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Current status and future directions of research on facial attractiveness

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ABSTRACT The aim of the present paper was to evaluate the current state of knowledge on the perception of facial attractiveness and to assess the opportunity for research on poorly explored issues regarding facial preferences. A theoretical framework of research problems was proposed, within which the current state of knowledge on each topic was estimated. The analysis proved that a disproportional amount of research concerned several topics, while many other topics were addressed by few studies, the results of which being sometimes contradictory. Next, possible obstacles to more comprehensive research are discussed. This leads to the conclusion that the obstacles do not severely hinder investigations of most poorly studied problems. The results of the author's recent studies on some of these topics are also briefly reported. In spite of thousands of studies conducted, facial attractiveness research may be regarded as rather poorly progressed, although prospects for it are good.

KEY WORDS: physical attractiveness, facial preferences, facial esthetics, human face

In the middle 1960s, quite unexpectedly, substantial agreement in assessments of facial attractiveness (FacA) between judges taken from the same or different populations was reached [Martin 1964, Udry 1965], and a person's physical attractiveness was proven to be decisive in determining an individual's willingness to date the person again, after the first date with them [Walster *et al*. 1966]. Soon, scientific interest in physical (and facial) attractiveness burgeoned, resulting in dozens of papers published yearly. Presently, the number of studies has accumulated to thousands, which may suggest that FacA-related issues have already all been well studied. However, Gillian Rhodes, one of the most prominent researchers of FacA, listed several missing pieces in the knowledge on FacA and concluded this with the sentence "Clearly, the evolutionary psychology of facial attractiveness is just beginning!" [Rhodes 2006: 218]. Such a diversity of opinions justifies the present work, the aims of which are threefold: (1) to assess the current state of knowledge on various FacA issues, (2) to point out the issues that most require further research, and (3) to discuss methodological possibilities to conduct the studies focussed on these issues.

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The scope and main issues of FacA research

It will be easier to recognize the scope of research on FacA when the concept of FacA is first well understood. A precise definition of facial attractiveness is difficult to achieve. A scientific approach to attractiveness should encompass not only subjective impressions but in also objective phenomena that accompany the subjective impressions. Thus, an attractive face attracts a perceiver, the perceiver makes a judgement about the face, he or she tends to look at it, and then experiences a will to engage in further contact with its owner. Usually, the envisaged contact is erotic in nature, though not always, which is why the concept of facial attractiveness is an ambiguous one. When a judge examines a face in order to assess its attractiveness, their judgement depends foremostly on the appearance of the face, but also on three important classes of modifiers of the particular judgement:

1. The meaning of attractiveness. A researcher may tell a judge how to interpret the notion of "attractiveness", or the judge may him- or herself explicitly or implicitly define the meaning of the attractiveness. Qualities of attractiveness are able to be distinguished in terms of a spouse, a lover, a friend, or a coworker, etc. People may judge FacA in individuals of their own sex in order to estimate their competitiveness on the mate market, or they may make a judgement about their own FacA to estimate their own competitiveness, or they may assess FacA of their children so as to decide about how much should be invested in them, etc.

2. The characteristics of the judge. Many factors influence an individual's pattern of facial preferences (FacP): genes, cultural norms and fads, lifetime experience, biological, ecological, physiological and psychological state of the judge, his knowledge or idea about the owner of the face examined, and the perceived similarity of the examined face to his own face [Kościński 2008].

3. The face's category. The perception of the judge as to affiliation of the face to a category (e.g., sexual, age, racial) may influence their assessment of the face and, thereby, the judgement of FacA. For example, a face of androgynous appearance may be taken for male or female one (an experimenter may, though need not, suggest a specific category), which can influence its perception [Webster *et al*. 2004].

Thus, the assessment of FacA is the method by which a person maps a facial image onto various evaluative judgements about the "imagined" owner of a face. The scope of research on FacA should comprise all biologically and socially significant forms of facial assessments (i.e., various senses of attractiveness and various facial categories) made by judges having diverse traits.

The three most general questions about a phenomenon are what?; why?; and what of it? These questions may be helpful in determining the main issues in research on FacA:

1. (A) What are FacPs in humans in general? (B) What are the variations of FacPs (i) between populations, (ii) within a population, between individuals, (iii) within a population, over time, and (iv) within an individual, over time? (C) What are atypical forms of FacP, both individual (possibly related to pedophilia and homosexuality) and populational (e.g., cultural "disadaptations")?

2. The question "Why are preferences what they are?" may be answered in four ways [Tinbergen 1963], namely, in terms of: (i) physiology: hormonal, neural, etc. influences on assessments of FacA, (ii) ontogeny:

genetic and environment impacts on the development of FacP, (iii) phylogeny: the evolutionary history of human FacP, (iv) function: past and/or present, survival and/or reproductive benefits of possessing a specific FacP, i.e., reasons for why these preferences have evolved. Physiology- and ontogeny-oriented explanations may be especially helpful for understanding intra-population and intra-individual variations in FacP. Inter-population variation in FacP may, in turn, be clarified by evolutionary and functional analyses.

3. The perception of FacA may have two types of consequences: (i) social ones, e.g., differential treatment of people varying in FacA, and (ii) biological ones: e.g., differential reproductive success of people varying in FacA.

In the following chapter, the extent to which each of these questions has been addressed in research and the extent to which it was answered will be discussed. The interest of scientists in various types of attractiveness and various kinds of subjects will also be discussed. The corpus of knowledge on FacA will not be presented in detail as this was published, together with references, in other papers by the author [Kościński 2007, 2008].

