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Kin recognition signals in adult faces

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ABSTRACT

Maloney and Dal Martello [Maloney, L.T., Dal Martello, M.F. (2006). Kin recognition and the perceived facial similarity of children. *Journal of Vision*, *6*(10), 1047–1056. http://www.journalofvision.org/6/10/4/] reported that similarity ratings of pairs of related and unrelated children were almost perfect predictors of the probability that those children were judged as being siblings by a second group of observers. Surprisingly, similarity ratings were poor predictors of whether a pair was same-sex or opposite-sex, suggesting that people ignore cues that are uninformative about kinship when making similarity judgments of faces. Using adult sibling faces, we find that similarity ratings for same-sex pairs were significantly higher than for opposite-sex pairs, suggesting that similarity judgments of adult faces are not entirely synonymous with kinship judgments.

1. Introduction

There has been a great deal of research on socially relevant facial cues such as attractiveness (DeBruine, Jones, Unger, Little, & Feinberg, 2007; Perrett et al., 1998), sexual dimorphism (Penton-Voak et al., 1999a; Perrett et al., 1998), health (Jones, Little, Burt, & Perrett, 2004; Jones et al., 2005), and emotion (Burt & Perrett, 1997; Ekman, 1993). One less well-studied signal available in the human face is genetic relatedness. Research on the ability to match the faces of children to their parents has shown that people are somewhat accurate at detecting genetic relatedness in the faces of strangers (Alvergne, Faurie, & Raymond, 2007; Brédart & French, 1999; Bressan & Grassi, 2004; Bressan & Dal Martello, 2002; McLain, Setters, Moulton, & Pratt, 2000; Nesse, Silverman, & Bortz, 1990; Oda, Matsumoto-Oda, & Kurashima, 2002).

More recently, research using computer-generated cues of facial resemblance to self has shown that people respond to facial self-resemblance in ways that are consistent with resemblance being a cue of kinship (see DeBruine, Jones, Little, & Perrett, 2008 for a review). Self-resemblance affects behavior in economic games, increasing trusting behavior in a two-player trust game (DeBruine, 2002) and increasing contributions to the group in a four-player public goods game (Krupp, DeBruine, & Barclay, 2008). Self-resemblance also increases attributions of attractiveness to same-sex faces (DeBruine, 2004b) and trustworthiness to opposite-sex faces (DeBruine, 2005). In line with predictions from considering the costs of inbreeding, self-resemblance has a small or negative effect on the attractiveness of opposite-sex faces (DeBruine, 2004b; DeBruine, Jones, & Perrett, 2005; Penton-Voak, Perrett, & Peirce, 1999b). Self-resmblance also causes more positive attitudes towards children (Bressan, Bertamini, Nalli, & Zanutto, 2008; DeBruine, 2004a; Platek, Burch, Panyavin, Wasserman, & Gallup, 2002; Platek, Raines, Gallup, Mohamed, & Thomson, 2004).

In light of this growing interest in perceptions of facial cues of kinship, Maloney and Dal Martello (2006) investigated the extent to which similarity judgments of pairs of faces correspond to genetic relatedness judgments and compared the accuracy with which the two types of judgment captured actual genetic relatedness. They reported that similarity ratings of pairs of related and unrelated children were surprisingly good predictors of the probability that those children were labeled as being siblings or not siblings by a second group of observers. However, similarity ratings were not good predictors of whether the sibling pair was same-sex or opposite-sex or how close the pair was in age.

Much previous research on the ability to detect genetic relatedness through facial resemblance has been done on parent-child pairs (Alvergne et al., 2007; Brédart & French, 1999; Bressan & Dal Martello, 2002; Bressan & Grassi, 2004; Christenfeld & Hill, 1995; McLain et al., 2000; Nesse et al., 1990; Oda et al., 2002; Parr & de Waal, 1999; Vokey, Rendall, Tangen, Parr, & de Waal, 2003). The above study of child sibling facial resemblance (Maloney & Dal Martello, 2006) would be complemented by an analogous study of adult sibling facial resemblance. Indeed, Maloney and

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Dal Martello (2006) qualify the finding that similarity and kinship judgments of child faces utilize identical information by stating that, "It remains to be seen whether this same bias is specific to children's faces or whether it is present in judgments of the similarity of adults' faces" (p. 1053). Thus, establishing the extent to which similarity ratings predict the probability of adult face pairs being judged as siblings would be important for our understanding of the perceptual processes that underpin kinship judgments.

