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Infants' Preferences for Toys, Colors, and Shapes: Sex Differences and Similarities

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Abstract Girls and boys differ in their preferences for toys such as dolls and trucks. These sex differences are present in infants, are seen in non-human primates, and relate, in part, to prenatal androgen exposure. This evidence of inborn influences on sex-typed toy preferences has led to suggestions that object features, such as the color or the shape of toys, may be of intrinsically different interest to males and females. We used a preferential looking task to examine preferences for different toys, colors, and shapes in 120 infants, ages 12, 18, or 24 months. Girls looked at dolls significantly more than boys did and boys looked at cars significantly more than girls did, irrespective of color, particularly when brightness was controlled. These outcomes did not vary with age. There were no significant sex differences in infants' preferences for different colors or shapes. Instead, both girls and boys preferred reddish colors over blue and rounded over angular shapes. These findings augment prior evidence of sex-typed toy preferences in infants, but suggest that color and shape do not determine these sex differences. In fact, the direction of influence could be the opposite. Girls may learn to prefer pink, for instance, because the toys that they enjoy playing with are often colored pink. Regarding within sex differences, as opposed to differences between boys and girls, both boys and girls preferred dolls to cars at age 12-months. The preference of young boys for dolls over cars suggests that older boys' avoidance of dolls may be acquired. Similarly, the sex similarities in infants' preferences for colors and shapes suggest that any subsequent sex differences in these preferences may arise from socialization or cognitive gender development rather than inborn factors.

Keywords Sex · Gender · Infants · Toy preference · Color preference · Shape preference

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Introduction

Children show clear sex-typed toy preferences, with girls showing more interest than boys do in dolls and boys showing more interest than girls do in vehicles (Alexander & Hines, 1994; Pasterski et al., 2005; Serbin, Poulin-Dubois, Colburne, Sen, & Eichstedt, 2001). In addition to these differences between the sexes, within sex analyses show that boys play more with masculine toys, like vehicles and weapons, than with feminine toys, like dolls and tea sets. In contrast, although girls play more with feminine toys than with masculine toys when the feminine toys are sufficiently interesting (e.g., Hines & Alexander, 2008; Pasterski et al., 2005), they sometimes show no significant preference for feminine over masculine toys (e.g., Berenbaum & Hines, 1992; Servin, Nordenstrom, Larsson, & Bohlin, 2003). The strong male preference for same-sex toys has sometimes been described as boys avoiding girls' toys (Maccoby & Jacklin, 1974).

Sex-typed toy preferences have been seen in infants (Alexander, Wilcox, & Woods, 2009; Campbell, Shirley, Heywood, & Crook, 2000; Serbin et al., 2001; Snow, Jacklin, & Maccoby, 1983), grow larger as childhood progresses (Golombok & Hines, 2002), and have been reported into young adulthood (Alexander, 2006). These sex differences have been documented using an array of research methodologies, including inventories of children's toys at home, observation of children's toy contact in a playroom, parental interviews and questionnaires, and visual preferences and eye-tracking.

Perspectives on the acquisition of sex-typed play, including toy preferences, can be categorized broadly into social learning theories, cognitive theories, and hormonal theories. Social learning theories posit that children are socialized into different gender role behaviors, including toy play (Bandura, 1977; Mischel, 1966). Boys are reinforced for engaging with male-typical toys and girls for engaging with female-typical toys. Opposite sex-typed behavior is punished or not rewarded, which leads to extinction. Children can also learn which behaviors to adopt by modeling individuals of the same sex as themselves or by complying with labels identifying behaviors as appropriate for children of one sex or the other.

From a social learning perspective, infants' preferences for sex-typed toys would suggest that the differential treatment of boys and girls begins at an early age. In support of this view, Snow et al. (1983) found that fathers of 12-month-old infants were less likely to give dolls to their sons than to their daughters. In addition, Caldera and Sciaraffa (1998) observed parents and their 18- to 23-month-old infants playing with either a doll or a clown. They found that parents of boys called their sons' attention to the clown more than the doll and parents of girls called their daughters' attention to the doll more than the clown. Similarly, Pomerleau, Bolduc, Malcuit, and Cossette (1990) found that parents of infants aged 5–25 months created different home environments for boys and girls. Boys had more sports equipment, tools and vehicles, and girls had more dolls and fictional characters. Thus, socialization of very young infants may be occurring not only through parents' interactions with their sons and daughters, but also in the way in which they design their infants' home environments.

Cognitive theories include cognitive developmental theories (Kohlberg, 1966) and gender schema theories (Bem, 1981; Martin & Halverson, 1981; Martin, Ruble, & Szkrybalo, 2002). According to cognitive developmental theories, gender role acquisition involves three stages: gender labeling, gender stability, and gender constancy. It is at this last stage, where the child understands that gender remains the same across different situations, that sex-typed preferences were originally thought to emerge. More recently, researchers have suggested that gender constancy is not a prerequisite for gender-typed behavior and, indeed, young children show sex-typed preferences before gender constancy is attained (Ruble, Martin, & Berenbaum, 2006). Gender schema theorists posit that children develop gender schemas to organize and structure gender-related information from their environment. The process of gender typing is thought to begin once the child is able to categorize him/herself as belonging to a particular gender. For cognitive theorists, sex-typed behavior follows from a child knowing his or her own gender and becoming aware of the stereotypes that exist in the social environment.

From the hormonal perspective, sex differences arise, in part, from early hormonal differences between boys and girls (Hines, 2004). In particular, sex differences in the prenatal hormone environment are thought to produce differences in neural organization, such that high concentrations of androgens, hormones typically produced in large amounts by the male fetus, lead to brain masculinization and increased male-typical behavior. One approach to understanding the effects of sex hormones has been to study children with congenital adrenal hyperplasia (CAH), a genetic condition where the female fetus is exposed to abnormally high concentrations of androgens. These studies have shown that girls with CAH spend more time playing with masculine toys and less time playing with feminine toys compared to control group girls (Berenbaum & Hines, 1992; Meyer-Bahlburg et al., 2004; Nordenstrom, Servin, Bohlin, Larsson, & Wedell, 2002; Pasterski et al., 2005). The suggestion that this may result from parents encouraging male-typical toy play in girls with CAH (Quadagno, Briscoe, & Quadagno, 1977) has not been supported by research finding that parents encourage feminine toy play, not masculine toy play, more in their daughters with CAH than in their unaffected daughters (Pasterski et al., 2005). Normal variability in androgen exposure prenatally also relates to male-typical childhood behavior (Auyeung et al., 2009; Hines et al., 2002), suggesting that the findings for girls with CAH relate to their androgen exposure, not to other aspects of the disorder. Sex-typed toy preferences similar to those seen in children have also been reported in two species of non-human primates, vervet monkeys and rhesus monkeys (Alexander & Hines, 2002; Hassett, Siebert, & Wallen, 2008), providing additional evidence of some innate contribution.