Current state of knowledge on FacA issues

Various meanings of FacA

Most studies have concerned assessments of FacA of the opposite-sex made in the erotic or marital context. Often, a researcher had both male and female judges each of whom assessed faces of both sexes. Thus, there exists much data on FacA as assessed by own-sex individuals. Studies on self-assessment of FacA are also quite numerous [Feingold 1992]. On the other hand, few studies have explored FacA in social contexts (the appropriateness of FacA for a friend or a co-worker) [Johnston *et al*. 2001, Scarbrough and Johnston 2005]. There is some work on assessing FacA in contexts suggesting kinship, i.e., with faces digitally made similar to the judge's face [Platek *et al*. 2002, DeBruine 2005].

Evidence exists that the sense of attractiveness substantially influences facial ratings, for example: (1) Pregnant women prefer different male faces than non-pregnant women, probably because they value facial cues for protectiveness more than those for good genes [Jones *et al*. 2005*c*]. (2) Other male faces are regarded as attractive in the context of a short-term bond rather than a long-term bond [Johnston *et al*. 2001, Little *et al*. 2002]. (3) Faces similar to the face of a judge are more attractive socially (seem to be more trustworthy), but less attractive in erotic terms [DeBruine 2005].

Sex and age of judges and judged persons

The majority of studies were conducted on students (≈ 20-25 yrs). They were used both as stimulus persons and as judges. Fewer studies have concerned FacA of infants [Hildebrandt and Fitzgerald 1979, Langlois *et al*. 1995], children [Zebrowitz *et al*. 1993], or elderly people [Mathes *et al*. 1985]. There is some research on FacP in infants [Langlois *et al*. 1987, Slater *et al*. 1998], but relatively little interest has been focused on the preferences of children [Cooper *et al*. 2006; Saxton *et al*. 2006, 2009*a*,*b*] and of elderly people [Mathes *et al*. 1985, Ebner 2008]. Both sexes have been studied with similar frequency in the respect of their preferences and their FacA.

General patterns of FacP

Many studies have focused on the average preferences of a group of judges and did not probe into the variation of their judgements. They were often aimed at seeking correlation between FacA assessments and various facial features. Facial averageness, symmetry and dimorphism definitely drew the most attention of researchers, and the positive influence of these traits on FacA (except for dimorphism for male faces) is now quite well documented [Rhodes 2006, Kościński 2007]. Surprisingly, female preference for male facial masculinity is still not resolved, as evidence exists both for above-average and below-average masculinity to be the most preferred [Rhodes 2006, Kościński 2007]. One possible cause of this contradiction may be the unnatural appearance of facial stimuli used in previous studies; specifically, scalp hair was totally blurred or artificially masked. The use of digitally manipulated faces with intact hair seems to be more promising in prospect.

Studies on scalp and facial hair, color of skin, hair and eyes have been much less popular [Van den Berghe and Frost 1986, Muscarella and Cunningham 1996, Little *et al*. 2003], and studies on the influence of skin condition and facial expression on FacA have only actually appeared in last few years [Jones *et al*. 2004, 2006; Conway *et al*. 2008; Fink and Matts 2008]. Therefore, most conclusions on these poorly studied features are still tentative. Additionally, the relative importance of facial features in determining FacA is poorly recognized; however, several studies have addressed this issue [Baudouin and Tiberghien 2004; Bronstad *et al*. 2008; Kagian *et al*. 2008; Komori *et al*. 2009*a*,*b*; Saxton *et al*. in press].

The majority of studies used facial photos taken in frontal view, but some features are visible only in profile, or more visible in profile than in frontal. However, their is sufficient research on perceiving FacA in profile to draw some conclusions on the determinants of profile esthetics, such as the orthognatism or, in females, prominent lips [Swaddle and Reierson 2002, Valentine *et al*. 2004, Maple *et al*. 2005]. No studies have examined assessments of FacA in semi-profile or other view.

Facial videos seem to be ecologically more relevant stimuli than facial photos. Nonetheless, there are few studies on the perception of FacA from videos, and their results are contradictory [Diener *et al*. 1995, Penton-Voak and Chang 2008, Roberts *et al*. 2009].

Inter-population variation

There is a shortage of research on inter-populational agreement and variation in FacP. Some studies compared preferences of various ethnic groups from the same culture (e.g., African Americans vs. European Americans). However, in multi-ethnic societies, the standard of facial beauty possessed by the socially dominant ethnicity (usually, that of European ancestry) spread to the other ethnic groups. A similar problem arises when the studied population is geographically distant, but still exposed to western media. That is why, highly valuable studies are carried out on non-westernized populations, such as, Indians from Paraguay and Venezuela [Jones 1996], Nigerians [Martin 1964], or Hadza people from Tanzania [Apicella *et al*. 2007]. Some data on esthetic preferences of primitive societies has also come from ethnographers.

Research has revealed some universal criteria for FacA: youthful and feminized appearance in women as well as symmetry and clean skin in both sexes are preferred in all societies [Kościński 2008]. Probably,

people in each population possess their own psychological model of face being the average of individual faces from the population. If such population-specific facial models serve as reference points in FacA assessments, they may at least partially account for inter-population variation in FacP.