Here, we replicate this study using two different sets of adult sibling pairs and control pairs. The first set is comprised of all-female, dizygotic (non-identical) twin pairs. In this set, age and sex are the same for both faces in each pair, so similarity judgments will not be affected by these factors. The second set is comprised of half same-sex sibling pairs and half opposite-sex sibling pairs. Each pair differed in age by one to seven years. For this set, cues to sex and age differences are available to influence similarity judgments.

2. Methods

2.1. Stimuli

Stimuli were two image sets: the twin image set and the sibling image set. The twin image set comprised 16 pairs of non-identical twins and 16 age-, ethnicity- and sex-matched unrelated control pairs. The sibling image set comprised five pairs of female siblings, five pairs of opposite-sex siblings, and 10 age-, ethnicity- and sex-matched unrelated control pairs.

We took digital full-face color photographs of a large group of pairs of dizygotic (DZ, non-identical) and monozygotic (MZ, identical) twins recruited from the TwinsUK adult twin registry (www.twinsuk.ac.uk). Zygosity was determined by a standard questionnaire and by genotyping in cases of uncertainty (Martin & Martin, 1975), as is standard for other twin studies (e.g. Mohammed, Cherkas, Riley, Spector, & Trudgill, 2005; Roberts et al., 2005). Stimuli for the twin image set were all of the 16 pairs of DZ twins for whom control pairs matching in age, sex and ethnicity could be found. All selected faces were female, of European ethnicity, and ranged in age from 28 to 46 years (mean = 37.9, *SD* = 4.7). The sixteen control pairs were selected from the 55 pairs of MZ female twins (only one face from each pair was used). Control pairs were selected by randomly assigning to each DZ pair the first and second MZ twins matching in age. The original image set included only two pairs of male DZ twins and no opposite-sex DZ twins, so male and opposite-sex pairs were excluded from the twin image set.

We also took digital full-face color photographs of pairs of twins, siblings, cousins, and friends. Stimuli for the sibling image set were five pairs of same-sex female siblings and five pairs of opposite-sex siblings. All opposite-sex sibling pairs in the larger set were used and same-sex pairs were chosen based on the availability of age-, sex- and ethnicity-matched controls. Three of the same-sex pairs were of European ethnicity and two were of East Asian ethnicity, while three of the opposite-sex pairs were of European ethnicity and two were of West Asian/Indian ethnicity. The faces ranged in age from 16 to 26 years (mean = 19.5, *SD* = 2.3) and the age difference between the pairs ranged from 1 to 7 years. Ten pairs of age-matched (to within 1 year), sex-matched and ethnicity-matched unrelated control images were also selected from the same image set (only one image from MZ twin pairs was used). Only one same-sex male sibling pair existed in the larger set, so we excluded male–male pairs from the sibling image set.

Within image set, images were all taken against a standard background with the same camera using standard lighting. Images were standardized for interpupillary distance (faces were resized so distance between the pupils was equal between image) and each image was cropped to a standard size where the pupils were aligned to the same place in each image. A masked version of each image was also made (Fig. 1). We masked the hair and clothing by marking a continuous line around the chin and hairline and covering the background with solid grey.

2.2. Participants and procedure

All raters were undergraduate psychology students naive to the purposes of the experiment. Raters completed the task at individual computers in a large computer lab. Each rater completed one of two tasks. In the kinship judgment task, raters were told that half the pairs were siblings and were asked to judge whether each pictured pair was "siblings" or "not siblings". In the similarity judgment task, raters were not given any information about kinship and were simply asked to "rate each pair for similarity on a scale from 0 (not very similar) to 10 (very similar)". Each rater completed the same task for both the twin and sibling image sets, which were shown in separate blocks. Each rater completed only one type of task and viewed only one type of masking (full-face or hair and clothing masked).

Thirty raters (17 female, mean age = 20.6, *SD* = 4.5) completed the kinship judgment task with unmasked face pairs and 34 different raters (27 female, mean age = 22.2, *SD* = 6.7) completed the similarity judgment task with the same unmasked face pairs. Twenty-seven raters (23 female, mean age = 20.8, *SD* = 3.9) completed the kinship judgment task with masked face pairs and 27 different raters (24 female, mean age = 20.5, *SD* = 4.4) completed the similarity judgment task with the same masked face pairs.

3. Results

Similarity and kinship judgments were compared for unmasked and masked faces. The Pearson's product-moment correlations (Fig. 2) between mean rated similarity and the proportion of observers who judged the pair to be siblings were comparable to the figure of .92 reported in (Maloney & Dal Martello, 2006) for the twin image set ($R_{unmasked} = .890$, $p < .001$; $R_{masked} = .922$, $p < .001$) and somewhat lower for the sibling image set ($R_{unmasked} = .717$, $p < .001$; $R_{masked} = .504$, $p = .023$).

