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What do people with prosopagnosia find attractive?

Bakalářská práce

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Prohlašuji, že jsem práci vypracoval/a samostatně. Všechny použité prameny a literatura byly řádně citovány. Práce nebyla využita k získání jiného nebo stejného titulu.

1. Abstract

In this thesis, we will address attraction and its numerous aspects in cognitively impaired individuals suffering from prosopagnosia which is defined as„a form of visual agnosia in which the ability to perceive and recognize faces is impaired, whereas the ability to recognize other objects may be relatively unaffected. The term was originally limited to impairment following acute brain damage, but a congenital form of the disorder has since been recognized.“ (APA Dictionary of Psychology, n.d.). This research examines whether people with prosopagnosia use different attraction cues when choosing a romantic partner compared to healthy individuals and identified which specific aspects do subjects with prosopagnosia prioritize in potential partners and how do they differ from healthy control group. The recruitment of respondents for the research was done through social media and targeted people diagnosed with prosopagnosia as well as people who have a face memory problem, but have not yet been diagnosed. Each subject was tested by The Twenty Item Prosopagnosia Index (PI20) (Tsantani et al., 2021) to establish the severity of the impairment. A questionnaire was developed to assess what subjects consider attractive without relying on visual inputs (auditory, physical, olfactory...). We used mixed design of variance, also known as a split-plot ANOVA and multiple regression analysis. We analyzed the importance of each sensory realm and interpersonal factors for both men and women and then we compared answers of non-prosopagnosic subjects to healthy subject.

Among our most important findings is that prosopagnosic individuals deemphasize facial features when judging an individual's attractiveness. However, compensation strategies are uncertain, therefore further research is needed to fill in the gaps. The mean score on PI 20 was significantly higher (and above the cut-off of 65) in participants with prosopagnosia compared to control participants. ANOVA did not find a significant main effect of gender or a significant group x gender interaction. Participants in the control group (N=94) ranged in age from 18 to 60 years and were predominantly female (74%), whereas participants in the prosopagnosia group (N=45) were almost evenly split between females and males; therefore, the gender distribution in the prosopagnosia group was 54.55% female participants and 45.45% male participants. Female bias of this research is considered and reflected.

Key words

Attraction, developmental prosopagnosia, Autism, attraction cues, The Twenty Item Prosopagnosia Index (PI20), Evolutionary attraction hypotheses, Predictors of facial attractiveness

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2. Introduction

Vision is a primary sense and because of that attraction and what we know about it, has been exclusively retracted from sighted individuals and those who possess the ability to discriminate. Attraction is defined as „the interest in and liking of one individual by another, or the mutual interest and liking between two or more individuals. Interpersonal attraction may be based on shared experiences or characteristics, physical appearance, internal motivation (e.g., for affiliation), or some combination of these, also called the "interpersonal attraction" (VandenBos, 2015) Additionally, much of our knowledge about attraction and this definition itself relies on visual cues, however, we know nothing about what cognitively impaired and blind individuals find attractive or which aspects they prefer in potential partners. Faces play a vital function in social interactions, what happens when our facial processing function doesn't seem to work as well?

When making an attractive-unattractive distinction, face perception and body type are the most important, as facial attractiveness has been suggested to provide signals of biological quality, particularly health, in humans. The attractive traits that have been implicated as signals of biological quality include sexual dimorphism, symmetry, averageness, adiposity, and carotenoid- based skin color (Foo et al., 2017). The question that arises is what becomes attractive if an individual is incapable of recognizing or recalling faces?

Up to date no research has been conducted on the similar matter, this research will explore whether prosopagnosia is able to alter these biologically conditioned attraction preferences (Buss, 1989), alternatively, whether individuals suffering from prosopagnosia de-emphasize face-related aspects and prefer other variables such as audio cues, haptic cues, olfactory cues etc. The working hypothesis is that subjects suffering from prosopagnosia will consider non-visual sensory input to be of greater importance when determining an individual's attractiveness.

The motivation for research in this area was my own long-standing problem with remembering faces.

3. Physical attraction and mating preferences/ evolutionary attraction theory

Attraction is defined by the APA Dictionary of Psychology (VandenBos, 2015) as „the interest in and liking of one individual by another, or the mutual interest and liking between two or more individuals. Interpersonal attraction may be based on shared experiences or characteristics, physical appearance, internal motivation (e.g., for affiliation), or some combination of these. Also called interpersonal attraction." (VandenBos, 2015) How do we assess whether the person standing in front of us is attractive?

David Hume, an 18th-century philosopher wrote: "Beauty is no quality in things themselves: It exists merely in the mind which contemplates them; and each mind perceives a different beauty." (Hume, 1757) In his essay collection titled Four Dissertations (1757), Hume explores the subjective nature of aesthetic judgments and argues, that while there are commonalities in taste - beauty ultimately depends on individual perception.

In the ocean of theories assessing attractiveness, we decided to use evolutionary psychology as the guide. Evolutionary psychologists suggest that an individual's attractiveness is closely linked to potential they have as reproductive partners (Buss, 1999). Based on this perspective, humans tend to choose partners who can increase their chances of successful reproduction, therefore place a significant importance on specific traits. So, what are these traits?

Physical attractiveness is an extremely important aspect, with features such as facial symmetry, clear skin, and a healthy body commonly serving as indicators of good health and genetic quality. Youth is another important attribute, because it is associated with higher fertility, making younger individuals more attractive as potential mates. In addition, the ability to provide resources and achieve high social status are traits that are particularly valued in males, mainly as they may ensure the well-being and survival of offspring (Buss, 1999). Buss's (1994) study suggested that women not only value resources man has in present but also qualities like social status, financial potential, and ambition that could lead to financial gain in the future. Most interestingly, these findings are consistent across cultures, suggesting that focus on resource acquisition is a universal aspect of women's choice of partners. Before humans assess these personality qualities, physical attractiveness is often the first thing noticed about a potential mate, and it plays a crucial role in initial attraction.

Humans can therefore derive a lot of information from faces alone - emotions, moods, communication cues, identity, and health of the person, etc. Facial attractiveness is also one of the most heavily researched areas within physical attraction. What is considered an attractive face from an evolutionary psychology point of view? Research in evolutionary psychology has identified several key factors that are commonly perceived attractive across several different cultures. Some of those are:

1. Facial symmetry: This signals health and developmental stability (Rhodes, 2006). According to Buss (1994), facial symmetry signals that individuals have developed without significant disturbances, making them good potential mates. A study by Rhodes et al. (1998) also demonstrated preference for symmetrical faces across different cultures. This preference is therefore believed to be an adaptive trait. Individuals with symmetrical facial features may be free from genetic mutations and possess better health.The 'good genes' hypothesis suggests that facial symmetry (alongside with other features), are signals of the quality of the genes. Individuals with these traits are more likely to have offspring with better chance of surviving and reproducing. Facial symmetry is thought to be one of these traits because it indicates an individual's genetic resilience to environmental stressors (Gangestad & Simpson, 2000). Thornhill and Gangestad (2006) found that men with more symmetrical faces had higher sperm quality, linking facial symmetry to reproductive health. Symmetrical individuals are also often perceived as more socially competent and psychologically stable, which can enhance their desirability (Rhodes et al., 2001).

