2002

The use of photographic caricatures to examine the development of a perception of facial attractiveness

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A Report Submitted in Partial Fulfilment of the Requirements for the Award of Bachelor of Arts (Psychology) Honours Faculty of Community Studies, Education and Social Sciences, Edith Cowan University.

Submitted October 2002.

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Throughout the human population, there is remarkable agreement as to what constitutes an attractive face. The consistency of attractiveness ratings across age, gender and culture has led to a search for an underlying construct that determines facial attractiveness. Langlois and Roggman (1990) proposed the "average is attractive" hypothesis arguing that facial attractiveness is determined by the level of averageness of facial features. Langlois and Roggman (1990) created composite faces to examine this hypothesis but their methodology was criticised, particularly because the technique used to create the composites tended to remove facial flaws and blemishes. This led to the argument that the increased attractiveness of the composite faces was the result of the smoothing of the faces rather than from their increased averageness. This study used photographic quality caricatures, which retain facial texture, to further examine the "average is attractive" hypothesis. From a digitised photograph, faces shifted away from the average by +18% and +36% (caricatures), and faces shifted closer to the average by −18% and −36% (anticaricatures) were produced. Along with the original photograph this provided five different versions of the same face varying only on averageness. Forty-eight of these face sets were created: six male and six female sets for the ages 6-, 8-, 10-year-olds and adults. Twenty participants in each of the age groups 6-, 8-, 10-year-olds and adults were asked to select the most and the least attractive face from each set. Examination of the mean caricature level chosen by each group found an overall preference for average faces providing support for the "average is attractive" hypothesis. The preference for average faces was present in the youngest age groups but the strength of the effect increased with age. There is, however, a suggestion that absolute averageness is not preferred, with some support for the idea of an optimum level of averageness.

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Submitted: October 2002

Declaration

I certify that this thesis does not incorporate, without acknowledgement, any material previously submitted for a degree or diploma in any institution of higher education and that, to the best of my knowledge and belief, it does not contain material previously published or written by another person except where due reference is made in the text.

Signature:_____

Date: 5 Feb 03

Acknowledgements

I would like to thank my supervisor, Paul Chang, who provided the impetus for this study. Paul's untiring interest, assistance, and advice kept me on track throughout the course of the project.

The staff, students and parents from Heathridge Primary School provided much needed support in the area of data collection. My special thanks go to the principal, Trevor Mitchell, for his understanding and support. Thanks also to Linda and Terry Morich for their assistance in participant recruitment.

Many friends and colleagues provided support and encouragement over the course of this project but special thanks are due to Eileen and Ron Palmer, Lorraine May and Kim O'Mallon who ensured that, no matter what, life went on. This help was invaluable. Also appreciated were the erudite and entertaining editorial comments provided by Pat O'Mallon and Nicole's computer expertise.

For my brothers and sisters-in-law, Hamish and Jo, Doogz and Ben, and Malc and Rebecca, who provided inspiration, perspective, and strength, and to Mum and Dad who gave me the tools to get there, the encouragement to see it through and who will share my relief now it's done!

To my super children, Alex and Heather, who were incredibly understanding of my need to get this "feefis" done. You guys are the best!

And, most importantly, to my partner, Aaron, who has as much ownership of this project as I do. For understanding that this had to be done, for your patience on the bad days, and your support always. We did it!

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Introduction

Every single face has two eyes, a nose, and a mouth arranged in the same pattern on every human face. Yet, all faces certainly do not look the same. Every face varies in colour and texture, and spatial arrangements of facial features also vary from person to person, but the structure is basically the same. It is a tribute, then, to our ability to process faces that we are able to distinguish between the thousands of faces we encounter in a lifetime.

Of those thousands of faces that we encounter, some appeal more than others. This paper will examine a number of the constructs which determine the perception of facial attractiveness. The theoretical perspectives of attractiveness, from feature-based theories to those from the evolutionary/biological and cognitive perspectives will also be briefly described. These theories are described to provide perspective to the construct underlying attractiveness examined in this paper, namely, the one proposed by Langlois and Roggman (1990): that facial averageness determines attractiveness. Langlois and Roggman's procedure to examine the "average is attractive" hypothesis has been criticised on methodological grounds (e.g., Pittinger, 1991; Rhodes & Tremewan, 1996) and this paper presents photographic caricatures as an improved procedure with which to examine the "average is attractive" hypothesis. The present study also examines the development of the perception of attractiveness by comparing children and adults.

Having studied the people of a large number of races and cultures, Darwin (1979) noted wide differences in their appearance. The huge variation in facial appearance throughout the world was quite remarkable and, as with different animal species, certain features in each race were valued or considered attractive. Darwin commented that a woman considered to be beautiful in one race was quite different in appearance to a beautiful woman in another race, suggesting that standards of beauty were cultural-specific. Darwin concluded that beauty is a construct that exists individually in the perceiver's mind and that it is not determined by any single structural feature or set of features of the face. Darwin's argument is that perception of attractiveness is learned and depends largely on the faces to which an individual has been exposed during the course of their life.

Darwin's (1979) suggestion that the perception of attractiveness would be a construct unique to an individual appears sensible. It would be expected that a face considered attractive by an African woman would not be the same as a face rated as attractive by a Caucasian man. As we develop from infancy to adulthood, the faces to which we are exposed would increase our appreciation for the variety of faces available and, therefore, alter our perception of the criteria determining facial attractiveness. After all, conventional wisdom states that beauty is in the eye of the beholder. Research findings, however, show the opposite. In their comprehensive meta-analysis of studies of facial attractiveness, Langlois, Kalakanis, Rubenstien, Larson, Hallam, and Smoot

(2000) found that when participants were asked to rate facial beauty, the inter-rater agreement in evaluations of attractiveness was never less than $r = .85$, $p<.05$. This analysis included cross-gender comparisons, studies of adults and children, as well as inter-racial and inter-ethnic comparisons. Furthermore, Langlois, Roggman, Casey, Ritter, Rieser-Danner, and Jenkins (1987) found that, in a forced-choice procedure, infants aged only 2-3 months spent more time looking at an attractive face (as rated by adults) and less time looking at a less attractive face. Langlois et al. (1987) concluded that the longer looking time indicated a preference for the attractive faces. In a further study with Caucasian infants, a similar preference was found with both male and female face stimuli, infant faces, and with black women's faces (Langlois, Ritter, Roggman, & Vaughn, 1991). The consistent agreement across so many groups suggests the existence of a construct that underlies facial attractiveness. Furthermore, young children seem to agree with adult raters as to what constitutes an attractive face.

Feature-Based Theories of Attractiveness

The search for an underlying construct which makes a face attractive has been the topic of much research. The Ancient Greeks believed that beauty was achieved through an appropriate balance of features and searched for a mathematical function of ratios to describe an attractive face (Bruce & Young, 1998). Following from this idea, one current theory is that when facial features exist in a ratio of 1:1·68 the resulting face will be beautiful (Erskine & Stewart, 2001). For example, the distance from the corner of the mouth to the jaw is 1·68

times the width of the mouth. Several beautiful faces did, in fact, fit a template created using this ratio; this template, however, has never been tested empirically.