3.1. Likelihood analyses

The estimated likelihood functions for similarity ratings were calculated as the probability that each level of similarity judgment was given to related ($P[s|R]$) and unrelated ($P[s|\bar{R}]$) pairs (Fig. 3). These likelihood functions were then used to calculate the log posterior odds (i.e., the natural logarithms of the ratios of $P[s|R]$ to $P[s|\bar{R}]$) for each similarity rating (Fig. 4).

Fig. 1. Examples of manipulations to stimuli. Raters judged the kinship of pairs of either unmasked (left) or masked (right) faces.

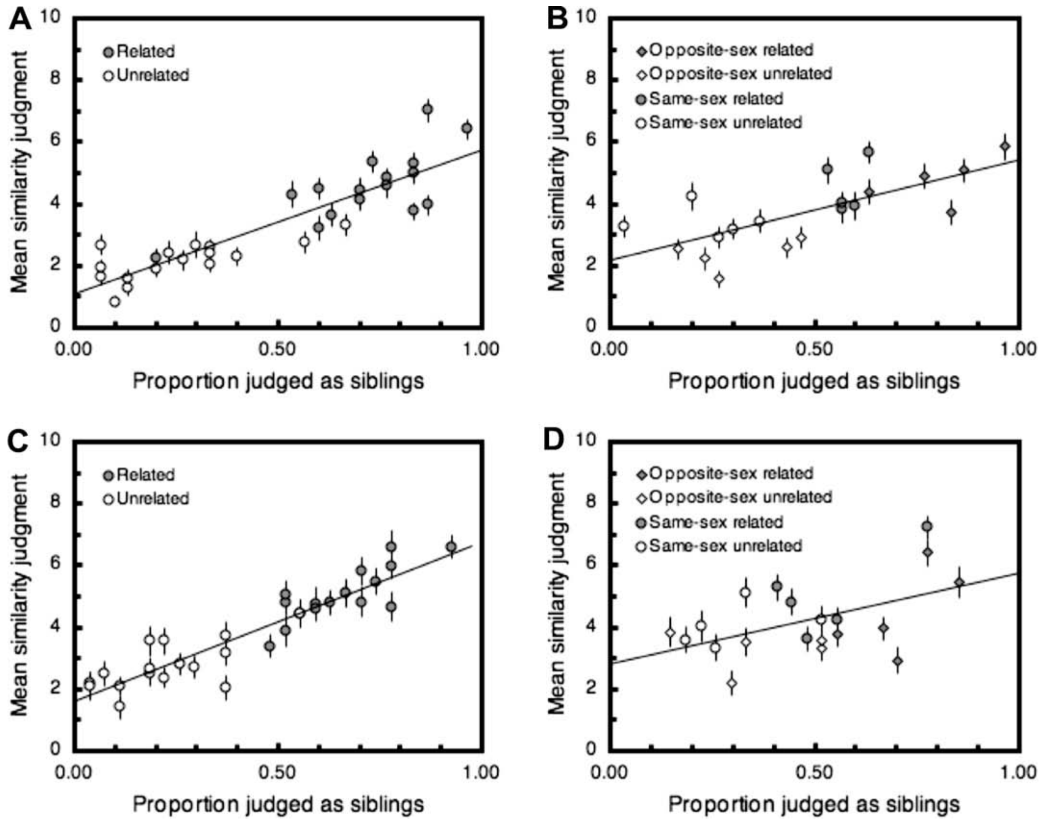

Fig. 2. Mean rated similarity of each pair versus the proportion of observers who judged the pair to be siblings. Closed markers plot related pairs, while open markers plot unrelated control pairs. Same-sex pairs are plotted by circles, while opposite-sex pars are plotted by diamonds. Stimuli were unmasked twins (A), unmasked siblings (B), masked twins (C), or masked siblings (D). Error bars represent SEM.

The proportions of variance accounted for by the maximum likelihood regression fit for the twin image set (unmasked: $R^2 = .98$; masked: $R^2 = .91$) are comparable to the value of $R^2 = .96$ found by Maloney and Dal Martello (2006), also suggesting that similarity judgments primarily convey information about kinship. However, the pairs in the twin image set are all the same sex and age. The R^2s for the sibling image set are significantly lower than .96 for the masked condition ($R^2 = .85, z = 3.02$, $p = .003$), but not for the unmasked condition ($R^2 = .88, z = 0.89$, $p = .374$), suggesting that similarity judgments of adults of varying sex and age may convey some information other than kinship.

