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Sex-related preferences for real and doll faces versus real and toy objects in young infants and adults

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ABSTRACT

Findings of previous studies demonstrate sex-related preferences for toys in 6-month-old infants; boys prefer nonsocial or mechanical toys such as cars, whereas girls prefer social toys such as dolls. Here, we explored the innate versus learned nature of this sex-related preferences using multiple pictures of doll and real faces (of men and women) as well as pictures of toy and real objects (cars and stoves). In total, 48 4- and 5-month-old infants (24 girls and 24 boys) and 48 young adults (24 women and 24 men) saw six trials of all relevant pairs of faces and objects, with each trial containing a different exemplar of a stimulus type. The infant results showed no sex-related preferences; infants preferred faces of men and women regardless of whether they were real or doll faces. Similarly, adults did not show sex-related preferences for social versus nonsocial stimuli, but unlike infants they preferred faces of the opposite sex over objects. These results challenge claims of an innate basis for sex-related preferences for toy real stimuli and suggest that sex-related preferences result from maturational and social development that continues into adulthood.

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Introduction

Previous studies have shown that 3-year-old boys prefer to play with transportation and construction toys, whereas girls prefer to play with dolls (Connor & Serbin, 1977; Liss, 1981), and that 3- to 10-year-old children prefer toys associated with their respective sex (Pasterski et al., 2005). Learning and cognitive theories suggest that these toy preferences arise from modeling and reinforcement of sex-typical play (Bandura, 1977; Fagot & Hagan, 1991; Langlois & Downs, 1990) and that gender identity acquired through social context leads to mental representations of gender-appropriate toys (Martin, 1999; Martin, Wood, & Little, 1990). Other studies, however, suggest that preferences for sex-typed toys could be linked to biological differences between males and females. For example, high levels of androgen were associated with male toy preference in human females (Berenbaum & Hines, 1992; Hines & Kaufman, 1994). However, this pattern could also be the result of an alteration in learning histories or of an altered cognitive development such as social encouragement or development of self-identification toward masculinity (Alexander & Hines, 2002; Fausto-Sterling, 1992; Hines, 2010). Importantly, sex-specific toy preferences are not exclusive to human children; young male monkeys were reported to spend more time interacting with and looking at "human boy toys" than were young female monkeys, and the latter preferred to interact with and look at "human girl toys" over "human boy toys," supporting a role for biological differences (Alexander & Hines, 2002; Hassett, Siebert, & Wallen, 2008).

To test whether preferences for sex-specific objects are present early in life and are perhaps innate, Alexander, Wilcox, and Woods (2009) tested 6-month-old infants, for whom social experience presumably has less impact than for the 3- to 10-year-olds mentioned earlier. They presented infants with two three-dimensional objects, namely a doll and a toy truck, which have been shown to yield sex-related preferences in 2-year-olds (Zosuls et al., 2009). Using an eye tracker, Alexander and colleagues found that, just like older children and young monkeys, infant boys were more interested in the toy truck than were infant girls, whereas infant girls were more interested in the doll, as measured by the number of gaze fixations. Although girls preferred to look at the doll more than at the toy truck, boys did not show a toy preference overall.

An independent line of research has shown that sex differences in preference are also found in neonates, with more newborn girls showing preference for a real female face over a mobile made from a scrambled face picture on a mechanical ball (36% vs. 17% of the sample) but more newborn boys showing the opposite preference (43% vs. 25%) (Connellan, Baron-Cohen, Wheelwright, Batki, & Ahluwalia, 2000). Although the largest group of newborn girls tested in this study showed no preference (47%), the authors concluded that these sex differences in attention toward social versus nonsocial stimuli have a strong innate component because they are present at birth and are then reinforced by social influences. The authors also suggested that their results are in line with the sex differences in toy preferences mentioned above.

In the current study, we asked whether pictures of social and nonsocial toys and real objects would yield similar sex differences in preference. Using a within-participant design, we presented 4- and 5-month-old infants, as well as young adults, with pictures of four types of objects, namely doll faces, human faces, toys, and real objects. To ensure the generalization of our findings, we included six exemplars of each object type and 48 trials that included all relevant comparisons (real vs. toy, toy vs. toy, and real vs. real), unlike previous studies that included a maximum of two unique stimuli per category. To test whether the sex specificity of the stimuli influenced preference, infants were presented with female faces and cars (Experiment 1a) and with male faces and stoves (Experiment 1b). We presented social versus nonsocial stimuli side by side for a better understanding of relative preferences. In addition, we also ran the same task on adults (Experiments 2a and 2b) and asked them to judge the *attractiveness* of the pictures. This allowed us to compare fixation preferences with explicitly stated preferences and to interpret the infant eye-tracking results in terms of attractiveness (cf. Quinn, Kelly, Lee, Pascalis, & Slater, 2008).