Structural changes occur in the face as a child grows. Some examples of age-related changes in the face include the lengthening of the nose, the increasing prominence of the jaw (especially in males) and the relative decrease in the size of the eyes (Etcoff, 1998; Peterson, 1989). According to feature-based theories, the attractiveness of a face is determined by the degree to which it resembles a facial template, made up of features of maximum attractiveness and proportion. It seems unlikely, however, that there is a single template or set of facial features that would apply to all ages. In order to judge the attractiveness of a face, the feature-based argument would require the comparison of the face with the appropriate aged template. There is an amount of uncertainty in this theory because the continuous nature of facial development means it is not clear as to when a new feature-based template would apply. Second, the requirement for storing a number of different templates indicates a lack of parsimony as a flaw in this feature-based group of theories. Finally, there has been no explanation as to why *any* particular ratio of proportions would be considered attractive.

Evolutionary/Biological Theories of Attractiveness

A second theory of attractiveness adopts an evolutionary/biological perspective. Dawkins (1989) contends that we choose reproductive partners

who will give our own genes the best chance of survival. At a genetic level, an indicator of strong, healthy genes is parasite resistance and parasite resistance is positively correlated with bilateral symmetry. If parasites invade the body during development, they can cause genetic and structural anomalies, so symmetry, according to Dawkins, indicates both resistance to invasion from such organisms as well as developmental stability. According to the evolutionary/biological perspective of attractiveness, we are genetically programmed to prefer partners with more symmetric faces because it is an outward manifestation of genetic health (Grammer, Thornhill, & Boltzmann, 1994; Rhodes, Hickford, & Jeffery, 2000; Thornhill & Gangestad, 1993).

Within this evolutionary/biological framework, individuals with more symmetric faces should be considered to be more attractive reproductive partners. Rhodes, Proffitt, Grady, and Sumich (1998) found that adults chose the most symmetric faces when asked to select a "preferred" life partner from a set of faces that varied in symmetry. In fact, the positive correlation between facial symmetry and attractiveness is a robust finding in the face perception literature which has been examined using both manipulated and naturally occurring faces (Bruce & Young, 1998; Little & Perrett, 2002; Mealey, Bridgstock, & Townsend, 1999). Rhodes, Yoshikawa, Clark, Lee, McKay, and Akamatsu (2001) further examined the symmetry argument using Japanese faces and participants. Once again, it was found that participants chose symmetric faces as being the most attractive, providing more evidence of the correlation between facial symmetry

and attractiveness; in this case, Rhodes et al. (2001) extended the finding beyond Caucasian participants.

The relationship between symmetry and attractiveness extends across races but does it apply to different age groups? When investigating the effect of facial symmetry in infants, it was observed that babies aged between 5-8 months were able to discriminate between symmetric and nonsymmetric faces, as measured by the length of time spent looking at one face or another. The infants, however, spent more time looking at the nonsymmetric faces (Rhodes, Geddes, Jeffery, Dziurawiec, & Clark, 2002). If, as has been argued, longer looking times indicate preference for one stimulus over another, infants appeared to prefer the non-symmetric faces. Rhodes et al. argued that the dissimilar results with this very young age group were due to an infant preference for novel stimuli rather than a preference for non-symmetric faces. These results provide an indication of how difficult it is to draw conclusions with such young infants – experimenters can only make assumptions about the motivation for an observed behaviour.

The argument that the degree of facial symmetry determines the level of attractiveness is certainly more parsimonious than the feature-based theories, but there are criticisms of this symmetry theory. Rhodes, Sumich, and Byatt (1999) found that symmetry did explain a significant part of the perception of facial attractiveness but they also noted that the averageness of the facial features made an independent contribution to facial attractiveness. It may even

be the case that symmetry is, in fact, one feature of a further construct that accounts for attractiveness.

The evolutionary/biological perspective on attractiveness is also related to potential reproductive success. Rather than looking at a genetic level, however, we can also examine attractiveness as it relates to secondary sexual characteristics between females and males. This theory suggests that an individual exhibiting more obvious secondary sexual characteristics (i.e., looking more like the average male or average female) would be considered more attractive because of their implied reproductive potential (Mealey, Bridgestock, & Townsend, 1999). In terms of facial attractiveness, the theory predicts that, as the specific facial features that distinguish the genders become more obvious, as would be the case with "prototypical" or average male or female faces, the face would be rated as more attractive (Etcoff, 1999).

Rhodes, Hickford, and Jeffery (2000) tested this theory by creating facial images that exaggerated the feminine or masculine features, to produce what they termed "supermale" and "superfemale" faces. This procedure either increased or decreased the spatial differences between an individual male face and an averaged male face and the differences between an individual female face and an averaged female face to create a group of variations of the same face, with differing levels of masculine or feminine features. For female faces, Rhodes et al. found faces that had been feminised relative to the average were preferred, but for male faces, the preferred faces were those which had had the

masculine characteristics reduced. That is, the preferred male face, for both female and male participants, was one whose features had been adjusted to more closely resemble the characteristics of a female face. These results were consistent with those of Perrett et al. (1998, cited in Etcoff, 1999) and applied similarly to Caucasian and Chinese participants for faces of both races. Chinese participants preferred a more feminised image for both genders than Caucasian participants (Rhodes et al., 2000). This finding is slightly contrary to that predicted by the sexual selection theory, in that preferred male faces are those with less obvious secondary sexual characteristics. Rhodes et al. noted that increasing the feminisation of faces tended to increase the appearance of youth in the faces and suggested that perceived youth may be one reason for increased preference for the feminised faces.

Studies that have examined the relationship between the youthfulness and attractiveness of a face have produced mixed results. The obvious shift in facial features at puberty means that the maturation of facial features is not represented as a steady continuum. Results generally indicate that youthful but not "babyish" faces are preferred (Bruce & Young, 1998). There seems to be an acknowledgement that pre-pubescent features in adults are less attractive than those of young, but sexually mature individuals, particularly for female faces (Etcoff, 1999).

The finding that young, but sexually mature, faces are preferred is consistent with the sexual selection theory predicting that faces indicating

reproductive healthiness would be considered most attractive. The preference observed by Rhodes et al. (2000), for less masculine male faces, however, is inconsistent with this approach. The biologically based theories provide an argument as to why certain faces are considered to be attractive, however, they would seem to be most applicable to adults. They do not explain why adults consistently rate the same infant and children's faces as being more attractive (Langlois et al., 2000). Infants and children have not yet reached sexual maturity and therefore cannot be rated with respect to their reproductive potential. Similarly, infants would have no need to judge faces on the basis of reproductive potential but they appear to prefer the same faces as adults (Langlois et al., 1987), indicating that both groups judge faces by the same criteria. Perhaps there is another construct that helps to determine attractiveness that has yet to be explored.

Cognitive Theories of Attractiveness

Determinations of attractiveness may be related to the way in which faces are mentally represented. If the cognitive framework in which we encode faces is structured around certain features or characteristics, these features are likely to be the aspects of the face on which we focus more closely. It may be that these are the characteristics of the face that determine its attractiveness.

Within cognitive theory, many objects are represented in schemata based around the concept of a norm. The norm is the average or most typical representation of the concept. The norm does not necessarily exist in a physical

sense, but instead, exists as a mental construct that may be established over time as more and more examples from within the category are experienced (Posner & Keele, 1968; Reed, 1972). When a new object is experienced, it is compared to the existing norm and placed within the framework relative to the norm as well as to other existing exemplars (Anderson, 1995; Rhodes, Brennan, & Carey, 1987).