3.2. Signal detection analyses

Following Maloney and Dal Martello (2006), we computed signal detection measures of performance for kinship judgments (Fig. 5). For masked and unmasked images in both image sets, the d' values were significantly greater than zero (twins unmasked: $d' = 1.20 \pm 0.09$ (SD); twins masked: $d' = 1.16 \pm 0.09$; siblings unmasked: $d' = 1.19 \pm 0.11$; siblings masked: $d' = 0.74 \pm 0.11$; all $p < .001$), indicating that participants were somewhat accurate in their judgments.

Following Maloney and Dal Martello, 2006, we also computed signal detection measures of performance for similarity judgments using a *thresholded similarity observer* (TSO). This was done by converting similarity scores into "siblings" or "not siblings" judgments using thresholds as estimated by the linear regressions in Fig. 4. Thus, similarity scores below the threshold were treated as "not siblings" judgments and scores above the threshold were treated as "siblings" judgments. As in the signal detection analysis for kinship judgments, the d' values were significantly greater than 0 for both image sets (twins unmasked: $d' = 1.15 \pm 0.08$ (SD); twins masked: $d' = 1.10 \pm 0.09$; siblings unmasked: $d' = 0.74 \pm 0.10$; siblings masked: $d' = 0.55 \pm 0.11$; all $p < .001$), indicating that similarity judgments are somewhat effective at discriminating related from unrelated pairs. Maloney and Dal Martello (2006) reported a slightly (but not significantly) larger d' for their TSO than their kinship condition (1.057 ± 0.084 versus 0.999 ± 0.084) and concluded that kinship and similarity judgments are equally effective at discriminating related and unrelated pairs. However, here we find that the d' for the TSO is *smaller* than that for kinship judgments for both the twin and sibling image sets in both the unmasked and masked conditions. This difference was significant only for the sibling image set in the unmasked condition ($z = 2.562, p = .010$; all other $z < 1.27, p > .20$). This suggests that similarity judgments may not be as effective as kinship judgments at discriminating related and unrelated pairs of adults, at least when the pairs are not all the same age and sex.

3.3. Sex differences

In light of the significantly smaller d' for the similarity TSO than the kinship judgments for the sibling image set, we used the TSO to try to predict sex differences in the sibling image set, again following Maloney and Dal Martello (2006). Same-sex pairs were designated as the signal and we used a threshold of 3.5, which was chosen so that "the likelihood criterion β was as close as possible to 1" [following][p. 1053] Maloney and Dal Martello, 2006. This analysis produced d's that differed significantly from 0 for the masked images ($d' = 0.235, z = 2.145, p = .032$) and approached significance for the unmasked images ($d' = 0.177, z = 1.828, p = .068$).