Intra-population variation between individuals

Since the 1970s, many studies have estimated the level of agreement of judges in FacA assessments, but, up to the 1990s, little attention was paid to the factors responsible for the disagreement in assessment. In recent years, many traits of the judges were found to influence their FacP, e.g., cues to high biological quality of a judge, such as physical attractiveness, somatic and mental health [Penton-Voak *et al*. 2003, Jones *et al*. 2005*b*, Scott *et al*. 2008, Smith *et al*. 2009], self-perceived FacA [Little *et al*. 2001], testosterone level in female judges [Scarbrough and Johnston 2005], sex-typicality of personality [Johnston *et al*. 2001], extraversion [Welling *et al*. 2009], sociosexual attitudes [Waynforth *et al*. 2005, Provost *et al*. 2006], chronic anxiety [Pettijohn and Tesser 2005], education level [Turkkahraman and Gokalp 2004], and the desired personality of a potential partner [Little *et al*. 2006].

Some ecological variables were also found to influence FacP, e.g., accessibility to opposite-sex persons [Madey *et al*. 1996], being in a stable relationship [Simpson *et al*. 1990], knowledge about the assessed person [Paunonen 2006], and acquaintance with the assessed person [Hume and Montgomerie 2001]. Each of these physiological, psychological and ecological variables was examined only in one or a couple of FacA studies, so their effects on FacA are still poorly conceived. Somewhat more research has been concerned with the influence of previously seen faces on subsequent FacP. It has been proven that viewing faces with a distinguishing feature makes other faces with the same feature to be perceived as more attractive. However, several attempts to prove that the composite face made of previously seen faces is more attractive than other composite faces was unsuccessful [Rhodes *et al*. 2001, 2005*a*]. This exposure effect may play a role in real life, when a person sees the same faces every day. Intra-population variation in FacP comes partly from intra-individual variation.

Intra-population variation over time

Little is known about the determinants of FacP changes in a population over time. Usually, such changes are perceived as fads, but some of them may stem from adaptive mechanisms. Studies of Pettijohn and coworkers [Pettijohn and Tesser 1999, Pettijohn and Jungeberg 2004] showed that changes in preference for eyes and chin sizes are adaptively related to national changes in socioeconomic situation. Changes in preferences for hair and eyes color may come from frequency-dependent selection for these traits [Frost 2006]. Barber [2001] demonstrated that the fashion for facial hair in men depended on such ecological factors as the operational sex ratio and illegitimacy ratio. On the other hand, in the last half century there has been an increase in the preference for faces with large, prominent and curled up lips in Whites and Blacks, both in men and women [Nguyen and Turley 1998, Auger and Turley 1999, Yehezkel and Turley 2004], and this may be a fad for the Negroid appearance.

Intra-individual variation

Irrespective of sex, an individual's FacP changes substantially over time [Hönekopp 2006], but the causes of this variation are poorly studied. The only exception is

the phases of the female menstrual cycle, which was the focus of relatively many studies, which revealed interesting relationships (e.g., women about to ovulate prefer more masculine male faces than in other phases of their menstrual cycle; see review in Jones *et al*. [2008]). Single experimental studies have found dependency of FacA assessments on mood [Cunningham *et al*. 1995], temporal anxiety [Pettijohn and Tesser 2005], and being under the influence of alcohol [Jones *et al*. 2003, Parker *et al*. 2008] or nicotine [Attwood *et al*. 2009]; these results therefore need replication.

Recently, we conducted a more extensive study on naturally occurring intra-individual variation of facial preferences. We explored women's evaluations of real and digitally manipulated male faces at a monthly and yearly interval, and obtained the following results: (1) Stability of attractiveness assessments over a year was not less than over a month. This suggests that between-session disparity is due predominantly to factors fluctuating over time with no directional trends. (2) Breakdown of a bond resulted in the increase of the preference for friendly looking faces. (3) Change of mood positively correlated with the change of preference for good-genes facial cues, but only in paired women. This suggests the influence of mood changes on a woman's readiness to cheat on their long-term partner in order to "gain" good genes. (4) Women that were relatively open for casual sex manifested a relatively high stability of preferences for sexy looking faces. Altogether, these results prove the intra-individual variation of preferences to be a very promising field for future research.

Atypical forms of FacP

Regarding the psychology and behavior of humans (among others, FacP), it is not always easy to establish normal from deviant or pathological. Some traits (e.g., psychopathic personality) are socially harmful, thereby commonly recognized as pathological, but may be beneficial for the individual who possesses the trait; thus, the trait is not necessarily abnormal from the biological point of view. Some other traits (e.g., homosexuality) may be evolutionarily maladaptive and, at the same time, socially perceived as normal.

Little research has been conducted on possible abnormal forms of FacP: (1) Some (but not all) people afflicted by prosopagnosia (the inability to recognize faces) assess FacA similar to normal people [Le Grand *et al*. 2006, Iaria *et al*. 2008]. (2) Marcus and Cunningham [2003] showed that pedophiles and rapists were attracted to youthfulness cues and to maturity cues in faces in the same way and to the same extent as other men. (3) Kranz and Ishai [2006] found that heterosexuals and homosexuals assessed FacA of each sex similar to each other but the brain (thalamus and medial orbitofrontal cortex) of heterosexuals was activated more by the opposite-sex faces than by those of their own-sex, while the brain of homosexuals reacted more strongly to faces of their own sex. Glassenberg *et al*. (in press) has studied preferences for facial sexual dimorphism by heterosexual and homosexual men and women, but have obtained rather intricate, not easily explainable results.