If a general biological constraint, perhaps innate to humans and other primates, underlies their preference for different objects (some of which have been associated with different sexes), both infants and adults should prefer all types of sex-specific items, either toys or real objects; that is, females

should prefer face-like (social) stimuli and males should prefer stove/car-like (nonsocial) stimuli. A similar result for infants and adults would also be in line with Quinn and colleagues' (2008) demonstration that 4-month-old infants preferred the same cat faces that adults rated as attractive. However, research has also shown that infants prefer face-like stimuli over scrambled faces and other objects (Johnson, Dziurawiec, Ellis, & Morton, 1991; Leo & Simion, 2009), which predicts a preference for faces in infants of both sexes.

If sex-related differences for social versus nonsocial stimuli develop with maturation and social development, we would expect to find different preferences for infants and adults. That is, if sex-related preferences are learned through exposure to social norms, young infants should not show them, whereas adults may show similar sex-related preferences to those found in previous studies. Our stimuli included faces of attractive men and women. Accordingly, we predicted that adults, but not infants, should show preferences for faces of the opposite sex because opposite sex attraction emerges around puberty and may be stronger than social versus nonsocial preferences during adulthood.

Experiment 1: Infants

Infants' preference for faces over objects was tested with two sex-specific sets of stimuli, namely female faces and cars (Experiment 1a) and male faces and stoves (Experiment 1b). The goal of using both sexes in the two stimulus sets was to reveal whether infants' preference for social versus nonsocial/mechanical objects applies to female and male faces as well as to different mechanical objects, which might be associated more with males (cars) or females (stoves) in older children. If the sex-related preference for social versus nonsocial objects is present before 6 months of age, female infants should show a preference for male and female faces over cars and stoves, whereas male infants should show the opposite preference. Alternatively, if faces have a different status than objects during infancy, all infants may prefer all faces. In addition, inclusion of male and female faces in the stimuli will show whether 4- and 5-month-olds prefer female faces in general (Quinn, Yahr, & Kuhn, 2002) or whether signs of attraction to the opposite sex are found at this early age. Furthermore, including toy and real versions of the nonsocial stimuli will show whether infants' preference is linked to the level of "reality" in the objects, that is, whether it applies to only toys or to real objects as well.

Experiment 1a: Preference for female faces versus cars

Method

Participants. The final sample of participants comprised 24 4-month-old infants: 12 girls (mean age = 3 months 27 days, range = 3 months 15 days to 4 months 6 days) and 12 boys (mean age = 3 months 26 days, range = 3 months 18 days to 4 months 6 days). All infants were full-term with no known developmental difficulties. Infants were selected from a public database of new parents and were recruited by letters and telephone calls. An additional 14 infants were observed but not included in the final sample due to fussiness ($n = 5$), side bias greater than 95% ($n = 6$), failure to look at either stimulus when tested with one or more stimulus pairs ($n = 2$) or to balance the sex distribution (1 girl).

Stimuli and apparatus. Stimuli were static pictures obtained from the internet. Pictures belonged to one of four categories: toy cars, female doll faces, real cars, or real female faces. There were 6 different pictures for each category for a total of 24 pictures, as shown in Fig. 1. These were divided into four fixed paired categories, namely toy cars–female doll faces, toy cars–real cars, female doll faces–real female faces, and real cars–real female faces. Picture size was approximately 12.0 × 14.0 cm (height × width, 11.4 × 13.3° visual angle at infants' 60-cm viewing distance) with 3.0 cm (2.9°) between the pictures of a pair. Each pair type included six pairs, and a pair contained one of the 6 different images of the corresponding categories. Side presentation was counterbalanced; therefore, the experiment had a total of 48 trials (4 pair types × 6 different pairs × 2 side orders = 48) presented in random order.

Gaze was measured using a Tobii corneal reflection eye tracker (Model 1750, Tobii Technology, Falls Church, VA, USA). Stimuli were presented on a Tobii screen of 27 × 34 cm (height × width). A

Fig. 1. Full set of stimuli for Experiments 1a and 2a. From top row to bottom row: real female faces, female doll faces, toy cars, and real cars.

standard 5-point calibration was used. E-Prime 2.0 was used for stimuli presentation and eye gaze was recorded by Tobii software.

Procedure. Infants were tested individually. During the session, the infant sat on a caregiver's lap on a chair approximately 60 cm from the screen while the eye tracker recorded the infant's eye movements. Before each trial, the infant was shown an "attention-getter" (a short graphic clip with sound) that appeared at the center of the screen. The experimenter sat in an adjacent room and initiated each trial when the participant's attention was fixated on the attention-getter. The participant was presented with 48 trials of 5 s (4 min total), so that the duration of a session, including attention getters, was a maximum of 5 min. The parent was asked to close her or his eyes during calibration and was not told the hypothesis until the study was completed. Each family received a small gift (e.g., a toy) for participation.

