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The influence of averageness on judgments of facial attractiveness: No own-age or own-sex advantage among children attending single-sex schools

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ABSTRACT

We examined how recent biased face experience affects the influence of averageness on judgments of facial attractiveness among 8- and 9-year-old children attending a girls' school, a boys' school, and a mixed-sex school. We presented pairs of individual faces in which one face was transformed 50% toward its group average, whereas the other face was transformed 50% away from that average. Across blocks, the faces varied in age (adult, 9-year-old, or 5-year-old) and sex (male or female). We expected that averageness might influence attractiveness judgments more strongly for same-age faces and, for children attending single-sex schools, same-sex faces of that age because their prototype(s) should be best tuned to the faces they see most frequently. Averageness influenced children's judgments of attractiveness, but the strength of the influence was not modulated by the age of the face, nor did the effects of sex of face differ across schools. Recent biased experience might not have affected the results because of similarities between the average faces of different ages and sexes and/or because a minimum level of experience with a particular group of faces may be adequate for the formation of a veridical prototype and its influence on judgments of attractiveness. The results suggest that averageness affects children's judgments of the attractiveness of the faces they encounter in everyday life regardless of age or sex of face.

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Introduction

When asked to judge the attractiveness of faces, adults from different cultures and children of different ages show striking agreement about which faces are most attractive (Bernstein, Lin, & McClellan, 1982; Cunningham, Roberts, Barbee, & Druen, 1995; Johnson, Dannenbring, Anderson, & Villa, 1983; Langlois et al., 1987; Langlois et al., 2000; Perrett, May, & Yoshikawa, 1994; Rhodes, Harwood, Yoshikawa, Nishitani, & McLean, 2002; Samuels, Butterworth, Roberts, Graupner, & Hole, 1994; Slater, Quinn, Hayes, & Brown, 2000; Slater et al., 1998). These attractiveness judgments affect social interactions because they lead to attributions of positive qualities to those perceived as attractive ("what is beautiful is good" stereotype; Dion, Berscheid, & Walster, 1972). One influence on judgments of facial attractiveness is the proximity of a face to the population average. Composite faces created by averaging luminance levels from 16 or 32 images are judged by adults to be more attractive than the original faces used to create the composites (Langlois & Roggman, 1990). The attractiveness of more average faces is a robust finding, and control experiments have ruled out artifactual explanations based on smoothing of skin texture in the pixel-based averaging procedure (Little & Hancock, 2002; Rhodes & Tremewan, 1996) or the increasing symmetry of faces as they approach group averages (Rhodes, Sumich, & Byatt, 1999; Valentine, Darling, & Donnelly, 2004).

There is also evidence that children's judgments of attractiveness are influenced by averageness; adolescents find faces that have been transformed toward an average face to be more attractive than the original versions of the faces (Saxton, DeBruine, Jones, Little, & Roberts, 2009; Saxton, DeBruine, Jones, Little, & Roberts, 2011; Saxton et al., 2010), and children as young as 5 years find faces that have been transformed toward average to be more attractive than faces transformed away from average, although to a lesser extent than 9-year-olds or adults (Vingilis-Jaremko & Maurer, 2013a). These studies, along with evidence that averageness influences judgments of attractiveness cross-culturally (see Rhodes, Harwood, et al., 2002; Rhodes et al., 2001) and that faces naturally lying closer to the population average are considered to be more attractive than more distinctive faces (Light, Hollander, & Kayra-Stuart, 1981), provide strong evidence that average faces are attractive.

Faces are hypothesized to be encoded within a multidimensional face space centered on a prototype that is formed from our accumulated experience with faces (Rhodes, 2006; Valentine, 1991). The prototype is constantly being updated as we encounter new faces, each of which is encoded as a multidimensional vector based on differences and distance from the prototype. As a result, more distinctive faces lie farther from the prototype (Valentine, 1991). It has been theorized that faces closer to the prototype may be processed more quickly and easily than more distinctive faces and consequently may be preferred (Valentine, 1991; Winkielman, Halberstadt, Fazendeiro, & Catty, 2006). Indeed, adults categorize prototypical random dot and geometric patterns more quickly than less prototypical patterns and rate them as more attractive than less prototypical patterns (Winkielman et al., 2006). Adults also judge more prototypical dogs, wristwatches, and birds to be more attractive than more distinctive exemplars of these categories (Halberstadt & Rhodes, 2000). Similarly, adapting adults to a distorted face in which all of the features are compressed (or expanded) shifts their subsequent judgments of attractiveness in the distorted direction, as would be expected if the norm had been updated during the adaptation (Rhodes, Jeffery, Watson, Clifford, & Nakayama, 2003; see Cooper & Maurer, 2008, for similar evidence with adaptation to high or low feature height in adults). Thus, adults may perceive prototypical faces, objects, and patterns as attractive because they more closely match the norm for that category and hence are processed more fluently than less prototypical exemplars.

There is evidence that children also process faces relative to a norm and that, at least by 5 years of age, the norm influences their judgments of attractiveness, as 5-year-olds select faces that have been transformed toward the group average to be more attractive than faces that have been transformed away from the group average, although to a lesser extent than adults (Vingilis-Jaremko & Maurer, 2013a). Three-month-old infants (but not 1-month-olds) treat a four-face composite as familiar after being exposed to the four individual faces (de Haan, Johnson, Maurer, & Perrett, 2001; see Rubenstein, Kalakanis, & Langlois, 1999, for similar evidence in 6-month-olds), a pattern suggesting that they have the cognitive skills to form a prototype. Six-month-old infants look longer at an average face than at faces rated by adults as unattractive (Rubenstein et al., 1999), although 5- to 8-month-olds do not look longer at faces transformed toward the group average; their longest look was toward faces transformed away from the group average (Rhodes, Geddes, Jeffery, Dziurawiec, & Clark, 2002). By 4 to 6 years (youngest age tested), children show evidence of processing faces relative to a prototype; after adaptation to a distorted face or a specific face identity, their recognition of other faces shifts in the expected direction (Jeffery et al., 2010; Jeffery et al., 2011; 8-year-olds: Nishimura, Maurer, Jeffery, Pellicano, & Rhodes, 2008; Pimperton, Pellicano, Jeffery, & Rhodes, 2009). The shifts are greater the farther the adapting face is from the norm, as would be expected with norm-based coding (demonstrated for figural aftereffects at 4–5 years of age: Jeffery et al., 2010; demonstrated for facial identity at 4 years of age: Jeffery, Read, & Rhodes, 2013). By 8 or 9 years (youngest age tested), for recognizing identity, the shift is specific to faces on a vector going through a prototypical face (Jeffery et al., 2011). Children's judgments of oddness also shift in the adapted direction after adaptation to high or low feature height (as young as 6 years: Hills, Holland, & Lewis, 2010), and their judgments of attractiveness shift in the adapted direction after adaptation to compressed or expanded faces (at 8 years of age: Anzures, Mondloch, & Lackner, 2009).