Physiological explanations

Many studies found that viewing an attractive face (especially of the opposite sex) influenced brain activity in a different way to when viewing unattractive faces [Johnston and Oliver-Rodriguez 1997, Nakamura *et al*. 1998, O'Doherty *et al*. 2003, Iaria *et al*. 2008, Chatterjee *et al*. 2009]. Some neural structures (e.g., nucleus accumbens)

react for attractive faces, while others react for unattractive ones (e.g., insula). In addition, the brain's EEG is influenced by the attractiveness of the face seen. Involuntary contractions of facial muscles [Hazlett and Hoehn-Saric 2000] and changes in skin resistance [McDonald *et al*. 2008] were also detected on viewing attractive faces. Mehrabian and Blum [1997] argue that the image of an attractive face evokes some emotions (through specific brain activation) which, in turn, influences the judge's verbal assessment of FacA; however, this claim awaits further verification.

Hormone levels seem to have a substantial impact on FacP. The level of preference for sexually dimorphic traits in opposite-sex faces tracks the changes in testosterone level in men [Welling *et al*. 2008] and between-cycle changes of estrogen level in women [Roney and Simmons 2008]. Female preference for masculinity, symmetry and healthy appearance of male faces also changes within her cycle; it is not known, however, which hormone is responsible for this – estrogen [Roney and Simmons 2008], progesterone [Jones *et al*. 2005*a*], or testosterone [Welling *et al*. 2007]. Oxytocin [Theodoridou *et al*. 2009] and cortisol [López *et al*. 2009] have also been associated with the perception of FacA. Thus, research indicates a complex neural and hormonal basis for FacP and its perception, but further studies are needed to replicate and extend previous findings.

FacA itself is also susceptible to changes in sex hormone levels, e.g., women in the fertile phase of their menstrual cycles (high level of estrogen) have a lighter skin (a relatively pale skin is preferred in most societies; Van den Berghe and Frost [1986]), and a generally higher FacA [Roberts *et al*. 2004]. Research on the dependence of FacA on health, physical condition, or mood has yet to be done.

Ontogenetic explanations

The development of most biological traits is dependent on both genes and environment, and an essential question to be answered is their relative contributions to the variation of the trait under consideration. Large gaps in FacA research exist for coefficients for heritability of FacA and preferences for FacA. According to the author's knowledge, not a single study has been attempted to determine these for FacP or for FacA. Only from data in McGovern *et al*. [2004] and Cornwell and Perrett [2008] can one estimate the heritability of female FacA at about 0.6, while the heritability of FacA in males is insignificant. A few studies have reported associations between FacA and some genotypic characteristics [Roberts *et al*. 2005*a*,*b*; Lie *et al*. 2008, in press].

Several studies suggest that both FacA and FacP depend on an individual's sex hormone levels: (1) Women with high level of estrogen (and, to a lesser degree, progesterone level) have more feminine and attractive faces [Law Smith *et al*. 2006]. (2) Men with high testosterone levels have more masculinized faces, but the relationship of testosterone level with FacA is more complex [Penton-Voak and Chen 2004, Roney *et al*. 2006]. (3) Women exposed to relatively high levels of testosterone in their fetal life prefer more masculinized male faces than do other women [Scarbrough and Johnston 2005]. Facial preferences change with age: young children prefer more babylike faces than older children or adults [Cooper *et al*. 2006] and older adults prefer older faces than younger adults [Mathes *et al*. 1985], but generally people in various age groups agree with one another in their assessment of FacA [Udry 1965]. More detailed studies on the lifetime development of FacP are urgently needed, especially for the periods of onset and termination of the reproductive phase of life.

Many studies focused on an individual's biological quality as a factor of FacA. Severe disorders were shown to deform the face and decrease its attractiveness [Thornhill and Møller 1997]; however, results for possible associations between small departures from facial esthetic standards and biological quality are inconsistent. One can risk a conclusion that FacA is weakly related to parasitic health [Kościński 2008], and moderately with longevity [Henderson and Anglin 2003], physical fitness [Hönekopp *et al*. 2004, Shoup and Gallup 2008, Williams *et al*. 2009] and sperm quality [Soler *et al*. 2003]. Clarification of these findings would obviously necessitate further research.

A theoretical perspective for the life history of facial preferences is still lacking, as is relevant empirical research. Recently, we attempted to fill the gap in a study on the evaluation of male faces by girls at puberty, non-pregnant and pregnant young women, and middle-aged women. The following results were obtained: (1) All four female groups assessed male facial attractiveness very similarly. (2) The older women preferred older-looking male faces more than the younger ones did. (3) The preference for sexy-looking faces was the strongest in young, non-pregnant women. (4) Girls perceived facial attractiveness in a similar way to adult women; nevertheless, their perceptual apparatus was not yet fully developed. (5) Intra-group consistency of postmenopausal women was relatively low. (6) In terms of the preference pattern, pregnant women departed from their non-pregnant peers toward perimenopausal women. In another recent survey, we found that more adult-like criteria of facial preferences were manifested by girls of 12-13 years who were more advanced in their biological development, as measured by the time from the menarche. Altogether, these results suggest that the life history of facial preferences is, to a large extent, hormone-driven and is underpinned by a set of evolutionary adaptations.

