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Sex-related preferences for real and doll's 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 non-social or mechanical toys such as cars, while 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). Forty-eight 4- and 5-month-old infants (24 girls) and 48 young adults (24 women) 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's faces. Similarly, adults did not show sex-related preferences for social versus non-social 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 and real stimuli preferences (Connellan et al., 2000) and suggest that sex-related preferences result from maturational and social development, which continues into adulthood.

Previous studies have shown that 3-year old boys prefer to play with transportation and construction toys while girls prefer dolls (Connor & Serbin, 1977; Liss, 1981), and that 3- to 10-year-old children prefer toys associated with their respective sex (Pasterski, Geffner, Brain, Hindmarsh, Brook, & Hines, 2005). Learning and cognitive theories suggest that these toy preferences arise from modelling 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, suggested 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; Hines, 2010; Fausto-Sterling, 1992). Importantly, sex-specific toy preferences are not exclusive to human children: Young male monkeys

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were reported to spend more time interacting with and looking at “human boy toys” than young female monkeys did, 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 has presumably 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-old children (Zosuls, Ruble, Tamis-LeMonda, Shrout, Bornstein, & Greulich, 2009). Using an eye-tracker, Alexander et al. found that, just like older children and young monkeys, infant boys were more interested in the toy truck than were infant girls, while 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% versus 17% of the sample), but more newborn boys showing the opposite preference (43% versus 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 non-social stimuli have a strong innate component, since they are present at birth, and that they 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 present study, we asked whether pictures of social and non-social toys and real objects would yield similar sex-differences in preference. Using a within-subject design, we presented 4- and 5-month-old infants as well as young adults 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 which 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 non-social 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 we asked them to judge the *attractiveness* of the pictures. This allows us to compare fixation preferences to explicitly stated preferences and 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), then both infants and adults should prefer all types of sex-specific items, either toys or real objects, i.e. females should prefer face-like (social) stimuli and males should prefer stove/car-like (non-social) stimuli. A similar result for infants and adults would also be in line with Quinn et al.’s (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 to 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 non-social stimuli develop with maturation and social development, we 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, while 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 non-social preferences in adulthood.

Experiment 1 – Infants

Infants' preference for faces over objects was tested with two sex-specific sets of stimuli, namely with 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 non-social/mechanical objects applies to female and male faces as well as 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 non-social objects is present before 6 months of age, female infants should show a preference for male and female faces over cars and stoves, while male infants should show the opposite preference. Alternatively, if faces have a different status to objects during infancy, all infants may prefer all faces. Additionally, inclusion of male and female faces in the stimuli will show whether 4- and 5-month-old infants prefer female faces in general (Quinn, Yahr, & Kuhn, 2002), or whether signs of attraction for the opposite sex are found at this early age. Furthermore, including toy and real versions of the non-social stimuli will show whether infants' preference is linked to the level of "reality" in the objects, i.e. whether it applies to only toys or real objects as well.

Experiment 1a – preference for female faces versus cars

Methods

Participants: The final sample of participants comprised 24 4-month-old infants, 12 girls (*M* age = 3 months and 27 days, range: 3 months and 15 days – 4 months and 6 days) and 12 boys (*M* age = 3 months and 26 days, range: 3 months and 18 days – 4 months and 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. Fourteen infants were observed but not included in the final sample due to fussiness (5), side bias greater than 95% (6), failure to look at either stimulus when tested with one or more stimulus pairs (2), or to balance the sex distribution (1 girl).

Stimuli and apparatus: Stimuli were static pictures chosen from the internet. Pictures belonged to one of four categories: toy cars, female doll faces, real cars, and real female faces. There were six different pictures for each category for a total of 24 pictures, as shown in Figure 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 the infant's 60-cm viewing distance) with 3.0 cm (2.9°) between. Each pair type included six pairs, and a pair contained one of the six different images of the corresponding categories. Side presentation was counterbalanced and 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 model 1750 corneal-reflection eye tacker (Tobii Technology, Falls Church, VA). Stimuli were presented on a Tobii screen of 27 cm (height)

× 34 cm (width). A standard 5-point calibration was used. E-Prime 2.0 was used for stimuli presentation, while eye-gaze was recorded by Tobii software.