Given the evidence that sex differences in toy preferences emerge early in life and appear to relate, in part, to hormonal or other inborn influences, some researchers have begun to ask what properties of sex-typed toys differentially attract boys and girls (Alexander & Hines, 2002; Campbell et al., 2000). For example, are boys attracted to wheels and motion, and girls to faces and imaginary role-play? Moller and Serbin (1996) argued that toy preferences result from what the toy can do, rather than from children knowing that a toy is appropriate for their own gender. Similarly, Alexander (2003) suggested that sex-typed toy preferences may result from a preference for different object features, including color, movement, or form.

Sex-typed Toys and Color

Toys for boys and girls tend to differ in many ways. One of the most obvious is color. Pennell (1994) found that girls' toys tended to be colored in pastel shades, especially pink and lavender, and boys' toys tended to be colored in intense colors, such as red, blue, and black. These colors are also differentially preferred by girls and boys. For example, Picariello, Greenberg, and Pillemer (1990) asked 3- to 7-year-old children to choose their favorite felt pig from a choice of pigs colored in either

stereotypically masculine colors (navy blue, brown, maroon) or stereotypically feminine colors (light pink, bright pink, lavender), and found that they were likely to choose a pig in a color stereotyped as for their own sex. Similarly, Chiu et al. (2006) asked girls and boys aged 3–12 years to choose their three favorite colors from a color chart, and found that boys preferred blue to pink/purple, and girls preferred pink/purple to blue. There also are sex differences in children's use of color in drawings (Iijima, Arisaka, Minamoto, & Arai, 2001). Girls use more "warm" colors, including pink, than boys, whereas boys use more "cold" colors, such as gray and blue, compared to girls. Sex-typed color preferences appear to persist into adulthood; Hurlbert and Ling (2007) examined the color preferences of adults using a forced choice color picking task and found females to prefer reddish purple and males to prefer blue-green.

Few studies have examined the color preferences of children below the age of 3 years, and none have looked at sex differences in infants' preferences. However, babies as young as 3 months can see color (Bornstein, 1985; Cohen, DeLoache, & Strauss, 1979; Franklin, Pitchford, Mahony, & Davies, 2006) and both male and female infants between the ages of 3 and 5 months appear to like red most and green least (Adams, 1987; Bornstein, 1975). It is not known, however, if infants display sex-typed color preferences similar to those of older children and adults or, if so, when these sex differences emerge.

Sex-typed Toys and Shape

In addition to color, sex-typed toys differ in their shape. For instance, cars and other vehicles tend to be angular, whereas dolls tend to be rounded. Although research has not examined preferences for different shaped toys per se, some studies have examined the content of drawings, finding sex differences in images produced by adults, as well as children. Franck and Rosen (1949) found that men tend to "close off" stimuli, to enlarge images (mainly by extending the image upwards), and to emphasize sharp or angular lines, while women tend to leave the stimulus areas "open", to elaborate the drawing within the confines of the presented lines and to blunt or round off any angular lines. Among children, girls are more likely than boys to draw flowers, butterflies, the sun, and human motifs, whereas boys are more likely than girls to draw mobile objects, such as vehicles, trains, aircraft, and rockets (Iijima et al., 2001).

The present study examined toy preferences, as well as color and shape preferences, in infants ages 12, 18, and 24 months. We evaluated the hypotheses that these young children show preferences for sex-typical toys and colors, for sex-typed toys in sex-typed colors, and for angular versus rounded shapes. Infants across a range of ages were studied in anticipation of determining not only infants' sex-typed preferences, but also the age at which any such preferences emerge.

Method

Participants

Parents of infants were contacted through nurseries and mother and baby groups in London, UK. Infants were recruited into three age categories: 12 months (for boys: $M = 54.51$ weeks, $SD = 5.20$; for girls: $M = 53.66$ weeks, $SD = 4.76$), 18 months (for boys: $M = 80.45$ weeks, $SD = 3.42$; for girls, $M = 81.26$ weeks, $SD = 5.24$), and 24 months (for boys: $M = 106.58$ weeks, $SD = 6.36$; for girls, $M = 105.85$ weeks, $SD = 5.28$). Each age category consisted of 20 boys and 20 girls. Most infants ($N = 116$) participated with their mothers; four infants participated with their fathers. Each parent–infant pair was paid £10 sterling (about $20) for taking part in the study.

The majority of mothers (72, 60%) and fathers (81, 67.5%) had a professional occupation, as defined by the modified version of the Registrar Generals classification (OPCS and Employment Department Group, 1991) and 94 (78.3%) mothers and 96 (80%) fathers held a university degree. Sixty-six (55%) of the mothers were not working at the time of study, 13 (10.8%) worked full-time, and 41 (34.2%) worked part-time. Ninety-eight (81.7%) infants were Caucasian according to the Commission for Racial Equality classification for ethnicity.

Measures

We used a preferential looking task, whereby two images were shown simultaneously to the infant in a darkened room. Each image in each stimulus pair was mounted in a square, colored in gray (hue = 160, saturation = 0, luminance = 202). The infant's face was recorded by videotape and later coded for the length of time that the infant looked at each image. The stimuli used for the preferential looking task were chosen to test specific hypotheses, and these stimuli, and the hypotheses they were chosen to assess, are described below.

