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The influence of recent experience on perceptions of attractiveness

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Abstract. Adults rate average faces as more attractive than most of the faces used in the creation of the average. One explanation for this is that average faces appear as both more familiar and more attractive because they resemble internal face prototypes formed from experience. Here we evaluated that explanation by examining the influence of recent experience on participants' subsequent judgments of attractiveness. Participants first performed a memory task lasting 8 min in which all of the female faces to be remembered had their features placed in a low, average, or high position, depending on experimental condition. In what was described as a separate experiment, participants then moved the features of a female face with averaged features to their most attractive vertical location. The most attractive location was affected by the faces seen during the memory task, with participants who saw faces with features in the high position placing features in higher locations than participants who saw faces with features in either the low or average positions. The results demonstrate that perceptions of attractiveness are influenced by recent experience, and suggest that internal face prototypes are constantly being updated by experience.

1 Introduction

Adults from different cultural and racial backgrounds give similar ratings of facial attractiveness, even when they rate faces from a racial group with which they have had limited experience (Cunningham et al 1995; Perrett et al 1994, 1998; Rhodes et al 2001). The perception of attractiveness is influenced by facial characteristics such as averageness (Baudouin and Tiberghien 2004; Langlois and Roggman 1990; Perrett et al 1998; Rhodes and Tremewan 1996; Rhodes et al 2001; Rubenstein et al 1999; Valentine et al 2004), symmetry (Little et al 2007; Perrett et al 1999; Rhodes et al 1998), and secondary sexual characteristics (Baudouin and Tiberghien 2004; Perrett et al 1994, 1998; Rhodes et al 2000; see Rhodes 2006 for a meta-analysis of the three effects). These influences remain consistent even when the racial and/or cultural background of the faces being rated differs from that of the observer. Despite these similarities in the perceptions of attractiveness, the existence of individual preferences is unquestioned (Hönekopp 2006).

Valentine (Valentine 1991; Valentine and Bruce 1986) theorises that the cognitive representation of faces is organised in an n-dimensional 'face space' centred on a prototypical face that represents the mean of an individual's experience (with the possibility of there being separate prototypes for categories defined by sex, race, or age). The structure of this face space directly mirrors an individual's unique experience with faces and changes over the course of his or her lifetime to reflect changes in experience. Consistent with this theory, when adults are shown faces morphed between Asian and Caucasian faces, the perceived boundary of Asian viewers differs from that of North American Caucasian viewers, with the size of the difference decreasing as Asian viewers spend more time in the United States and report more contact with individuals of the other ethnicity (Webster et al 2004). The finding that adults rate

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computer-generated average faces as more attractive than most of the individual faces used in their creation might be related to the structure of face space (Langlois and Roggman 1990; Rhodes et al 1999; Rhodes and Tremewan 1996; Valentine et al 2004). Average faces are artificially generated to have the average proportions, features, and colouring that have been calculated from a large number of individual faces. As a result, average faces should theoretically more closely resemble prototypes in face space than do most naturally occurring faces. Average faces may be perceived as attractive because they resemble faces that are most often experienced and are therefore perceived as highly familiar and more readily processed (Langlois and Roggman 1990; see Winkielman et al 2006 for converging evidence from studies of dot patterns).

We theorise that, similar to the way in which experience may lead to a preference for average faces over most individual faces, idiosyncratic experiences may lead to individual differences in the perception of attractiveness. Three pieces of evidence lend indirect support to this hypothesis. First, adults rate faces of their own sex manipulated to resemble their own face as being both more average and more attractive than faces altered to resemble unfamiliar adults, possibly as a result of frequent experience with their own face or the faces of close relatives (DeBruine 2002, 2004). Second, adults choose mates with eye and hair colour (Little et al 2003) and relative age (Perrett et al 2002) that are correlated with those attributes in their opposite-sex parent, possibly as a result of the extensive experience children have with their parents' faces while growing up. Adults may perceive self-resembling faces and faces that share characteristics with the faces of their parents as more attractive because these faces better approximate the internal face prototypes at the centre of their face space than do other faces.