A cognitive model which has been proposed to account for face representation is the multi-dimensional face space. This model is represented as an *n*-dimensional space with all dimensions intersecting at the origin. The dimensions are both physical and perceptual aspects of the face that can alter – any aspect of the face that can be regarded as varying on a continuum, from eye spacing to the length of the nose, or the smoothness of the skin. Arguing that these dimensions each show a normal distribution, the origin is the midpoint or average for each and a face constructed from the values found at the origin would be an average or norm face (Valentine, 1999). Faces experienced by an individual are positioned within the multi-dimensional face space, relative to the norm face or origin. Faces are clustered densely around the origin because this is the location of the average. The number of exemplars thin out as the distance from the origin increases because faces further from the norm are less typical and, therefore, less common (Valentine, 1999). Faces which are close together within the face space are most like each other on more

dimensions than those faces that are represented further apart in face space (Benson & Perrett, 1991a; Johnston & Ellis, 1995; Valentine, 1999).

Studies of face recognition have yielded results that are consistent with a face-space model. The model predicts that faces which are closer to the norm face would take longer to recognise than faces further from the norm because the more average faces would have a greater number of other faces close by with which to become confused. Typical face representations, in effect, become distractors for a face. Similar-looking exemplars would distract from the correct face due to their proximity in the cognitive framework. Conversely, faces which are further from the norm which, by definition, are more distinctive, are predicted by this theory to be more quickly and more easily recognised because they are not close to other faces in the face space. A distinctive face representation, in effect, has fewer distractors around it.

Research findings have supported the face-space model. Johnston and Ellis (1995) and Valentine (1999) found that distinctive faces were recognised more quickly than typical faces and also that unfamiliar distinctive faces were less likely to produce a false positive recognition result than unfamiliar typical faces. This result also holds for research conducted prior to the proposal of the face-space model. For example, Vokey and Read (1992) demonstrated that atypical faces were more memorable than typical faces but were not able at that time to offer a theoretical argument for why this was the case.

Recognition studies have contributed to the examination of the face-space model. Results of recognition studies in children have demonstrated an increase in recognition memory with age. In a study by Blaney and Winograd (1978), children 6-, 8-, and 10- years of age were tested for recognition memory with adult male faces and an increase in performance with increasing age was found. The children were given different instruction conditions during the task asking them to focus on different aspects of the face. For example, one group was asked to judge whether the face had a big nose while another group was asked to judge how nice the face was. For all ages, the children who had judged the niceness of the face demonstrated greater recognition memory for faces overall. This suggests that faces are encoded in an holistic, rather than a feature-based manner, because a judgment of niceness encouraged assessment of more than a single feature (Blaney & Winograd, 1978). This result is consistent with the face-space model in which faces are encoded in a multi-dimensional framework, the dimensions consisting of just about any aspect of the face that can vary along a continuum.

As with any averaging technique, when a small number of examples are used to calculate an average, additional examples have the potential to alter the average dramatically. When the average is calculated from a large number of individual measurements, a new example is likely to have less impact on the average. It seems reasonable to suggest that, according to the face-space model, the position of the origin will be relatively fluid in people who have had

relatively less experience of faces, that is, young children. As more faces are added to the face space, the average will become more fixed or steady and, therefore, less likely to alter with the addition of new faces.

This argument is supported by findings of Goldstein and Chance (1980) who examined recognition performance for own- and other-race faces. For Caucasian children aged between 6- and 12- years of age, Goldstein and Chance found no difference in performance among age groups across both race conditions whereas adults performed poorly with Japanese faces relative to Caucasian faces. Goldstein and Chance suggested that the processing schema in adults had become rigid. They argued that the schema had been built around Caucasian faces which left the adults able to process Caucasian faces efficiently. Because Japanese faces were being processed in a framework that was created primarily using Caucasian faces, they were processed less efficiently. Having had less experience of faces than adults, children would have a relatively flexible face-space structure which would accommodate faces that are outside their usual experience, as demonstrated by their equivalent performance for both Caucasian and Japanese faces (Goldstein & Chance, 1980).

Chung and Thompson (1995) reviewed studies of face recognition in order to examine developmental patterns. They noted the lack of research with children compared with the number of face recognition studies that had been conducted with infants and with adults. They also noted that different

methodologies had been used with adults and children, thus making a continuous pattern of development difficult to assess. For example, participants were tested with faces of different ages and were assessed using different measures. Nonetheless, Chung and Thompson found an improvement in recognition of unfamiliar faces from the age of five years through to adulthood. The authors' assumption that this cognitive ability improved continuously from infancy to adulthood seems reasonable, but is not based on comparisons of results which used a similar procedure. Clearly, a study using consistent methodology with both participants and facial stimuli from children through to adults would be valuable in confirming the findings of their review.

Results of recognition studies fit well with the face-space model. But what of attractiveness? How would facial attractiveness be addressed under this model? As discussed previously, the origin in the face-space model provides an average value for each of the dimensions making up the face space. A face constructed from these values would be an average face – perhaps average in the sense of attractiveness, as well as average in terms of all of the face space dimensions. That is, compared to the norm, the nose would be neither too big nor too small, the eyes would be neither too far apart nor too close together and the chin would have just the right amount of pointiness. It is predicted that this prototypical face would, therefore, be more attractive than the faces that go to make up the prototype. The face-space model predicts those faces placed close

to the origin may be considered the most attractive because they would be most like the average face.

The "Average is Attractive" Hypothesis

Langlois and Roggman (1990) proposed the "average is attractive" hypothesis arguing from both the cognitive and evolutionary/biological perspectives. Cognitively, they suggested that a prototype would be preferred because it is a central representation and would therefore be perceived as familiar. Familiarity has been found to be a factor in facial preferences (Zebrowitz & Rhodes, 2002) with familiar faces preferred to unfamiliar faces. From the biological perspective, Langlois and Roggman suggested that averageness on all facial dimensions would indicate the absence of genetic or developmental anomalies. Averageness appeared to be a parsimonious explanation for attractiveness fitting into these two major theoretical frameworks.

To examine their hypothesis, Langlois and Roggman (1990) constructed a series of composite faces. In the composition of faces, black and white photographs of faces were digitised and then "anchored" at the pupils and the centre of the upper lip and a 512 x 512 grid was laid over the face. The individual faces were adjusted so the three "anchor" points were standardised. In other words, these points were in the same position on the grid for all of the original faces. Next the grey value, or level of greyness, was noted for each point on the grid. A composite of two faces was created by averaging the grey values of the two faces for each point on the grid. Finally, the images were

smoothed over to ensure that there were no double or sharp edges. These two-face composites were then combined with other faces in a similar manner to produce four-face composites and so on.

In their study, Langlois and Roggman (1990) had participants rate the attractiveness of the composite faces on a five-point Likert scale. They found that, as more faces were added to the composite, the composite was rated as more and more attractive. Furthermore, by the time 16 faces were included, the resulting composite face was rated as being more attractive than all of the individual faces that formed the composite. Langlois and Roggman argued that, as more faces were added to the composite, the resulting image came closer to an "average" face and concluded that averageness was an important factor in determining the attractiveness of the face.

From a technical perspective, Pittinger (1991) was not convinced that the composited average face created by Langlois and Roggman (1990) really represented an average of the component faces. He argued that alteration of facial features and their spatial relationships would produce a more valid average. Pittinger (1991) provided mathematical proofs in support of his criticism but failed to provide a methodology for creating a more valid "average".

An important criticism of the procedure employed by Langlois and Roggman (1990) was that the technique used to create the composites tended to reduce or remove blemishes and imperfections that were present in the individual faces (Benson & Perrett, 1992). The argument here is that the

increase in perceived attractiveness that came as more and more faces were added to the composite was actually the result of the smoothing of the image that removed imperfections (e.g., freckles, moles, scars, blotches, etc.), rather than an actual increase in averageness of the facial features per se.