2. Facial averageness: we tend to rank individuals with culturally average faces as more attractive partly because it is more predictable and safer to invest in mating with individuals that do not exhibit traits that deviate too much from what is considered average in given population (Rhodes, 2006). Langlois and Roggman (1990) provided empirical support for this hypothesis by showing that composite images of multiple faces (which tend to be more average) are rated as more attractive than individual faces. Studies have also linked facial averageness to health and immunocompetence. Rhodes et al. (2001) found that individuals with more average faces tended to have stronger immune systems and less health problems. Symmetrical and average faces are also more often perceived as more trustworthy, kind, and socially competent (Langlois et al., 1990).

3. Healthy skin: firmness and flawlessness of skin signals youth, while discoloration and blemishes might be sign of underlying health problems (Fink, Grammer, & Thornhill, 2001). Healthy skin is universally considered attractive. Skin condition can also signal hormonal balance and fertility, particularly in women. Individuals with clear skin tend to have stronger immune systems and fewer genetic disorders. For instance, Fink et al. (2001) found that men with clearer skin had higher reproductive success. Skin condition is very easily observable and provides quick information about an individual's health status. Mesko and Bereczkei (2004) studied the impact of hair color on attractiveness and found that while there are cultural variations, healthy-looking hair is generally preferred. Studies on animals proved, that skin health plays an important role in mate selection across various species. For instance, female primates often prefer males with healthier fur, which indicates good health and genetic quality (Zahavi & Zahavi, 1997).

4. Neoteny/youthfulness: retention of child-like features into the adulthood such as big eyes, plump cheeks, hairless face, small nose etc. serve as an indicator of youth and fertility, especially for women - making it one of the important attraction cues (Jones et al., 1995). Cross-cultural studies have confirmed that neoteny is considered attractive across different cultures. Cunningham et al. (1995) found that features such as large eyes, small nose, and full lips, which are neotenous traits, are preferred across different cultures.

5. Sexual dimorphism or what do we consider feminine, signaling high estrogen (big eyes, high cheekbones, and full lips) and masculine, signaling high testosterone (Strong jawline, pronounced brow ridge, and broader shoulders) - refers to traits that help us separate men from women (Perrett et al., 1998). Women's preferences for masculine faces change depending on the state of their menstrual cycle (Johnston et al., 2001). During ovulation, when fertility is highest, women tend to rate more masculine faces as more attractive. Having very high testosterone levels is not considered attractive in long-term mating strategy. Elevated testosterone levels increase the likelihood of developing cardiovascular disease, prostate problems, and aggressive behaviors (Booth, Granger, Mazur, & Kivlighan, 2006). Men with higher testosterone levels are also less likely to exhibit nurturing behaviors and long-term commitment to their partners and offspring (Gettler, McDade, Feranil, & Kuzawa, 2011). Buss and Schmitt (1993) suggested that while short-term mating strategies (for example producing an offspring) may favor these masculine traits, long-term mating strategies (partnership) prioritize traits indicative of good parenting and reliability. While the preference for sexually dimorphic traits is well documented, some researchers argue that cultural and social influences play a significant role (Jones et al., 2004).

4. Bodily attraction cues

Assessing whether person is of high attractiveness might happen before we are even able to see persons face. Bodies, similarly to faces, are great sources from which we derive information about potential mates. Body shape is the second most crucial aspect of physical attractiveness. Some of the qualities that are of greater significance based on Buss (1999) are:

1. Waist-to-hip ratio (WHR): Buss identified that a 0.7 ratio is considered most attractive in females, signaling great child bearing potential and low health concerns. Singh (1993) also found a low WHR to be very reliable indicator of reproductive health. Women with a WHR of 0.7

generally have higher estrogen levels, greater reproductive success, and better overall health, making them more attractive to men. WHR is also very easily observable and provides immediate information about an individual's reproductive potential. While the preference for a lower WHR is well documented, some researchers argue that cultural and social influences play a significant role too (Different historical and cultural standards). Individuals with optimal WHRs often receive more positive social interactions and are perceived as more attractive and competent (Rhodes et al., 2001).

2. Height is also factor that mostly females assess when choosing a partner. Taller bodies are associated with dominance and power, signaling respect and potentially better intrasexual competition. Buss (1989) found that women generally prefer taller men, because height is associated with strength, protection, and social status. Men prefer slightly shorter partners than themselves. Another attribute that should be mentioned is posture. Buss (1994) argued that an upright, open posture is perceived as more attractive and it signals confidence and good health. On the other hand, slouched or closed postures might indicate low self-esteem or health problems.

3. Muscle tone/fat distribution - highly valued mostly in males. Muscle tone and strength was crucial for survival in evolutionary context as it signified the ability to protect offsprings and partners. Physical strength is linked to higher chances of survival. Buss (1989) also noted that women generally prefer men with a muscular body because it signals physical strength, health, and the ability to protect and provide. Frederick and Haselton (2007) found that while moderate muscularity is rated as most attractive, extreme muscularity is perceived as intimidating or unhealthy. Humans generally tend to consider average attributes as attractive. Frederick and Haselton (2007) also found that women from various cultures prefer men with defined muscles and that Individuals with better muscle tone are often perceived as more confident, dominant, and socially competent compared to individuals with bigger built bodies (Fink et al., 2014).

4. BMI - Based on Buss (1989) there are cultural differences in BMI preferences, with some cultures preferring fuller figures (Mauritania, Niger, Polynesia, Nigeria) and others favoring slimmer bodies (North America, Western Europe, India). These preferences are most often influenced by environmental factors such as food availability and social norms. Tovée et al. (1999) found out that while there is variation, a healthy BMI is generally preferred. This preference likely comes from the connection between healthy body weight and overall health. In regions where food scarcity is a concern, higher BMI means wealth and health. Both females and males use BMI as criterion for mate selection, males with an optimal BMI are perceived as healthier and more capable of providing resources and protection (Singh, 1993).

5. Auditorial attraction cues

Sexual dimorphisms goes beyond looks with different auditory preferences in both males and females. Vocal pitch is one of the most studied aspects of vocal attractiveness. Pitch refers to the frequency of a voice. Higher pitched voice in females is considered more attractive than lower pitched voice. Typically, younger women have a higher voice at the peak of their reproductive potential. (Fisher, 2013). When it comes to assessing attractiveness of male voices, the preference is lower-pitched voice due to it's association with higher testosterone levels and bigger body size. (Feinberg et al., 2005; Puts, 2005). Vocal quality is also important, hoarseness or nasality are considered highly unattractive due to signaling potentially infectious diseases or just generally an unhealthy state of body (Zuckerman & Driver, 1989). Voices can also tell us a lot about kindness and confidence of the person serving as an important cue for both, health and personal traits. Xu et al. (2013) claims that both men and women perceive breathy female voices as more attractive. Softer, gentler voice indicates a nurturing and kind disposition. The sound of a person's voice can carries a multitude of information - emotional state, personality, even physical disposition. Studies have shown that voices can convey cues about age, health, and physical attractiveness (Zäske et al., 2017). A deep, resonant voice in men and a higher-pitched, melodious voice in women are generally perceived positively.