Third, developmental changes in the attractiveness of faces with altered vertical location of internal facial features appear to be influenced by age-related experience (Cooper et al 2006; Geldart et al 1999). In these studies, adults, infants, and children of various ages were tested with faces altered to have facial features placed in average (the population mean), low (two standard deviations below the population mean), and high (two standard deviations above the population mean) positions, according to measurements of facial physiognomy of North Americans of Northern European descent (Farkas 1994). Adults rate faces with features in low or average positions as more attractive than faces with features in a high position, and faces with features in an average position as more attractive than faces with features in a low position (Cooper et al 2006; Geldart et al 1999). This pattern of adult preferences is not observed in children until they reach the age of 12 years, with 5-month-old infants looking longest at faces with features in a high position and children aged 4 and 9 years rating faces with features in average and low positions as equally attractive. One interpretation of the developmental changes is that participants find most attractive those faces whose proportions most closely resemble the face proportions they see in their everyday lives. By this account, adults might rate faces with features in an average position as most attractive because they most resemble the central tendency of their experience, and faces with features in a low position as second best because they have proportions similar to those of the faces in infants and children. Children might rate faces with features in average and low positions as equally attractive because their proportionally greater experience with the faces of their peers, who have features located lower than adults, results in their internal prototype having facial proportions somewhere between those of the faces of young children and those of adults. Finally, infants might show a (slight) looking preference for faces with features in a high position over faces with features in a low position because of the skewed perspective from which they view the faces of adults, which accentuates the size of the chin and decreases the size of the forehead, leading to the appearance of higher features.

The only direct test of whether experience modifies the perception of attractiveness comes from recent laboratory studies of face adaptation. Brief exposure to a biased sample of faces can alter adults' perceptions of subsequently presented faces (Anderson and Wilson 2005; Jeffrey et al 2006; Jiang et al 2006; Leopold and Bondar 2005; Leopold et al 2001; MacLin and Webster 2001; Rhodes and Jeffrey 2006; Rhodes et al 2003, 2005; Watson and Clifford 2003; Webster et al 2004; Webster and MacLin 1999). For example, after adaptation to 10 compressed faces, adults judge faces that have been slightly compressed to be more normal and more attractive than faces that have not been compressed (Rhodes et al 2003). Note that the preferred face shape shifts only slightly toward the biased shape of the recently experienced faces, presumably because the years of experience seeing faces centred on a true average carry more weight. In addition to perceptions of normalcy and attractiveness, similar adaptation influences the perceptions of sex, ethnicity, facial expression, and facial identity (Anderson and Wilson 2005; Jeffrey et al 2006; Jiang et al 2006; Leopold and Bondar 2005; Leopold et al 2001; MacLin and Webster 2001; Nishimura et al 2008; Rhodes and Jeffrey 2006; Rhodes et al 2003, 2005; Watson and Clifford 2003; Webster et al 2004; Webster and MacLin 1999). After adaptation to a particular face, participants judge neutral faces, created by averaging faces from two extremes of a category (male and female; happy and sad; European and Asian; or Dan and anti-Dan that differ by equivalent amounts on opposite sides of an average face) as belonging to the category opposite from the category of adaptation. For example, after viewing a male face, an androgynous face that had previously been judged to be gender-neutral is more likely to be judged as being female. Several authors have speculated that our everyday encounters with faces act in a similar way to these short-term adaptation effects, with changes in our experience altering our internal representations of faces and the prototype or norm to which they are compared (Leopold and Bondar 2005; MacLin and Webster 2001; Rhodes et al 2003, 2005; Webster et al 2004).

In this experiment we used a similar approach but set up the adaptation to more closely approximate the way in which natural experience might alter face prototypes and subsequent judgments of attractiveness. Unlike previous research (Rhodes et al 2003), the adaptation was not passive but required active processing of facial identity, the adapting stimuli were not distorted but altered in natural ways, and the subsequent effects on judgments of attractiveness were tested after a short delay. Specifically, we biased participants' experience in the first phase by asking them to remember 40 unfamiliar faces in which we had systematically varied the proportions so that features were, depending on condition, at a lower-than-average location, an average location, or a higher-than-average location. The locations of features of the adaptation stimuli were within natural limits (Farkas 1994) and were similar to the locations used in our previous studies of the effect of feature height on judgments of facial attractiveness (Cooper et al 2006; Geldart et al 1999). The 40 unfamiliar faces were each presented three times during the memory task and participants had to indicate how many times each face they had been seen before. This resulted in participants receiving approximately 8 min of experience with a set of 40 faces with features in a low, average, or high location. The memory task was designed to be demanding and to encourage active processing of each individual face so as to better approximate face processing outside of the lab, where experience with faces is hypothesised to modify internal prototypes. After an approximately 2 min delay between adaptation and test, participants moved the features of an average female face to what they perceived to be the most attractive location of features.