Procedure: Infants were tested individually. During the session, infants sat on a caregiver's lap on a chair approximately 60 cm from the screen while the eye tracker recorded their eye movements. Before each trial infants were 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. Participants were 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. Parents were asked to close their eyes during calibration, and were not told the study hypothesis until it was completed. Each family received a small gift (e.g., a toy) for their participation.

Results and discussion—Similarly 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 normalised 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 useable data on all trials, but the average number of trials for infants in each condition was always above 4. These *normalised* total fixation preference scores are shown in Figure 2. Results were also calculated for normalised fixation counts (total counts/number of trials × 5s), but as analysis of these was very similar to total normalised fixation preferences they will not be reported.

A 4 (pair) × 2 (sex) 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, toy cars over real cars, 43.7%, $p = .019$, d = 0.53, and real female faces over real cars, 65.4%, $p = .001$, d = 0.81.

Since most previous studies only included 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, for 4.2% it was the second trial)[2]. The results of the ANOVA were the same as those for all 48 trials: 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 over female doll faces was revealed, 62.5%, $p = .064$, d = 0.41. Patterns of results for the other pairs were the same: preference for female doll faces over toy cars, 71.6%, $p = .001$, d = 0.77, and 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

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

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

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

Methods

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

Stimuli and apparatus: As for Experiment 1a, stimuli were static pictures chosen 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 six different pictures for each category for a total of 24 pictures, as shown in Figure 3. These were divided into four fixed paired categories, as for 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°), 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 and 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 tacker (Tobii Technology, Falls Church, VA), model X120. Stimuli were presented on a BenQ LCD monitor of 34 cm (width) × 20 cm (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 the child). A standard 5-point calibration was used. Tobii Studio 2.0.2 software (Tobii Technology) 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., normalised dwell times) were calculated as for Experiment 1a, along with normalised count scores. The average number of trials for infants in each condition was always above 4. Normalised total fixation preference scores are shown in Figure 4. Results for normalised 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% versus 54.0%). That is, males were closer to 50% (no

preference). For the main effect of pair, collapsed across sex, *t*-tests 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). Similarly to Experiment 1a, infants preferred male doll faces over toy stoves, 68.2%, $p = .001$, d = 1.21, toy over real stoves, 35.86%, $p < .001$, d = 0.82, and 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 to 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 for Experiment 1a, we also calculated results for the first trial in each condition for which an infant produced usable data (one was excluded from this analysis because she did not produce useable data even by the third trial, but for the rest 96.7% was for the first trial shown in that condition, 3.3% for the second trial)[3]. The results of the ANOVA were similar to those for the 48 trials: 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 analysed). 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 over real stoves, 56.0%, $p = .476$, d = 0.22 or real over doll male faces, 49.6%, $p = .924$, d = 0.02. Similarly to the results of the multiple-trial analysis, the other two conditions showed a significant preference: male doll faces over toy stoves, 72.45%, $p < .001$, d = 1.18; men's faces over real stoves, 83.5%, $p < .001$, d = 2.02.

Thus, results for the first-and multi-trial analyses were again very similar, but since preference for faces over objects was found for both pair comparisons in the multi-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 toy 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 the sex of the faces, which runs contrary to the hypothesis that sex-related preferences are either 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, infants do not seem to develop a sex-related preference for faces versus objects but simply show a stronger preference for faces.

Although across the two experiments results were more consistent for multi-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 which led to this result. It might be thought that the current results are somewhat inconsistent with Connellan et al., (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 predominately showed no preference. We note that the low-level visual qualities of Connellan et al.'s stimuli were much more similar than ours, and these stimuli were moving in different ways. This is likely to be important as Johnson et al. (1991) previously found an overall preference for faces compared to scrambled faces in

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

non-moving stimuli in neonates (they did not test for sex differences). Interestingly, however, Johnson et al. found no preference in 3–5 months. With our stimuli, where low-level and object level information is more different than that in Johnson et al.'s 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 Paterski et al., 2005) is not present in younger infants, indicating that such preferences are either the results of 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 for the 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 allows 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 non-social/mechanical objects in children older than 3 years of age (Paterski et al., 2005), men should prefer toy cars over (female) doll faces, whereas the reverse would be true for women. However, given that these adults are post-puberty we predicted that men would prefer real female faces over dolls and that women would prefer real male faces over dolls. Additionally, 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