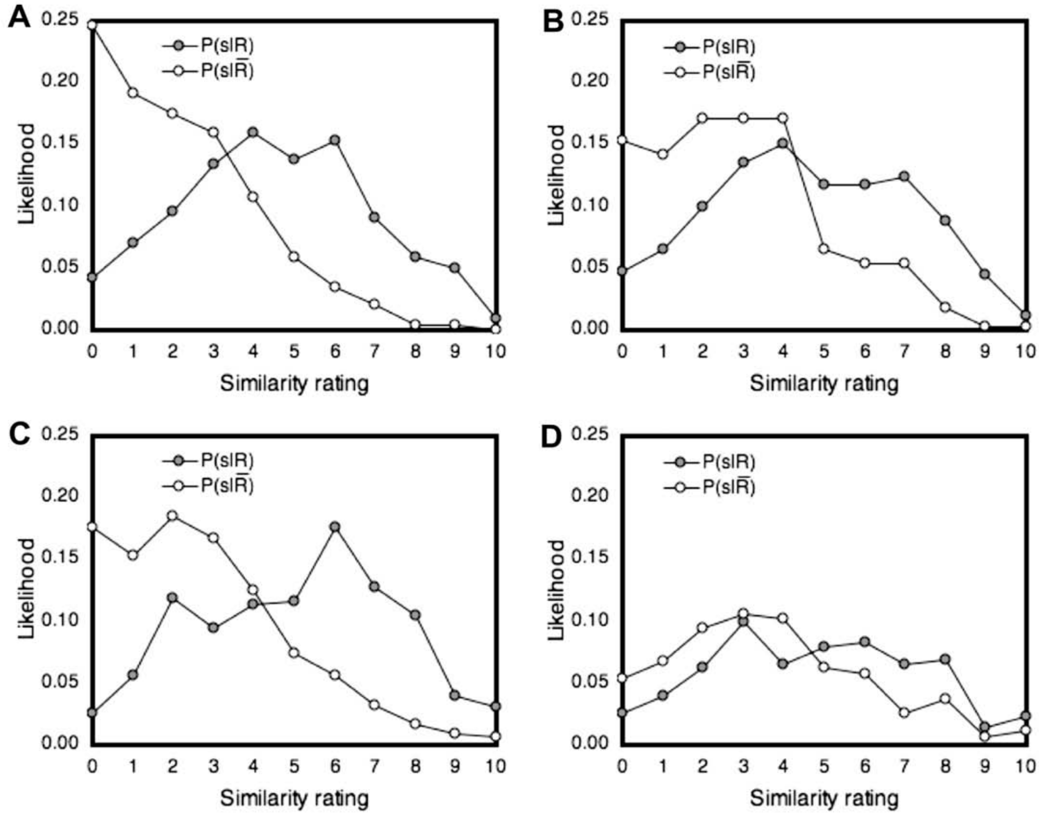

Fig. 3. The estimated likelihood functions for similarity ratings of related pairs ($P[s|R]$) and unrelated control pairs ($P[s|\bar{R}]$) Stimuli were unmasked twins (A), unmasked siblings (B), masked twins (C), or masked siblings (D).

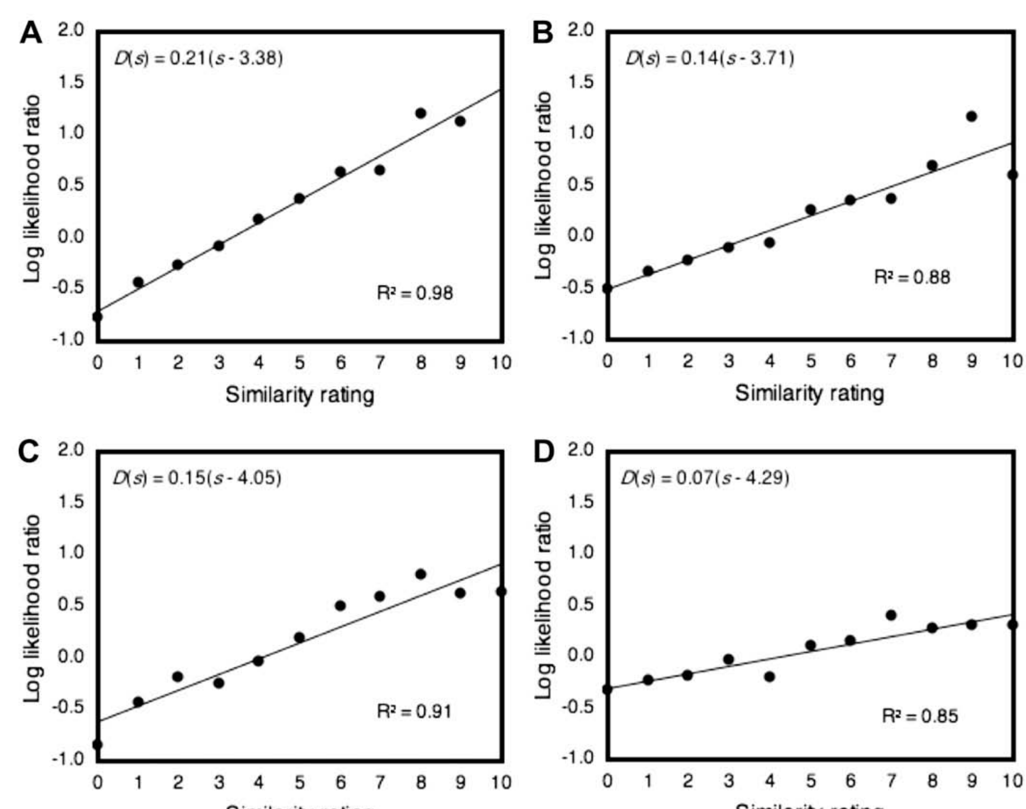

Fig. 4. The natural logarithms of the ratios of $P[s|R]$ to $P[s|\bar{R}]$ for each similarity rating (log posterior odds; $\hat{D}(s)$). The solid line is the maximum likelihood regression fit to the log posterior odds and the equation for this line is given in the upper left corner of each graph. The proportion of variance accounted for (R^2) is given in the lower right corner of each graph. Stimuli were unmasked twins (A), unmasked siblings (B), masked twins (C), or masked siblings (D).