We predicted that participants would move the features of the average face in the same direction as the alterations made to the faces seen during the memory task. Our previous studies provide indirect evidence that judgments of attractiveness for faces with features

at different locations are influenced by age-related experience (Cooper et al 2006; Geldart et al 1999). Here we tested directly whether recent experience with altered vertical placement of features is sufficient to effect changes in adults' perceptions of attractiveness.

2 Method

2.1 *Participants*

Three groups of twenty-four adults (half female) were tested. All participants were Caucasian, aged 18 – 25 years, and reported having normal or corrected-to-normal vision. They participated either for credit in an introductory psychology course or for monetary compensation.

2.2 *Stimuli*

2.2.1 *Memory stimuli.* Stimuli used in the memory task were created from colour, frontal photographs of 40 female Caucasian models with neutral expressions. They were photographed with even lighting created by two flashes that were placed symmetrically on either side of the camera and that were reflected off white reflective umbrellas. The photographs were cropped so that only the head, hair, and shoulders of the models were visible in the final stimuli. Models wore black capes to cover their clothing.

The internal facial features of the 40 models were altered with Adobe Photoshop to create three different vertical placements (figure 1). The three different locations of features were calculated from published measurements of the average size of the forehead and chin of the faces of adult females (Farkas 1994), and expressed in terms of ratios calculated by dividing forehead size by chin size. The final stimuli had proportions similar to those used in our previous studies of the development of perceptions of attractiveness (Cooper et al 2006; Geldart et al 1999). The average forehead-to-chin ratio of 1.45 represents the ratio based on average forehead height divided by average chin size. The high ratio of 1.03 was the result of decreasing forehead size by two standard deviations and increasing chin size by two standard deviations. The low ratio of 2.02 was the result of increasing forehead size by two standard deviations and decreasing chin size by two standard deviations. The features of all stimulus faces were moved the necessary number of pixels up or down on the face with Adobe Photoshop to achieve the desired forehead-to-chin ratio. All stimuli were presented approximately life-sized and measured 13.3 deg wide by 16.3 deg high at the viewing distance of 100 cm. The faces were standardised so that they measured 9.6 deg (16.8 cm) from the hairline to the bottom of the chin.

Figure 1. An example of a female face with the features moved to the low height, the average height, and the high height. The original stimuli were approximately life-size and in colour. The alterations were made to the faces of 40 adult females.

2.2.2 *Attractiveness stimulus.* The attractiveness stimulus was a 100-frame morph-movie of a computer-generated averaged Caucasian female face that transitioned from having features located in an extremely low position to having features in an extremely high position (figure 2). The average face was created by morphing together the photographs of 16 female models with neutral expressions with Gryphon Morph software. The average was then modified with Adobe Photoshop to create one version with extremely high features and a second version with extremely low features. Finally, the movie stimulus depicting the transition between the extremely high and extremely low versions of the average face was generated with Gryphon Morph software. All stimuli were presented at approximately life-size and standardised to measure 9.6 deg (16.8 cm) from the hairline to the bottom of the chin from the testing distance of 100 cm. Participants used the computer keyboard to move the internal features vertically within the face frame.

Figure 2. Extreme low and high feature placements of the 'attractiveness' stimulus. The original stimulus was presented as approximately life-sized and in colour.

The stimuli were displayed on a 21 inch (53.4 cm) Hewlett-Packard colour display controlled by an Apple PowerMac G4. The memory task was run with Cedrus SuperLab software and the attractiveness task with Apple QuickTime.

2.3 *Procedure*

Participants were told that they would be taking part in two unrelated experiments: a face-memory task and an attractiveness task. Participants were tested individually in a darkened room and were seated approximately 100 cm from the monitor for both parts of the experiment. For the face-memory task, each participant saw faces from only one of the three possible feature heights (low, average, high) with one third of the participants of each sex assigned to each condition. Target faces were presented three times each for a total of 120 trials. Participants were asked to keep track of the number of times they had seen each of the 40 individual target faces (up to a maximum of three times per face). After each 4 s trial, participants were asked to press the number-pad key corresponding to the number of times they had seen the target face. Stimuli were presented in a semi-random order that controlled the distribution of first, second, and third presentations across the 120 trials. The task was broken into twelve blocks of 10 faces; the stimuli presented in each block were the same for all participants and chosen so that participants would not receive only first presentations in the early trials and third presentations in the later trials and to keep the experiment challenging throughout the twelve blocks. The order of stimuli in each block was randomised across participants.