Many of the criticisms of Langlois and Roggman's (1990) stimuli were addressed in a study by Rhodes and Tremewan (1996). Rhodes and Tremewan created line drawings of faces by mapping and joining key points on photographs of faces. The coordinates of the key points were then used to produce a set of measurements for an average face. Caricature generating software was then used to manipulate the difference between an unaltered drawing and the average face. A caricature is a facial image created by altering the features and feature relationships of a face to be more distinct from the average than they are in the original drawing. Conversely, an anticaricature alters the original drawing to be more like the average face. Using this technique, Rhodes and Tremewan created line drawings of faces which were more distinctive than, or closer to the average face. The line drawn faces were rated for attractiveness by adult participants and the results supported the hypothesis that, as faces were altered to be closer to the average face (anticaricatures), they were rated as being more attractive. On the other hand, as faces were made less like the average (caricatures), the faces were rated as less attractive.

The use of line drawings in Rhodes and Tremewan's study meant that all of the images were free from blemishes and imperfections unlike the images shown by Langlois and Roggman (1990). Rhodes and Tremewan's stimuli eliminated concerns over smoothing as a confound as averageness was increased. A further advantage was that this technique was able to manipulate faces both further from and closer to an average. In contrast, the compositing technique of Langlois and Roggman was only able to manipulate faces closer to an average. By definition, the combination of two or more faces resulted in a more average face meaning that a face that was less average than the original face could not be created with this technique. The caricature technique is, therefore, able to provide a wider range of stimuli than previous methods. At this point, it is important to remember that the images used by Rhodes and Tremewan were only line drawings, so it is questionable whether the results could be generalised to real faces, or, at least, two-dimensional representations of faces, as seen in photographs.

This caricature-generating technique has been developed further so that photographic caricatures that look like real faces can be created (Benson & Perrett, 1991a). Photographs of faces can be altered to produce images which are either closer to or further from an average whilst retaining the colours, textures, and any blemishes inherent in the original face. This technique allows further examination of the hypothesis that average faces are more attractive than less average faces using realistic looking faces. While this methodology

has been used to investigate the perception of facial attractiveness in adults (e.g. Rubenstein, Langlois, Kalakanis, & Larson, 1996), systematic studies of children's perceptions of attractiveness have not been conducted (Langlois, et al., 2000).

The purpose of the current study was to examine the hypothesis that averageness is attractive using computer generated photographic quality caricatures. Several realistic versions of the same face were created. These faces varied only in the degree by which they resembled a facial norm. In this way, variables such as blemishes, colours, textures and imperfections were consistent across all versions of an individual's face. In separate conditions, participants were asked to select which was either the most or least attractive face from five different levels of caricature of the same face: two anticaricatures (faces shifted toward the average), two caricatures (faces shifted further from the average) and the original photograph. The measure of interest was the preferred level of caricature chosen by participants when asked to select the most attractive face from the five versions. Similarly, the caricature level of the face participants selected as the least attractive was also ascertained.

This procedure was applied to both adults and children allowing an examination of the development of the perception of facial attractiveness. A comparison of the mean level of caricature chosen for both the most and least attractive conditions was made for the age groups 6-, 8-, and 10- year-old and adult participants to observe whether all age groups have the same preferences.

It was predicted that results from this study would support the average is attractive hypothesis in that participants would select anticaricatures as the most attractive version of a face and caricatures as the least attractive version of the face because they are closer to or further from the norm face, respectively. If young children's norms are not as well developed as a norm in older children or adults, it was predicted that young children would show a very limited preference for anticaricatures as the most attractive version of the face and would be less likely to choose a caricature as the least attractive version of the face.

Method

Design

The study employed a 2 x 2 x 4 mixed design. The within-subject variable was the judgment condition (most attractive judgment, least attractive judgment) and the between-subject variables were the gender of the participant (female, male), and the age of the participant (6-, 8-, 10- years old, and adults). The primary dependent variable reported here is the mean caricature level of the most and least attractive judgments.

Participants

There were 20 participants in each of the four age groups. The mean age of the participants in each group was 6 years 5 months, 8 years 5 months, 10 years 6 months, and 39 years 10 months. All participants were Caucasian and there were approximately equivalent numbers of females and males in each age group. The children were all students at a local primary school whose parents had provided written consent. The adults were parents of the children or volunteers known to the researcher. Copies of correspondence and consent forms are attached at Appendices A-C.

Stimuli

One hundred and nine people were photographed in order to create caricatures. Before photography, external cues such as glasses, hats and jewellery were removed. No one with a moustache or beard was photographed. Each person was asked to pose with a neutral expression looking directly at the

camera. Lighting and background were consistent for all photographs. The photographs were first digitised and then specialised caricature generating software was used to create the stimuli (Benson & Perrett, 1991b).

The process to create the caricatures and anticaricatures proceeded as follows. On a computer monitor, a mouse keypress was used to map 208 reference points on and around the face. For example, these points were outlines of features, the jaw, the hairline, and the position of the cheekbones and so on. The points were then joined to create a line drawn representation of the face; in effect, a veridical line drawing of the face was created. The line representations of all faces, blocked by age and gender of the face, were then averaged to create a standard set of measurements for each gender and age group. Twenty-seven six-year-old faces, 32 eight-year-old faces, 24 ten-year-old faces and 26 adult faces were averaged to make eight (four male and four female) norm faces.

Prior to creating the caricatures, the unaltered line drawing was re-sized so that the inter-pupil distance was matched to that of its age and gender norm. This allowed other measurements on the face to be altered relative to the average face dimensions. Line drawing caricatures were created by exaggerating the difference between an original face's individual measurements and the measurements of the average for its age and gender. For example, if an adult male photograph had a nose that was 5 cm long and the average nose length for the adult male faces was 4 cm, the difference would be 1 cm. A 50%

caricature would add 50% more onto the difference, that is 0.5 cm. Thus the resulting nose length for the caricature would be 5.5 cm. Conversely, in a 50% anticaricature, the difference between the face and the average would be reduced, resulting in a nose length of 4.5 cm. In other words, all of the stimuli were adjusted to make each face depiction look more (anticaricature) or less (caricature) like the norm face.

The reference points were then used to divide the face into about three hundred adjoining triangles. The same triangles were created on the caricature face. The levels of pixel intensity for very point in each of the triangles on the original face were then replicated in the appropriate position in the corresponding triangle on the caricatured face. In this way, the texture and colours of the original face were retained in the caricatures.

Along with the original picture, four versions of each face were created to produce a set of five depictions for each face. An example of a set of faces are shown in Figure 1. For this study, a set of caricatures (+18% and +36%) and anticaricatures (-18% and -36%) were produced. Each face was caricatured (or anticaricatured) relative to the appropriate age and gender norm. For example, the face of a 10-year-old girl was adjusted relative to the average 10-year-old, female face. The percentage levels of these stimuli were within the bounds of stimuli that produced realistic looking faces whilst allowing sufficient alteration from the original for the images to be perceptually distinct from each other. The whole set of stimuli consisted of six female face sets and six male face sets from

each of the four age groups. This number was chosen in order to reduce boredom, which was a potential problem with the younger participants. Thus, the overall study was conducted with 48 face sets.