Color Stimuli

Four pairs of stimuli were used to evaluate infants' preferences for colors on their own. These stimulus pairs examined the hypotheses that boys prefer blue and girls prefer pink, as well as that infants show these sex-typed color preferences when brightness is controlled. Two pairs of stimuli compared pink (hue = 234, saturation = 235, luminance = 191) and blue (hue = 146, saturation = 240, luminance = 115). To ensure that the color of the stimuli matched the shades of pink and blue of existing toys, two toys (a doll's dress and a building block) were scanned directly into the computer and their shades of pink and blue were recorded. Because pink and blue are made up of different brightness (luminance) levels, with pink being brighter than blue, and because differences in the brightness levels of colors have been

shown to modify infants' color preferences (Cohen et al., 1979), two additional stimulus pairs were used to control for brightness. The pink was matched for brightness with the blue to produce red (hue = 234, saturation = 235, luminance = 115), and the blue was matched for brightness with the pink to produce pale blue (hue = 146, saturation = 240, luminance = 191). Thus, there were four pairings: pink/blue; red/pale blue; pink/pale blue; and red/blue.

Toy Stimuli

Two sex-typed toys (a doll and a car) provided the toy stimulus pairings. Simple line drawings of a doll and a car were scanned into a computer to create the stimuli (Fig. 1). To allow assessment of relationships between toy and color, as well as toy preferences on their own, the car and the doll were colored in the same four colors used for the color stimuli (pink, blue, red, pale blue).

The stimuli were paired to examine specific hypotheses. To test the hypothesis that boys and girls prefer sex-typed toys in sex-typed colors, we compared the doll to the car when colored in sex congruent colors, i.e., pink doll/blue car. To test the hypothesis that the preference for sex-typed toys would be weaker when they are colored in cross sex-typed colors, we compared the doll to the car when colored in sex incongruent colors, i.e., blue doll/pink car. To examine the same hypotheses with brightness controlled, we paired the doll to the car when colored in sex congruent colors and sex incongruent colors controlling for the difference in brightness levels of pink and blue. As all possible color combinations were included, this resulted in four pairings: two pairings of toys colored in sex congruent colors (i.e., red doll/blue car and pink doll/pale blue car) and two parings of toys colored in sex incongruent colors (i.e., red car/blue doll and pale blue doll/pink car).

We also tested the hypothesis that boys and girls differ in their preference for the car and doll when both toys were of the same color or no color, by pairing the doll with the car of the same color, i.e., pink car/pink doll, blue doll/blue car, and by pairing a colorless car with a colorless doll. Finally, to test the hypothesis that boys and girls differ in preferences for the colors pink and blue, we paired pink to blue with the toy held constant: blue doll/pink doll and pink car/blue car.

Shape Stimuli

Three pairs of stimuli tested the hypothesis that boys and girls differ in their preferences for angular shapes versus rounded shapes: an angular triangle paired with a triangle with rounded edges (rounded triangle), an angular star paired with a star with rounded edges (rounded star), and an overlapping square and rectangle (rectangles) paired with an overlapping circle and oval (circles). The shapes were colored in white (Fig. 2.)

Procedure

Procedures were conducted at City University in London. On arrival, parents and infants were taken into a reception room where they were informed about the procedure for the study and parental consent was obtained. They were then taken into the laboratory where parents were asked to seat their infants in their laps. In front of them, at a distance of 2 m, was a large white screen onto which the prepared images were projected. Hidden behind the screen was a stand holding a video camera and speakers. Only the lens of the video camera, which protruded from a hole cut out of the screen, was visible from the front of the screen. Parents were advised not to direct their child to a particular stimulus, either verbally or physically. They were also told that they could stop the testing procedure at any time by getting up from their seat. The experimenter sat in the observation room, separated from the laboratory by a one-way mirror.

As in other preferential looking studies (Campbell et al., 2000; Serbin et al., 2001), two stimuli were presented simultaneously, one on either side of the child's central gaze. The stimuli measured 45 × 45 cm and were located approximately 45 cm apart when projected onto the screen. The experimenter waited for the child to have a central gaze before showing each pair of stimuli. The infant could also be encouraged to look centrally at the screen by projecting a red spot onto the central point of the

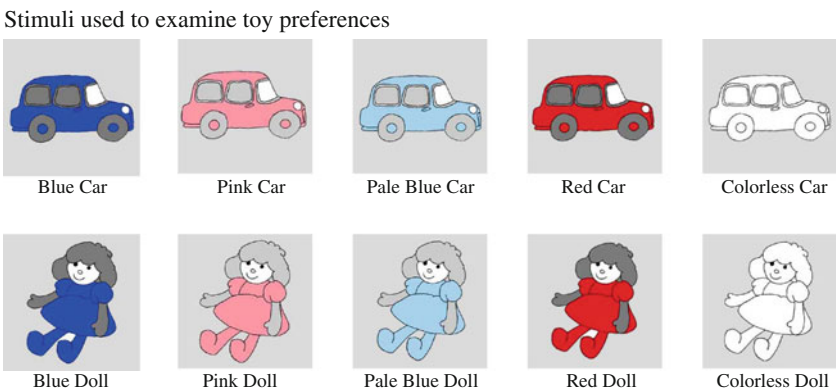

Fig. 1 Stimuli used to examine toy preferences

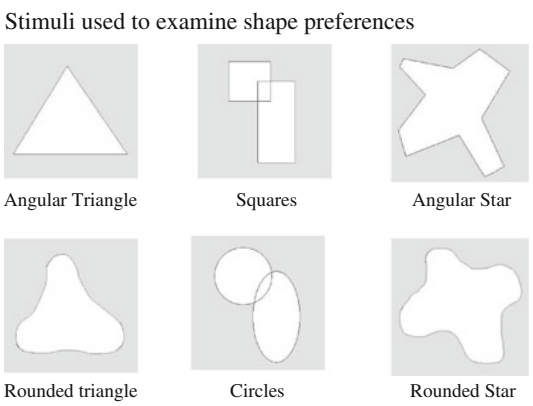

Fig. 2 Stimuli used to examine shape preferences

screen (used when the infant was looking in the direction of the screen) or by playing a sound (used when the infant was looking away from the screen area or was being especially fidgety). Generally, these devices were only required before the first pair of stimuli were presented.