Results and discussion

Similar to previous studies, preference scores based on accumulated fixations (i.e., dwell times) were calculated; the total fixation time for each item of a pair was divided by the total time available in a trial (i.e., preference scores were normalized for trial duration and number of trials). This was done for each repetition of an item, and the result was divided by the time spent looking at both items of a pair on each repeat, such that 50% was no preference. Not all infants provided usable data on all trials, but the average number of trials for infants in each condition was always above 4. These *normalized* total fixation preference scores are shown in Fig. 2. Results were also calculated for normalized fixation counts (total counts/number of trials × 5 s), but because analysis of these was very similar to total normalized fixation preferences, they are not reported.

A 4 (Pair) × 2 (Sex) analysis of variance (ANOVA) was conducted on fixation preferences in all 48 trials. There was a statistically significant main effect of pair, Wilks' lambda = .515,[1] $F(3, 20) = 6.27$, $p = .004$, $\eta_p^2 = .485$, and no other significant effects ($ps > .132$), confirming no reliable evidence for sex differences. *t*-tests showed that, collapsed across sex, there were significant preferences in all pairs except those containing female doll and real faces (46.3%, $p = .077$, Cohen's $d = 0.39$). For the other pairings, infants preferred female doll faces over toy cars (58.8%, $p = .014$, $d = 0.56$), preferred toy cars over real cars (43.7%, $p = .019$, $d = 0.53$), and preferred real female faces over real cars (65.4%, $p = .001$, $d = 0.81$).

[1] Where sphericity is violated, Wilks' lambda is used (Mauchly, 1940).

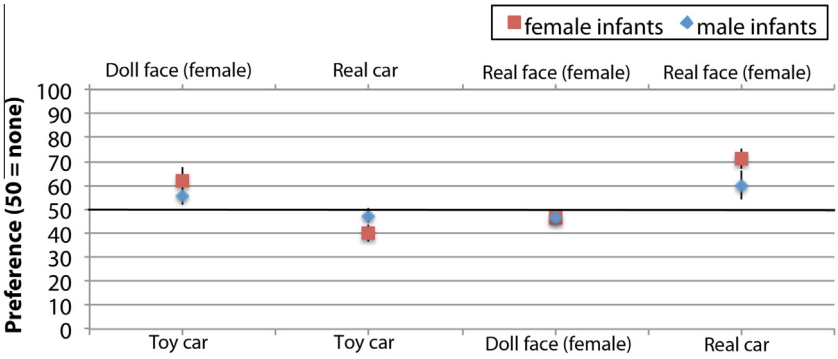

Fig. 2. Infant normalized fixation preference in Experiment 1a for each of the four pair types. Preference is shown as closer to one or other item, with 50% = no preference. Error bars show ± 1 standard error.

Because most previous studies included only one or two trials to measure infants' preference, we also calculated results for the first trial in each pair condition for which an infant produced usable data (for 95.8% this was the first trial on which the pair was shown, and for 4.2% it was the second trial).[2] The results of the ANOVA were the same as those for all 48 trials, namely a significant main effect of pair, $F(3, 66) = 11.46$, $p < .001$, $\eta_p^2 = .343$, and no other significant results ($ps > .330$). However, the results of the *t*-test were somewhat different; the preference for real female faces over real cars was no longer significant (55.4%, $p = .339$, Cohen's $d = 0.20$), and a preference for real female faces over female doll faces was revealed (62.5%, $p = .064$, $d = 0.41$). Patterns of results for the other pairs were the same, namely a preference for female doll faces over toy cars (71.6%, $p = .001$, $d = 0.77$) and for toy cars over real cars (24.1%, $p < .001$, $d = 1.07$).

The results of Experiment 1a, thus, suggest that infants, regardless of their sex, prefer both real and doll faces over real and toy cars, which runs contrary to a hypothesis that sex-related differences are either inborn or appear early in life. Results from single and multiple trials yield the same results, but we argue that the results from the 48 trials are likely to be more reliable. In the next experiment, we tested whether these findings also apply to male faces and stoves as stimuli.

Experiment 1b: Preference for male faces versus stoves

Method

Participants. The final sample of participants comprised 24 5-month-old infants: 12 girls (mean age = 5 months 12 days, range = 3 months 15 days to 6 months 15 days) and 12 boys (mean age = 5 months 6 days, range = 3 months 15 days to 6 months 12 days). All infants were full-term with no known developmental difficulties. Infants were recruited via advertisements in a regional parents' magazine. An additional 14 infants were observed but not included in the final sample due to fussiness ($n = 7$), side bias ($n = 1$), failure to look at either stimulus when tested with one or more stimulus pairs ($n = 1$), technical problems ($n = 1$) or to balance the sex distribution (4 males).

