke" brand name for international audiences.

[3] 46 consumers of the total vending machine users (total 1065) had missing values on clothing color. The missing values were due to inability to register the main color of the shirt/top because of many vague colors applied in the cloth. Observations with no missing values were 1019.

to choose a beverage with an increasingly masculine image (Diet Coke → Coke Zero → Regular Coke) and to wear increasingly masculine-colored clothing (warm & light colors → white color → dark & cold colors).

As to the results, for male participants, the digit ratio coefficient is negative and significant for beverages ($b = -6.53$, $SE = 2.66$, $p < .01$), as well as for clothing colors ($b = -2.84$, $SE = 1.72$, $p < .05$) in the all-controls model (panel A, in Tables 1 and 2[4]). These coefficients are non-significant for females (panel B, in Tables 1 and 2). This suggests that the lower/more masculine (higher/more feminine) the digit ratio, the greater the likelihood to choose and use products with a more masculine (feminine) image—yet, this effect is found only for male consumers (see Figs. 1 and 2). The results do not change when the digit ratio is winsorized, indicating that the results are not spuriously created by outliers.

3. Conclusion

Our results are consistent with research showing that sex hormones which are present during prenatal development predict sexually differentiated dispositions and behaviors later in life (Cohen-Bendahan et al., 2005). In particular, we replicate the finding that prenatal testosterone exposure affects product preferences (Alexander, 2006), yet conclude that digit ratio affects not only visual preferences for toys in laboratory, but also actual product and clothing color choices in real markets. We anticipate that prenatal testosterone exposure may affect preferences in other product categories than these as well, because the digit ratio is a relatively permanent, innate characteristic that may exert its influence on a wide range of economic preferences (for a review, see Millet, 2011).

However, we failed to replicate the association between prenatal hormone exposure and product preferences in females. It is possible that males' gendered traits and behaviors are generally more driven by biological factors, whereas women may be more likely to be influenced by situational, social, and cultural factors (see Lippa, 2003). Alternatively, the pattern could also be explained by the fact that women are more likely to experience cyclical shifts in sex hormones that might overshadow the effects of prenatal testosterone. For example, we know that women's clothing choices and color preferences are affected by ovulation (Beall & Tracy, 2013; Durante, Griskevicius, Hill, Perilloux, & Li, 2011).[5]

In broader terms, our results are consistent with research documenting hormonal (Durante et al., 2011) and even genetic (Simonson & Sela, 2011) influences on consumer behavior. Nevertheless, more future research is needed to better document and understand the effect of biological variables on consumption decisions more broadly.

Regarding the practical implications of the present study, our results suggest that the digit ratio could serve as a useful segmentation variable for marketers who sell distinctly positioned products and brands along the masculinity–femininity continuum. Indeed, marketers are increasingly interested in more subtle gender image-based marketing strategies than to simply target masculine products at males and feminine products at females (cf. Grohmann, 2009). For example, products that have less masculine or more feminine images (e.g., pink shirts; decorated watches) are increasingly sold to male consumers. The fact that we found similar patterns for very different products – (i) a soda beverage, which is a relatively non-conspicuous, inexpensive, and hedonic product, versus (ii) clothing, which is more conspicuous and expensive, and both hedonic and utilitarian – gives confidence that our results may generalize to multiple product categories and consumption settings. Thus, we anticipate that similar results could be found for both markedly cheap and expensive product categories (e.g., soap vs. cars), and for both conspicuous/hedonic and mundane/utilitarian product categories (e.g., entertainment vs. gasoline). These are only speculations, however, and need further replication studies.

[4] As common in digit ratio studies, we ran separate estimations for male and female participants, because the baseline digit ratios of males and females differ (i.e., males have lower average digit ratios than females) and because studies often find that digit ratio predicts behaviors of one sex but not the other.

[5] On the other hand, males may experience shifts in levels of testosterone as well, even throughout the day.

Acknowledgment

The authors are grateful to Matti Keloharju for valuable discussions and comments, as well as to Tomi Fyrqvist for assistance in data collection. Aspara would also like to thank Helsinki School of Economics Foundation for a research grant related to the topic.

Appendix A

Table A.1
Gender image ratings of beverages.

	Perceived masculinity vs. femininity
Regular Coke	5.07^{M**}
Coke Zero	3.95^{N}
Diet Coke	2.70^{F**}

The figures indicate respondents' (independent sample, n = 129) mean responses to question: "In your view, are the following products typically used by women or men?" (1 = "almost only by women" and 7 = "almost only by men").
Means with different superscripts differ significantly from each other at $p < .01$.
^{M**}The mean leans towards the male/masculine image pole and is significantly ($p < .01$) different from the scale midpoint (4).
^{N}The mean is not significantly different from the scale midpoint (4), indicating a neutral product image.
^{F**}The mean leans towards the female/feminine image pole and is significantly ($p < .01$) different from the scale midpoint (4).

Table A.2
Gender image ratings of colors.

	Perceived masculinity vs. femininity
Gray	4.87^{M**}
Brown	4.73^{M**}
Black	4.63^{M**}
Green	4.63^{M**}
Blue	4.50^{M**}
White	3.77^{N}
Light blue	3.33^{F**}
Red	3.17^{F**}
Yellow	3.13^{F**}
Orange	3.10^{F**}
Purple	2.80^{F**}
Light red	2.37^{F**}

The figures indicate respondents' (independent test, n = 30) mean responses to the question "Please tell us whether you think that the following colors are typically used more by females or males in Finland, when it comes to shirts in the summertime. Please answer by selecting numbers between 1 and 7. (If you think that the color is only used by females, mark "1", and if you think that the color is only used by males, mark "7". If you think that the color is used equally by both, mark "4".)"
Means with different superscripts differ from each other at $p < .01$.
^{M**}The mean leans towards the male/masculine image pole and is significantly ($p < .01$) different from the scale neutral value (4).
^{N}The mean is not significantly different from the scale midpoint (4), indicating a neutral product image.
^{F**}The mean leans towards the female/feminine image pole and is significantly ($p < .01$) different from the scale midpoint (4).

Appendix B. Supplementary data

Supplementary data to this article can be found online at http://dx.doi.org/10.1016/j.ijresmar.2013.09.001.

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