The first sets of stimuli shown were the four pairs of color stimuli combined with the 11 pairs of toy stimuli. To ensure counterbalancing, each pairing was shown twice, with each stimulus within a pair appearing once on the left and once on the right side of the child's gaze. Thus, 30 pairs of stimuli were shown for 5 s each. The shape stimuli were shown after the color and toy stimuli. The three pairs of shape stimuli were counterbalanced producing six pairs shown for 5 s each. Order of presentation was randomized within each of the two groups of stimuli.

Data Analysis

Coding of the videotapes from the toy, color, and shape presentations was carried out by playing the tape on a VHS videorecorder and freezing the initial image. The frame advance function was then used to move the picture frame by frame. Data were coded directly onto a spreadsheet where it was noted whether the infant was looking at the left hand image, the right hand image or neither image during each frame. There were a total of 25 frames per second. As the images were counterbalanced by showing each stimulus per pair on each side of the child's central gaze, the total looking times for both images of a pair were added together. This meant that the final score ranged from 0 to 10 s (or 0 to 250 frames). To assess inter-rater reliability, a randomly selected sample of the videotapes was coded by two scorers. Pearson correlation coefficients for the pairings, calculated using the combined raw scores for each pair of stimuli, ranged from .80 to .99 with an average correlation of .95.

Data were lost for some subjects during the preferential looking task due to infant fussiness. As counterbalancing was achieved by showing the same pairings twice, some infants saw only one of the two versions of a pairing. When this happened, the data for that infant for both versions of that particular pairing were deleted. During the first session 107 of the 120 infants saw all the pairings. Fewer infants participated in the shape preference procedure due to fussiness, and 90 infants saw all the pairings for the shape preference procedure.

Some infants looked longer at the pairings than others. To adjust for these differences, scores were converted into the proportion of time spent looking at one stimulus over the total looking time for both stimuli. Proportions were transformed into percentage values; thus, an infant looking at a particular stimulus for 50% of the time meant that no preference was shown. All subsequent analyses were conducted using these percentage values.

Results

Mean proportions of time that infants looked at each of the color, toy, and shape stimulus pairings broken down by sex and age are shown in Table 1. Sex and age differences and their interaction were evaluated using analysis of variance for each of the pairings (See Table 2).

Color Stimuli

No main effects of sex were found for any of the four color pairings. A significant main effect of age was found only for the red/pale blue pairing, $F(2, 101) = 4.94$, $p < .01$ with 12-month-olds looking significantly longer at red compared to 24-month-olds ($p < .01$). There were no significant interaction effects. A composite score was computed to examine sex and age influences on preferences for pink/red versus blue/pale blue collapsed across all four pairings. There were no significant main effects of sex or age and no interaction between sex and age.

Toy Stimuli

Five of the 11 pairings designed to test specific hypotheses were significant, and, contrary to the expectation that sex-typed toys would be of most interest when of sex-typed colors, findings suggested that infants preferred looking at sex-typed toys whether or not they were of sex-typed colors, but only when the brightness of colors was matched (Table 1). In addition, means, even when not significant, were in the direction consistent with a preference for sex-typed toys, regardless of their color.

Shape Stimuli

No main effects of sex or age and no interactions were found for any of the three shape pairings comparing rounded shapes to angular shapes. An overall score, collapsed across all three pairings, also showed no main effects of sex or age and no interaction between sex and age.

Table 1 The mean proportion (%) of looking time for individual toy, color, and shape pairings by sex and by age