The updating of the norm that has been shown in adults and children as young as 4 years in laboratory experiments suggests that individuals with differences in natural face experience could differ in their perceptions of attractiveness. Because the norm is based on the faces a person has seen, norms should have different characteristics if they are based on different types of faces or different types of experience with faces. Indeed, shorter adults, who tend to look up at faces, find faces with a larger chin and a smaller forehead to be more attractive than faces with average features, consistent with the foreshortening that occurs from their viewing angle (Geldart, 2008). This is also true of the looking preferences of infants, who tend to look up at faces (Geldart, Maurer, & Henderson, 1999), but not of children who have entered preschool, where they interact with peers at eye level; instead, they find faces with smaller chins and larger foreheads, similar to the proportions of their peers' faces, to be most attractive (Cooper, Geldart, Mondloch, & Maurer, 2006).

A complete lack of experience with a particular group of faces affects attractiveness judgments, as would be expected if they are influenced by a norm built up with experience. For example, the Hadza, an isolated hunter–gatherer tribe in Africa, find averageness to be attractive in faces of the Hadza but not in White British faces, a group with whom they have little to no experience. However, Westerners, who presumably have more experience with faces from diverse cultures, find averageness to be attractive in both Hadza and White British faces (Apicella, Little, & Marlowe, 2007). Consistent with these findings, newborn infants show no spontaneous looking preference for same- or other-race faces, but by 3 months of age infants look longer at same-race faces than at other-race faces (Bar-Haim, Ziv, Lamy, & Hodes, 2006; Kelly et al., 2005; Kelly et al., 2007). Similarly, by 3 or 4 months of age, infants raised by a female caretaker have a looking preference for female faces over male faces, a preference that appears to be reversed in infants raised by a male caretaker (Quinn, Yahr, Kuhn, Slater, & Pascalis, 2002). The continued biasing of the experience of most infants in favor of female faces (Rennels & Davis, 2008) may be the foundation for infants' more advanced processing of female faces than of male faces (Ramsey-Rennels & Langlois, 2006). The findings described in this paragraph suggest that as experience with a particular group of faces grows, the prototype for those faces becomes more refined, a process leading to a looking preference in infants and attractiveness judgments based on a veridical prototype for the experienced categories in adults. Although adults prefer averageness not only in own-race faces but also in other-race faces with which they have had some but less experience (e.g., Rhodes, Harwood, et al., 2002; Rhodes et al., 2001), children's norms might be less well developed for infrequent categories of faces and more malleable. Indirect evidence for this possibility comes from the finding that 5- and 8-year-old children require larger distortions than adults in order for their attractiveness judgments to shift after adaptation (Anzures et al., 2009; Short, Hatry, & Mondloch, 2011) and that 6- to 12-year-old children can be adapted to unnatural distortions that do not affect teenagers' judgments of oddness (Hills et al., 2010). These findings suggest that children could have a less stable norm than teenagers or adults.

The purpose of this study was to explore how recent biased experience affects the influence of averageness on children's judgments of attractiveness. We hypothesized that biased experience with a particular group of faces would lead to greater refinement of the norm for those faces and a stronger preference for averageness within that face category. We took advantage of a natural experiment by testing Grade 4 students (ages 8–9 years) attending private schools that were limited to girls, were limited to boys, or included children of both sexes. We created separate averages for the faces of 8- and 9-year-old boys and girls and transformed individual faces 50% toward and away from their group averages. Participants selected which face from each pair was more attractive. We hypothesized that averageness should influence attractiveness judgments more strongly for same-sex faces among children in single-sex schools because of the biased experience with those faces. We made the same manipulations to faces of two other age groups (adults and 5-year-olds); we expected that the influence of averageness might be greater for same-age faces because children likely have more experience with faces of their own age than younger or older ages and because children have an own-age bias in recognizing faces (Anastasi & Rhodes, 2005; Hills & Lewis, 2011; but see Macchi Cassia, 2011, for evidence that children have a processing advantage for adult faces).

Method

Participants

We tested 25 girls attending a girls' school (mean age = 9 years 4 months, range = 8–10 years, 9 non-White), 21 boys attending a boys' school (mean age = 9 years 5 months, range = 8–9 years, 0 non-White), and 20 children attending a mixed-sex school (mean age = 9 years 4 months, range = 8–9 years, 8 girls and 12 boys, 5 non-White). Students from each of the schools were from a variety of ethnic backgrounds. All participants had normal or corrected-to-normal vision with a Snellen acuity of 20/20 or better in each eye, as measured on a Lighthouse eye chart.

All schools were private schools in metropolitan areas of Ontario, Canada, charging similar levels of school fees. The boys' school spans junior kindergarten (ages 3–4 years) through Grade 8 (ages 12–13 years), and the girls' school and mixed-sex school span junior kindergarten through Grade 12 (ages 16–17 years), although students from Grade 9 (ages 13–14 years) and up are housed in a separate building. The mixed-sex school has students in both a regular school program and a Montessori program (an educational approach developed in 1907 by Maria Montessori). None of the schools shares any classes with any other school. Both single-sex schools have single-sex sports teams that compete only against single-sex sports teams, and the mixed-sex school has both mixed-sex and single-sex sports teams that compete against both single-sex and mixed-sex sports teams. At the time of testing, the boys' school had 304 students and 42 teachers/staff, the girls' school had 295 students and 40 teachers/staff in its junior school, and the mixed-sex school had 334 students and 40 teachers/staff in the Montessori and junior schools. Donations were made to the school libraries in appreciation of the students' participation.

An additional 11 children were tested but excluded from the data because they failed our visual screening requirements (9 children), because of a computer error (1 child), or because the child had gone through the same procedure in another study in our laboratory (1 child).