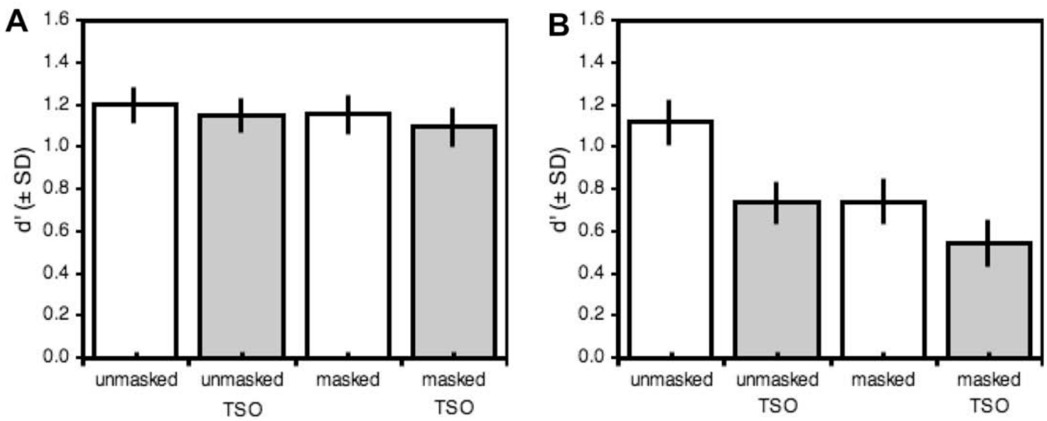

Fig. 5. The d's for the twin (A) and sibling (B) image sets. White bars show d's for kinship judgments and grey bars show d's for similarity judgment TSOs. Error bars show standard deviation as calculated by 10,000 bootstrap iterations. Stimuli were masked or unmasked images.

We also analyzed similarity judgments using a repeated-measures ANOVA with relatedness (siblings or unrelated) and sex composition (same or opposite) as repeated factors. The analysis for unmasked images revealed a main effect of relatedness ($F_{1,33} = 136.715, p < .001$), whereby related pairs were given higher similarity ratings than unrelated pairs, and a main effect of sex composition ($F_{1,33} = 4.282, p = .046$), whereby same-sex pairs were given higher similarity ratings than opposite-sex pairs. However, these main effects were qualified by an interaction between relatedness and sex composition ($F_{1,33} = 23.277, p < .001$), whereby same-sex unrelated pairs were given higher similarity ratings than opposite-sex unrelated pairs ($t_{33} = 5.543, p < .001$), but same-sex and opposite-sex related pairs were not given significantly different similarity ratings ($t_{33} = -1.043, p = .305$). The analysis for masked images revealed the same main effects of relatedness ($F_{1,26} = 25.133, p < .001$) and sex composition ($F_{1,26} = 13.402, p = .001$), but no interaction between these two factors ($F_{1,26} = 0.605, p = .444$).

4. Discussion

For adult sibling faces, we found that similarity judgments primarily convey the same information as kinship judgments when judging pairs of faces that are matched on sex and age. This is consistent with the finding of Maloney and Dal Martello (2006) for child faces of varying age and sex. However, for adult faces of varying age and sex, we found that similarity ratings conveyed some information that was not present in kinship judgments. For unmasked faces, similarity ratings were lower for opposite-sex pairs than for same-sex pairs among the unrelated pairs, but not among the related pairs. For masked faces, similarity ratings were lower for opposite-sex pairs than for same-sex pairs for both unrelated and related pairs.

Unfortunately, sex and age differences were confounded in our sample[1], with the average age difference between opposite-sex pairs ($m = 3.90$ years, $SD = 2.47$) being greater than the average age difference between same-sex pairs ($m = 1.50$ years, $SD = 0.71$) ($t_{18} = 2.95, p = .008$). However, we can still conclude that sex and/or age differences influence judgments of facial similarity for adult faces. This may reflect the fact that adult faces display much greater levels of sexual dimorphism than child faces Enlow, 1990; Ferrario, Sforza, Poggio, and Schmitz, 1998. Additionally, the task of judging child faces for similarity may cue kinship more than the task of judging adult faces for similarity. Our experience with pairs of children, especially those of different sexes or ages, is likely to be more biased towards experience with siblings than is our experience with pairs of adults.