Phylogenetic explanations

The reconstruction of the phylogeny of a biological trait is never easy, because the past cannot be directly observed. This task is made even more difficult by features absent in fossil material, e.g., for FacP. Therefore, hypotheses on the evolutionary history of FacP are very difficult to verify. The evolution of the human face is characterized by its gracilization, which is commonly explained in terms of natural selection. However, gracilization can also be perceived as neotenization or feminization, and this evolutionary trend can then be explained in terms of sexual selection (namely, specific FacP in mating) [Penton-Voak and Perrett 2001]. There are some arguments that the male beard evolved through sexual selection. Facial hair is present only in men, only in the lower part of the face, is probably not associated with survival, and it increases the perceived masculinity. Thus, facial hair could had been preferred by past women as a signal of maleness [Muscarella and Cunningham 1996]. One may also speculate that the origin of long-term bonds and long biparental care for children had a great influence on facial preferences: males had begun to prefer young females (so to benefit from their high reproductive potential), and females had started to prefer only moderately masculinized male faces (since they signaled pro-family personality) [Kościński 2008].

Functional explanations

Currently, FacPs are regarded as evolutionary adaptations that direct an observer toward individuals of high mate value, i.e.,

individuals possessing genes that determine high biological quality (so-called good genes), and having desirable phenotypic (biological and psychological) traits [Gangestad and Scheyd 2005]. Patterns of FacP obtained in many studies are therefore explained in terms of biological adaptations and regarded as functional. However, scientists are able to think up a functional explanation for virtually every possible human behavior, so one needs a more solid methodology of drawing and testing functional/adaptive explanations of empirically found FacPs than so-called "story telling". A hypothesis seems more credible if it correctly predicts some phenomena instead of being post hoc. As regards FacP, one general prediction is that there should be a correlation between determinants of facial attractiveness and the quality of a face owner. However, a facial preference of a functional/adaptive origin does not have to differentiate high- and low-quality people in the contemporary population, because the structure of modern populations and their environment differs substantially from ancestral ones (as does the fitness of individuals with a specific genotype or phenotype). Neither a correlation of a facial trait with a component of fitness proves the adaptiveness of a preference for the trait, because such a correlation may be produced by several other mechanisms [Kościński 2008]. Nonetheless, results of studies that sought such a correlation are mixed (see section "Ontogenetic explanations").

In evolutionary biology, a reliable criterion for adaptiveness is a special design, which means that a trait is constructed in such a way that it is difficult to deny that the trait was evolutionarily shaped to perform a given function [Gangestad and Cousins 2001]. Such a special design was found for several contingency-dependent patterns of FacP: (1) Female preferences for male facial masculinity change in such a way as to be able to mate with a man with good-genes in the time around the ovulation period [Jones *et al*. 2008]. (2) High-quality women (i.e., those of high FacA, high self-assessed FacA, low WHR, or good psychological health) prefer men with high-quality cues (i.e., those with masculinized, symmetrical, and healthy looking faces) [Little *et al*. 2001, Penton-Voak *et al*. 2003, Jones *et al*. 2005*b*, Scott *et al*. 2008, Smith *et al*. 2009]. (3) In threatening circumstances, individuals with facial cues to strength (small eyes and big chin) are preferred [Pettijohn and Tesser 2005]. On the other hand, two the most well known criteria of FacP, namely averageness and symmetry, have not been proved to be adaptive, and, moreover, some studies point to the non-adaptive basis for these preferences (perceptual bias in particular) [Johnstone 1994, Halberstadt and Rhodes 2003].

The functionality of facial preferences is also testified by cross-region and cross-modality correlations of attractiveness. Specifically, people who have attractive faces also have attractive body shapes and voices, and their smell is acknowledged as nice and sexy [Kościński 2008]. Preliminary results of one of our ongoing studies suggest a moderate correlation between the attractiveness of faces and hands in men and women. Such correlations presumably reflect an evolutionarily shaped ability to recognize an individual's biological quality through its cues in various parts and aspects of their body (e.g., the face, silhouette, hand, voice, and smell).

Social consequences

Social consequences of perceiving FacA are the FacA-related topics that first drew scientific attention. Since the 1960s, hundreds of studies have been conducted, and

it is now well-established that (1) People of high FacA are perceived as possessing many virtues (physical and psychological health, intelligence, social and erotic competencies, assertiveness, happiness), but also some faults (egotism, vanity, conceit). (2) People of high FacA are treated better than low-FacA people: strangers give them more help, ask them for help more frequently, trust them, agree with them more frequently, and punish them less severely. (3) Such favoring and discriminating on the grounds of FacA may impact on people's personality according to the mechanism of self-fulfilling prophecy [Eagly *et al*. 1991, Feingold 1992, Langlois *et al*. 2000]. Many studies on social consequences of FacA were conducted in realistic conditions, so their results apply to everyday life. Yet, it is still poorly recognized whether temporary (experimental) effects of FacA correspond with real life permanent ones [Zebrowitz *et al*. 1998].

Biological consequences

The concern here is what changes in distributions of genetic and phenotypic characteristics in a population may result from the phenomenon of FacA. There is not much research on this topic, yet the results are reasonably consistent: (1) For both sexes, assessments of FacA translate into the will to date, mate and marry with the owner of a face [Cunningham 1986, Cunningham *et al*. 1990]. (2) Partners in a bond are usually of similar FacA to each other [Feingold 1988]. (3) In each sex, high FacA facilitates attaining aims specific to the sex: high-FacA women have had more long-term bonds, marry earlier and remain old maids less frequently; in turn, high-FacA men have had more short-term bonds, and their female partners have orgasms (and simultaneous orgasms) more frequently [Thornhill *et al*. 1995, Kalick *et al*. 1998, Rhodes 2005*b*]. (4) The number of children in marriage pairs is at best weakly related to parents' FacA [Kalick *et al*. 1998, Pawłowski *et al*. 2008, Jokela 2009], which suggests that reproductive health is rather unrelated to FacA.