Stimuli and apparatus. As in Experiment 1a, stimuli were static pictures obtained from the internet and belonged to one of four categories. In Experiment 1b, the categories were toy stoves, male doll faces, real stoves, and real male faces. There were 6 different pictures for each category for a total of 24 pictures, as shown in Fig. 3. These were divided into four fixed paired categories, as in Experiment 1a, namely toy stoves–male doll faces, toy stoves–real stoves, male doll faces–real male faces, and real stoves–real male faces. Picture size was approximately 10.0 × 11.5 cm (height × width, 9.5 × 11.0°),

[2] Given that the experiment was designed to contain 48 trials, the order of conditions was held constant but exact items were randomized across infants, making results somewhat more difficult to compare with previous studies with fewer items (we controlled for this in Experiment 1b).

Fig. 3. Full set of stimuli for Experiments 1b and 2b. From top row to bottom row: real male faces, male doll faces, toy stoves, and real stoves.

with 5 cm (4.8°) between the two pictures of the pair, shown at a viewing distance of approximately 60 cm. As before, each pair type included six pairs, and a pair contained one of the six different images of the corresponding categories. Side presentation was counterbalanced; therefore, the experiment had a total of 48 trials (4 pair types × 6 different pairs × 2 side orders = 48) presented in random order. Unlike Experiment 1a, infants saw the 48 trials in the same order so that the first trial analysis could be conducted on fixations to the same item pairs across infants, as had been done in previous studies.

Gaze was measured using a Tobii corneal reflection eye tracker (Model X120, Tobii Technology). Stimuli were presented on a BenQ LCD monitor of 34 × 20 cm (width × height), which was placed 25 cm behind the back of the eye tracker and with its lower edge positioned 26.5 cm above the table where the eye tracker was placed. The monitor was angled at approximately 5° backward tilt (top tilting away from children). A standard 5-point calibration was used. Tobii Studio 2.0.2 software was used for stimuli presentation and eye gaze recording.

Procedure. The procedure was identical to that of Experiment 1a.

Results and discussion

Preference scores based on accumulated fixations (i.e., normalized dwell times) were calculated as in Experiment 1a along with normalized count scores. The average number of trials for infants in each condition was always above 4. Normalized total fixation preference scores are shown in Fig. 4. Results for normalized fixation counts were again very similar and are not reported.

As in Experiment 1a, a 4 (Pair) × 2 (Sex) ANOVA on fixation preferences in the 48 trials showed no statistically significant main effect of pair, $F(3, 66) = 31.44$, $p < .001$, $\eta_p^2 = .588$, and no significant interaction ($p = .945$). Contrary to the results of Experiment 1a, where we found no main effect of sex, Experiment 1b yielded a significant main effect of sex, $F(1, 22) = 4.70$, $p = .041$, $\eta_p^2 = .176$, such that females showed a stronger preference than males, collapsed over conditions (61.2% vs. 54.0%). That is, males were closer to 50% (no preference). For the main effect of pair, collapsed across sex, *t*-tests

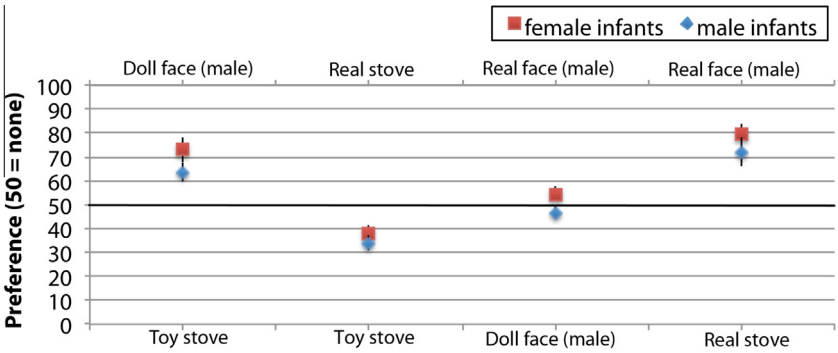

Fig. 4. Infant normalized fixation preference in Experiment 1b for each of the four pair types. Preference is shown as closer to one or other item, with 50% = no preference. Error bars show ± 1 standard error.

showed that, as in Experiment 1a, there were significant preferences in all pairs except those containing male doll and real male faces (50.5%, $p = .86$, Cohen's $d = 0.04$). Similar to Experiment 1a, infants preferred male doll faces over toy stoves (68.2%, $p = .001$, $d = 1.21$), preferred toy stoves over real stoves (35.86%, $p < .001$, $d = 0.82$), and preferred men's faces over real stoves (75.86%, $p < .001$, $d = 1.50$). This suggests that the effects in Experiment 1b may be stronger for male infants compared with results in Experiment 1a. However, it should be noted that in both experiments there was no significant Sex × Pair interaction, and the overall pattern of results was the same across experiments.