	Girls			Boys		
	12 months *M* % (*SD*)	18 months *M* % (*SD*)	24 months *M* % (*SD*)	12 months *M* % (*SD*)	18 months *M* % (*SD*)	24 months *M* % (*SD*)
Color						
Pairings comparing pink to blue						
Pink	45.8 (15.5)	50.1 (11.2)	46.9 (11.9)	47.6 (14.3)	46.3 (15.2)	52.5 (16.5)
Blue	54.2 (15.5)	49.9 (11.2)	53.1 (11.9)	52.4 (14.3)	53.7 (15.2)	47.5 (16.5)
Red	65.1 (14.2)	59.1 (16.0)	55.8 (16.9)	66.4 (15.2)	59.8 (15.5)	54.5 (12.5)
Pale blue	34.9 (14.2)	40.9 (16.0)	44.2 (16.9)	33.6 (15.2)	40.2 (15.5)	45.5 (12.5)
Pairings comparing pink to blue with brightness controlled						
Pink	53.7 (19.3)	46.7 (17.9)	53.7 (11.9)	61.4 (20.2)	49.1 (22.8)	53.1 (15.8)
Pale blue	46.3 (19.3)	53.3 (17.9)	46.3 (11.9)	38.6 (20.2)	50.9 (22.8)	46.9 (15.8)
Red	55.7 (23.5)	54.1 (11.6)	60.0 (17.1)	54.2 (15.2)	58.1 (12.3)	51.2 (11.0)
Blue	44.3 (23.5)	45.9 (11.6)	40.0 (17.1)	45.8 (15.2)	41.9 (12.3)	48.8 (11.0)
Toys						
Pairings comparing doll to car of sex-congruent and sex-incongruent colors						
Pink doll	55.2 (20.4)	51.0 (17.2)	44.5 (20.1)	49.5 (12.8)	47.0 (20.8)	43.7 (17.3)
Blue car	44.8 (20.4)	49.0 (17.2)	55.5 (20.1)	50.5 (12.8)	53.0 (20.7)	56.3 (17.3)
Blue doll	65.2 (17.7)	54.5 (21.7)	53.4 (16.3)	60.6 (21.2)	45.5 (20.9)	47.8 (17.5)
Pink car	34.8 (17.7)	45.5 (21.7)	46.6 (16.3)	39.4 (21.2)	54.5 (20.9)	52.2 (17.5)
Pairings comparing doll to car of sex-congruent and sex-incongruent colors (brightness controlled)						
Red doll	66.3 (14.3)	57.8 (15.6)	61.3 (20.2)	61.9 (15.4)	44.1 (19.6)	47.1 (17.1)
Blue car	33.7 (14.3)	42.2 (15.6)	38.7 (20.2)	38.1 (15.4)	55.9 (19.6)	52.9 (17.1)
Blue doll	52.5 (15.9)	56.5 (11.7)	49.3 (14.8)	53.6 (14.3)	44.5 (20.2)	39.5 (12.7)
Red car	47.5 (15.9)	43.5 (11.7)	50.7 (14.8)	46.4 (14.3)	55.5 (20.2)	60.5 (12.7)
Pink doll	61.6 (18.7)	60.5 (18.9)	55.9 (14.2)	63.9 (16.8)	43.6 (15.2)	49.3 (11.4)
Pale blue car	38.4 (18.7)	39.5 (18.9)	44.1 (14.2)	36.1 (16.8)	56.4 (15.2)	50.7 (11.4)
Pale blue doll	56.7 (15.7)	57.8 (13.9)	54.4 (16.8)	54.7 (24.1)	47.1 (20.2)	43.5 (14.1)
Pink car	43.3 (15.7)	42.2 (13.9)	45.6 (16.8)	45.3 (24.1)	52.9 (20.2)	56.5 (14.1)
Pairings comparing doll to car with color held constant						
Pink doll	57.7 (16.5)	54.1 (16.2)	51.1 (21.3)	58.3 (16.7)	53.9 (25.8)	48.8 (13.5)
Pink car	42.3 (16.5)	45.9 (16.2)	48.9 (21.3)	41.7 (16.7)	46.1 (25.8)	51.2 (13.5)
Blue doll	56.3 (23.3)	54.3 (11.8)	55.9 (13.8)	56.9 (13.4)	45.5 (21.7)	48.7 (17.3)
Blue car	43.7 (23.3)	45.7 (11.8)	44.1 (13.8)	43.1 (13.4)	54.5 (21.7)	51.3 (17.3)
Neutral doll	57.3 (14.0)	50.4 (11.3)	50.7 (15.9)	58.8 (17.4)	44.5 (14.9)	45.5 (11.7)
Neutral car	42.7 (14.0)	49.6 (11.3)	49.3 (15.9)	41.2 (17.4)	55.5 (14.9)	54.5 (11.8)
Pairings comparing pink to blue with toy held constant						
Pink doll	45.2 (18.8)	56.9 (16.7)	48.6 (9.6)	48.1 (13.5)	41.8 (12.9)	44.0 (9.4)
Blue doll	54.8 (18.8)	43.1 (16.7)	51.4 (9.6)	51.9 (13.5)	58.2 (12.9)	56.0 (9.4)
Pink car	49.9 (17.3)	54.0 (16.5)	50.6 (11.6)	49.4 (18.0)	47.4 (13.5)	46.0 (10.0)
Blue car	50.1 (17.3)	46.0 (16.5)	49.4 (11.6)	50.6 (18.0)	52.6 (13.5)	54.0 (10.0)

Table 1 The mean proportion (%) of looking time for individual toy, color, and shape pairings by sex and by age

	Girls			Boys		
	12 months *M* % (*SD*)	18 months *M* % (*SD*)	24 months *M* % (*SD*)	12 months *M* % (*SD*)	18 months *M* % (*SD*)	24 months *M* % (*SD*)
Shape						
Pairings comparing rounded to angular images						
Circles	63.5 (22.8)	54.1 (19.1)	58.5 (13.2)	60.3 (29.1)	64.3 (9.9)	58.1 (15.4)
Squares	36.5 (22.8)	45.9 (19.1)	41.5 (13.2)	39.7 (29.1)	35.7 (9.9)	41.9 (15.4)
Rounded star	51.0 (14.9)	52.4 (11.6)	47.6 (10.8)	57.6 (15.4)	49.0 (15.2)	46.3 (19.2)
Angular Star	49.0 (14.9)	47.6 (11.6)	52.4 (10.8)	42.4 (15.4)	51.0 (15.2)	53.7 (19.2)
Rounded triangle	58.5 (17.8)	52.3 (15.4)	53.9 (15.2)	66.8 (18.0)	60.4 (22.9)	51.4 (17.4)
Triangle	41.5 (17.8)	47.7 (15.4)	46.1 (15.2)	33.2 (18.0)	39.6 (22.9)	48.6 (17.4)

Composite Stimuli

We next combined stimulus pairs to provide more reliable, composite estimates of children's preferences for sex-typed toys and sex-typed colors. Preferences for sex-typed toys were assessed by computing infants' average scores for looking at the doll versus the car, irrespective of color, across all pairings. Preferences for sex-typed colors were assessed by computing infants' average scores for looking at pink/red versus blue/pale blue, across all color pairings and, irrespective of the toy, across all toy pairings. Results are summarized in Tables 3 and 4.

The combined analysis of toy type revealed a main effect of sex. Girls looked longer at the doll than boys did, and boys looked longer at the car than girls did, $F(1, 101) = 7.68$, $p < .01$. There also was a main effect of age, $F(2, 101) = 6.84$, $p < .01$. Infants looked significantly longer at the doll at 12 months of age than at either 18 months ($p < .01$) or 24 months ($p < .01$), but 18- and 24-month-olds did not differ. There was no significant interaction between sex and age. The combined analysis of color preferences across all toys and color pairings showed no significant main effects of sex or age and no significant interaction.

Using the composite scores, we also looked at within sex preferences for same sex-typed toys over other sex-typed toys (i.e., boys' preferences for cars over dolls and girls' preferences for dolls over cars) in each age group (Fig. 3). Girls showed a significant preference for the doll over the car at ages 12 months, $t(18) = 4.99$, $p < .001$, and 18 months, $t(16) = 3.40$, $p < .01$, but this difference, though in the same direction, was not statistically significant at 24 months. Boys also showed a significant preference for the doll over the car at 12 months, $t(16) = 3.75$, $p < .01$. At ages 18 and 24 months, boys no longer showed a preference for the doll, and, although they looked longer at the car than the doll at these later ages, their preference for the car was not statistically significant.

Finally, at the suggestion of a reviewer, we analyzed difference scores, obtained by subtracting percentage looking time at the colorless doll and car from percentage looking time at the same stimuli when colored. These analyses also suggested that infants did not show sex typed color preferences. There were no significant main or interaction effects for the composite color difference scores, and only one main effect and no interactions for any of the individual pairings.