6. Olfactory attraction cues

Commonly underrated but generally very important cues are olfactory attributes. Subconsciously providing us with information about genetic compatibility, menstrual cycle, health of an individual, personality and even genetic fitness. Pheromones are chemical signals that play crucial role in mate selection. Studies have repeatedly shown how individuals are often attracted to the scent of potential partners with different immune system than their own, this is called Major Histocompatibility Complex, or MHC. Genetic diversity of immune systems can lead to healthier offspring (Wedekind et al., 1995). Buss (1994) claims that individuals tend to prefer the scent of potential mates with different MHC genes to increase genetic diversity and provides offspring with a strong immune system. Wedekind et al. (1995) conducted a landmark study known as the "sweaty T-shirt experiment," which reaped results consisted with the Busses claims. In this study, male wore T-shirts for two consecutive nights without using deodorants or engaging in activities that could alter their natural scent. After that, female participants were then asked to smell the T-shirts and rate their attractiveness based on scent alone. The results showed that women preferred the scent of T-shirts worn by men with different MHC genes than their own (Wedekind et al., 1995).

7. Interpersonal attraction cues

Personality of potential mating partner has the ability to 'make or break' any kind of romantic interaction. Humans tend to lean towards partners that are somewhat similar to them in general world views or emotional settings. Similarity regarding opinions, values and interests is a particularly strong predictor of interpersonal attraction (Byrne, 1971). Similarity between potential partners facilitates reciprocal liking and increases the perceived sense of compatibility (Montoya, Horton, & Kirchner, 2008). Another predictor is geographical closeness or proximity. The single exposure effect postulated by Zajonc (1968) implies that being repeatedly exposed to someone increases our liking for them. Another item that can enhance attraction is social status. Not only high socioeconomic positioning is considered attractive, but traits such as ambition, education are often valued too because they indicate the potential of financial stability in the future (Buss, 1989). Some of the other valued personality traits are: Kindness and compassion, suggesting a caring nature - important for long-term relationship satisfaction (Farrelly, 2016). Another one is confidence which signals competence, self-assurance and dominance (Swann et al., 1994). A good sense of humor is consistently rated as an attractive trait. Compatible humor can enhance bonding and relieve stress (Bressler & Balshine, 2006). Eric Bressler and Sigal Balshine in their study titled "The influence of humor on desirability" found that, while a woman will say that man has a „good sense of humor“ when he jokes, a man will regard women as funny if they laugh at his jokes.

8. Short term vs. long term mating strategies

David Buss's short-term vs. long-term mating theories are primarily discussed within the framework of evolutionary psychology. Buss suggests that males are more inclined towards short-term mating strategies and although females also engage in short-term mating, they supposedly do so for different evolutionary reasons. Short-term mating strategies could be defined as behaviors individuals use to maximize their reproductive success. Long-term commitment is not the primary goal in this strategy. Women may seek partners with superior genetic qualities during ovulation when fertility is highest (Gangestad & Simpson, 2000). Both genders apply different selection criteria when engaging in different type of mating strategies. When males use short-term strategies, their preferences often lay within physical attractiveness and youth and generally show lower selectivity compared to long-term ones; women prioritize genetic benefits, high testosterone levels and resource provision.

Both genders behave in a way that signals commitment, reliability, and long-term resource investment when engaging in long-term mating strategies. When looking for a partner in long-term perspective, both genders are inclined to consider many more aspects of their potential mate. Fidelity, kindness, compatibility and partnership are just some of them, however, physical attractiveness still plays an important role (Buss, 1989).

9. Differences in attraction between males and females

Several studies proved that although there are some similarities in attraction preferencies between genders, there are also notable differences. Men are generally more focused on physical attractiveness in potential mates. This preference may be due to evolutionary pressures which favour indicators of fertility and health (Buss, 1989; Singh, 1993). While women do consider physical attractiveness, they tend to place greater emphasis on resource availability and stability. Traits such as social status, ambition and financial prospects are often more important to women because they might indicate ability to provide offspring (Buss, 1989; Li et al., 2002). Both genders value emotional stability, kindness and sense of humor, however for men, those come after physical attractiveness. Women place a higher importance on emotional stability and dependability in partners (Buss & Schmitt, 1993; Sprecher & Regan, 2002). Contemporary studies suggest that while men do appreciate resourceful women, it is also secondary to physical attractiveness (Buss, 1989). Women's attraction heavily leans on a partner's ability to provide (Trivers, 1972; Li et al., 2002). Men generally prioritize physical attractiveness over intelligence in initial selection, intelligence and competence become more valued and significant in long-term relationships. (Li et al., 2002; Buss & Schmitt, 1993). Women on the other hand, value intelligence and competence more. These traits might be perceived as indicators of a partner's ability to provide. (Buss, 1989; Kenrick et al., 1990). Men often prefer feminine features (softer jawline and higher-pitched voice) associated with higher estrogen levels and reproductive potential (Rhodes, 2006). Women's preferences for masculine features vary based on menstrual cycle phases and sociosexual orientation, in their fertile periods, there is notable preference for musculine features and feminine or softer features at other times (Penton-Voak et al., 1999). Men are also more likely to engage in short-term mating strategies where they prioritize physical attractiveness and youth. Long-term mating strategies still prioritize physical attractiveness but also traits that might indicate fidelity and nurturing ability (Buss & Schmitt, 1993; Gangestad & Simpson, 2000). Women are generally more selective and cautious in short-term mating contexts and emphasize physical attractiveness and genetic fitness. In long-term contexts, they prioritize resource availability, emotional stability, and compatibility (Trivers, 1972; Gangestad & Simpson, 2000).

Buss's theory also examines adaptive problems humans faced throughout evolutionary history and the strategies used to solve them such as: strategies for selecting mates who possess desirable traits (health, fertility etc. and avoiding those with undesirable traits (parasites, degeneration). He also identified behaviors aimed at retaining a mate and preventing them from straying, such as demonstrating commitment and jealousy. One of the strengths of Buss's theory and most admirable aspects is its cross-cultural applicability. Everything we know comes from extensive cross-cultural studies and consistent patterns in mate preferences across cultures, reinforcing the idea that these preferences are deeply rooted in human evolution (Buss, 1989).

10. Other theories of attraction

Since there are many other theories about attraction, I'll discuss at few of them:
Social Exchange Theory: The main idea of this theory, introduced by Thibaut & Kelley, is that human relationships are formed based on expected cost-benefits ratio and the expectations of reciprocity. People seek relationships that maximize their benefits and minimize their costs. Individuals also assess their option and make sure they can’t find a better relationship elsewhere (Thibaut & Kelley, 1959).

Attachment Theory, originally developed by John Bowlby and later elaborated by Mary Ainsworth, explores how early attachments to caregivers influence relationships later in life. Attachment styles developed in childhood can affect adult romantic relationships by influencing how individuals approach intimacy, trust and dependence (Bowlby, 1969; Ainsworth et al., 1978).

Similarity-Attraction Hypothesis suggests that people are attracted to those similar to them in terms of attitudes, values, interests, and personality traits because similarity provides cognitive consistency which makes interactions smooth, and predictable. These individuals also validate each other's beliefs and values (Byrne, 1971).

Interpersonal Attraction Theory explores factors between individuals that lead to attraction with focus on physical attractiveness (plays significant role in initial attraction), similarity, and proximity (geographic closeness) (Berscheid & Walster, 1978).