Using the same child face pairs as Dal Martello and Maloney (2006); Maloney and Dal Martello (2006) reported that correct categorization of kinship was affected more when the upper half of the face was masked than when the lower half was masked. They interpreted this as confirmation that the lower half of children's faces conveys less useful information about genetic kinship because the extent of growth through childhood an puberty is greater than in the upper half of the face. However, the question remains, "would the observer continue to use the same features with the same weighting in judging kinship, age, gender, or similarity between adults" (Maloney & Dal Martello, 2006; p. 1054).

In conclusion, our findings are evidence that people use context-specific criteria for judging kinship and similarity in faces. While sex and age differences were ignored when judging the similarity between child faces (Maloney & Dal Martello, 2006), here we find that sex and/or age differences are considered when judging the similarity between adult faces.

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Appendix A. Signal detection analyses

Image set	Analysis	Masking	$d' \pm SD$	$\beta \pm SD$	z	p
Twin	TSO	Unmasked	1.153 ± 0.081	1.215 ± 0.060	14.206	<.001
	KR	Unmasked	1.202 ± 0.087	1.042 ± 0.055	13.810	<.001
	TSO	Masked	1.096 ± 0.092	1.410 ± 0.088	11.897	<.001
	KR	Masked	1.156 ± 0.092	1.230 ±0.070	12.559	<.001
Sibling	TSO	Unmasked	0.739 ± 0.100	0.983 ± 0.037	7.427	<.001
	TSO sex	Unmasked	0.177 ± 0.097	0.996 ± 0.010	1.828	.068
	KR	Unmasked	1.118 ± 0.109	1.050 ± 0.065	10.215	<.001
	TSO	Masked	0.545 ± 0.111	1.108 ± 0.043	4.931	<.001
	TSO sex	Masked	0.235 ± 0.110	0.964 ± 0.021	2.145	.032
	KR	Masked	0.742 ± 0.110	1.045 ± 0.044	6.734	<.001

[1] There was no such confound in Maloney and Dal Martello, 2006. Their same-sex pairs had a mean age difference of 42.0 months ($SD = 18.4$) and the opposite-sex pairs had a mean age difference of 32.6 months ($SD = 23.3$). The difference was not significant ($t_{28} = 1.200, p = .24$; Dal Martello, personal communication).

References

Alvergne, A., Faurie, C., & Raymond, M. (2007). Differential facial resemblance of young children to their parents: Who do children look like more? *Evolution and Human Behavior, 28*, 135–144.

Brédart, S., & French, R. M. (1999). Do babies resemble their fathers more than their mothers? A failure to replicate Christenfeld and Hill (1995). *Evolution and Human Behavior, 20*(2), 129–135.

Bressan, P., Bertamini, M., Nalli, A., Zanutto, A. (in press). Men do not have a stronger preference than women for self-resemblant child faces. *Archives of Sexual Behavior*. (doi:10.1007/s10508-008-9350-0).

Bressan, P., & Dal Martello, M. F. (2002). Talis pater, talis filius: Perceived resemblance and the belief in genetic relatedness. *Psychological Science, 13*, 213–218.

Bressan, P., & Grassi, M. (2004). Parental resemblance in one-year-olds and the Gaussian curve. *Evolution and Human Behavior, 25*, 133–141.

Burt, D. M., & Perrett, D. I. (1997). Perceptual asymmetries in judgements of facial attractiveness, age, gender, speech and expression. *Neuropsychologia, 35*, 685–693.

Christenfeld, N. J. S., & Hill, E. A. (1995). Whose baby are you? *Nature, 378*, 669.

Dal Martello, M.F., Maloney, L.T. (2006). Where are kin recognition signals in the human face?. *Journal of Vision*, *6*(12), 1356–1366. http://journalofvision.org/6/12/2/.

DeBruine, L. M. (2002). Facial resemblance enhances trust. *Proceedings of the Royal Society of London B, 269*, 1307–1312.

DeBruine, L. M. (2004a). Facial resemblance increases the attractiveness of same-sex faces more than other-sex faces. *Proceedings of the Royal Society of London B, 271*, 2085–2090.

DeBruine, L. M. (2004b). Resemblance to self increases the appeal of child faces to both men and women. *Evolution and Human Behavior, 25*, 142–154.

DeBruine, L. M. (2005). Trustworthy but not lust-worthy context-specific effects of facial resemblance. *Proceedings of the Royal Society of London B, 272*, 919–922.

DeBruine, L. M., Jones, B. C., Little, A. C., & Perrett, D. I. (2008). Social perception of facial resemblance in humans. *Archives of Sexual Behavior, 37*(1), 64–77.