Stimuli

The stimuli were the same as those used in Vingilis-Jaremko and Maurer (2013a). Briefly, stimuli were created from 16 color, full front face photographs with neutral expressions from each of six categories: young adult men, young adult women, 8- and 9-year-old boys, 8- and 9-year-old girls, 4- and 5-year-old boys, and 4- and 5-year-old girls. We used Psychomorph software to create an average face for each face category and transformed the original faces 50% toward and away from their group average (see Rowland & Perrett, 1995; Tiddeman, Burt, & Perrett, 2001). This resulted in pairs of faces that maintained the texture of the original face but differed in proximity to the group average based on shape. Because faces that are closer to average are also more symmetrical, we made all faces perfectly symmetrical by averaging each face with its mirror image. We removed hair and external features because we did not want participants' judgments to be influenced by distortions in the hairstyle. The external face shape, however, was retained. We standardized faces for size based on interpupillary distance and presented the faces on a black background (Fig. 1). We

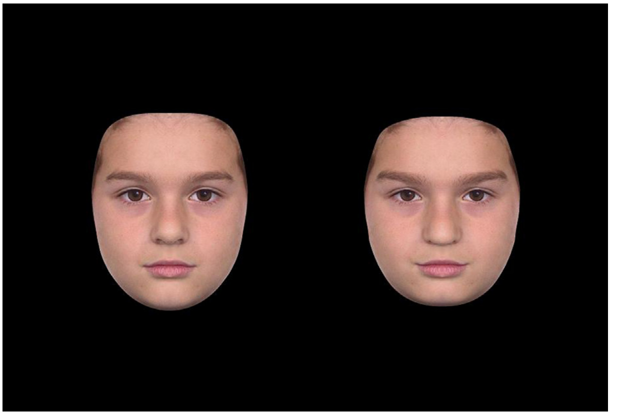

Fig. 1. More average (left) and less average (right) versions of a 9-year-old boy's face.

used a BenQ ET-0027-B 24-inch wide-screen LCD monitor with the screen resolution set to 1024×768. From a viewing distance of 50 cm, faces subtended a visual angle of approximately 12 degrees in height and 7 degrees in width.

Design

We tested participants at three different schools, all of which saw the six face categories (16 face pairs per face category), which were blocked, for a total of 96 trials per participant. For each participant, the side of the more average face was randomized across trials, and the presentation of stimuli was randomized within each block. The order of blocks was counterbalanced across participants from each school with a Latin square design.

Procedure

This study received ethics clearance from the institutional research ethics board. Grade 4 students (ages 8–10 years) at each school were given a package that included a letter from the school, a letter from our lab giving information about the study, and a consent form. Children of parents who gave consent were tested individually in a small conference room with a table and chairs. The same testing computers and identical screens were set up in each school's conference room. The rooms were reasonably quiet except for some ambient noise from other students through the door, which was left ajar. After explaining the procedure, we obtained verbal assent from child participants. We used the same instructions as Vingilis-Jaremko and Maurer (2013a):

> I'm having a birthday party and I have invited all of my friends! Among my friends, pairs of brothers and pairs of sisters will be attending the party. These brothers and sisters have been trying very hard to look their very best. They are trying to make themselves look nice because a clown at the party will be giving a red balloon to the brother or sister from each pair who looks cuter, prettier, or more handsome today. Every time you see two faces on the screen, they are either sisters or brothers, and it will be your job to figure out who looks better, nicer, or more attractive today and will receive the red balloon from the clown!

We used a number of words throughout the experiment to describe the concept of attractiveness, including *prettier*, *more handsome*, *nicer looking*, *better looking*, *cuter*, and *more attractive*, and we told participants which age and sex of face they would be rating before beginning each block. As young as 3 years, children can reliably provide judgments of attractiveness in the same direction as those of adults when hearing the words *pretty*, *cute*, and *handsome* for children's and adults' faces (Cooper

Table 1
Proportion of students with one or more opposite-sex siblings (including infants and teenagers) at each school.

	Mean	SD
Boys' school	.619	.498
Girls' school	.542	.509
Mixed-sex school	.546	.510

et al., 2006; Dion, 1973; Langlois & Stephan, 1977; Vingilis-Jaremko & Maurer, 2013a; Vingilis-Jaremko & Maurer, 2013b).

We asked participants whether they understood the procedure and then presented them with 9 criterion trials comprising pairs of non-face objects that differed greatly in attractiveness (e.g., a new book and an old tattered book). We asked participants to select which object from each pair looked better or nicer. All participants met the 100% accuracy criterion required to move onto the main experiment. Trials were self-paced, and participants selected the more attractive face on each trial by clicking with a mouse, which initiated the next trial. We visually screened participants after the third block of faces and took additional breaks as needed. Total testing time lasted approximately 20 min per participant.

After completing the experiment, we asked each child to report the age and sex of their siblings and of the five friends they see most frequently. We specified that these friends could include kids from school, kids from their neighborhoods, or other kids such as cousins. We asked children about the friends they see most frequently rather than attempting to record their total contact with boys and girls because studies of the own-race effect report that quality of contact with other-race faces improves recognition of other-race faces more than quantity of contact (e.g., Bukach, Cottle, Ubiwa, & Miller, 2012; Walker & Hewstone, 2006; Walker & Hewstone, 2008). If children were unable to report five close friends, we recorded the number of friends they could report, and if children felt that they had missed anyone once they reached five friends, we recorded the additional friends. Slightly more than half of the children at each school had one or more opposite-sex siblings (including infants and teenagers), with no difference in the percentages among the children from the three schools (see Table 1). Children at the mixed-sex school had more opposite-sex friends ($M = .455$, $SD = .510$) than children at the single-sex schools, but the difference was significant only for the boys' school ($M = .095$, $SD = .301$), $t(34.32) = 2.83$, $p = .004$, $d = 0.966$ (one-tailed), and not for the girls' school ($M = .250$, $SD = .252$), $t(41.81) = 1.45$, $p = .078$, $d = 0.514$. Levene's test indicated unequal variances for the comparison of the mixed-sex school with the boys' school ($F = 37.46$, $p < .001$) and with the girls' school ($F = 6.31$, $p = .016$), so degrees of freedom were adjusted from 41 to 34.32 and from 44 to 41.81, respectively.