11. Conclusions on attraction and importance of deriving information from faces

The assessment of someone’s attraction happens faster than we realize. A study by Willis and Todorov (2006) examined how quickly after seeing an individual people form impressions about their attractiveness. This research concluded that individuals can make assessments of a person's attractiveness in 100 milliseconds. This rapid evaluation suggests that very little mental processing is required to form a judgement about a person's attractiveness. A lot of assessing happens on subconscious level so individuals do not often realize how complex are the cognitive processes involved. Human attraction is a complex phenomenon influenced by a mixture of biological, psychological and social factors. Evolutionary framework helps us explain why are certain physical features (facial symmetry, clear skin…) universally considered attractive. There is a network of brain regions involved in assessment of the attraction - each contributes to different parts of the process. These regions include the ventral tegmental area (VTA), the nucleus accumbens, the amygdala, and the prefrontal cortex. The VTA is a part of the brain's reward system. It plays a central role in the human experience of attraction. Viewing pictures of attractive individuals, results in heightened activity in the VTA (Aron et al., 2005). This area is rich in dopamine neurons which released in response to rewarding stimuli. It has a potential to reinforce beneficial behaviors and form habits. The amygdala is responsible for processing emotional reactions and social signals, including those related to attraction. It also helps us evaluate the emotional significance of stimuli. An increased amygdala activity can be observed as a response to individuals viewing attractive faces. (Winston, O'Doherty, Kilner, Perrett, & Dolan, 2007). Another involved brain region is the prefrontal cortex. It is responsible for higher-order cognitive processes, such as decision-making and social judgments. Prefrontal cortex integrates information from various sensory modalities and helps assess the overall desirability and attraction of potential partners. The medial prefrontal cortex (mPFC) is activated when making judgments about the attractiveness and trustworthiness of others (Cloutier, Heatherton, Whalen, & Kelley, 2008). The nucleus accumbens, is also key region of the reward system. Studies using fMRI showed that this part of the brain is active when individuals anticipate interactions with attractive people (Fisher, Aron, & Brown, 2005).

Facial perception is the end result of evolutionary processes that have allowed humans to quickly and accurately interpret other people's identity, emotional state and intentions. Facial perception also facilitates social cohesion and effective communication (Darwin, 1872). It is therefore undeniable that faces are rich source of information when assessing attraction, the question is, what happens when individual can't remember or recall faces?

12. Prosopagnosia

Prosopagnosia is defined as the inability to recognize known and new faces and identity of a person to which they belong. It is also known as facial/visual agnosia (Corrow, Dalrymple, Barton). The word comes from Greek *prosopon,* meaning face and *agnosia,* meaning lack of knowledge (Cabrero & De Jesus, 2023).

There are two types of prosopagnosia currently recognized. The first type is acquired. This stems from brain damage or trauma to the right fusiform gyrus of the cortex. The modern study of this condition began with Bodamer's report in 1947, where he described impaired face recognition in wounded soldiers (Bodamer, 1947). The second type is called developmental prosopagnosia. This refers to the inability to identify, recognize, and remember faces in the absence of obvious head trauma or other pathology to a person's brain.

The prevalence of developmental prosopagnosia in general population was considered to fluctuate from 1% to 2%, but a recent study conducted by researchers at Harvard Medical School and the VA Boston Healthcare System indicates that the number might be closer to 3.08 percent (DeGutis et al., 2023). The fluctuations across the findings are most likely caused by the variety of tools used to measure prosopagnosia.

Acquired prosopagnosia is mostly found in adults following acute brain damage. While early literature on hemispheric specialization indicated that the facial processing may be lateralized to the right hemisphere, „seminal autopsy studies on two small series of patients concluded that prosopagnosia was caused by bilateral lesions in the medial occipitotemporal cortex" (Damasio, Damasio, & van Hoessen, 1982; Meadows, 1974). These findings were later supported also by neuroimaging studies (Barton, 2008).

Prosopagnosia sufferers show a wide variability in severity. There are another two variants recognized within each developmental, and acquired prosopagnosia. Apperceptive and associative variant. While apperceptive prosopagnosia is broadly understood as the inability to perceive and to cognitively process a face an associative variant is defined as the inability to recognize, remember or apply any meaning to a face despite being able to perceive it. Anatomic substrate for apperceptive variant seems to point towards fusiform gyral lesions (Barton, 2008b). While associative variant (based on J. J. S. Barton (2008c) research) occurs when there is „damage to the right anterior temporal lobe, but only when there is associated damage to other structures, including the left anterior temporal lobe" (Barton, 2008).

What is it like to live with prosopagnosia? Healthy people should be able to remember 500+ faces over the course of their lives and generally perceives faces holistically, rather than focusing on individual features as prosopagnosic individuals do (Barton, 2008).

Prosopagnosia also significantly impacts social life, often leading to difficulties in recognizing friends, family members, and colleagues. That alone often causes social anxiety and embarrassment which leads many to avoid social situation. (Yardley et al., 2008) (Dalrymple & Palermo, 2016). Author with prosopagnosia named Heather Sellers, described growing up with the condition without knowing it had a name or that it was a recognized neurological disorder. She writes about how her inability to recognize faces led her to social isolation, avoidance and misunderstanding from others, including her own family. The psychological impact of prosopagnosia is intensely overwhelming (Sellers, 2010). Individuals with prosopagnosia usually develop number of strategies and copying mechanisms to help them better identify who is the person they are interacting with. Anything from voice, smell, posture, unique features, glasses or height might be helpful (Barton, 2008). This reliance on contextual and non-facial information proves that there are some adaptive responses in place.

12.1. Developmental Prosopagnosia

In developmental prosopagnosia, individuals experience lifelong problems with face recognition without any identifiable brain damage (Bentin et al., 1999; de Gelder and Rouw, 2000b, 2001). Although prosopagnosia can sometimes affect other recognition tasks (de Gelder et al., 1998), it primarily affects face recognition, with individuals generally functioning normally when it comes to recognizing other visual stimuli. Developmental prosopagnosia is thought to have a genetic component because it is often passed from parents to children (Duchaine, 2000). Studies using neuroimagining techniques have shown that individuals with prosopagnosia have reduced activity in the fusiform face area (FFA) and other face-processing regions of the brain (Avidan et al., 2005). Duchaine (2000) also suggests that developmental prosopagnosia may be the result of atypical development of the neural networks involved in face processing.

The study by Brunsdon et al. (2006) called *Developmental prosopagnosia: A case analysis and treatment study* identified several cognitive deficits associated with developmental prosopagnosia:

1. Configural Processing Deficits: As previously mentioned, individuals with developmental prosopagnosia struggle with overall configuration of faces, which is crucial for recognition.

2. Feature Integration Problems: Individuals with prosopagnosia experience difficulty integrating individual facial features into a coherent whole so they have to rely on isolated features.
3. Memory Deficits for Faces: Impaired ability to form and recall memories of faces.
4. Holistic Processing Issues: Challenges in processing faces holistically.

Prosopagnosia is defined as the inability to recognize known and new faces and identity of a person to which they belong. It is also known as facial/visual agnosia (Corrow, Dalrymple, Barton). The word comes from Greek *prosopon,* meaning face and *agnosia,* meaning lack of knowledge (Cabrero & De Jesus, 2023).

Several specialized neural mechanisms are present to provide us with the ability to process and understand facial information. The fusiform face area (FFA), located in the temporal lobe, is found to be most important for recognizing faces (Kanwisher, McDermott, & Chun, 1997)

The nature of developmental prosopagnosia has prompted a debate whether the disorder occurs during face perception, for example, when comparing two faces presented consecutively, or during face memory, for instance, when trying to access a memory of the face presented (Liu et al., 2021).