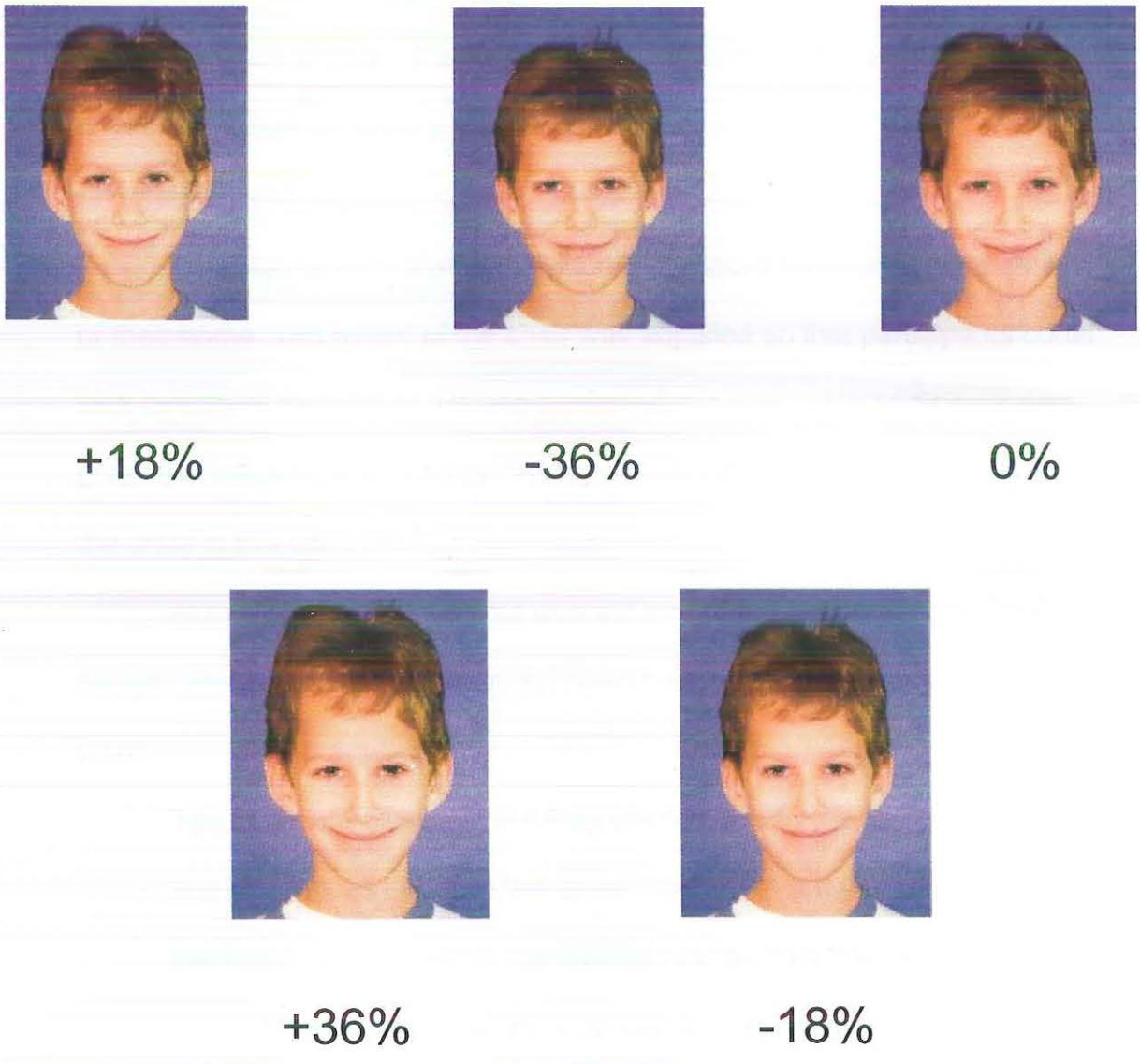

Figure 1. An example of a stimulus set. The caricature levels shown underneath the photographs were not presented to participants.

Apparatus

The stimuli were presented on a G3 MacIntosh computer using a high-resolution monitor with 12-bit presentation, thousands of colours, and with a resolution of 832 x 624 pixels at 75 Hz. All the face depictions were easily seen from a distance of 60cm. Participants sat in a position allowing them to comfortably view all faces within a face set as they were presented.

Procedure

Participants were tested individually in a quiet room either at their school or their home. The height of the chair was adjusted so that participants could look directly at the screen. Having confirmed consent, each participant was given the following instructions: "Today we are going to look at some faces like the ones in this example."

At this point a face set that was not part of the experimental stimuli was shown. Any adjustments to seating position were made. The experimenter then said:

> The faces are all similar but they are not exactly the same. Can you see any differences between the faces? It is likely that you will find one of the faces more attractive (pretty/handsome) than the others.
>
> When I show you the face sets for the study, what I would like you to do is tell me which face you think is the most attractive (pretty/handsome). There is no time limit so please look carefully at all of

the faces. There is no right or wrong answer – I would just like to know what you think.

Do you have any questions before we start?

Numbers were attached to the outside of the screen corresponding to the five positions in which the faces would appear. Participants indicated their choice in each trial either by telling the experimenter the number of the face they had chosen or by pointing to the face. The experimenter recorded the responses manually. As trials proceeded, the instructions, or part thereof, were repeated occasionally.

The stimuli were presented in blocks of six faces of the same age and gender until all 48 sets of faces were presented. For each participant, the order of the blocks was randomised as was the order of the face sets within the block and the order of the faces within the face set. Following the presentation of all blocks, the 6-, 8-, and 10-year-old participants were asked to explain what they had been doing during the task.

All face sets were then shown again, this time with participants indicating which face they thought was the least attractive. Half of the participants made the most attractive judgments before the least attractive judgments while the other half made the least attractive judgment first. Each testing session took approximately 35 minutes to complete. At the completion of the session each of the children was given a sticker and a pen.

Results

The caricature level that was selected on every trial was averaged for each face that was seen to give a mean caricature level (MCL) for both the most and least attractive conditions for each participant. Examination of the MCLs for the most attractive condition revealed similar overall MCLs for female participants, $M = -10{\cdot}11\%$ ($SD = 9{\cdot}72$), and for male participants, $M = -10{\cdot}52\%$ ($SD = 9{\cdot}28$). For the least attractive condition, the MCLs for females and males were also similar with respective values of M = 12·75% (SD = 10·43) and M = 14·28% (SD = 10·14). The differences between the MCLs were not significant for gender ($F(1,72) = {\cdot}022$, $p > {\cdot}05$), nor was there a significant interaction between either gender and age ($F(3,72) = 1{\cdot}43$, $p > {\cdot}05$), or gender and attractiveness judgment ($F(1,72) = {\cdot}001$, $p > {\cdot}05$), so all further analyses were conducted with age as the only between-subjects factor.

For the most attractive condition, the MCL for each age group was compared to zero. All of the values (according to t-tests) were significantly different at $p < {\cdot}01$. The same result was found for the least attractive condition in that the MCL for each age group was significantly different to zero at $p < {\cdot}01$. T-test results are shown in Table 1. The MCL was compared to zero because zero is the MCL value we would expect if participants randomly chose a face from the array. It is important to note that an MCL of zero may also result if participants chose the caricature level of 0% as being the most attractive face, however, the overall pattern of selection will be observed in the frequency

selection data, that is, the MCL values need to be taken into account along with the actual choices that the participants made.