Methods

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

Stimuli and apparatus: Stimuli were as for 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 cm (height) and 32 cm (width). Gaze was measured using a Tobii corneal-reflection eye tacker (Tobii Technology, Falls Church, VA), model T60. A standard 5-point calibration was used. E-Prime 2.0 was used for stimuli presentation, while eye-gaze was recorded by Tobii Studio software.

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

Results and discussion—Preference scores were computed in the same way as for infants. These normalised total fixation preference scores for adults are shown in Figure 5. For adults, we can also compare fixation preference to their overt attractiveness responses shown in Figure 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 toy cars over real cars, 52.9%, $p = .289$, d = 0.23; however there was a significant preference for real female faces over doll faces, 55.8%, p = .013, d = 0.56. As for infants, there was also a preference for real female faces over real cars, 57.0%, p =.006, d =. 63. As suggested by the figure, 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, adult's 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 no other preferences, $p > .261$, ds > 0.36. Males preferred real over toy cars, $p = .012$, d = 0.91, real female faces over female doll faces, $p < .001$, d = 4.02, and 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 preference responses for the adults in Experiment 2a seemed to be much stronger than fixations (and fixation results were generally weaker than infants in Experiment 1a).

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

Experiment 2b – preference for male faces versus stoves

Method

Participants: The final sample of participants comprised 24 adults, 12 females (M age = 22 years, SD = 8.06, range = 18–40) and 12 males (M age = 24.9, SD = 6.36, range = 18–40). Adults were undergraduate students participating for course credit, or 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 for Experiments 1 and 2a, and are shown in Figure 7. Overt attractiveness responses are shown in Figure 8.

A 4 (pair) × 2 (sex) ANOVA on fixation preferences showed a significant interaction, pair × sex $F(3, 66) = 3.37$, $p = .023$, $\eta_p^2 = .133$, 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 over real stoves, 72.1%, $p = .008$, d = 1.0 (other ps >.44, ds < 0.24), while males only had a significant preference for real 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 only showed 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 over toy stoves, 1.75, $p = .001$, d = 0.82, and real male faces over male doll faces, 1.83, $p < .001$, d = 1.27, but no preference for toy stoves over male doll faces, 1.43, $p = .258$, d = 0.24 or for real male faces over real stoves, 1.62, $p = .091$, d = 0.37.

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 more strongly seen 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 non-social 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 to doll faces, but had no preference between real and doll faces for same-sex.

General discussion

Unlike previous results on sex differences in neonates and young infants (e.g., Alexander et al. 2009, Connellan et al., 2002, Lutchmaya & Baron-Cohen, 2002), the 4- and 5-month-old-infants in the present study did not manifest sex-related preferences: Both girls and boys preferred faces to 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 show 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 non-social stimuli, but instead to attraction for the opposite sex. Also consistent with a maturational explanation, and unlike the infants tested in the present study, young female and male adults showed preference for real over doll's faces of the opposite sex.

Our results thus differ from previous findings from experiments that presented infants with pairs of social vs. non-social 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 which used only one, 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, which suggests that the inclusion of multiple trials was not the reason for the difference between our findings and those of previous studies.

Additionally, 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 over doll faces, indicating that a preference for real faces develops after 5 months. 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 measured used for infants. Quinn et al. (2008), previously showed that adult ratings of the attractiveness of cat faces matched infant looking preferences, but they did not comparing the adults' ratings to 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 present 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 non-preference for social versus non-social stimuli in many newborns, 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 present study, suggests 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 mostly driven by males, versus Alexander et al., 2009 and Lutchmaya & Baron-Cohen, 2002, where effects were largely driven by females). Overall, we suggest that sociality and toy preference are not solely biological in origin but the result of maturational processes (hormonal, social, motor, cognitive, etc.).