12. 2. Diagnosing Prosopagnosia

Up to this day there is no standard unified procedure of diagnosing prosopagnosia. Researchers are forced to use quite limited range of facial processing tests. The most often used test is the Cambridge Face Memory Test (CFMT: Duchaine & Nakayama, 2006; Arrington et al., 2022). CFMT asks participants to identify one of six previously shown target faces from a lineup which includes the target face and two lures. Difficulty is increased by the final section, where participants are also asked to identify faces, but with added visual noise. The test contains 72 trials in total, and participants get one point for each correct response. CFMT is also commonly used to assess face memory abilities in neurotypical samples (e.g., Bate et al., 2019; Dennett et al., 2012; McKone et al., 2012) (Burns et al. 2022). CFMT has been also found to not produce consistent results: Some subjects do not meet the diagnostic criteria of CFMT on one day, but will meet them another. (Murray & Bate, 2020). CFMT also requires a relatively long time to administer.

Another neuropsychological test is Benton Facial Recognition Test (BFRT). It is a „face matching task that is traditionally administered face-to-face using hard copy materials. It consists of 54 tasks in which participants are asked to compare faces presented in different lighting conditions and angles (Benton & Van Allen, 1968). It has shorter administration time compared to CFMT. It has also been criticized for not producing consistent results.

Famous Faces Test evaluates an individual's ability to recognize well-known public figures. This test relies on pre-existing knowledge therefore might be very culturaly and generationaly biased. (Duchaine & Weidenfeld, 2003).

Prosopagnosia Index (PI20) is a self-report questionnaire designed to assess subjects experience of face recognition difficulties in every-day life. It contains 20 items that participants rate based on the severity of their hardship (Shah et al., 2015). Respondents indicate the extent to which they agree with each statement from strongly disagree to strongly agree. PI20 is very easy to administer and score, it is commonly used in clinical settings. Many argue that the subjective nature of the tests might introduce bias. Clinical interviews conducted by neuropsychologists or neurologists can also provide valuable qualitative data about an individual's face recognition abilities. Due to the complexity of facial blindness it is recommended to involve multiple diagnostic tools to assess individuals recognition abilities. Assessing both perceptual and mnemonic aspects of

face processing also allows differentiation between different types of prosopagnosia. There is also a number of neuroimaging techniques that can help with diagnosing process. One of them being structural MRI which provides detailed images of brain anatomy and is able to detect abnormalities in brain structures. Functional MRI (fMRI) measures brain activity by detecting changes in blood flow. It is also useful in identifying functional abnormalities in brain. Diffusion Tensor Imaging (DTI) maps the diffusion of water molecules in brain tissue and is able to visualize white matter. Electroencephalography (EEG) and Magnetoencephalography (MEG) both measure electrical activity and magnetic fields generated by neuronal activity. They are used to study the timing of brain responses, both less costly and invasive than fMRI. Neuroimaging techniques are usually not commonly used in clinical settings.

12.3. Comorbidity of prosopagnosia.

Even the first Bodamer's findings (Bodamer, 1947) point towards the fact that prosopagnosia is both syndrome and a symptom. Soldiers that suffered head trauma to specific areas of brain have only sparely shown face-blindness as an one and only symptom resulting from this trauma when it comes to injury as a main cause, however as Barton (2008) points out, face blindness can be also „one of many deficits in patients with widespread cognitive dysfunction, as in Alzheimer's disease, Huntington's disease, Parkinson's disease, autism, and schizophrenia.“ It is because of this wide variety of manifestations, underlying causes and intensity, we decided to focus strictly on developmental forms of prosopagnosia when looking for respondents which meant ruling out all the subjects with severe head injuries, or illnesses that might have started later in life, those will be listed in the table regarding general health status of participants. Recent research puts significant emphasis on subjects with autism spectrum disorder (ASD) and its link to developmental prosopagnosia. Autism Spectrum Disorder (ASD) and prosopagnosia are both different neurodevelopmental conditions but share some similarities. Research has identified abnormalities in specific brain regions and networks in both autism and prosopagnosia. In ASD, there are often atypicalities found in the fusiform face area (FFA) (Schultz, 2005). Similarly, individuals with prosopagnosia typically show ' functional impairments in the FFA and other related areas such as the occipital face area (OFA) and the anterior temporal lobe (Barton et al., 2002).There is enough evidence that individuals with this neurodevelopmental condition face challenges in tasks that involve facial processing. Multiple meta-analyses and numerous case-control studies have shown that these individuals generally experience moderate difficulties (Kamensek et al., 2023).

12.4. Attraction and prosopagnosia

It is unknown whether individuals with developmental prosopagnosia have different idea of general attraction and whether their preferences differ from the unimpaired population. While researching an online forums and discussions on prosopagnosia to get more first-hand experience, I came across an insightful debate in which member was asked to describe what "attractive" means to them. The following answer is intriguing: *„I don't know what the general population finds attractive (of course, I know what is believed to be most attractive to most straight women, perpetuated by the media - masculine faces, muscles, tall, etc., but I don't know whether this is actually an accurate representation of what's attractive to the general population of straight women) I don't have a 'type'. I don't know whether any differences I have in who I'm attracted to are due to my prosopagnosia, my autism, or biological/genetic suitability (or a host of other factors which could influence attractiveness) (Smith, n.d.).“*

If a significant part of what we consider attractive is derived from facial features, and the preferred traits are simply subconscious predictors of fitness, shouldn't this system stay intact for individuals with prosopagnosia? Or do they fail to recognize facial traits as predictors in the first place and instead use other traits as predictors?

13. The present thesis

In the present thesis, I sought to examine what people with prosopagnosia find attractive about a potential partner relative to people without prosopagnosia. The following hypotheses were tested:

Hypothesis 1: Participants with prosopagnosia will score higher on the PI 20 than controls.

Hypothesis 2: Participants with prosopagnosia will differ from controls on the importance of physical features of attraction overall.

Hypothesis 3: Participants with prosopagnosia will respond less to facial cues than controls.

Hypothesis 4: Participants with prosopagnosia will not be able to picture a face when experiencing sexual fantasy

Hypothesis 5: Participants with prosopagnosia will emphasize auditory and olfactory cues more than the control group.

Hypothesis 6: Participants with prosopagnosia will emphasize height, muscle tone, and body shape more than facial features more than the control group.

14. Methods

A cross-sectional online survey was used to test these hypotheses and was hosted on Survio.com. A wide range of questions were included to acquire information on participant demographics, attraction preferences, and face recognition ability. The survey consisted of four components: demographic data, 5- and 9-point Likert scales, yes/no questions, and the PI20 questionnaire. A total of 140 participants were recruited, including individuals diagnosed with prosopagnosia, individuals without an official prosopagnosia diagnosis but who nevertheless had symptoms of prosopagnosia, and a control group without face recognition impairments. The goal was to recruit at least 20 male and 20 female subjects of reproductive age in two groups, one with prosopagnosia and a control group without prosopagnosia. Data collection commenced on 02/13/2024 and ended on 10/06/2024. Participants were recruited either through social media under "#prosopagnosia" where we contacted them in private chats after seeing that they had shared a post or talked about their life with prosopagnosia, or prosopagnosia forums on various sites. The normative data of people who did not have prosopagnosia were collected based on proximity and availability from our circles. Every effort was made to match participants on age and gender for both groups.