Infant Preferences Regardless of Sex and Age

Because no sex or age differences emerged for the color or shape stimuli, we examined color and shape preferences, irrespective of sex and age (see Table 5). For the color stimuli, infants looked longer at red than blue and longer at red than pale blue. For the shape stimuli, infants looked longer at circles than squares and longer at rounded triangles than triangles. For the four color stimuli combined, infants looked longer at pink/red than blue/pale blue, $t(112) = 5.67$, $p < .001$. For the three shape stimuli combined, infants looked longer at rounded images than angular images, $t(88) = 5.14$, $p < .001$.

Discussion

Our results found both sex differences and sex similarities in infants' toy, color, and shape preferences. We saw the expected sex differences in toy preferences, with girls showing more interest than boys in dolls, and boys showing more interest than girls in cars. These results did not interact with age. The differences were most apparent in stimulus pairings when colors were controlled for brightness. Contrary to prediction, however, sex-typed toy preferences were not stronger when toys were of sex-typed colors. In addition, infants did not show the predicted sex differences in color or shape preferences. Instead, we saw sex similarities in these areas. Both boys and girls preferred reddish colors to blue colors, and rounded shapes to angular shapes. There was also an age effect for interest in the doll. Both boys and girls looked longer at the doll at age 12 months, than at 18 or 24 months.

Table 2 Analysis of variance for color, toy, and shape stimuli

Source	df	*F*	*p*
Color			
Pairings comparing pink to blue			
Pink vs. Blue			
Sex	1	<1	ns
Age	2	<1	ns
Sex × Age	2	1.06	ns
Error	110		
Red vs. Pale blue			
Sex	1	<1	ns
Age	2	4.94	<.01
Sex × Age	2	<1	ns
Error	111		
Pairings comparing pink to blue with brightness controlled			
Pink vs. Pale blue			
Sex	1	<1	ns
Age	2	2.68	.07
Sex × Age	2	<1	ns
Error	109		
Red vs. Blue			
Sex	1	<1	ns
Age	2	<1	ns
Sex × Age	2	1.63	ns
Error	111		
Toys			
Pairings comparing doll to car of sex-congruent and sex-incongruent colors			
Pink doll vs. Blue car			
Sex	1	1.05	ns
Age	2	1.90	ns
Sex × Age	2	<1	ns
Error	109		
Blue doll vs. Pink car			
Sex	1	3.15	.08
Age	2	5.50	<.01
Sex × Age	2	<1	ns
Error	109		
Pairings comparing doll to car of sex-congruent and sex-incongruent colors (brightness controlled)			
Red doll vs. Blue car			
Sex	1	11.38	<.01
Age	2	6.23	<.01
Sex × Age	2	1.01	ns
Error	111		
Blue doll vs. Red car			
Sex	1	5.89	.02
Age	2	3.31	.04
Sex × Age	2	2.05	ns
Error	110		
Pink doll vs. Pale blue car			
Sex	1	5.75	.02
Age	2	5.44	<.01
Sex × Age	2	3.43	.04
Error	110		
Pale blue doll vs. Pink car			
Sex	1	5.47	.02
Age	2	1.33	ns
Sex × Age	2	<1	ns
Error	108		
Pairings comparing doll to car with color held constant			
Pink doll vs. Pink car			
Sex	1	<1	ns
Age	2	1.82	ns
Sex × Age	2	<1	ns
Error	112		
Blue doll vs. Blue car			
Sex	1	2.46	ns
Age	2	1.46	ns
Sex × Age	2	<1	ns
Error	109		
Neutral doll vs. Neutral car			
Sex	1	1.45	ns
Age	2	6.76	<.01
Sex × Age	2	<1	ns
Error	111		
Pairings comparing pink to blue with toy held constant			
Pink doll vs. Blue doll			
Sex	1	4.80	.03
Age	2	<1	ns
Sex × Age	2	4.17	.02
Error	112		
Pink car vs. Blue car			
Sex	1	2.01	ns
Age	2	<1	ns
Sex × Age	2	<1	ns
Error	110		
Shape			
Pairings comparing rounded to angular images			
Circles vs. Squares			
Sex	1	<1	ns
Age	2	<1	ns
Sex × Age	2	1.01	ns
Error	85		
Rounded star vs. Angular star			
Sex	1	<1	ns
Age	2	1.86	ns

Table 2 continued

Source	df	*F*	*p*
Sex × Age	2	<1	ns
Error	87		
Rounded triangle vs. Triangle			
Sex	1	1.55	ns
Age	2	2.42	.10
Sex × Age	2	<1	ns
Error	111		

Controlling the brightness of colors was a novel aspect of the current study and, given that sex differences in toy preferences were most obvious when brightness was controlled, this could be a useful design feature for future studies. Controlling brightness may be particularly important in studies such as ours, which present images in a darkened room, allowing the brightness of a color, as well as its hue or other characteristics to influence its attractiveness.

Our observation that 12- to 24-month-old boys show more interest than girls do in cars, and that girls of this age show more interest than boys do in dolls, resemble observations of sex differences in toy preferences in older children, and add to evidence that these sex differences emerge at a very young age. Such early sex differences could reflect inborn tendencies for girls and boys to prefer different toys. This interpretation is consistent with findings linking prenatal androgen exposure to toy preferences in children (Hines, 2004) and with findings of similar sex differences in toy preferences in non-human primates (Alexander & Hines, 2002; Hassett et al., 2008). Additionally, early socialization could contribute to sex differences in infants, since they have already been provided with sex-typed toys (Pomerleau et al., 1990). Thus, their looking preferences may reflect the type of toys that they have been exposed to in their environment. This interpretation would suggest that children learn sex-typed behaviors at a very young age.