Interestingly, the sex-related preferences shown in the young adults of the present study do not correspond to those found for social versus non-social stimuli or “girl-toys” versus “boy-toys.” As mentioned in the Introduction, it seems that attractiveness for 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 exerted effort (press a key more often) to see pictures of attractive female faces (Ahron, Etcoff, Ariely, Chabris, O’Connor & Breiter, 2001), the current study shows that this is only related to overt behaviour, while the fixation results demonstrate that the underlying psychological attraction and desire of the two sexes to see each other’s’ faces is mutual.

In sum, the present study combines the research questions of the literature on toy and social vs. non-social 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. Additionally, 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 a post-puberty attraction for the opposite sex. Further research with older infants, toddlers and children using similar methodology could shed more light on the developmental components of sex difference in preference for objects.

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Highlights

- Multiple faces and objects were used to examine sex-related preferences in infants and adults
- Infants showed no sex-related preference but a group preference for faces
- Male adults preferred women's faces over objects, while females preferred men's faces
- This challenges an innate basis for sex-related preference in object perception
- Sex-related preferences seem to result from maturation and social learning

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

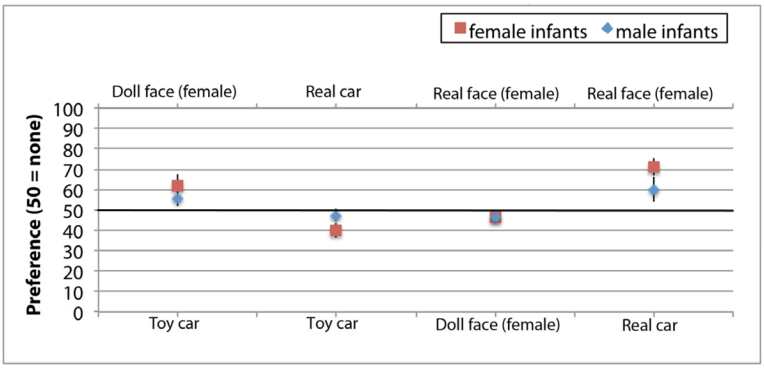

Figure 2.

Infant normalised 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 SEM.

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

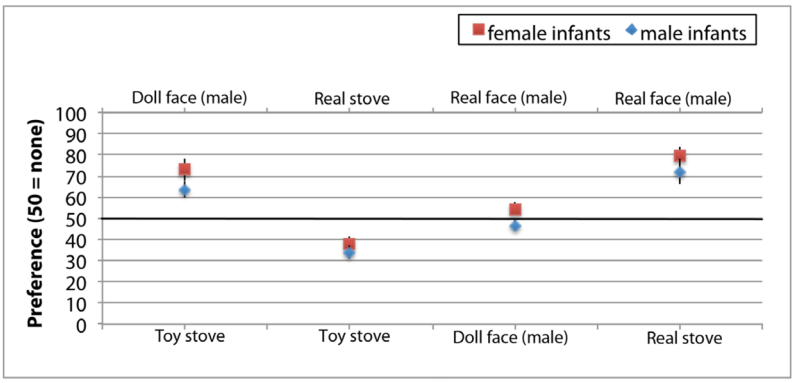

Figure 4.
Infant normalised fixation preference in Experiment 1b for each of the four pair types. Preference is shown as closer to one or other item, with 50% = no preference. Error bars show ± 1 SEM.

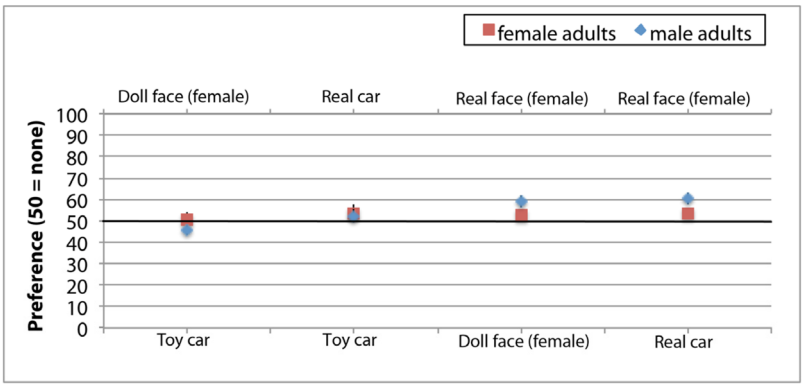

Figure 5.
Adult normalised fixation preference in Experiment 2a for each of the four pair types. Preference is shown as closer to one or other item, with 50% = no preference. Error bars show ± 1 SEM.