These results suggest that, in modern populations, genes enhancing FacA are favored much more by sexual selection than natural selection. However, because of the small number of relevant studies to date, this conclusion requires verification. Some special questions still remain unanswered, e.g.: (1) Do individual FacP translate to the face appearance of real partners? (2) Do high-FacA women and/or men in primitive societies (i.e., in ancestral-like living conditions) have more children in marriage than low-FacA ones (only Hill and Hurtado [1996] suggested that for Aché women)?

Implications for future research

Greatest unknowns in FacA knowledge

The above review of the current state of knowledge on various issues of FacA is summarized in Table 1. For each FacA-related research problem, the degree to which it has been answered was estimated by the author on the basis of three criteria: the number of studies aimed at the problem, the consistency among relevant studies in results obtained, and the consistency of empirical results with theoretical predictions. As can be seen from the table, only a few issues are quite well recognized: the partnership context of FacA assessments, FacP of young adults (mainly students), and short-term social consequences of FacA. The list of unknowns is much longer, and, in the author's opinion, the most important poorly-studied FacA-related problems are as follows:

Table 1. Current state of knowledge on facial attractiveness issues

Problem	State of knowledge
The assessment of facial attractiveness in various contexts:	
– opposite-sex persons in reproductive context (dating, mating, marriage)	••••
– same-sex persons	•••
– self-assessment	•••
– social context	••
– a context suggesting kinship	••
Age of judges and assessed persons:	
– young adults (student age)	••••
– infants	•••
– children, adolescents	••
– elderly persons	•
Determinants of facial attractiveness:	
– averageness, symmetry, masculinity, frontal and profile view	•••
– scalp and facial hair, color of skin and hair, skin condition, facial expression	••
– eyes color, semi-profile view	•
– relative importance of determinants	••
Inter-population variation of preferences:	
– populations exposed to Western culture	••
– populations not exposed to Western culture	•
Determinants of inter-individual variation of preferences:	
– biological quality	•••
– personality, experience (previously seen faces)	••
– ecological factors	••
– intellectual competence and education level	••
Intra-population variation of preferences over time	••
Intra-individual variation of preferences over time	•
Determinants of intra-individual variation of preferences:	
– menstrual cycle	•••
– other factors	•
Atypical forms of facial preferences	•
Physiological explanations:	
– of facial attractiveness	•••
– of facial preferences	••
Ontogenetic explanations:	
– of facial attractiveness	••
– of facial preferences	••
– heritability of facial attractiveness and facial preferences	•
Phylogenetic explanations	•
Functional explanations	••
Social consequences of facial attractiveness:	
– short-term	••••
– long-term	•
Biological consequences of facial attractiveness	••

• • • • – quite good, • • • – moderate, • • – poor, • – very poor

1. Phylogenetic explanations. "Nothing in biology makes sense except in the light of evolution" – this famous sentence by Dobzhansky [1973] also applies to FacP, provided it is a biological trait in the sense of extended phenotype. Both scientists and laymen are interested in the course of human evolution, its causes, the homology of specific patterns of FacP between humans and apes, and their adaptive values or perhaps being atavisms. Having these problems explored for FacP would be of high cognitive significance and would have substantial influence on the way humans perceive themselves.

2. Inter-population variation. Some light on the evolution of FacP could be shed by inter-population research. For example, if populations isolated from one another possess similar patterns of FacP (e.g., the preference for clean skin), or inter-population variation in FacP is associated with an ecological variable in an adaptive way (e.g., the pathogen prevalence impacts on female preference for male facial masculinity), then such preferences would support the thesis that the perception of FacA is an evolutionary adaptation. On the other hand, studies on non-isolated populations may elucidate mechanisms of cultural impacts on FacP.

3. Heritability of FacA and FacP. Both FacA and FacP may evolve only when they are at least partly dependent on genes. Thus, an estimation of heritability coefficients of these traits could be a test of accuracy of an evolutionary approach to FacA. Values of these parameters may also give some idea of the effectiveness of possible activities aimed at changing individuals' FacA (e.g., by assuring good conditions for development) or FacP (e.g., training of tolerance for low-FacA people).

4. Ecological and psychological causes of variation in FacP. Inter-individual variation in FacP is substantial, and it is interesting whether the variation is random in character or contingency-dependent. In the latter case, the question is whether an association between FacP and a factor is adaptive or not. Some factors influencing FacP are known to some extent (e.g., the biological quality of the judge), but many others are not (e.g., social and economical status, sexual orientation).

5. Causes of intra-individual variation. While inter-judge disagreement in FacA assessments is commonly regarded as the variability in individual tastes, the substantial intra-judges variation raises the suspicion of lack of any taste. Such suspicion would be strengthened if this intra-individual variation were random. It is already known that, in women, the variation is partly accounted for by changes in estrogen and progesterone levels during the menstrual cycle and in pregnancy, and these effects seem to be adaptive. In turn, intra-individual variation of FacP in men is partly underpinned by fluctuations in testosterone levels. Many psychological variables are potential causes of rapid changes in someone's FacP.