Results

For each group of faces, we calculated the proportion of trials on which each participant selected the more average face. No outliers were identified as greater than 3 standard deviations from the mean. We did a preliminary analysis to assess whether children were becoming less attentive during the experiment. We organized the data into the order of blocks in which the faces appeared for each participant and did a repeated-measures analysis of variance (ANOVA) with the within-participants factor of block order (Blocks 1–6) and the between-participants factor of school. Mauchly's test indicated that the assumption of sphericity had been violated, $\chi^2(14) = 26.16$, $p < .025$; therefore, degrees of freedom were corrected using Greenhouse–Geisser estimates of sphericity ($\varepsilon = .884$). There was no main effect of block order, $F(4.42, 278.55) = 1.72$, $p = .140$, $\eta_p^2 = .027$, or any interaction between block order and school, $F(10, 63) = 0.669$, $p = .753$, $\eta_p^2 = .021$, suggesting that children at all schools maintained attention throughout the experiment. As in the main analysis, there was a main effect of school.

The data for all additional analyses were organized by face category rather than by block order. To assess whether each group of participants selected the more average faces more frequently than

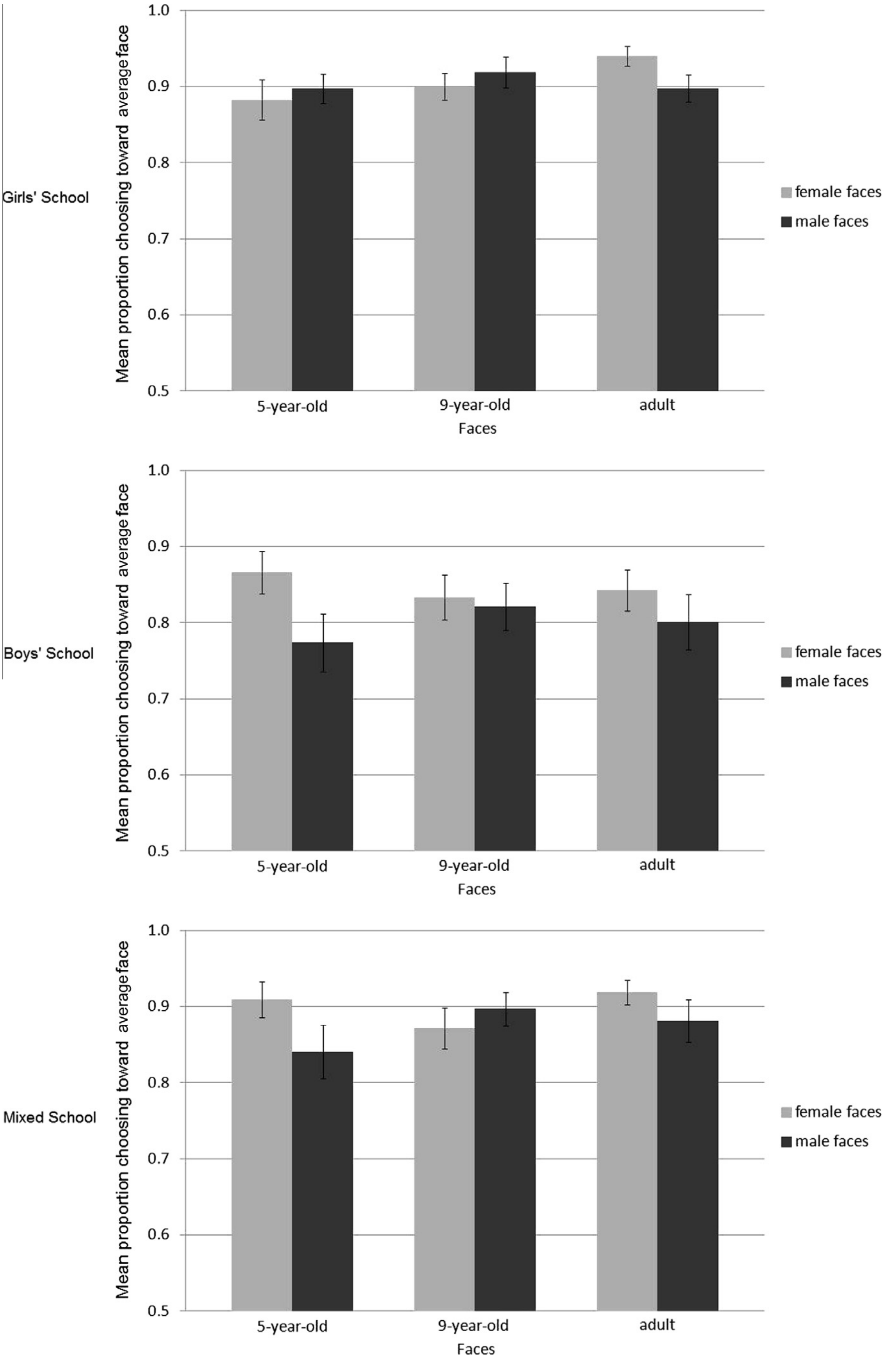

Fig. 2. Mean proportions (±1 *SE*) of trials on which participants at the girls' school, boys' school and mixed-sex school selected the more average face for each face category. The *y* axis begins from the chance level of .50.

chance, we performed one-tailed one-sample *t* tests comparing the mean of each face category with chance (0.5) for each of the schools (Bonferroni-corrected α = .008). Participants from all of the schools selected the more average face more frequently than chance for all face categories (all *p*s < .001; see Fig. 2).