Table 1

Mean Caricature Levels and T-Test Values for 6-, 8-, 10- Year-Olds and Adults

Most attractive condition

Age	n	MCL (%)	SD	t	df	Significance (2 tailed) *
6 years	20	-4.65	5.75	-3.61	19	$p<.002$
8 years	20	-4.63	3.78	-5.48	19	$p<.001$
10 years	20	-13.58	6.49	-9.35	19	$p<.001$
Adult	20	-21.64	4.10	-23.63	19	$p<.001$

Least attractive condition

Age	n	MCL (%)	SD	t	df	Significance (2 tailed) *
6 years	20	5.25	6.28	3.74	19	$p<.001$
8 years	20	5.84	4.31	6.06	19	$p<.001$
10 years	20	16.50	7.00	10.55	19	$p<.001$
Adult	20	26.42	3.43	34.43	19	$p<.001$

* Note: Indicates a significant difference between the MCL and 0 when tested using an independent-sample t-test.

As illustrated in Figure 2, the MCL for the most attractive condition in each age group was a negative value indicating that participants selected anticaricatures more than caricatures. The MCL averaged over all of the age groups was $M = -11{\cdot}12\%$, ($SD = 8{\cdot}74$). Conversely, the MCLs for the least attractive condition were positive for each age group (indicating that participants selected caricatures more than anticaricatures). For the least attractive condition, there was an overall positive MCL value of $M = 13{\cdot}50\%$ ($SD = 10{\cdot}26$). The MCLs for each age group and attractiveness judgment are listed at Table 1.

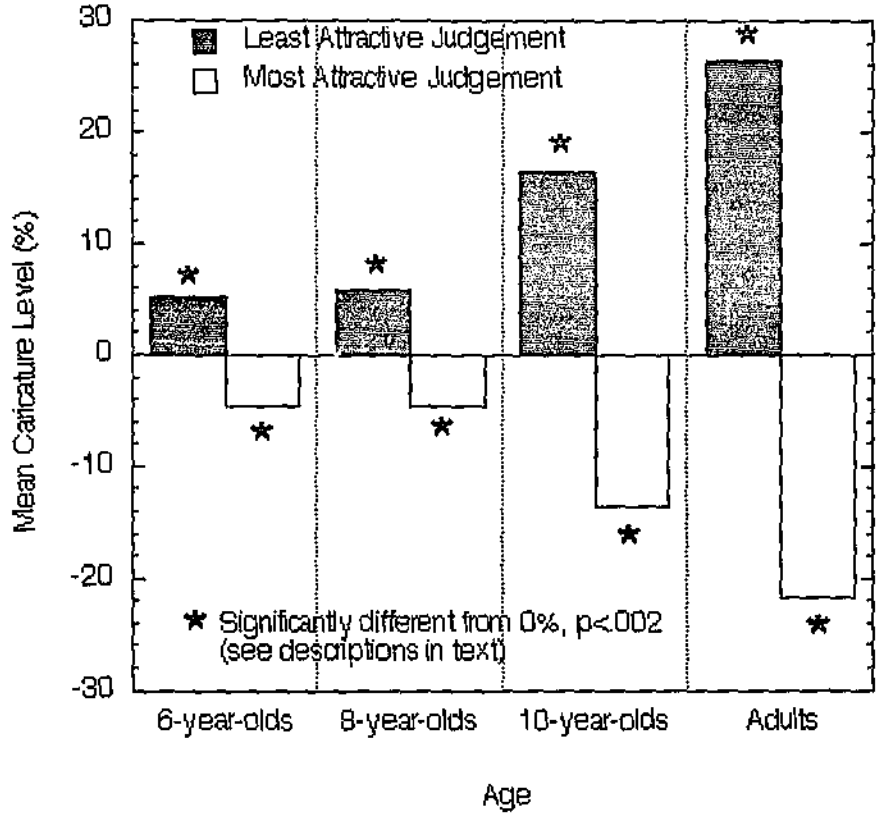

Figure 2. The Mean Caricature Level chosen by each age group for both the most and least attractive judgments.

The MCL values indicated that all age groups selected caricatures rather than anticaricatures when asked to select the least attractive face and anticaricatures rather than caricatures when asked to select the most attractive face. The MCL values, however, do need to be considered in conjunction with a measure of the frequency selectivity for each level of caricature to indicate that the pattern of responding shown by the age groups was non-random. Further evidence of a non-random pattern of responding is found in the frequency data which is presented in Figure 3. For the most attractive judgment, the −36% caricature level was chosen most often for all age groups: 25·5% of the time for the 6-year-olds, 28·9% of the time for the 8-year-olds, 39·8% of the time for the 10-year-olds, and 52·4% of the time for the adults. The mean selection frequency of the remaining caricature levels during the most attractive judgment decreased consistently as the caricature level became more positive.

In contrast, the face selected most often for the least attractive condition was the +36% caricature level: 28·8% of the time for the 6-year-olds, 30·63% of the time for the 8-year-olds, 50·1% of the time for the 10-year-olds, and 73·0% of the time for the adults. In contrast, the mean selection frequency decreased as the caricature level became more negative.

Comparison of MCLs revealed a significant main effect for the attractiveness condition (i.e., most or least attractive judgment) with $F(1,76) = 420{\cdot}26$, $p < {\cdot}001$, that is, the MCL for the most attractive judgment was significantly different from that for the least attractive judgment. There was a

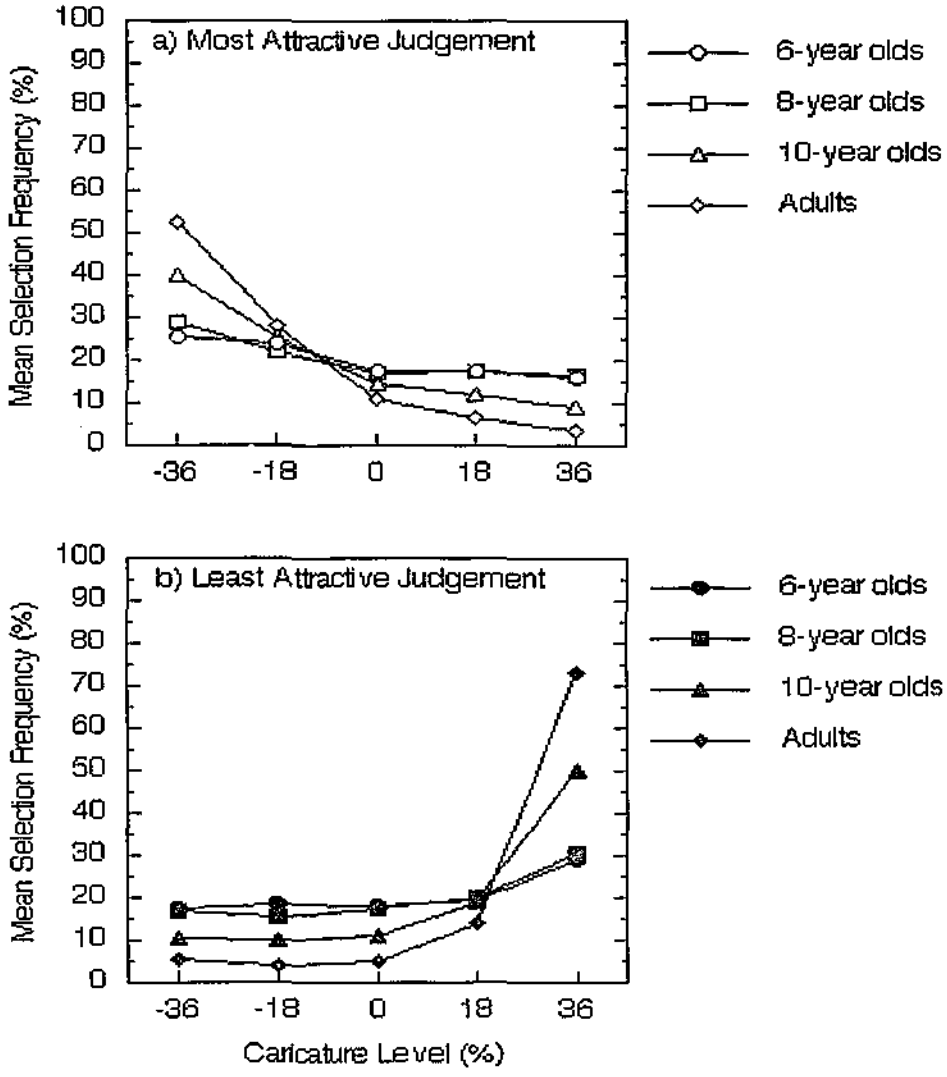

Figure 3. The mean selection frequency for each of the five caricature levels for both the most and least attractive judgments.