6. Long-term social consequences of FacA. The well-known phenomenon of the large impact of a person's FacA on perceiving and treating the person by others would not be as significant if the effect applies only to relations between strangers and evokes no permanent changes in the person's psyche. This is why long-term mechanisms and effects of perceiving FacA need to be explored: Do these effects exist in relations between friends or relatives; what permanent psychological changes are induced by differential treatment by others; and how do FacA-related stereotypes spread over a population and develop in time?

7. Atypical forms of FacP. Research in this field may be useful at least twofold:

(i) If unwanted sexual preferences (e.g., pedophilia, homosexuality) are accompanied by biased FacP, then correcting these FacP (through e.g., conditioning) might be helpful in curing these sexual preferences. (ii) Further research on perception of FacA by people with neural or cognitive disorders (e.g., prosopagnosia) may improve our understanding of facial processing in the brain.

8. Facial preferences in non-reproductive contexts. Reproduction is not always the point in relations between humans. Therefore, impressions evoked by a face, and consequently the assessment of attractiveness of the face, are probably not only related to the choice of a lover or spouse, but also uniquely incorporated into many other types of social relations. Facial preferences of people beyond their reproductive period may differ from those being within this period, and people in the reproductive period may assess FacA differently depending on the type of attractiveness under consideration, and individuals in pre- or post-reproductive phase of their lives are certainly assessed by other criteria than are young adults.

9. The ontogeny of FacP. Each stage of human life is characterized by specific needs and threats; therefore, both physiology and behavior of an individual changes throughout their life in an adaptive way. If facial perception is adaptive, it may also change over time. In the pre- and post-reproductive phases of life, criteria of FacP may differ from those in early adulthood. Ancestral women were pregnant for a substantial part of their lives, so one may expect some specific, evolutionary shaped patterns of FacP in pregnant women.

10. The relative importance of FacA determinants. Although many morphological and behavioral determinants of FacA have been identified, little is known on which facial features are more, and which are less, important for being attractive. While most studies examined just one facial feature at a time, only multi-factorial analysis would be helpful here.

Limiting factors for FacA research

When discussing problems that should be addressed in future research, one should not omit obstacles that would potentially hinder such research. There are several kinds of limiting factors:

1. Fundamental. In this case, the nature of the research problem itself makes it very difficult to investigate. Questions about events from the distant past usually belong to this category, and a specific example is the phylogenetic explanation of FacP: skeletal remains of human ancestors' faces are rare, the reconstruction of the life-time appearance of a face is virtually impossible, and FacP are not preserved in the form of fossils. Thus, the course of the evolution of FacP is subject to speculation based on current preferences of humans and other species, as well as on theoretical considerations and simulations of the evolution of mating preferences. Research on FacP in apes and other monkeys may be helpful, and there exists several studies on this topic [Kościński 2008].

2. Ethical. Long-term social consequences of FacA are difficult to investigate, partly through ethical reasons. Methodologically, it would be great to take pairs of monozygotic twins, treat each of them in a different way to its sibling (according to FacA-related stereotypes), and observe the development of their personalities for years; however, such an experiment is not allowed. Similarly, one can not do the following: (i) permanently expose subjects to experimentally prepared media in order to

test the hypothesis on the crucial role of the media in shaping social stereotypes of attractiveness, (ii) freely manipulate the levels of hormones to check their impact on FacP, (iii) infect individuals to check how their immune resistance is related to FacA, etc.

3. Time-consuming. Longitudinal studies on FacP are really time-consuming, e.g., an experimenter needs 40 years to get the correlation between a judge's taste at the age of 10 and 50. For changes of FacA during the course of life, a researcher may gather photos of the same person at various ages, which is not especially time-consuming. From among other sorts of FacA research, a substantial amount of time is required for truly inter-population studies in which expeditions to remote and isolated societies are necessary.

4. Economical. Several types of FacA-related studies are economically expensive: (i) studies that determine molecular (e.g., genetic, hormonal) parameters of raters and/or ratees, (costs of these specialized analyses decrease with time, however, so possibilities for conducting molecularly-oriented research on FacA increase), (ii) large-sample studies in which subjects are paid money, (iii) truly inter-population studies, which necessitate expeditions to remote and isolated societies.

5. Methodological. In last decade, methods of FacA-related research has advanced dramatically, mainly due to the development and popularization of computers and internet, as well as the progress in molecular biology: (i) High-quality methods of digital modification of facial images (the warping and morphing techniques) enable experiments for assessing attractiveness of precisely prepared faces. (ii) Assessing FacA via the Internet facilitates the collection of a huge sample of judges and the ability to reach very remote judges. (iii) Research on FacA of ratees and/or FacP of raters, as related to their genotype and levels of hormones, extends opportunities for testing the biologically oriented concept of FacA, although current techniques for modifying facial shape in a video remain poor.

As can be seen from above, many of the unstudied and under-studied issues in respect of FacA are not obstructed by any insurmountable obstacle. These issues include heritability of FacA and FacP, ecological and psychological causes of variation in FacP, causes of intra-individual variation, atypical forms of FacP, FacP in non-reproductive contexts, the ontogeny of FacP, and the relative importance of FacA determinants (i.e., Items 3, 4, 5, 7, 8, 9, 10 in the list in the section "Greatest unknowns in FacA knowledge" above). Research on strictly inter-populational variations of FacP and on long-term social consequences of FacA (i.e., Items 2 and 6) are relatively time-consuming, costly and ethically relevant, but not so much so as to be precluded. Only phylogenetic explanations of FacA and FacP (i.e., Item 1) need to remain speculative for fundamental reasons. Thus, prospects for research on facial attractiveness are good.