A mixed model ANOVA with the between-participants factor of school and the repeated measures of face age (5 years, 9 years, or adult) and face sex revealed a main effect of school, $F(2,63) = 5.21$, $p = .008$, $\eta_p^2 = .142$. Post hoc comparisons using the Tukey HSD (honestly significant difference) test indicated that children at the girls' school (*M* = .904, *SD* = .073) selected the more average faces more frequently than children at the boys' school (*M* = .823, *SD* = .111), *p* = .008. Children at the mixed-sex school (*M* = .887, *SD* = .077) selected the more average faces marginally more frequently than children at the boys' school, *p* = .061. There were no differences in selections of the more average faces between children at the mixed-sex school and those at the girls' school, *p* = .781. School did not interact with face sex, $F(2,63) = 1.65$, $p = .200$, $\eta_p^2 = .050$, face age, $F(4,63) = 0.35$, $p = .845$, $\eta_p^2 = .011$, or face sex and face age, $F(4,63) = 1.68$, $p = .158$, $\eta_p^2 = .051$. Thus, we did not find the expected interaction, as children attending single-sex schools did not select the more average faces more frequently in same-sex faces than in opposite-sex faces. The ANOVA also revealed a main effect of face sex, $F(1,63) = 8.11$, $p = .006$, $\eta_p^2 = .114$, qualified by an interaction between face sex and face age, $F(2,126) = 3.88$, $p = .023$, $\eta_p^2 = .058$. To break down the interaction between face sex and face age, we did two-tailed paired-samples *t* tests comparing male and female faces for each age of face (Bonferroni-corrected α = .017). Children selected the more average faces more frequently for 5-year-old girl faces (*M* = .885, *SD* = .123) than for 5-year-old boy faces (*M* = .841, *SD* = .151), $t(65) = 2.52$, $p = .014$, $d = 0.320$, and did so more frequently for adult female faces (*M* = .903, *SD* = .097) than for adult male faces (*M* = .862, *SD* = .134), $t(65) = 2.77$, $p = .008$, $d = 0.351$. There were no differences in selections of the more average faces between 9-year-old girl faces (*M* = .870, *SD* = .116) and 9-year-old boy faces (*M* = .877, *SD* = .119), $t(65) = -0.452$, $p = .653$, $d = 0.060$. Because it is also of interest to determine whether there is an influence of face age because of possible processing advantages for same-age faces (Anastasi & Rhodes, 2005; Hills, 2012; Hills & Lewis, 2011) or adult faces (Macchi Cassia, 2011), we broke down the interaction a second way and did separate ANOVAs for male and female faces with the within-participants factor of face age (5 years, 9 years, or adult). There was no main effect of face age in the female face ANOVA, $F(2,130) = 2.52$, $p = .085$, $\eta_p^2 = .037$, or in the male face ANOVA, $F(2,130) = 2.49$, $p = .087$, $\eta_p^2 = .037$. To summarize, we did not find the expected interaction, as children attending single-sex schools did not select the more average faces more frequently in same-sex faces than in opposite-sex faces. We also did not find any evidence of an own-age bias, as children did not select the more average faces more frequently in own-age faces than in other-age faces. However, we did find that boys attending the boys' school selected the more average faces less frequently than girls attending the girls' school and marginally less frequently than children attending the mixed-sex school.

We did several additional analyses to explore hypotheses about why we did not find the expected interaction between school and sex of face for same-age faces and to understand the origin of the main effect of school, which was caused by a difference between the girls' school and the boys' school and a marginal difference between the mixed-sex school and the boys' school. First, we evaluated whether there are sex differences in the strength of the influence of averageness at 9 years of age by comparing the responses of boys and girls from the mixed-sex school. To do so, we calculated a repeated-measures ANOVA on the data from the mixed-sex school with the between-participants factor of participant sex and the repeated measures of face age (5 years, 9 years, or adult) and face sex. The analysis revealed an interaction between face age and face sex, $F(2,36) = 4.05$, $p = .026$, $\eta_p^2 = .184$, such that participants selected the more average faces more frequently in 5-year-old girl faces (*M* = .909, *SD* = .106) than in 5-year-old boy faces (*M* = .841, *SD* = .158), $t(19) = 2.26$, $p = .036$, $d = 0.505$. The analysis revealed no main effect of participant sex, $F(1,18) = 0.0001$, $p = .991$, $\eta_p^2 < .001$, or any interaction between participant sex and face sex, $F(1,18) = 0.034$, $p = .125$, $\eta_p^2 = .126$, face age, $F(2,18) = .634$, $p = .537$, $\eta_p^2 = .126$, or face sex and face age, $F(2,18) = 1.74$, $p = .190$, $\eta_p^2 = .088$. Thus, the boys and girls at the mixed-sex school did not differ in the frequency of their selections of the more average faces.

Second, we evaluated the possibility that children from the single-sex schools might have formed a prototype of the less familiar face category (opposite-sex 9-year-old faces) during the actual test. This possibility is suggested by studies showing short-term adaptation of the prototype in the lab (Hills et al., 2010; Jeffery et al., 2010; Jeffery et al., 2011; Nishimura et al., 2008; Pimperton et al., 2009). To evaluate this possibility, we calculated the mean proportion of trials on which each participant selected the more average faces for the first 4 and last 4 trials of the 9-year-old girl and 9-year-old boy face categories. We then collapsed the data across single-sex schools and reorganized them into the categories of same-sex and opposite-sex faces. If children at single-sex schools were building a prototype of opposite-sex peer faces, we should see a stronger influence of averageness in the last 4 trials than in the first 4 trials in the block of opposite-sex peer faces. We did a repeated-measures ANOVA with the repeated participants factors of face type (same-sex faces or opposite-sex faces) and trial set (first 4 trials or last 4 trials) and found an interaction between face type and trial set, $F(1,45) = 7.67$, $p = .008$, $\eta_p^2 = .146$. To follow up, we did two-tailed paired-samples *t* tests comparing the first 4 and last 4 trials for same-sex and opposite-sex faces (Bonferroni-corrected $\alpha = .025$). For same-sex faces, participants selected the more average faces more frequently in the first 4 trials ($M = .913$, $SD = .151$) than in the last 4 trials ($M = .826$, $SD = .182$), $t(45) = 2.97$, $p = .005$, $d = 0.520$, although both of these values were well above the chance level of .50. For opposite-sex faces, there were no differences in selections of the more average faces between the first 4 trials ($M = .859$, $SD = .202$) and last 4 trials ($M = .897$, $SD = .154$), $t(45) = -1.27$, $p = .212$, $d = 0.212$. Thus, children at the single-sex schools did not appear to be forming prototypes of opposite-sex peer faces from the beginning to the end of the face block.