As in Experiment 1a, we also calculated results for the first trial in each condition for which an infant produced usable data (one infant was excluded from this analysis because she did not produce usable data even by the third trial, but for the rest 96.7% was for the first trial shown in that condition and 3.3% was for the second trial).[3] The results of the ANOVA were similar to those for the 48 trials, namely a significant main effect of pair, $F(3, 63) = 14.84$, $p < .001$, $\eta_p^2 = .4.14$, and no other significant results ($ps > .334$) (i.e., there was no main effect of sex when only first trials were analyzed). The results of the *t*-tests for first trials were slightly different from the multiple-trial analysis in that there was no difference in preference for toy stoves over real stoves (56.0%, $p = .476$, $d = 0.22$) or for real male faces over doll male faces (49.6%, $p = .924$, $d = 0.02$). Similar to the results of the multiple-trial analysis, the other two conditions showed a significant preference, namely male doll faces over toy stoves (72.45%, $p < .001$, $d = 1.18$) and men's faces over real stoves (83.5%, $p < .001$, $d = 2.02$).

Thus, results for the first- and multiple-trial analyses were again very similar, but because preference for faces over objects was found for both pair comparisons in the multiple-trial analysis, we suggest again that it may be more reliable.

Conclusions from Experiment 1

Overall, we found no interaction between sex and pair in either Experiment 1a or 1b, but in the full trial analysis for both experiments we found a significant preference for faces over mechanical objects and for toys over real mechanical objects, but no difference between real and doll faces. These results indicate that both female and male infants prefer faces over other objects regardless of type of object or sex of the faces, which runs contrary to the hypothesis that sex-related preferences either are inborn or appear very early in life. Importantly, infants' older age in Experiment 1b did not alter the main findings of Experiment 1a (if anything, it strengthened them). This indicates that from 4 to 5 months of age, infants do not seem to develop a sex-related preference for faces versus objects but simply show a stronger preference for faces.

[3] As mentioned earlier, in Experiment 1b items were shown in the same order so that the results could be more appropriately compared with previous experiments that showed only one trial.

Although across the two experiments results were more consistent for multiple-trial analyses, first-trial results were broadly similar and, importantly, still did not show interactions with sex, confirming that it was not the increased number of trials in the current experiment that led to this result. It might be thought that the current results are somewhat inconsistent with Connellan and colleagues (2000), who suggested sex-linked preferences for faces versus mechanical objects in neonates. Results in that study did suggest a slight preference in males for the mobile, but females predominantly showed no preference. We note that the low-level visual qualities of Connellan and colleagues' stimuli were much more similar than ours, and these stimuli were moving in different ways. This is likely to be important because Johnson and colleagues (1991) previously found an overall preference for faces compared with scrambled faces in nonmoving stimuli in neonates (they did not test for sex differences). Interestingly, however, Johnson and colleagues found no preference in 3- to 5-month-olds. With our stimuli, where low-level and object-level information is more different from that in Johnson and colleagues' stimuli, we found a distinct preference for face-like stimuli over mechanical stimuli. However, our results suggest that the sex difference in toy preference seen at older ages (6 months in Alexander et al., 2009, and 3–10 years in Pasterski et al., 2005) is not present in younger infants, indicating that such preferences are the results of either social learning or maturation.

Experiment 2: Adults

We presented adults with the same stimuli as those presented to infants to examine how visual preferences might differ between infancy and adulthood. The two stimulus sets were presented in two separate experiments, containing female faces and cars and male faces and stoves, respectively, as with infants. The main difference between infant and adult testing was that adults were also asked to choose the picture they thought was most attractive. This allowed us to compare an explicit preference measure with the implicit measure of looking time. Based on previous studies that show a preference for sex-related social or nonsocial/mechanical objects in children older than 3 years (Pasterski et al., 2005), men should prefer toy cars over (female) doll faces, whereas the reverse should be true for women. However, given that these adults are post-puberty, we predicted that men would prefer real female faces over doll faces and that women would prefer real male faces over doll faces. In addition, men and women should not show a preference for faces of their own sex over mechanical objects.

Experiment 2a: Preference for female faces versus cars

Method

Participants. The final sample of participants comprised 24 adults: 12 women (mean age = 22.6 years, *SD* = 5.79, range = 18–34) and 12 men (mean age = 21.4 years, *SD* = 3.35, range = 18–30). Adults were undergraduate students participating for course credit or were friends and associates of the second author. All were naive to the hypotheses of the experiment.

Stimuli and apparatus. Stimuli were the same as in Experiment 1a. For adults, picture size was approximately 7.5 × 9 cm (height × width, 7.2 × 8.6°), with 5 cm (4.8°) between the two pictures of the pair, shown at a viewing distance of approximately 60 cm. Stimuli were shown on a Tobii screen of 27 × 32 cm (height × width). Gaze was measured using a Tobii corneal reflection eye tracker (Model T60, Tobii Technology). A standard 5-point calibration was used. E-Prime 2.0 was used for stimuli presentation and eye gaze was recorded by Tobii Studio software.