Conclusions

In order to assess the level of scientific knowledge on FacA, a framework of research problems was proposed. The analysis conducted within this framework proved that a disproportional amount of research is concerned with several FacA-related topics, while many other topics were addressed by relatively few studies, the results of which were sometimes contradictory. Therefore, the domain of FacA may be regarded as being poorly explored in spite of thousands of relevant studies. The discussion on possible

obstacles to more comprehensive research leads to the conclusion that they do not severely hinder investigations of most of the poorly studied problems. Indeed, much progress in digital manipulations of facial stimuli, internet popularization, and molecular biology substantially enhances research methods. All this bodes well for further research on FacA.

Notes

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Streszczenie

Badania atrakcyjności fizycznej przeprowadzone w latach 60. ubiegłego wieku wykazały dużą zgodność w ocenie atrakcyjności twarzy przez osoby pochodzące z tej samej lub z różnych populacji. Wynikało z nich również, że cecha ta ma znaczenie dla łączenia się ludzi w pary. Od tego czasu nastąpił lawinowy wzrost liczby badań nad atrakcyjnością fizyczną. Opublikowano tysiące prac o atrakcyjności twarzy, a każdego roku pojawia się kilkadziesiąt nowych. Może to sugerować, że tematyka ta została już dobrze zbadana. W przedstawianej pracy podjęto próbę (1) oszacowania aktualnego stanu wiedzy na temat postrzegania atrakcyjności twarzy, (2) wskazania zagadnień niewystarczająco zbadanych oraz (3) ocenę możliwości i kierunków dalszych badań.

Wynik oceny atrakcyjności zależy od sposobu rozumienia przez osobę oceniającą (sędziego) pojęcia „atrakcyjność". Badania nad atrakcyjnością powinny więc dotyczyć nie tylko cech osób ocenianych, lecz również różnorakich cech sędziego oraz sposobu, w jaki pojmuje on pojęcie atrakcyjności. Opis preferencji dla twarzy powinien obejmować nie tylko ich typowy charakter, ale także ich międzyosobnicze i międzypopulacyjne zróżnicowanie, wewnątrzosobniczą i wewnątrzpopulacyjną zmienność w czasie, oraz ich nietypowe formy. Wyjaśnienia preferencji dla twarzy powinny być dokonywane na kilku płaszczyznach: fizjologicznej, ontogenetycznej, filogenetycznej i funkcjonalnej. Należy uwzględnić konsekwencje postrzegania atrakcyjności twarzy, zarówno biologiczne (sukces reprodukcyjny), jak i społeczne (dotyczące nie-reprodukcyjnych aspektów relacji międzyludzkich).

Oceny poziomu aktualnego stanu wiedzy o każdym z powyższych zagadnień dokonywano na podstawie trzech kryteriów: liczby badań dotyczących danego problemu, zgodności wyników między tymi badaniami oraz zgodności wyników empirycznych z teoretycznymi przewidywaniami. Analiza wykazała, że nieproporcjonalnie duża liczba badań dotyczyła kilku zagadnień, podczas gdy wiele innych poruszono w nielicznych pracach, których wyniki są czasami sprzeczne. Trzy zagadnienia można uznać za dobrze zbadane: ocenę atrakcyjności w kontekście partnerskim, preferencje młodych osób dorosłych (studentów) oraz krótkotrwałe skutki społeczne atrakcyjności (tab. 1). Wśród słabo zbadanych kwestii, za najważniejsze trzeba uznać: wyjaśnienia filogenetyczne preferencji, zmienność międzypopulacyjną preferencji, odziedziczalność atrakcyjności twarzy oraz preferencji, ekologiczne i psychologiczne uwarunkowania zmienności preferencji, przyczyny wewnątrzosobniczej zmienności preferencji,

długotrwałe konsekwencje społeczne atrakcyjności, nietypowe formy preferencji, preferencje dla twarzy w kontekstach nie-reprodukcyjnych, zmiany ontogenetyczne preferencji oraz względne znaczenie cech twarzy dla jej atrakcyjności (tab. 1).

Warto zwrócić uwagę na kilka czynników potencjalnie ograniczających możliwości badań nad powyższymi zagadnieniami. Istnieją przeszkody natury zasadniczej (związane z „nieuchwytnością" samego zjawiska), etycznej, czasowej, finansowej oraz metodologicznej. Analiza doprowadziła do wniosku, że badania nad większością słabo poznanych, jak dotąd, zagadnień nie są poważnie ograniczane przez żadną z tych przeszkód. Ograniczenia natury czasowej, finansowej oraz etycznej mają znaczenie dla badań preferencji w populacjach odizolowanych od kultury zachodniej oraz badań długotrwałych konsekwencji społecznych atrakcyjności. Ograniczenia te nie są jednak na tyle poważne, by wykluczały tego rodzaju badania. Jedynie wyjaśnienia filogenetyczne atrakcyjności twarzy oraz preferencji dla twarzy, z przyczyn zasadniczych, muszą pozostać spekulatywne. Zatem, pomimo tysięcy opublikowanych prac, badania nad atrakcyjnością twarzy należy uznać za dość słabo zaawansowane, natomiast perspektywy dalszego rozwoju tej dziedziny wydają się dobre.