A delay of approximately 2 min followed the memory task, during which the participant remained in the testing room and listened to the experimenter explain the procedures of the attractiveness task, which was described as a separate experiment. For the attractiveness task, participants were asked to move the features of the morph-movie to six different vertical locations: the most attractive location of features when starting from the lowest and the highest points of the morph-movie (attractive up/down), the point at which the face began to look unattractive (unattractive up/down), and the point at which the face began to look unnatural (unnatural up/down). Half the participants in each condition began with a movie in an extreme low position, the other half in an extreme high position. When beginning from the bottom (top) position, participants were asked to: (i) move the features up (down) until the face looked most attractive; (ii) keep moving the features up (down) until the face was no longer attractive; (iii) keep moving the features up (down) until the face no longer appeared to be natural; and (iv) keep moving the features up to the topmost (lowest) position. They were then asked to repeat the judgments starting from the top (bottom) position. Participants moved the position of the features by means of left and right keys and were allowed to make adjustments if they believed that they had moved the features too far in either direction. Vertical location of features increased or decreased steadily when the appropriate key was held; if the keys were tapped, vertical location increased or decreased incrementally one frame at a time. When the participants were satisfied with the placement of features, the experimenter recorded the frame number the participant had chosen and asked the participant the next question of the series. The attractiveness task took approximately 2 min to complete. The McMaster Research Ethics Board approved the protocol and procedures used in this study and all participants gave informed consent.

3 Results

We analysed the percentage of correct responses made over the 120 trials of the memory task by an ANOVA, with training condition (low, average, or high) and sex of participant (male or female) as between-subject factors. The main effect of training condition ($F_{2,66} = 1.405$, $p = 0.25$, ns), the main effect of sex of participant ($F_{1,66} = 2.424$, $p = 0.12$, ns), and the interaction ($F_{2,66} = 1.343$, $p = 0.27$, ns) were all non-significant. Across conditions, participants performed similarly with an overall mean of 74% (low: 73%; average: 76%; high: 73%) correct judgments of first, second, and third presentations, suggesting that we successfully created a challenging memory task.

The data for the attractiveness task were scored as the number of frames above the extreme low position (see table 1 for the mean and standard deviation for each condition). An ANOVA with training condition (low, average, or high) and sex of participant (male or female) as between-subjects factors and starting location (low and high) as a within-subject factor revealed significant main effects of starting location ($F_{1,66} = 127.9$, $p < 0.001$, $\eta_p^2 = 0.658$) and training condition ($F_{2,66} = 6.91$, $p < 0.002$, $\eta_p^2 = 0.172$). The main effect of sex of participant ($F_{1,66} = 0.11$, $p = 0.74$, ns), the interaction between sex of participant and training condition ($F_{2,66} = 0.28$, $p = 0.76$, ns), the interaction between sex of participant and starting location ($F_{1,66} = 0.68$, $p = 0.41$, ns), the interaction between training condition and starting location ($F_{2,66} = 1.72$, $p = 0.19$, ns), and the three-way interaction ($F_{2,66} = 0.11$, $p = 0.89$, ns) were all non-significant (figure 3). Fisher's protected-least-significant-difference (PLSD) a posteriori tests of the main effect of training condition, with correction for multiple comparisons, showed that participants in the high condition placed the features significantly higher than participants in both the average ($p = 0.036$) and low ($p < 0.001$) conditions. Although participants in the average condition did place the facial features of the target stimulus at a level between the low and high conditions, they did not differ significantly from participants in the low ($p = 0.125$) condition.

Table 1. Mean location of features in frames (standard deviations in parentheses). Mean frame selected (±1 SD) for the position where the face starts to look unnatural, starts to look unattractive, and looks most attractive starting from the highest (100) and lowest (0) positions. Data are shown for the groups who saw faces with features in high (82), average (58), and low (36) positions during the memory task. In general, judgments were pulled in the direction of the memory stimuli.