15. The questionnaire

The questionnaire (see Appendix 1) consisted of 42 questions. The first nine questions collected demographic data such as age, gender, sexual orientation, and their level of education.

Questions 10-13 consisted of questions about the general health status of participants. This included past diagnoses of prosopagnosia and other disorders (depression, anxiety, brain damage, etc.).

The aim of questions 14 to 16 was to find out how important are the physical attributes in decision making when choosing a partner and which attributes specifically hold the greatest significance.

Questions 17 to 20 measured levels of importance of different attractive features (facial features, personality, olfactory attributes, auditory cues) on a 5-point Likert scale.

Questions 21 to 23 assessed how much participants felt their partners matched their attraction preferences, and also whether participants could experience a difference between the mental image of their partner and their actual appearance. We also asked about participants' ability to visualize faces in their minds, specifically whether they can imagine someone's face when they are thinking of them. Additionally, we also looked at the role of facial imagery in sexual fantasies, examining whether participants perceive faces as both present and visible during sexual fantasies.

The last cluster of questions consisted of the 20-item prosopagnosia index (PI-20), a self-report instrument for identifying developmental prosopagnosia. It provided evidence of impairment and the level of severity. Although there are several tests that can reveal prosopagnosia, including the Benton Face Recognition Test, several versions of the Famous Faces Recognition Test (FFRT), the Cambridge Face Memory Test (CFMT), and the Cambridge Face Perception Test (CFPT) (Shah et al., 2015), the PI-20 has been validated and contains a clinically-relevant cut off score of 65 (Tsanti, Vestner, & Cook, 2021).

For the PI-20, participants reflected on 20 statements regarding their facial recognition/ memory on five-point scale with range from 'strongly agree' to 'strongly disagree.' Each item is rated on a 5-point Likert scale, where: 1 = Strongly disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly agree. Items 8, 9, 13, 17 and 19 were reverse scored. i.e., 5 = 1; 4 = 2; 3 = 3; 2 = 4; 1 = 5. The numbered responses added together to calculate a score between 20 (unimpaired face recognition) - 100 (severely impaired face recognition) (Dalrymple, Garrido, & Duchaine, 2014). Our findings for the face-blind group were following: Mean (Average) calculated by the sum of all scores and divided by the number of scores was 77.91, with median being 81 and standard deviation 17.32. We also calculated if there are any significant outliers using the Interquartile Range (IQR) method. Outliers are values below the lower bound or above the upper bound. Our calculation identified any value below 55.75 as a significant lower outlier. Therefore three of our participants (52, 53, 55) scored significantly lower than the rest of the data set, which might indicate that these individuals reported much fewer face recognition difficulties if some compared to others. The higher the score, the more severe is the prosopagnosia. The exact threshold values may vary, depending on the specific context of the study or clinical setting, but in general, scores above 65 out of 100 are considered to be evidence of severe prosopagnosia. Scores between 40 and 60 suggest mild prosopagnosic traits. Healthy individuals are expected to score less than 40, which indicates normal facial recognition abilities (Tsanti, Vestner, & Cook, 2021). There were 8 participants that didn't meet the criteria to be considered prosopagnosic (scored bellow the 65 points in PI20), their scores were: 60, 55, 53, 52, 57, 57, 62, 60. Sixteen people, (approximately 34.04% of the sample) reported that they were diagnosed with developmental form of prosopagnosia, 2 people, (4.26%) suffered from an acquired form and 27 (57.45% of the sample) participants reported that they haven't been diagnosed but they have symptoms and 2 participants (approximately 4.26%) of the sample reported that they haven't been diagnosed and don't experience any of the clinical symptoms of prosopagnosia. Those two participants also didn't meet the cut-off (65 points) in PI20. Eighteen participants out of our prosopagnosic sample reported to be officially diagnosed with prosopagnosia, which is approximately 38.30% of the sample and approximately 61.70% (29 people), were not diagnosed. Therefore larger proportion of the sample was not diagnosed.

16. Statistical analyses

All Likert-scale data and total PI-20 scores were analyzed by 2 (Group: Prosopagnosia versus Control) by 2 (Sex: Self-identification as natal Female or Male) factorial analyses of variance (ANOVAs) to assess main effects of group, sex, and their interaction. For each significant interaction, post-hoc Tukey HSD tests were run on the individual means. Effect size estimates were made using partial eta squared (ηp^2). χ^2 tests with 1 df were used to assess the proportion of participants who answered forced-choice "yes-no" questions. Statistical significance was set for all analyses at $p<0.05$. A trend toward significance was considered if the p values were between 0.05 and 0.1. Statistical analyses were made using Statistica v7.0 (Statsoft, 2007). All statistical analyses are shown in Appendix 2.

17. Results

The survio data included the amount of time it took to answer the questionnaire for each participant. This ranged from 5 minutes to 16 minutes, 15 seconds and the average time it took to complete the questionnaire was 7 minutes and 30 seconds for the control group and 6 minutes and 11 seconds for the prosopagnosia group. Most participants completed all parts of the questionnaire, for a return rate of 87%.

There was more variance in sexual orientation in the prosopagnosia group relative to the control group, and three participants indicated no sex and a nonbinary gender, a number too small to be included in the statistical analyses. However, all the other participants in both groups rated their gender the same as their sex for 100% concordance. There were no significant differences between the number of individuals who were single or in a relationship in either group, which was split nearly in half for both groups, $F(1,133) = 0.51$, $p = 0.45$. Likewise, no significant sex differences were found for relationship status, $F(1,133) = 0.009$, $p = 0.92$, nor was there a significant interaction of Group x Sex, $F(1,133) = 0.07$, $p = 0.79$. Participants in the control group (N=94) ranged in age from 18 to 60 and were largely female (74%), whereas participants in the prosopagnosia group (N=45) were almost evenly split between females and males, therefore the gender distribution in the prosopagnosic group being of 54.55% female participants, 45.45% male. Although the demographic questionnaire asked separate questions about sex and gender, all of the participants in both groups had identical sex and gender self-identification. Average age of the prosopagnosic group was 31.276 years while the control group was 23.956 years old. The sexual orientation distribution for the prosopagnosic group consisted of 55.32% straight participants, 31.91% bisexual participants, 10.64% asexual participants, and 2.13% pansexual participants. Control group's sexual orientation was: 72.60% straight participants, 23.29% bisexual participants, 2.74% pansexual participants and 1.37% asexual participants.

Participants with prosopagnosia had either been diagnosed with acquired (N=16) or developmental forms (N=2), or were not previously diagnosed but had significant trouble identifying faces (N=29). A one-way ANOVA for the scores on the PI 20 detected a significant overall difference between these subgroups, $F(3,43) = 8.33$, $p = 0.0002$, with a large effect size, $\eta p2 = 0.37$. Posthoc Tukey tests revealed that the participants diagnosed with prosopagnosia (acquired and developmental) scored significantly higher than the undiagnosed, though all but one of the undiagnosed were above the clinical cut-off of 65 for the PI 20. However, because the score of the one participant that fell slightly below the cut-off was more than 2 standard deviations above the highest score in the control group, the data of this participant were retained for subsequent analyses.

Education levels among the prosopagnosic participants were distributed as follows: 19 participants had a high school diploma (40.43%), 18 had a bachelor's degree (38.30%), 5 had a master's degree (10.64%), 3 had a doctorate (6.38%), and 2 had less than a high school education (4.26%). In the intact group, 49 participants had a high school diploma (52.69%), 33 had a bachelor's degree (35.48%), 9 had a master's degree (9.68%), and 2 had less than a high school education (2.15%) (see appendix 3).