Procedure. Participants were tested individually. Each adult was presented with a central fixation cross for 2 s before each trial, followed by a pair of stimuli for a maximum of 5 s. The adult was also asked to complete an explicit preference task by pressing either the left or right mouse button to indicate which item of a pair the participant found "most attractive." The adult was asked to respond as quickly as possible.

Results and discussion

Preference scores were computed in the same way as for infants. These normalized total fixation preference scores for adults are shown in Fig. 5. For adults, we can also compare fixation preference with their overt attractiveness responses shown in Fig. 6.

A 4 (Pair) × 2 (Sex) ANOVA for fixation preference scores showed a significant main effect of pair, $F(3, 66) = 3.46$, $p = .021$, $\eta_p^2 = .136$, but no other significant effects ($ps > .122$). *t*-tests confirmed that adult results were slightly different from those of infants; there was no significant preference for toy cars over female doll faces (48.3%, $p = .418$, Cohen's $d = 0.17$) or for toy cars over real cars (52.9%, $p = .289$, $d = 0.23$), but there was a significant preference for real female faces over doll faces (55.8%, $p = .013$, $d = 0.56$). As with infants, there was also a preference for real female faces over real cars (57.0%, $p = .006$, $d = 0.63$). As suggested by Fig. 5, the two significant preference scores are driven by males.

For the overt preference responses, a 4 (Pair) × 2 (Sex) ANOVA showed a marginal main effect of pair, Wilks' lambda = .683, $F(3, 20) = 3.09$, $p = .05$, $\eta_p^2 = .317$, as was the case for the fixation results. However, unlike for fixations, adults' overt attractiveness choices yielded a main effect of sex, $F(1, 22) = 4.49$, $p = .046$, $\eta_p^2 = .170$, and a Pair × Sex interaction, $F(3, 66) = 4.44$, $p = .007$, $\eta_p^2 = .168$. Females had a significant preference for real cars over toy cars ($p = .043$, $d = 0.69$) but had no other preferences ($ps > .261$, $ds > 0.36$). Males preferred real cars over toy cars ($p = .012$, $d = 0.91$), preferred real female faces over female doll faces ($p < .001$, $d = 4.02$), and preferred real female faces over real cars ($p = .005$, $d = 1.04$). They had no preference between toy cars and female doll faces ($p = .28$, $d = 0.43$). Explicit

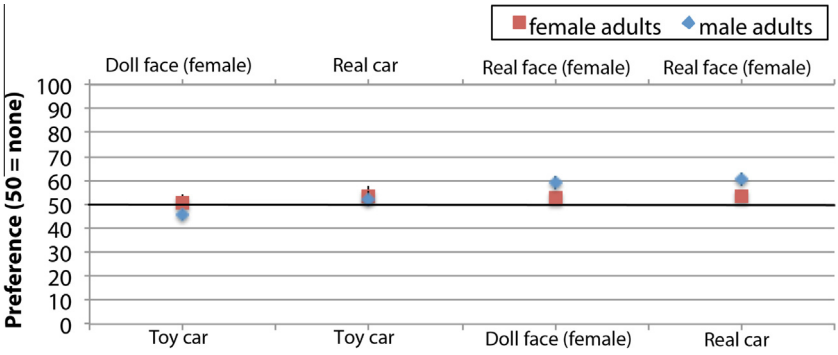

Fig. 5. Adult normalized fixation preference in Experiment 2a for each of the four pair types. Preference is shown as closer to one or other item, with 50% = no preference. Error bars show ± 1 standard error.

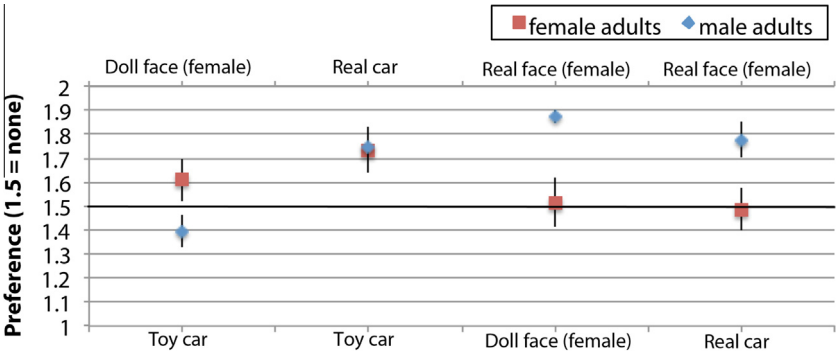

Fig. 6. Adult overt preference responses in Experiment 2a for each of the four pair types. Preference is shown as closer to one or other item, with 1.5 = no preference. Error bars show ± 1 standard error.

preference responses for the adults in Experiment 2a seemed to be much stronger than fixations (and fixation results were generally weaker than those for infants in Experiment 1a).