Cognitive developmental processes related to gender are not likely to explain sex-typed toy preferences in 12- to 24-month-old infants. At this age, many infants would not have reached even the first stage of gender acquisition (gender labeling). In addition, although there is evidence that female infants may display some understanding of gender by the age of 18 months, this is apparently not the case for boys (Serbin et al., 2001). Serbin et al. concluded that the role of gender identity in the acquisition of gender role learning needs to be re-evaluated, because toy preferences are found in male infants, even though they do not appear to be aware of their gender identity. Our findings also argue for reconsidering the role of cognitive understanding of gender, at least in the initial phase of children's acquisition of sex-typed toy preferences. Cognitive factors may play a role in later years, however, as sex-typed toy preferences become increasingly evident (Golombok et al., 2008).

We did not see sex differences in preferences for pink or reddish colors over blue, nor did we see sex differences in preferences for angular versus rounded shapes. Therefore, our findings did not support Alexander's (2003) suggestion that differences in color or shape preferences explain sex differences in toy preferences, at least at this early stage of development. Indeed, the causal relationships may be the opposite. Sex differences in toy preferences may contribute to sex differences in preferences for colors or shapes. For example, girls may learn to like pink because many of the toys they play with are pink. Alternatively, or additionally, they may learn this color preference through social or cognitive mechanisms. For example, girls may learn to prefer pink through modeling older girls who like pink, or through cultural labeling of pink as for girls. Similar mechanisms could explain sex differences in shape preferences. In addition to suggesting that the different colors of sex-typed toys could drive boys and girls differential interest in them, Alexander (2003) has suggested that females and males may have evolved to prefer pink and blue, respectively, a suggestion that has been reiterated by others (e.g., Hurlbert & Ling, 2007). Our findings argue against these suggestions as well.

Our observation that boys at 12 months of age, like girls, prefer the doll to the car is similar to that of Serbin et al. (2001), who found that children of both sexes prefer to look at dolls over trucks at 12 months of age. Both findings argue against suggestions that boys' strong preference for masculine toys or avoidance of feminine toys, such as dolls, is inborn (Hassett et al.,

Table 3 The mean proportion (%) of composite scores by sex and by age

	Girls			Boys		
	12 months *M* % (*SD*)	18 months *M* % (*SD*)	24 months *M* % (*SD*)	12 months *M* % (*SD*)	18 months *M* % (*SD*)	24 months *M* % (*SD*)
Pairings comparing dolls to cars combined across all stimulus pairs						
Doll	57.2 (6.3)	54.6 (5.5)	52.7 (9.3)	56.4 (7.0)	46.8 (12.6)	47.9 (6.5)
Car	42.8 (6.3)	45.4 (5.5)	47.3 (9.3)	43.6 (7.0)	53.2 (12.6)	52.1 (6.5)
Pairings comparing pink/red to blue/pale blue combined across all stimulus pairs						
Pink/red	53.5 (3.6)	51.7 (4.3)	51.9 (4.6)	53.3 (4.9)	50.7 (4.0)	52.1 (4.4)
Blue/pale blue	46.5 (3.6)	48.3 (4.3)	48.1 (4.6)	46.7 (4.9)	49.3 (4.0)	47.5 (4.2)

Table 4 Analysis of variance for composite scores

Source	df	*F*	*p*
Pairings comparing dolls to cars combined across all stimulus pairs			
Dolls vs. Cars			
Sex	1	7.68	<.01
Age	2	6.84	<.01
Sex × Age	2	1.57	ns
Error	101		
Pairings comparing pink/red to blue/pale blue combined across all stimulus pairs			
Pink/red vs. Blue/pale blue			
Sex	1	<1	ns
Age	2	2.31	.11
Sex × Age	2	<1	ns
Error	101		

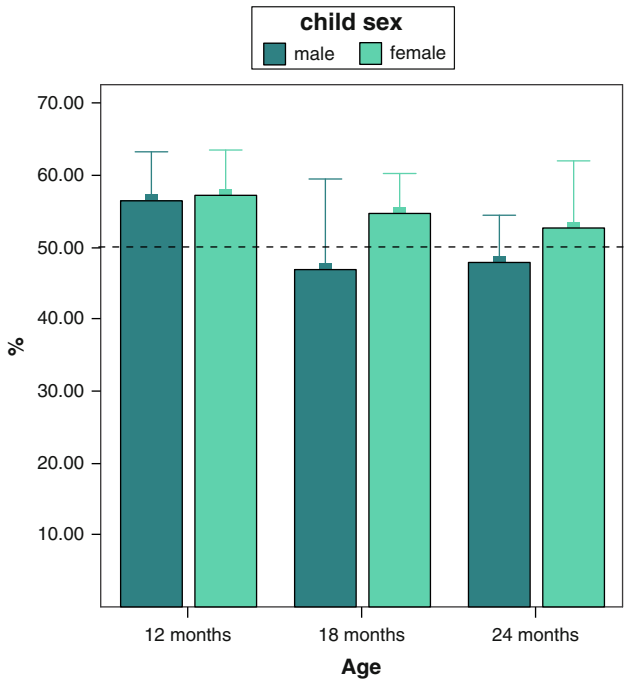

Fig. 3 Infants overall looking times at the doll when shown with the car (collapsed across all pairings) by sex and age

Table 5 Mean proportion (%) of time spent looking at stimuli for all infants irrespective of sex and age for color and shape stimuli

Stimuli pairings	*N*	%	*SD*	*t*	*p*
Color					
Pairings comparing pink to blue					
Blue	116	51.85	14.14	1.41	ns
Pink		48.15	14.14		
Red	117	60.15	15.39	7.14	<.001
Pale blue		39.84	15.39		
Pairings comparing pink to blue with brightness controlled					
Red	117	55.59	15.72	3.85	<.001
Blue		44.41	15.72		
Pink		52.97	18.52	1.72	ns
Pale blue	115	47.03	18.52		
Shape					
Pairings comparing rounded to angular images					
Circles	91	59.63	19.29	4.76	<.001
Squares		40.38	19.29		
Rounded star	93	50.84	14.64	<1	ns
Angular star		49.15	14.64		
Rounded triangle	93	57.44	18.24	3.93	<.001
Triangle		42.57	18.24		

2008; Williams & Pleil, 2008), and argue instead for the importance of social learning or cognitive developmental processes in the development of this particular aspect of sex-typed toy preferences. Consistent with this argument, boys avoidance of feminine toys has been found to increase with age, and to be stronger when an observer is present (Hartup, Moore, & Sager, 1963). Boys also receive stronger reinforcement than girls do to avoid cross sex toy play (Fagot, 1977; Lytton & Romney, 1991; Pasterski et al., 2005), and they are more likely than girls are to imitate the behavior of same sex models (Perry & Bussey, 1979). Thus, reinforcement and modeling could play an important role in boys' eventual strong preference for masculine toys or avoidance of feminine toys.