Most of out participants were white with 91.49% in the prosopagnosic group, asian 4.26% and 4.26% of African American. Intact group consisted of 82.8% white subjects, 9.68% African American subjects and 7.53% asian subjects. The control group is therefore slightly more diverse, compared to the prosopagnosic group. Most of the participants from prosopagnosic group are dating (42.55%) or single (38.30%) with only 12.77% being engaged and 6.38% participants married.

When it comes to relationship status of our control group, most of the participants reported that they are dating (54.26%), 41 participants are single (43.62%) with small percentage of engaged (1.06%) or married (1.06%) subjects. Univariate tests of significance for orientation shown that the group factor is not significant ($p > 0.45$), meaning that there is no significant difference in relationship status of prosopagnosic participant and participant from the control group. Group membership did not significantly affect relationship status. Prosopagnosic individuals are in relationships as often as the control group. The multiple regression analysis also didn't indicate that gender has a significant effect on the relationship status. The very low R-squared (0.00085679) and adjusted R-squared values (-0.00638338), along with a non-significant F-statistic (0.1183384) and p-value 0.731367), suggest that gender is not reliable predictor of relationship status of our participants. Orientation also didn't turn out to have significant effect on the relationship status of participants. The very low R-squared (0.00454362) and adjusted R-squared values (-0.00266983), together with a non-significant F-statistic (0.6298818) and p-value (0.428761), suggest that orientation does not a reliably predict relationship status. Demographic data for sexual orientation are shown in Table 1.

Table 1 - Breakdown: Group x Sex x Orientation

Group	Sex	Hetero (n, %)	Homo (n, %)	Bi (n, %)	Asexual (n, %)	Pansexual (n, %)
Con	Fem	50 (70%)	1 (1%)	13 (19%)	4 (6%)	2 (3%)

Con	Male	20 (91%)	1 (4.5%)	0	1 (4.5%)	0
Proso	Fem	7 (30%)	2 (9%)	6 (26%)	6 (26%)	2 (9%)
Proso	Male	13 (68%)	3 (16%)	2 (11%)	0	1 (5%)

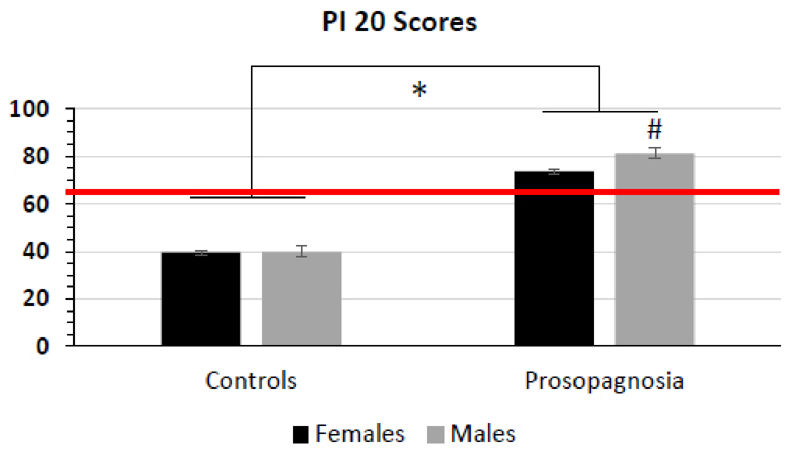
Orientation scores differed significantly between groups. Our prosopagnosic participants are more likely to be of different orientation than our 72.60% straight control group. The sex factor is also significant ($p < 0.0003$), indicating that women within prosopagnosic group reported different than heterosexual orientation more often than men. The interaction between group and sex is not significant ($p > 0.1647$) (See appendix 2). We also ran multiple regression analysis to see whether orientation could predict attraction. Orientation of our participants has a strong and significant impact on attraction (orientation beta=.684). On the other hand, gender did not predict orientation (Gender beta=-.01) and orientation also doesn't predict relationship status of participants. The relationship between Orientation and PI20 is weak but significant, while the relationship between PI 20 and Orientation is very weak and not significant. We ran regressions both ways. Gender is also not a good predictor of Relationship Status (appendix 2, regression analysis).

18. Hypothesis 1: Participants with prosopagnosia will score higher on the PI-20 than controls.

Figure 1 shows the average PI-20 scores for female and male participants in the control and prosopagnosia groups, with the clinical threshold for prosopagnosia set at 65 (Tsantani, Vestner, & Cook, 2021) and depicted in red. Sixteen people (34.04% of the sample) reported that they were diagnosed with the developmental form of prosopagnosia, 2 people, (4.26%) suffered from an acquired form and 29 people (61.7% of the sample) reported that they had not received an official diagnosis despite having symptoms. All participants in the prosopagnosia group were included for statistical analysis.

The ANOVA detected a significant main effect of group, $F(1,113) = 346.00$, p=0.000001, with a large effect size, ηp^2=0.72. The mean score on the PI-20 was significantly larger (and above the cutoff of 65) for participants with prosopagnosia compared to the control participants. The ANOVA detected a trend toward a significant main effect of sex, $F(1,133) = 3.71$, $p = 0.056$, with males showing a larger score than females, and a trend toward a significant interaction, $F(1,133) = 3.21$, $p = 0.072$. Posthoc Tukey tests showed that males in the prosopagnosia group were higher than women in the prosopagnosia group, but no differences between females and males in the control group.

Thus, the first hypothesis was confirmed. Collectively, participants with prosopagnosia in the present study had mean scores significantly higher than controls, and higher than the clinical cut-off of 65.



<u>Figure 1</u>: PI-20 scores (out of 100) for females and males in the control and prosopagnosia groups. *p<0.05. #p=0.056 (trend) from females in the prosopagnosia group. Data are means ± SEM. The red line indicates the clinical cutoff for the diagnosis of prosopagnosia.

The ANOVA did not detect a significant main effect of Sex, nor a significant Group x Sex interaction. The interaction effect of Group and Sex (Group*Sex) had an SS of 347.9, an MS of 347.9, an F value of 3.208, and a p-value of 0.075536. This indicates that the combination of group and sex might have an effect on PI20 scores, but this effect is also not statistically significant. The mean PI20 scores of the control group (group 1) are very similar for both females (39.59155) and males (39.86364). However, in the prosopagnosic group (group 2), males have higher mean PI20 scores (81.15000) compared to females (73.62500). the p-value (0.07554) indicates that these differences are also not statistically significant (considering 0.05 threshold).

Despite the prosopagnosia group scoring significantly higher on the PI-20 than the control group, it was of interest to see if any differences existed between those that were diagnosed with acquired (N=16) and developmental forms (N=2) and those that had not been diagnosed but claimed symptoms and scored higher on the PI-20 than controls (N=29). Because there were only two individuals with developmental forms, we collapsed their data with the acquired group to obtain diagnosed vs. undiagnosed groups. A one-way ANOVA for the scores on the PI-20 detected a significant overall difference between these subgroups, $F(1,45) = 14.96$, $p = 0.00003$, with a large effect size, $\eta p^2 = 0.25$. Participants diagnosed with one of the two forms of prosopagnosia (acquired and developmental) scored significantly higher than the undiagnosed. The mean ± SEM for the diagnosed were 84.72 ± 2.41, and for the undiagnosed were 72.86 ± 1.90. All but one participant in the undiagnosed group scored above the clinical cut-off of 65 for the PI-20. However, because the score of that one participant that fell slightly below the cut-off was more than 2 standard deviations above the highest score in the control group, this participant's data were included in the analyses.