significant main effect for age with $F(3,76) = 3{\cdot}25$, $p < {\cdot}05$, and the two variables also showed a significant interaction, $F(3,76) = 53{\cdot}87$, $p < {\cdot}001$.

For the most attractive judgment, post hoc analysis using Tukey's Honestly Significant Difference (HSD) indicated no difference between the MCL for 6-year-olds (M = -4.65%) and 8-year-olds (M = -4.63%). The MCL for the 10-year-old group was -13.58% which was significantly greater (in absolute value) than that of the 6- and 8- year-olds. The adult group MCL was -21.64% which was also significantly greater (in absolute value) to the MCL for all other groups.

For the least attractive judgment, post hoc analysis, using Tukey's (HSD), found, again, that the 6-year-olds' MCL (M = 5.25%) and 8-year-olds' MCL (M = 5.84%) did not differ significantly. As with the most attractive judgment, the MCL for the 10-year-old group was significantly greater than that of the 6- and 8-year-olds (16.50%), while the MCL of the adult group (26.42%), was significantly greater than the MCL for all other age groups.

At no time during the testing did any participant indicate that they could not see a difference between the faces in a set. They did, however, indicate that in some face sets the differences were more subtle than others. Children also noted this difference stating things like, "It's hard to choose this time," or "This one is easy to pick". There was, however, no requirement for differences in the faces to be pointed out to any participant and, in all cases participants were able to select one face as either the most or the least attractive.

Discussion

Female and male participants over all four age groups showed no difference in the faces they chose as being the most and the least attractive. This result is in keeping with previous research (e.g., Langlois et al, 2000) which has found no gender difference in perceptions of facial attractiveness. The current finding adds further support to the body of literature which has found no gender differences in attractiveness perception in particular, by providing a further comparison between female and male children.

The "Average is Attractive" Hypothesis

One of the aims of this study was to examine whether previous research, which has found that facial attractiveness increases as a face becomes more "average", would be supported through the use of the current methodology. By definition, the more negative the caricature level of a face, the more average it is. Anticaricatures are images with a negative caricature level, therefore, a preference for anticaricatures as the most attractive faces would support the "average is attractive" hypothesis. For the most attractive judgment, the significant negative MCL found for all age groups, suggests a preference for anticaricatures across all participant groups. Overall, participants preferred a caricature level less than zero. Frequency data add further support to the suggestion that anticaricatures are preferred, in that the −36% anticaricature was the most frequently selected face by all age groups when participants were asked to choose the most attractive face. As Figure 3 shows, the mean

frequency selection of the remaining faces in the face set decreased as the caricature level increased, that is, the further a face was from the average, the less often it was chosen as the most attractive face.

For the least attractive judgment, participants were consistent in their selection of caricatures, with a positive MCL found for each age group. Frequency data support the suggestion that this MCL indicates a preference for caricatures as the least attractive faces, because, in this instance, the +36% caricature was the face chosen most often, by all age groups, as being the least attractive of the faces. Figure 3 shows that, as the caricature level shifted the face further from the average (i.e., towards a more positive caricature level), it was more likely to be selected as the least attractive face by all age groups.

Taken together, these MCL and frequency data indicate support for Langlois and Roggman's "average is attractive" hypothesis. Anticaricatures, or more average faces, were chosen as the most attractive faces, while caricatures, or least average faces, were chosen as the least attractive faces. The use of photographic caricature-generating techniques to produce the facial stimuli used in this study, has enabled the creation of sets of faces that vary only on averageness. The procedure retains facial flaws and blemishes and, thus, overcomes criticisms of Langlois and Roggman's (1990) methodology which tended to smooth blemishes and inconsistencies from composite faces. As can be seen in Figure 1, the stimuli are realistic images, improving on Rhodes and Tremewan's (1996) line drawings, whilst retaining the mathematical averaging

procedure used in the caricature generation process. Using the improved methodology, the current finding is that faces whose features are closer to the average are selected as being more attractive than faces whose features are further from the average, demonstrating a positive correlation between facial averageness and perceived attractiveness.

Age Effects

The correlation between averageness and attractiveness exists for all the age groups in this study, however, the effect was less obvious in the youngest groups. It is interesting that the 6- and 8-year-olds' MCLs did not differ significantly for either attractiveness condition, and that the mean selection frequencies show very similar values for both age groups. There is an increase in the size of the MCL for both attractiveness judgments for the 10 year old group, and then a further increase for the adult group. Mean selection frequencies indicate a stronger preference by the 10-year-olds for the −36% and +36% caricature levels for the most and least attractive judgments respectively, with an increased preference again in the adult group.

These results suggest that the adult perception of attractiveness may exist in children as young as 6 years of age, but also that it develops over time with a noticeable increase around the age of ten. The small number of age groups included in this study means only a broad developmental pattern can be discussed leaving future studies, perhaps with a focus on 9- to 15-year-old participants, to examine the subtleties of the developmental pattern.

It is, however, possible that the same perception of attractiveness exists in all age groups and that the increase in the MCLs with age in this study was, in fact, due to an increase in the ability of the participants to understand the task. This is, however, unlikely. During the testing process, concentration was an issue with the younger participants, but this was overcome as much as possible by allowing participants to proceed through the testing at their own pace, and by encouraging them to take a break if they wished. The 6- and 8-year old participants were able to clearly articulate what they had been doing during testing, using phrases such as, "I was picking the face I liked the best", or "Choosing the yuckiest face". Also, if the results of the study were due only to an increase in the ability to understand the required task, a difference would have been expected between the 6- and 8-year old groups given the increased cognitive ability, particularly in language use, between these age groups (Peterson, 1989). It is, therefore, more likely that the observed pattern of responding is due to factors related to facial attractiveness, than to increased task comprehension.

Theoretical frameworks of attractiveness provide possible explanations for the developmental pattern of responding observed in the current study. Within the evolutionary/biological perspective, attractiveness is related to a perception of reproductive health. This theory suggests that an adult perception of attractiveness would emerge as an individual approached sexual maturity, that is, at puberty, because at that age mate selection would become important.

In the current study, the 10-year-old group did, in fact, demonstrate a more adult pattern of responding than the two younger age groups, however, examination of children up to the age of sexual maturity would provide a more comprehensive assessment of the role hormones play in the perception of attractiveness.