Start	Condition	Training condition		
		low	average	high
Low	most attractive	37.88 (8.09)	43.75 (8.85)	48.62 (9.40)
	unattractive	62.50 (10.71)	64.75 (10.46)	70.00 (9.16)
	unnatural	82.29 (13.30)	81.25 (10.04)	86.38 (8.77)
High	most attractive	52.21 (10.95)	53.79 (8.99)	59.21 (8.85)
	unattractive	23.29 (9.36)	30.04 (7.22)	37.17 (9.72)
	unnatural	9.29 (9.34)	18.17 (8.61)	21.58 (10.67)

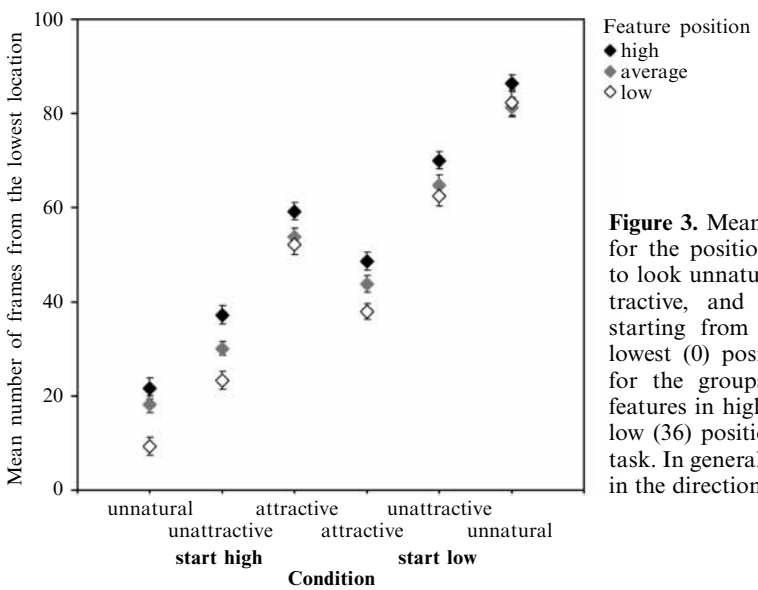

Figure 3. Mean frame selected (±1 SE) for the position where the face starts to look unnatural, starts to look unattractive, and looks most attractive starting from the highest (100) and lowest (0) positions. Data are shown for the groups who saw faces with features in high (82), average (58), and low (36) positions during the memory task. In general, judgments were pulled in the direction of the memory stimuli.

Separate ANOVAs for each of the remaining measures with training condition (low, average, or high) and sex of participant (male or female) as between-subjects factors revealed significant main effects of training condition for the unattractive up ($F_{2,66} = 3.39$, $p = 0.040$, $\eta_p^2 = 0.093$), unattractive down ($F_{2,66} = 15.0$, $p < 0.001$, $\eta_p^2 = 0.312$), unnatural down ($F_{2,66} = 10.9$, $p < 0.001$, $\eta_p^2 = 0.249$), but not the unnatural up ($F_{2,66} = 1.45$, $p = 0.241$, ns) conditions. Fisher's PLSD a posteriori tests of the main effect of training condition, with correction for multiple comparisons, showed that the participants in the high condition placed the features significantly higher than participants in the low condition for measures of unattractive up ($p = 0.0135$), unattractive down ($p < 0.001$), and unnatural down ($p < 0.001$). Participants in the average condition placed the features significantly higher than participants in the low condition for measures of unattractive down ($p = 0.010$) and unnatural down ($p = 0.002$). Finally, participants in the high condition placed the features significantly higher than participants in the average condition for the measure of unattractive down ($p = 0.007$). The main effects of sex of participant (all ps > 0.20, ns) and the interactions between sex of participant and training condition (all ps > 0.10, ns) were non-significant for all four measures.

4 Discussion

Performance on the memory task was both well above chance and well below ceiling, suggesting that we were effective in creating a challenging task that required participants to actively process the target faces. Furthermore, the finding that there was no difference in performance on the memory task across conditions suggests that participants in all conditions were paying similar amounts of attention during the memory task and receiving the same amount of biased experience with the height of facial features.