Third, we evaluated the possibility that contact with opposite-sex friends and siblings might strengthen the influence of averageness on attractiveness judgments for opposite-sex peer faces. To do so, we calculated the correlation between the number of same-age (8- or 9-year-old)

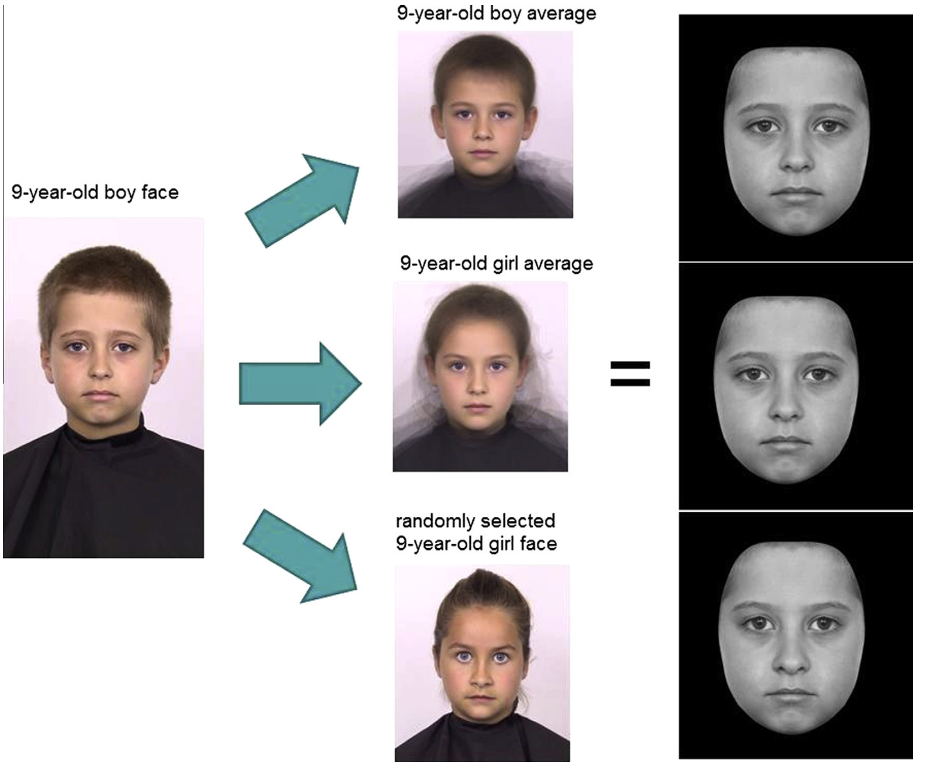

Fig. 3. Nine-year-old boy's face transformed 50% toward a 9-year-old boy average, 9-year-old girl average, and 1 of 16 randomly selected 9-year-old girl faces.

opposite-sex friends and siblings each participant reported in the questionnaire and the preference for averageness in 9-year-old faces of the opposite sex. The influence of averageness on judgments of attractiveness in opposite-sex peer faces was not significantly correlated with the number of same-age friends and siblings of the opposite sex, Pearson's $r(66) = .160$, $p = .196$. Thus, contact with opposite-sex peers did not appear to strengthen the influence of averageness on opposite-sex peer faces.

Fourth, we evaluated the possibility that experience with one face sex could facilitate processing of the other sex, as averages of male and female 9-year-old faces may be sufficiently similar to yield the same choices whether children are basing their attractiveness judgments on a 9-year-old boy average or a 9-year-old girl average. To test this hypothesis, we compared the similarity of the 9-year-old boy faces that had been transformed 50% toward their 9-year-old boy average with 9-year-old boy faces that had been transformed 50% toward the 9-year-old girl average (see Fig. 3). For comparison, we also transformed each 9-year-old boy face 50% toward a randomly chosen individual face of a 9-year-old girl. All faces were made perfectly symmetrical, aligned by interpupillary distance, and converted to grayscale. We measured similarity (Pearson correlation) among the transformed faces based on the pixel-wise luminance value in Matlab with custom code. We expected that there would be strong correlations among all of the faces because of their shared first-order face structure but also that the 9-year-old boy faces that had been transformed 50% toward their 9-year-old boy average should be more similar to the faces that had been transformed 50% toward the 9-year-old girl average than toward a randomly selected 9-year-old girl face. That pattern would be consistent with generalization across face prototypes and was what we found. For the 9-year-old boy faces, the faces that had been transformed toward their 9-year-old boy average were more similar to the faces that had been transformed toward the 9-year-old girl average ($r = .981 \pm .005$ [mean ± *SD*]) than toward a random 9-year-

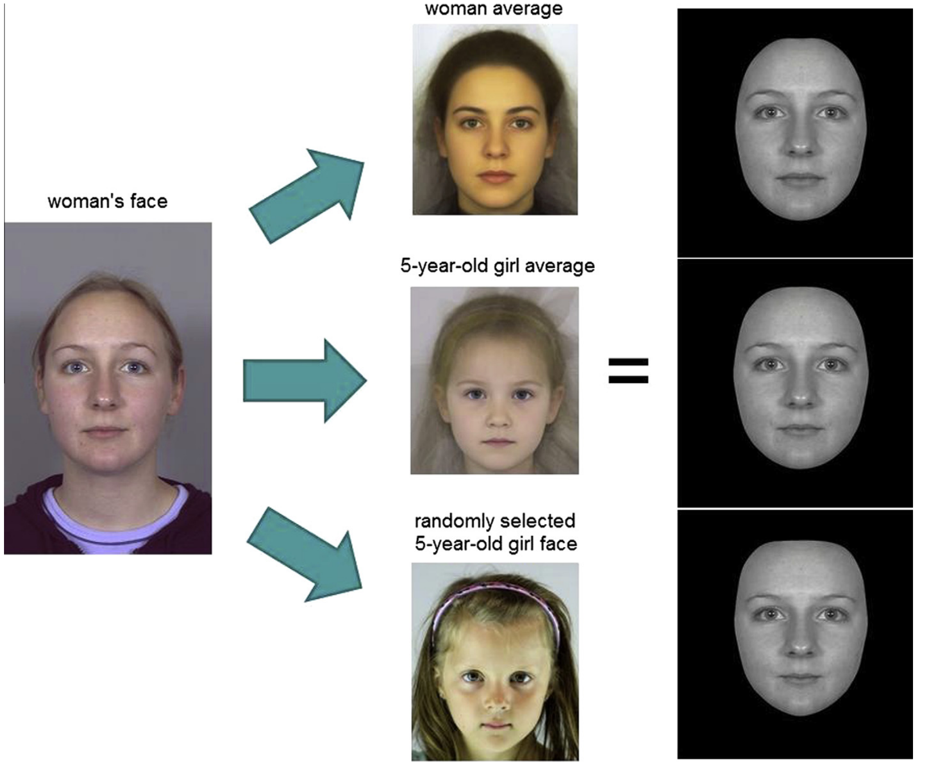

Fig. 4. Woman's face transformed 50% toward an average of women's faces, 5-year-old girl average, and 1 of 16 randomly selected 5-year-old girl faces.

old girl face ($r = .960 \pm .014$), $p < .001$ (two-tailed). The results were similar when the same analysis was done for 9-year-old girl faces; there was greater similarity between faces that had been transformed toward the 9-year-old girl average and 9-year-old boy average ($r = .983 \pm .004$) than toward a random 9-year-old boy face ($r = .957 \pm .016$), $p < .001$ (two-tailed). These results are consistent with findings that sexual dimorphism is not significant in the faces of young children (Samal, Subramani, & Marx, 2007) and support the possibility that children in the single-sex schools could have generated their attractiveness judgments for the faces of opposite-sex peers from a prototype formed from same-sex peer faces.