The results of Experiment 2a, thus, show that, as predicted by the hypothesis of attraction to the opposite sex, men preferred real female faces over female doll faces and over real cars, whereas women did not seem to have a preference given that the significant fixation preferences were driven mainly by men, as shown by Figs. 5 and 6. Contrary to the results of studies demonstrating sex-related preferences in children, there was no overall preference for social (faces) versus nonsocial (cars) stimuli for the adults in Experiment 2a. An unexpected result was women's preference for real cars over toy cars.

Experiment 2b: Preference for male faces versus stoves

Method

Participants. The final sample of participants comprised 24 adults: 12 women (mean age = 22 years, *SD* = 8.06, range = 18–40) and 12 men (mean age = 24.9 years, *SD* = 6.36, range = 18–40). Adults were undergraduate students participating for course credit or were friends and associates of the authors. As in Experiment 2a, all were naive to the hypotheses.

Stimuli, apparatus, and procedure. Stimuli were the same as those in Experiment 1b. The size of the stimuli and presentation were as in Experiment 2a. Gaze measurement and procedure were also as in Experiment 2a.

Results and discussion

Preference scores for adults were calculated as in Experiments 1 and 2a and are shown in Fig. 7. Overt attractiveness responses are shown in Fig. 8.

A 4 (Pair) × 2 (Sex) ANOVA on fixation preferences showed a significant Pair × Sex interaction, $F(3, 66) = 3.37$, $p = .023$, $\eta_p^2 = .133$, but no other significant effects ($ps > .125$). *t*-tests confirmed that adult results were again different from those of infants. Females preferred real male faces over male doll faces (63.9%, $p = .001$, $d = 1.46$) and preferred real male faces over real stoves (72.1%, $p = .008$, $d = 1.00$) (other $ps > .44$, $ds < 0.24$), whereas males only had a significant preference for real stoves over toy stoves (56.4%, $p = .03$, $d = 0.73$) (other $ps > .09$, $ds < 0.38$), which mimics the results of Experiment 2a but in the opposite sex direction.

Unlike analysis of fixations and overt preference results in Experiment 2a, the results of a 4 (Pair) × 2 (Sex) ANOVA on the overt responses showed only a main effect of pair, $F(3, 66) = 9.84$, $p < .001$, $\eta_p^2 = .309$, and no other effects ($ps = .079$). Collapsed over sex, there were significant preferences for real stoves over toy stoves ($p = .001$, $d = 0.82$) and for real male faces over male doll faces ($p < .001$, $d = 1.27$), but no preference for toy stoves over male doll faces ($p = .258$, $d = 0.24$) or for real male faces over real stoves ($p = .091$, $d = 0.37$).

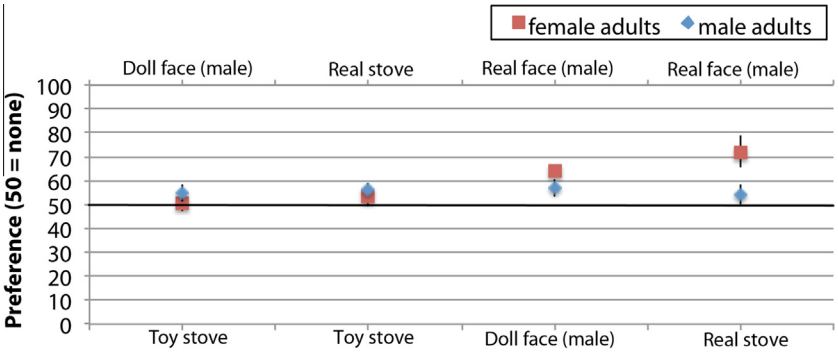

Fig. 7. Adult normalized fixation preference in Experiment 2b for each of the four pair types. Preference is shown as closer to one or other item, with 50% = no preference. Error bars show ± 1 standard error.

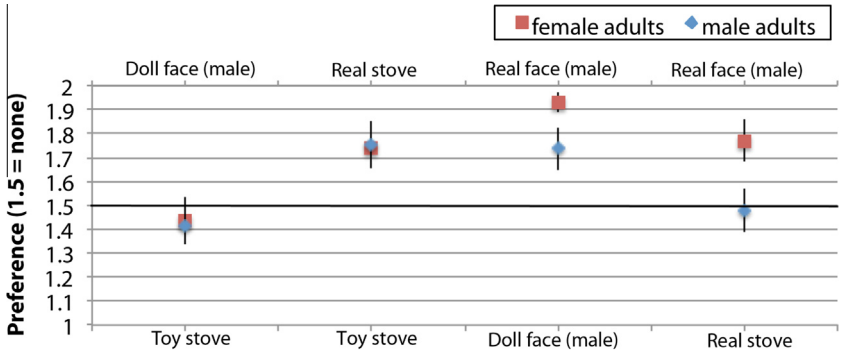

Fig. 8. Adult overt preference responses in Experiment 2b for each of the four pair types. Preference is shown as closer to one or other item, with 1.5 = no preference. Error bars show ± 1 standard error.