Within a cognitive framework, the attractiveness of a face is related to the degree to which it resembles a norm or average face. In a sense, the constructs overlap in that an assessment of the attractiveness of a face is, in fact, an assessment of its averageness. Given that the facial stimuli in this study varied only to the degree by which they resembled an average face, and that all participant groups selected the most average face as the most attractive, it appears participants were comparing the faces to a norm, as suggested by the cognitive argument. It is possible that the norm is less well established in young children, as suggested by Goldstein and Chance (1980), and that the norm becomes more fixed with age. The difference between the MCLs of the younger and older participant groups may have been because younger participants were comparing the faces to a more fluid norm.

Optimum Averageness

Although a preference for averageness was observed in this study, the overall MCL for the most attractive judgment (−11·12%) did not approach the caricature level of the most average face (−36%), and even the adult MCL

(−21·64%) is well short of the most average value. If averageness is preferred, why was the MCL not closer to −36%?

This finding, in fact, supports a suggestion made by Benson and Perrett (1991a), and Rhodes et al. (2000) who argued that facial averageness was attractive up to an optimum level, beyond which, faces became less attractive. The current study provides a level of support for this argument in that the most attractive caricature level was less than that of the most average face.

The results available from recognition studies provide a suggestion as to why absolute averageness may not be preferred. Typical, or average, faces take longer to recognise than faces that are more distinctive. The more average a face is, the more difficult it is to recognize quickly or correctly, making facial averageness a disadvantage. On the other hand, the evolutionary/biological and cognitive perspectives of facial attractiveness argue that facial averageness is an advantage. Perhaps there is a level of attractiveness at which the advantages and disadvantages of averageness are able to be balanced and perhaps *this* is the optimal level of attractiveness.

With only two levels of anticaricature in each face set, an optimal level cannot be established from the results of this study, however, the current procedure could be altered to include a greater number of anticaricature levels, to establish whether any particular level was preferred. Clearly, the current technique allows a more sophisticated examination of the role averageness plays in facial attractiveness.

This study has provided further insight into the role averageness plays in facial attractiveness, particularly in children. Whilst averageness and attractiveness are closely linked, there is a suggestion that, for all age groups, absolute averageness is not preferred. It is encouraging to know that we celebrate at least some of the diversity in faces noted by Darwin (1979), and that judgments of attractiveness include an appreciation of some of the aspects that make us unique.

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Appendix A

Letter of Invitation and Consent Form for Adult Participants

Dear Sir or Madam,

I would like to invite you to take part in a study conducted as part of my Honours degree at Edith Cowan University. I am interested in examining how people judge the attractiveness of faces. You may have seen the recent ABC TV series on the Human Face, which described research on how people recognise faces. My project is related to this area of research. The results will be written up for my Honours thesis. At no stage will individual participants be identified in the course of this study. This study has been approved by the ECU Faculty of Community Services, Education and Social Sciences Ethics Committee.

I am inviting you to join this study. If you agree to participate, the survey will only take about 30 minutes. You may choose not to answer any questions you do not want to and are welcome to stop at any time you wish. All that the task requires is for you to look at faces on a computer screen and give your opinions about these faces. The information gathered will be treated in the strictest confidence. Any reports stemming from the study will only discuss overall results and no one's individual data will be identified. If the survey raises any issues that you would like to discuss further, please feel free to contact either myself or my supervisor Dr Paul Chang.

Participation in the study is voluntary and you can withdraw from the study at any time. Please keep this letter for your information. If you have any questions, please do not hesitate to contact myself on 9402 2537 or Dr Paul Chang on 9400 5745. Alternatively, The Head of the School of Psychology, Dr Craig Speelman, can be contacted on 9400 5535.

I would greatly appreciate your help to make this study possible and I thank you in advance for your assistance.

Yours sincerely,

Bronwyn Struthers
Edith Cowan University
100 Joondalup Drive
Joondalup WA 6027

Supervisor: Dr Paul Chang
Edith Cowan University
100 Joondalup Drive
Joondalup WA 6027

A.2

CONSENT FORM FOR ADULTS

Please fill out the following form. Thank you.

❑ I agree to take part in the study

❑ I would rather not take part in the study

Name _____
(first name) (last name)

Date _____
(Month) (Day) (Year)

My date of birth is _____
(Month) (Day) (Year)

Appendix B

Letter of Invitation and Consent Form for Children

Dear Parent and Student,

Principal ..... and ... Primary School have agreed to take part in a study conducted as part of my Honours degree at Edith Cowan University. I am interested in examining how people judge the attractiveness of faces. You may have seen the recent ABC TV series on the Human Face, which described research on how people recognise faces. My project is related to this area of research. The results will be written up for my Honours thesis. At no stage will individual participants or their school be identified in the course of this study. This study has been approved by the ECU Faculty of Community Services, Education and Social Sciences Ethics Committee.

I am inviting your child to join this study. I know that each child is different in their opinions, so it is important to include as many children as possible. If you allow your child to participate, the survey will only take about 30 minutes and will be carried out during school hours. Children may choose not to answer any questions they do not want to and they are welcome to stop at any time if they wish. All that the task requires is that children look at faces on a computer screen and give their opinions about these faces. The information gathered will be treated in the strictest confidence. Any reports stemming from the study will only discuss overall results and no individual children will be identified. If the survey raises any issues that your child would like to discuss further, please feel free to contact either myself or my supervisor Dr Paul Chang.

Participation in the study is voluntary and your child can withdraw from the study at any time. Please fill in the attached form, indicating whether or not your child can participate and return it to the child's teacher. Please keep this letter for your information. If you have any questions, please do not hesitate to contact myself on 9402 2537 or Dr Paul Chang on 9400 5745. Alternatively, The Head of the School of Psychology, Dr Craig Speelman, can be contacted on 9400 5535.

I would greatly appreciate your help to make this study possible and I thank you in advance for your assistance.

Yours sincerely,

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Edith Cowan University
100 Joondalup Drive
Joondalup WA 6027

B.2

CONSENT FORM FOR CHILDREN AND CHILDREN'S PARENT/GUARDIAN

Please fill out the following form and have your child return it to his/her teacher. Thank you.

❑ I agree to allow my child to take part in the study

❑ I would rather my child did not take part in the study

The following information is needed for statistical purposes only. Your child and your child's school will not be identifiable in any way in the study.

Child's Name _____
(first name) (last name)

Parent's Signature _____

Date _____
(Month) (Day) (Year)

My child's date of birth is _____
(Month) (Day) (Year)

Appendix C

Letter to School Principal

Dear Principal,

I am conducting a research study on face recognition by children and would like to ask for your permission to approach some students in your school (aged between 6 and 10 years). This research is part of my Honours program at the School of Psychology at Edith Cowan University. In the study, I will ask the children to look at some faces on a computer screen and have them rate the attractiveness of the faces. The whole procedure will take about 30 minutes. The children will be tested individually in a quiet area. This study has been approved by the ECU Faculty of Community Services, Education and Social Sciences Ethics Committee.

Please be assured that I shall seek the consent of the children's parents before I proceed and that any information obtained in this study will be held in the strictest confidence. At no time will any personal questions be asked, except for their date of birth which will be used for statistical purposes. Attached is a copy of the information sheet and consent form that I will be sending out to the parents.

If you have any questions about the study, please feel free to contact myself or my supervisor Dr Paul Chang. Alternatively, The Head of the School of Psychology, Dr Craig Speelman, can be contacted on 9400 5535.

We greatly appreciate your help in making this study possible.

Yours sincerely,

Bronwyn Struthers, Student in Psychology
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