Finally, we compared the similarity of averages of different ages to assess whether a well-formed prototype of own-age faces could be sufficient to create an effect of averageness for faces of other ages. We tested this possibility by comparing the two face ages used here that differ the most: 5-year-old and adult faces. We used the same approach as described above for sex of face. Specifically, we created additional stimulus faces by transforming each adult face 50% toward its same-age same-sex average, 50% toward a 5-year-old same-sex average, and 50% toward a random 5-year-old same-sex face identity (Fig. 4). If there are similarities between averages of different ages, the faces that were transformed 50% toward their same-age averages should be more similar to those transformed toward the other-age averages than to those transformed toward the other-age random faces. This prediction was confirmed for both male and female faces. For female faces, the correlation between faces transformed toward the same-age and other-age average ($r = .966 \pm .005$) was higher than the correlation between faces transformed toward the same-age average and other-age random face ($r = .949 \pm .018$), $p = .002$ (two-tailed). For male faces, the correlation between faces transformed toward the same-age and other-age average ($r = .947 \pm .008$) was higher than the correlation between faces transformed toward the same-age average and other-age random face ($r = .936 \pm .017$), $p = .018$ (two-tailed). These results suggest that there are similarities in averages across age categories and support the possibility that the influence of averageness on children's judgments of the attractiveness of 5-year-old faces could have been generated from using a same-age 9-year-old prototype or even an adult prototype.

Discussion

We tested the influence of averageness on attractiveness judgments in children attending a boys' school, a girls' school, and a mixed-sex school and found that averageness influenced 8- and 9-year-olds' attractiveness judgments. These results are consistent with previous research (Vingilis-Jaremko & Maurer, 2013a) and show that the influence of averageness on children's judgments of facial attractiveness is a robust finding.

This study was designed to examine how experience affects children's attractiveness judgments in two ways. First, we tested children attending single-sex schools and hypothesized that averageness would influence attractiveness judgments more strongly in same-sex faces than in opposite-sex faces of the same age. We did not find the hypothesized interaction, as averageness did not consistently influence attractiveness judgments more strongly in female faces among girls at the girls' school or in male faces at the boys' school. Second, we included three ages of faces to assess the influence of recent experience on attractiveness judgments because children likely have the most experience with peers' faces (or possibly adult faces; Macchi Cassia, 2011) and children have an own-age advantage when recognizing faces to which they were exposed previously in the lab, whether compared with the recognition of adult faces or with the faces of younger and older children (Anastasi & Rhodes, 2005; Hills, 2012; Hills & Lewis, 2011). We did not find any evidence of an own-age bias or a processing advantage for adult faces in this study, as children did not consistently prefer averageness more strongly in same-age or adult faces, a pattern replicating findings from a previous study that tested a smaller sample of 9-year-olds (Vingilis-Jaremko & Maurer, 2013a).

The lack of an influence of recent biased face experience on the strength of the preference for averageness is a surprising result given the changes in attractiveness judgments that have been found after biased face experience in the lab; after adaptation to faces with compressed/expanded features (Anzures et al., 2009; Rhodes et al., 2003; Short et al., 2011) or low/high feature height (Cooper & Maurer, 2008; Hills et al., 2010), children and adults shift their judgments of attractiveness or oddness in the adapted direction. Biased real-world experience also seems to induce such shifts; infants (Geldart et al., 1999), children (Cooper et al., 2006), and adults (Geldart, 2008) tend to prefer faces with feature heights similar to what they see most frequently, presumably because their prototype is tuned toward those faces. In addition, although adults who have some experience with other-race faces prefer averageness in both own-race and other-race faces (Rhodes, Geddes, et al., 2002; Rhodes, Harwood, et al., 2002; Rhodes et al., 2001), adults who have little to no experience with other-race faces do not find averageness attractive in those faces, although they do in own-race faces (Apicella et al., 2007). Similarly, 3-month-old infants (but not 1-month-olds) have a looking preference for same-race faces over other-race faces (Bar-Haim et al., 2006; Kelly et al., 2005; Kelly et al., 2007), and 3- and 4-month-old infants who have been raised by a female caregiver look longer at female faces than at male faces, a preference that appears to be reversed in infants raised by a male caregiver (Quinn et al., 2002). As a result, we expected that biased exposure to one sex among children in a single-sex school would induce stronger effects of averageness in same-sex own-age faces than in faces of the opposite sex or from younger ages. These predictions are based on an assumption of age-specific and sex-specific norms, as have been suggested from evidence of the own-age effect (Anastasi & Rhodes, 2005; Hills, 2012; Hills & Lewis, 2011), and evidence of age-contingent (Little, DeBruine, Jones, & Waitt, 2008) and sex-contingent opposite aftereffects (Jaquet & Rhodes, 2008; Little, DeBruine, & Jones, 2005; Rhodes et al., 2011; Schweinberger et al., 2010). Similar evidence has been presented for race-specific norms based on the own-race bias (see Meissner & Brigham, 2001) and race-contingent opposite aftereffects (Jaquet, Rhodes, & Hayward, 2008; Little et al., 2008; 5- and 8-year-olds: Short et al., 2011).