Conclusions from Experiment 2

Overall, results from Experiment 2 suggested that, unlike the infant results in Experiment 1, adults showed sex-related differences, which were seen more strongly in their overt preference responses for Experiment 2a and in their fixations for Experiment 2b. As predicted following a maturational post-puberty hypothesis rather than a social versus nonsocial preference, each sex seemed to prefer the opposite sex faces over the real mechanical option; that is, men preferred real female faces over cars and women preferred real male faces over stoves. Similarly, each sex preferred the real faces of the opposite sex over doll faces but had no preference between real and doll faces for the same sex.

General discussion

Unlike previous results on sex differences in neonates and young infants (e.g., Alexander et al., 2009; Connellan et al., 2000; Lutchmaya & Baron-Cohen, 2002), the 4- and 5-month-old infants in the current study did not manifest sex-related preferences; both girls and boys preferred faces over objects regardless of whether the faces were real or doll faces. This infant result is consistent with previous studies showing that infants prefer face-like stimuli (Johnson et al., 1991; Leo & Simion, 2009). We showed here, for the first time, that this preference is comparable for real objects and toys. Conversely, the young adults showed sex-related preferences. These preferences were not related to social versus nonsocial stimuli but instead were related to attraction to the opposite sex. Also consistent with a maturational explanation, and unlike the infants tested in the current study, young female and male adults showed a preference for real faces over doll faces of the opposite sex.

Our results, thus, differ from previous findings from experiments that presented infants with pairs of social versus nonsocial items in sequence (Connellan et al., 2000; Lutchmaya & Baron-Cohen, 2002) or simultaneously (Alexander et al., 2009). We used a number of exemplars for each category, unlike previous studies that used only one exemplar, and we gave infants the opportunity to express a preference by having the items side by side, allowing more direct comparison than presenting the items one at a time (i.e., each pair shows an actual preference rather than just an overall looking time). Our analysis of two measures—all trials in each experiment and the first trial per category—showed similar results, suggesting that the inclusion of multiple trials was not the reason for the difference between our findings and those of previous studies.

In addition, our doll faces were more face-like than the whole baby dolls used in other studies, allowing us to make a comparison between real and toy objects. Our results revealed that only adults exhibited clear preferences when viewing real faces over doll faces, indicating that a preference for real faces develops after 5 months of age. Given that the adults in this study were instructed to compare the two stimuli and make a judgment, their visual preferences might be different from those resulting from spontaneous fixations, the measure used for infants. Quinn and colleagues (2008) previously showed that adult ratings of the attractiveness of cat faces matched infant looking preferences,

but they did not compare the adults' ratings with their own looking preference. Further research should test whether visual preference is different in overt versus spontaneous visual patterns and whether this possible difference changes developmentally. Nevertheless, the current results suggest that the developmental trajectory of face preference is both complex and prolonged, extending well beyond infancy.

It is also important to note that the results of previous studies show a high rate of nonpreference for social versus nonsocial stimuli in many newborns and 6- and 12-month-old boys and girls. That is, even in those experiments reporting evidence for sex-related preferences, the effect is not very consistent. This apparent lack of preference of many infants in previous studies, together with the lack of a sex effect in the current study, suggests that the effect may be quite variable across individuals. The results of a longitudinal study by Campbell, Shirley, Haywood, and Crook (2000) further support this variability, although in their study the difference in toy preference was driven by male infants, whereas this is not always the case (cf. Connellan et al., 2000, where the effect was also driven mostly driven by males, with Alexander et al., 2009, and Lutchmaya & Baron-Cohen, 2002, where effects were driven largely by females). Overall, we suggest that sociality and toy preference are not solely biological in origin but rather the result of maturational processes (e.g., hormonal, social, motor, cognitive).

Interestingly, the sex-related preferences shown by the young adults in the current study do not correspond to those found for social versus nonsocial stimuli or "girl toys" versus "boy toys." As mentioned in the Introduction, it seems that attraction to the other sex underlies young adults' preferences for real faces because such a preference did not extend to doll faces. Although previous research has shown that men exert effort (press a key more often) to see pictures of attractive female faces (Ahron et al., 2001), the current study shows that this is related only to overt behavior, whereas the fixation results demonstrate that the underlying psychological attraction and desire of the two sexes to see each other's faces are mutual.

In summary, the current study combines the research questions of the literature on toy and social versus nonsocial object preference. The absence of a sex-related preference in our 4- and 5-month-olds challenges the biological view on sexual preferences, which was based in part on results from newborn girls and boys. In addition, our results with adults using the same methodology suggest that sex-related preferences for toys and real objects are likely the result of learning and maturational factors such as post-puberty attraction to the opposite sex. Further research with older infants, toddlers and children using a similar methodology could shed more light on the developmental components of sex difference in preference for objects.

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