Starting location of the features of the movie stimuli influenced choice of most attractive location of features during the attractiveness task: participants placed features significantly higher when starting from the high position than when starting from the low position. Starting-point biases are a common finding in tests of visual sensitivity that compare ascending limits (starting from below threshold) and descending limits (starting from above threshold). In addition, in the current experiment, seeing the movie stimulus with unnaturally high or low features at the beginning of the attractiveness task may have been sufficient to induce additional changes in the structure of face space, as would be expected if brief experience can alter the prototype and subsequent judgments of attractiveness. However, any effect of starting location was not sufficient to negate the effect of the prior memory task: regardless of starting location, adults' choice of most attractive location was biased in the direction of the faces they had seen in the prior memory experiment. The persistence of the effect of training condition across the 2 min delay and the viewing of the face at the starting point suggests that the adaptation aftereffects reported in the literature may be more robust than previously believed (Anderson and Wilson 2005; Jeffrey et al 2006; Jiang et al 2006; Leopold and Bondar 2005; Leopold et al 2001; MacLin and Webster 2001; Rhodes and Jeffrey 2006; Rhodes et al 2003, 2005; Watson and Clifford 2003; Webster et al 2004; Webster and MacLin 1999).

As predicted, participants' choice of most attractive location was influenced by the experience they received during the memory task. Furthermore, the training condition affected measures of the upper and lower limits of both unattractiveness and unnaturalness in a similar way. The effect was strongest for participants in the high condition of the memory task, who placed the features of the attractiveness stimulus in a higher location than participants in either the average or low conditions and who showed significant effects on three of the four measures of unnaturalness and unattractiveness. Participants in the low condition did place features in a lower location than participants in the average condition on four of the five measures, but the difference was significant in only two cases, which did not include the measure of most attractive location. That pattern suggests that the 8 min of differential experience for participants in the average and low conditions were not sufficient to effect a significant change in the most attractive location of features. One possible explanation is that the faces presented in these two conditions did not diverge sufficiently from prior experience to alter participants' perceptions of attractiveness over such a brief period. In addition to experience with adult faces, which have features in a more or less average position, adults are more likely to have had experience with faces with low features, like the faces of infants, than with faces with high features. Such variable experience with low and average features may result in the structure of face space being more responsive to change when exposed to faces with less common proportions, like the faces presented in the high condition of the memory experiment.

Whatever the explanation for the asymmetrical effects of the memory task, the results suggest that recent experience can alter perceptions of attractiveness. This is consistent with the hypothesis that the constant updating of face space in response to experience may be sufficient to induce changes in perceptions of attractiveness.

These data are also consistent with the hypothesis that developmental changes in preference for height of internal facial features may be influenced by age-specific experience (Cooper et al 2006; Geldart et al 1999): at each age tested, the most attractive placement of features matched age-specific face experience. Here we found that as little as 8 min of experience was sufficient to alter preference for feature height. Over extended periods of time, experience may come to shape more stable long-term attractiveness preferences.

The data are also consistent with the literature on adaptation aftereffects (Anderson and Wilson 2005; Jeffrey et al 2006; Jiang et al 2006; Leopold and Bondar 2005; Leopold et al 2001; MacLin and Webster 2001; Rhodes and Jeffrey 2006; Rhodes et al 2003, 2005; Watson and Clifford 2003; Webster et al 2004; Webster and MacLin 1999) but extend those results in several ways. First, prior studies presented 'refresher' stimuli between test trials to maintain adaptation over a large number of trials. This creates a risk of participants making direct comparisons between the target stimulus and the training stimuli seen immediately before. Here we effectively controlled against the possibility of direct comparison by having a 2 min gap between the two phases of the experiment and by having participants move the facial stimuli through a wide variety of unnatural placements before arriving at the placement they perceived as most attractive. Second, by demonstrating that the adaptation aftereffects last longer than a few seconds after exposure, these results add credence to the possibility that long-term changes in perceptions of attractiveness may occur in a manner similar to these short-term changes, with systematic changes in the types of faces to which an individual is exposed effecting analogous changes in perceptions of attractiveness.

In summary, the results indicate that adults' experience can alter their perceptions of attractiveness and hence suggest the possibility that experience may also produce more long-term changes in the perceptions of attractiveness. Future research should examine both the magnitude and the type of experience necessary to produce changes in perceptions of attractiveness, whether their effect varies with age, and the factors that influence the persistence of these changes.

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