There are several possible explanations for the absence of the predicted effect. One possibility is that the differences between stimuli were too large to pick up subtle differences between groups, although we note that none of the groups was at ceiling in its performance and the same stimulus set revealed differences between 9-year-olds and adults (Vingilis-Jaremko & Maurer, 2013a). Another possibility, consistent with the efficacy of short-term adaptation in the lab (Hills et al., 2010; Jeffery et al., 2010; Jeffery et al., 2011; Nishimura et al., 2008; Pimperton et al., 2009) is that a minimum level of face experience is adequate to allow the formation of a prototype sufficiently well defined to influence judgments of attractiveness. In this study, although the children at single-sex schools have predominantly male or female face experience, it is likely that they have some exposure to children of the opposite sex. This theoretical possibility was confirmed by the questions about the five friends the children see most frequently, as 9.5% of children at the boys' school and 25% of children at the girls' school reported at least one friend of the opposite sex they see frequently. If children have representations of as few as 16 faces of the opposite sex, their prototype should be an accurate representation of the group average (see Langlois & Roggman, 1990), and representations based on fewer than 16 faces will still approach the group average, allowing for attractiveness judgments based on a representative norm.

A related possibility is that experience with one face sex could facilitate processing of the other sex. Our findings that 9-year-old faces transformed toward same-sex averages are more similar to 9-year-old faces transformed toward opposite-sex averages than randomly selected faces of the opposite sex demonstrate that there are similarities between 9-year-old girl and 9-year-old boy averages. These findings are consistent with measurements demonstrating that sexual dimorphism is not significant among faces of children under 12 years of age (Samal et al., 2007) and support the possibility that children attending single-sex schools could have based their attractiveness judgments of opposite-sex peers on a prototype formed from their many socially salient encounters with same-sex peer faces.

We also did not find the expected interaction with age of face; the influence of averageness was not stronger for own-age faces than for the faces of 5-year-olds or adults. Perhaps 8- and 9-year-old children may have sufficient interactions with enough adults to form a fairly accurate prototype for adult faces despite being better at remembering own-age faces than adult faces learned in an experiment (Anastasi & Rhodes, 2005; Hills, 2012; Hills & Lewis, 2011). They may also have remnants of the prototypes formed when they were 5-years-old themselves despite the strong own-age advantage when remembering the faces of children their own age or slightly younger (Hills, 2012). Alternatively, as with sex of face, there may be sufficient similarity among the prototypes of faces of different ages; a well-formed prototype of a 9-year-old face could be sufficient to create an effect of averageness for faces of other ages. Our findings of similarities in averages across age categories support the possibility that the influence of averageness on children's judgments of the attractiveness of 5-year-old faces could have been generated from using a same-age 9-year-old prototype or even an adult prototype.

Although contingent aftereffects were demonstrated for different face categories, the transfer of simple aftereffects suggests that there is also some common neural representation. Simple aftereffects transfer to some extent across age (Barrett & O'Toole, 2009), sex (Jaquet & Rhodes, 2008), and race (Jaquet et al., 2008) categories. In addition, judgments of attractiveness increase whether faces have been transformed to same-race or other-race averages (Rhodes et al., 2001), a finding that suggests some shared dimensions among averages. Our finding of similarities among averages of different ages and sexes supports the idea of shared dimensions across face age and face sex in addition to face race. We speculate that some aspects of face processing might be based on age-, sex-, and race-specific norms, whereas other aspects might be based on a general norm and/or shared dimensions among norms. For example, judgments of identity, which are facilitated by caricaturing faces (Benson & Perrett, 1994; Byatt & Rhodes, 1998; Calder, Young, Benson, & Perrett, 1996; Lee, Byatt, & Rhodes, 2000; Rhodes, Brennan, & Carey, 1987) and focus on how faces differ, might be based on specific norms. By contrast, some aspects of attractiveness judgments might be based on shared dimensions.

Although we did not find an interaction between recent biased face experience and the influence of averageness on same-sex or opposite-sex faces, we did find a cohort effect, as children at the boys' school selected the more average faces less frequently than children at the mixed-sex school or girls' school, a result suggesting that there are individual differences in attractiveness judgments. This is not likely to be a sex difference because there was no difference between boys' and girls' judgments at the mixed-sex school, and previous studies have not found a sex difference in either adults (Rhodes et al., 1999; Vingilis-Jaremko & Maurer, 2013a), 5- and 9-year-old children (Vingilis-Jaremko & Maurer, 2013a), or adolescents (Saxton et al., 2010; Saxton et al., 2011) except for one study that found that adolescent girls were more likely than boys to select the more average faces when judging male faces (Saxton et al., 2009). It is possible that other differences between the schools, such as differences in the school environment and differences in the kind of children recruited to each type of school, could have influenced the findings. For example, the girls' school and mixed-sex school both require students to take an entrance examination prior to acceptance, whereas the boys' school does not have any merit-based entry requirements. This difference in student selection could lead to differences in IQ across the three groups and could affect performance on the task and/or the strength of the averageness preference. Any or all of these differences could have led to the between-school differences we observed.

We found an interaction between age and sex of face such that participants selected the more average faces more frequently in female faces than in male faces in the 5-year-old and adult faces, but there were no differences in selections between male and female same-age faces. One possibility is that children show a stronger influence of averageness in female faces because of a history of biased exposure to female faces beginning in infancy (Rennels & Davis, 2008) and likely continuing through preschool. Faces of their own age could be the exception for which their keen interest ensures enough exposure to develop a stable prototype that exerts an influence on their judgments of attractiveness of faces of either sex. However, in a previous study, we did not find this pattern in the 9-year-olds and adults we tested. Alternatively, the pattern of interactions, which are similar but not identical to those found in a previous study (Vingilis-Jaremko & Maurer, 2013a), could be caused by noise in the data and/or subtle differences in the face sets from which the stimuli were formed, although no differences emerged in judgments of normality for the original faces in each set by a separate group of raters (Vingilis-Jaremko & Maurer, 2013a).

In sum, we found that averageness influenced children's attractiveness judgments but that recent biased experience with girls' or boys' faces did not strengthen its influence on attractiveness judgments. Nor were there experience-based effects of the age of the face. Other studies have found that averageness influences attractiveness judgments as early as 5 years of age but is not yet adult-like by 9 years (Vingilis-Jaremko & Maurer, 2013a). The results of this study suggest that the differences among age groups in the strength of the influence of averageness on judgments of attractiveness does not arise mainly, if at all, from experiencing different types of faces in everyday life. The significant effect of averageness on judgments for every face category suggests that averageness will influence children's judgments of the attractiveness of the faces they encounter in everyday life regardless of sex or age.

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