Instead of providing evidence of sex differences in infants' visual preference for pink and blue, our findings suggest that infants prefer red, irrespective of their sex. Other studies also have reported that infants from as young as 2 months of age look longer at red than at other colors (Adams, 1987; Bornstein, 1975; Franklin et al., 2006). Similarly, both girls and boys, ages 2.5–5 years, have been found to indicate that their favorite colors are red and pink (Zentner, 2001). The absence of sex differences in infants' and young children's color preferences, coupled with findings that older children display sex-typed color choices (Chiu et al., 2006; Picariello et al., 1990), suggests that children learn these preferences. The timing of the emergence of sex-typed color preference (after age two, or maybe even five, years) is also

consistent with cognitive developmental perspectives, which suggest that sex differences in children's behavior emerge as children develop a cognitive understanding of their gender and its stability and constancy, a process that continues after the age of two until as late as age seven years or older (Ruble et al., 2007).

Our results also suggest sex similarity rather than difference in infants' shape preferences; irrespective of sex, infants looked longer at rounded shapes (circles, rounded triangles) than at angular shapes (squares, triangles). The preference for rounded over angular shapes could relate to the emotional responses that different shapes elicit. A study asking college students to rate their emotional response to stimuli consisting of either an ellipse or a straight line found that roundedness conveyed warmth and acute angles conveyed threat (Aronoff, Woike, & Hyman, 1992). Bar and Neta (2006) showed adults a series of stimuli consisting of sharp angled images or curved images, and found that they liked the curved objects and disliked the sharp objects. It was suggested that sharp angles convey a sense of threat which results in a negative bias. It also has been suggested that the visual properties of angularity could reflect the facial attributes of an angry face and roundedness could reflect the facial attributes of a happy face (Aronoff, Barclay, & Stevenson, 1988). Further studies could examine if these associations that have been found in adults are also seen in children.

The question of male and female shape preferences in general also would benefit from additional research. As noted above, Iijima et al. (2001) reported that boys tend to draw angular shapes and girls tend to draw rounded shapes, and Franck and Rosen (1949) reported similar findings for the drawings of adults, with men tending to sharp, angular lines and women to rounded lines. Both these studies looked at shapes that people draw and not what they prefer if given a choice, however. Studies involving choice have not produced clear sex differences for shape preferences. For instance, Munroe, Munroe, and Lansky (1976) presented children with two containers holding either spherical or cubed sweets, and found that although both sexes chose the spherical sweets more than the cubed sweets, this preference was only significant for girls.

In addition to seeing unexpected sex similarities in the color and shape preferences of infants, we saw an unpredicted effect of age. Regardless of sex, infants looked longer at the doll at age 12 months than at later ages. The interest of 12-month-old infants of both sexes in dolls was also noted by Serbin et al. (2001), who suggested that it might relate to infants' interest in faces (Morton & Johnson, 1991). If so, our results suggest that this interest is more pronounced in younger infants than in older infants.

The preferential looking paradigm is a widely used method for assessing the preferences of pre-verbal infants. However, it assumes that infants will look longer at images that they prefer. Future studies using observational methods could see if similar sex differences to those we report using preferential looking are found for play with actual toys, colors and shapes. Also, it could be argued that larger samples might have produced evidence of sex differences in color or shape preferences. However, our study used a large number of infants than other studies of this type ($n = 30$ in Alexander et al., 2009, $n = 60$ in Campbell et al., 2000, and $n = 77$ in Serbin et al., 2001), and provided 83% and 76% power to detect moderate-sized or larger sex differences in color and shape preferences, respectively. Effect sizes also suggest that if any sex differences exist in these areas, they are small to negligible, and, for shape, in the direction opposite to that predicted ($d = 0.06$ for color preferences, and $d = -34$ for shape preferences). Finally, although we suggest that the absence of certain sex differences (e.g., sex-typed color preferences) in 12- to 24-month-old infants argues that inborn factors do not play a role in their emergence, we can not rule out the possibility that inborn factors, such as prenatal androgen exposure, contribute to sex differences that appear only later in life. Although it seems more likely that socialization or cognitive developmental processes are the primary cause of differences that are present only in older children, additional research, looking, for example, at color preferences in individuals exposed to high levels of androgens prenatally or in non-human primates, could help resolve this issue.

The current study adds to growing evidence that infants younger than 2 years of age display sex-typed toy preferences, with boys showing more interest than girls do in cars, and girls showing more interest than boys do in dolls. Within sex analyses found that the female preference for dolls over cars begins as early as 12 months of age, whereas boys of this age also prefer dolls to cars. The male preference for cars over dolls, or avoidance of dolls, emerges later, suggesting that socialization or cognitive development, rather than inborn factors, causes the male avoidance of feminine toys. Similarly the lack of sex differences in color or shape preferences in infants suggests that sex differences in these areas emerge later, perhaps also under the influence of socialization or cognitive developmental processes. In addition to seeing sex differences in infants, we also observed sex similarities. Infants of both sexes preferred reddish colors to blue and rounded shapes to angular shapes. One implication of our findings is that sex differences in toy preferences in infancy are not driven by sex-linked preferences for different colors or shapes, since sex differences in these areas are not yet present. Instead, the direction of influence could be the opposite. Girls may learn to prefer pink, for instance, because the toys that they enjoy playing with are often colored pink. Finally, our results suggest that different types of factors influence different aspects of children's sex-typed preferences. Inborn factors, such as the prenatal testosterone surge in male fetuses, may be particularly important for boys' greater interest than girls in vehicles and girls' greater interest than boys in dolls. In contrast, sex-typed color and shape preferences, and the male avoidance of girls' toys, which appear to emerge later in life, may depend more extensively on sex-related differences in socialization or cognitive developmental processes.

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