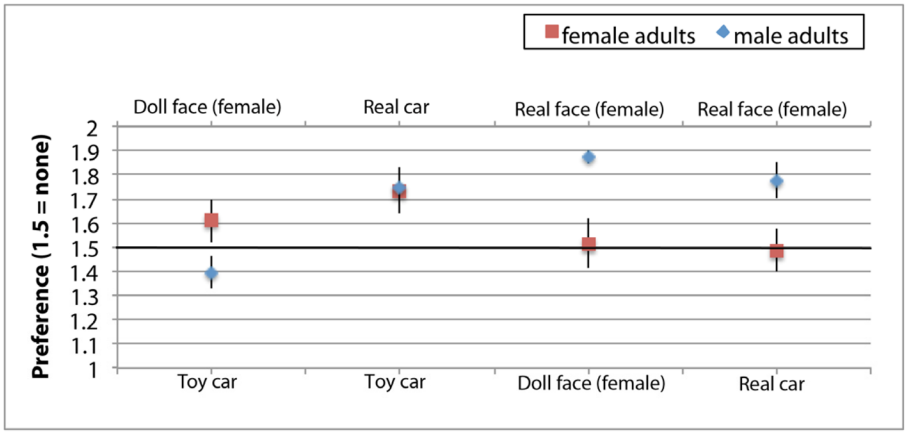

Figure 6.
Adult overt preference responses in Experiment 2a for each of the four pair types. Preference is shown as closer to one or other item, with 1.5 = no preference. Error bars show ± 1 SEM.

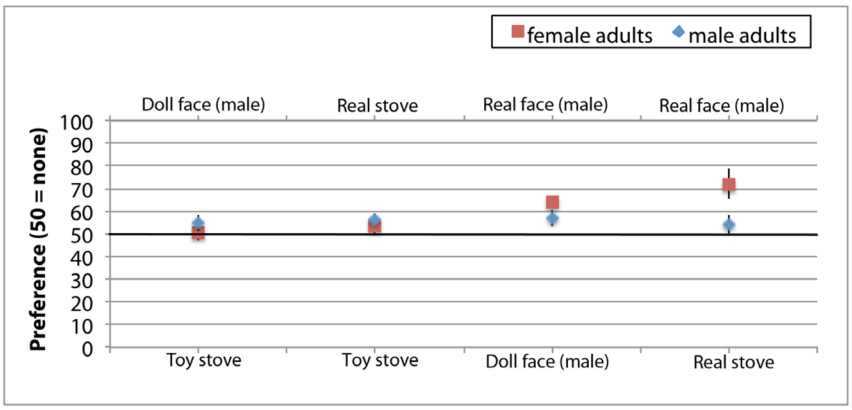

Figure 7.

Adult normalised 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 SEM.

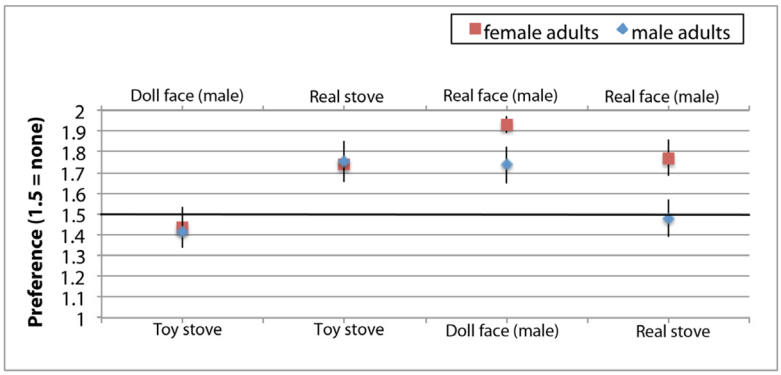

Figure 8.

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 SEM.