DeBruine, L. M., Jones, B. C., & Perrett, D. I. (2005). Women's attractiveness judgments of self-resembling faces change across the menstrual cycle. *Hormones and Behavior, 47*, 379–383.

DeBruine, L. M., Jones, B. C., Unger, L., Little, A. C., & Feinberg, D. R. (2007). Dissociating averageness and attractiveness: Attractive faces are not always average. *Journal of Experimental Psychology: Human Perception and Performance, 33*(6), 1420–1430.

Ekman, P. (1993). Facial expression and emotion. *American Psychologist, 48*, 384–392.

Enlow, D. H. (1990). *Facial growth*. Philadelphia, PA: Harcourt Brace.

Ferrario, V. F., Sforza, C., Poggio, C. E., & Schmitz, J. H. (1998). Facial volume changes during normal human growth and development. *The Anatomical Record, 250*, 480–487.

Jones, B. C., Little, A. C., Burt, D. M., & Perrett, D. I. (2004). When facial attractiveness is only skin deep. *Perception, 33*, 569–576.

Jones, B. C., Perrett, D. I., Little, A. C., Boothroyd, L., Cornwell, R. E., Feinberg, D. R., et al. (2005). Menstrual cycle, pregnancy and oral contraceptive use alter attraction to apparent health in faces. *Proceedings of the Royal Society of London B, 272*, 347–354.

Krupp, D. B., DeBruine, L. M., & Barclay, P. (2008). A cue of kinship promotes cooperation for the public good. *Evolution and Human Behavior, 29*(1), 49–55.

Maloney, L.T., Dal Martello, M.F. (2006). Kin recognition and the perceived facial similarity of children. *Journal of Vision*, *6*(10), 1047–1056. http://www.journalofvision.org/6/10/4/.

Martin, N. G., & Martin, P. G. (1975). The inheritance of scholastic abilities in a sample of twins. ascertainments of the sample and diagnosis of zygosity. *Annals of Human Genetics, 39*, 213–218.

McLain, D. K., Setters, D., Moulton, M. P., & Pratt, A. E. (2000). Ascription of resemblance of newborns by parents and nonrelatives. *Evolution and Human Behavior, 21*(1), 11–23.

Mohammed, I., Cherkas, L. F., Riley, S. A., Spector, T. D., & Trudgill, N. (2005). Genetic influences in irritable bowel syndrome: A twin study. *American Journal of Gastroenterology, 100*, 1340–1344.

Nesse, R. M., Silverman, A., & Bortz, A. (1990). Sex differences in ability to recognize family resemblance. *Ethology and Sociobiology, 11*, 11–21.

Oda, R., Matsumoto-Oda, A., & Kurashima, O. (2002). Facial resemblance of Japanese children to their parents. *Journal of Ethology, 20*, 81–85.

Parr, L. A., & de Waal, F. B. M. (1999). Visual kin recognition in chimpanzees. *Nature, 399*, 647–648.

Penton-Voak, I. S., Perrett, D. I., Castles, D. L., Kobayashi, T., Burt, D. M., Murray, L. K., et al. (1999a). Menstrual cycle alters face preference. *Nature, 399*, 741–742.

Penton-Voak, I. S., Perrett, D. I., & Peirce, J. W. (1999b). Computer graphic studies of the role of facial similarity in judgments of attractiveness. *Current Psychology, 18*, 104–117.

Perrett, D. I., Lee, K., Penton-Voak, I. S., Rowland, D., Yoshikawa, S., Burt, D. M., et al. (1998). Effects of sexual dimorphism on facial attractiveness. *Nature, 394*, 884–887.

Platek, S. M., Burch, R. L., Panyavin, I. S., Wasserman, B. H., & Gallup, G. G. Jr., (2002). Reactions to children's faces: Resemblance affects males more than females. *Evolution and Human Behavior, 23*, 159–166.

Platek, S. M., Raines, D. M., Gallup, G. G., Jr., Mohamed, F. B., Thomson, J. W., et al. (2004). Reactions to children's faces: Males are more affected by resemblance than females are, and so are their brains. *Evolution and Human Behavior, 25*, 394–405.

Roberts, S. C., Gosling, L. M., Spector, T. D., Miller, P., Penn, D. J., & Petrie, M. (2005). Body odor similarity of non-cohabiting twins. *Chemical Senses, 30*, 651–656.

Vokey, J. R., Rendall, D., Tangen, J. M., Parr, L. A., & de Waal, F. B. M. (2003). On visual kin recognition and family resemblance in chimpanzees (Pan troglodytes). *Journal of Comparative Psychology, 118*, 194–199.