Table 2 - Scores of the prosopagnosia types on the PI 20:

Effect	SS	Degr. Of Freedom	MS	F	P
Intercept	77970.11	1	77970.11	844.9160	0.000000
„Var1"	2307.21	3	769.07	8.3340	0.000176
Error	3968.10	43	92.28		

19. Hypothesis 2: Participants with prosopagnosia will differ from controls on the importance of physical features of attraction overall.

This hypothesis was tested by asking participants to rate the importance of overall physical attractiveness for a relationship on a 0 to 5-point Likert scale (Figure 2). The 2 x 2 factorial ANOVA found a significant main effect of group, $F(1,133) = 31.11$, $p = 0.000001$, with a large effect size, $\eta p^2 = 0.19$. The ANOVA also found a significant main effect of sex, $F(1,133) = 7.07$, $p = 0.009$, with a small to moderate effect size, $\eta p^2 = 0.05$. There was no significant Group x Sex interaction.

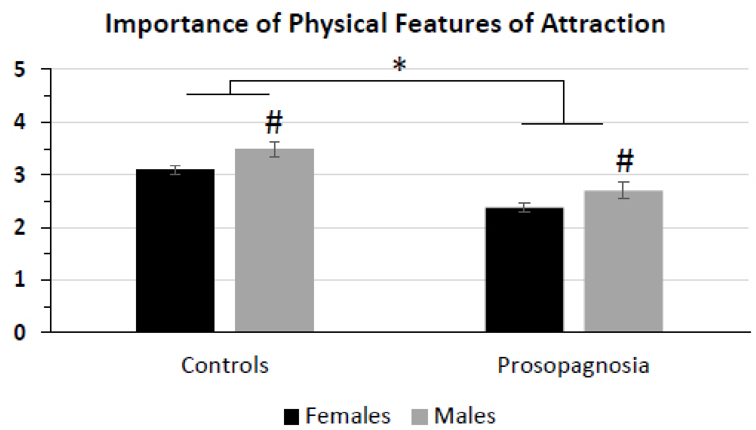
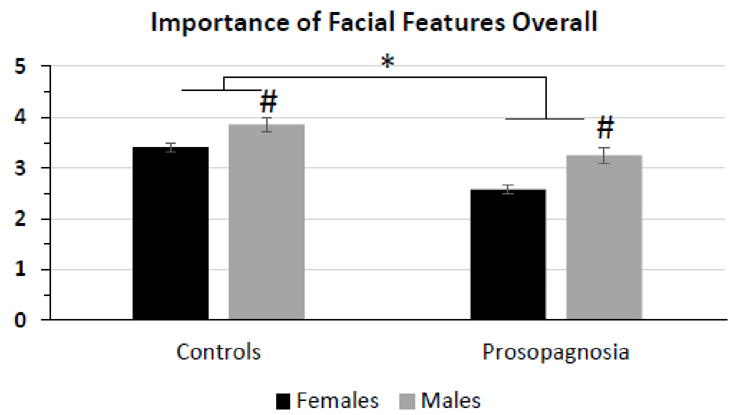


Figure 2: Importance of physical features of attraction for females and males in the control and prosopagnosia groups on the 5-pt Likert scale. *p<0.05 (group). #p<0.05 males vs. females. Data are means ± SEM.

20. Hypothesis 3: Participants with prosopagnosia will respond less to facial cues than controls.

This hypothesis was tested by asking participants about the importance of facial features overall for attraction on the 0 to 5-point Likert scale (Figure 3), the importance of an attractive face as a characteristic that individuals must have to be considered attractive on the 0 to 9-point Likert scale (Figure 4), whether facial symmetry, certain facial characteristics, eye color, and smile were important characteristics for attractivity on a Yes-No forced choice (Figure 5).

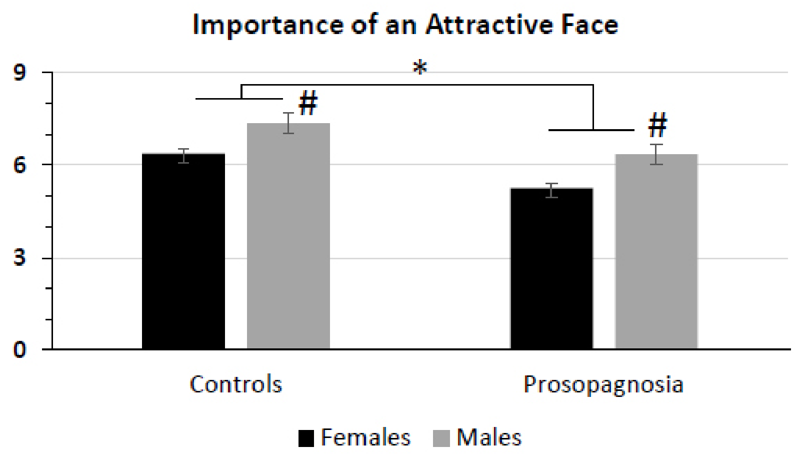
The importance of facial features overall was significantly higher for controls than for prosopagnosics, $F(1,133) = 20.85$, $p = 0.00001$, with a large effect size, $\eta p^2 = 0.14$. The ANOVA also found that facial features were significantly more important for males than females overall, $F(1,133) = 12.67$, $p = 0.0005$, with a moderate effect size, $\eta p^2 = 0.09$. There was no significant interaction of Group x Sex.



<u>Figure 3</u>: Importance of facial features overall for females and males in the control and prosopagnosia groups on the 5-pt Likert scale. *p<0.05 (group). #p<0.05 males vs. females. Data are means ± SEM.

The data confirms that there are differences between how groups and sexes perceive the importance of facial features, with control group and female participants valuing these attributes more.

The importance of an attractive face as a characteristic that individuals must have to be considered attractive was also found to be significantly different between group and sex and was similar to what was found for the question about the importance of facial features overall. This importance was significantly greater for the controls than prosopagnosics, $F(1.133) = 12.45$, $p = 0.0005$, with a moderate effect size, $\eta p2 = 0.09$. This importance was also greater for males than females overall, $F(1.133) = 12.07$, $p = 0.0006$, with a moderate effect size, $\eta p^2 = 0.09$. There was no significant interaction of Group x Sex.



<u>Figure 4</u>: Importance of an attractive face for females and males in the control and prosopagnosia groups on the 9-pt Likert scale. *p<0.05 (group). #p<0.05 males vs. females. Data are means ± SEM.

Whether facial symmetry, certain facial characteristics, eye color, and smile were important characteristics for attractivity was made on a Yes-No forced choice, and analyzed by χ^2 tests. Although facial symmetry was not significantly different between the groups, $\chi^2 = 2.12$, $p = 0.45$, certain facial characteristics were, $\chi^2 = 12.14$, $p = 0.0005$, as were eye color, $\chi^2 = 4.26$, $p = 0.03$, and smile, $\chi 2 = 5.11$, $p = 0.02$. In each of the significant cases, a greater proportion of participants with prosopagnosia found those features to be <u>less important</u> relative to controls.

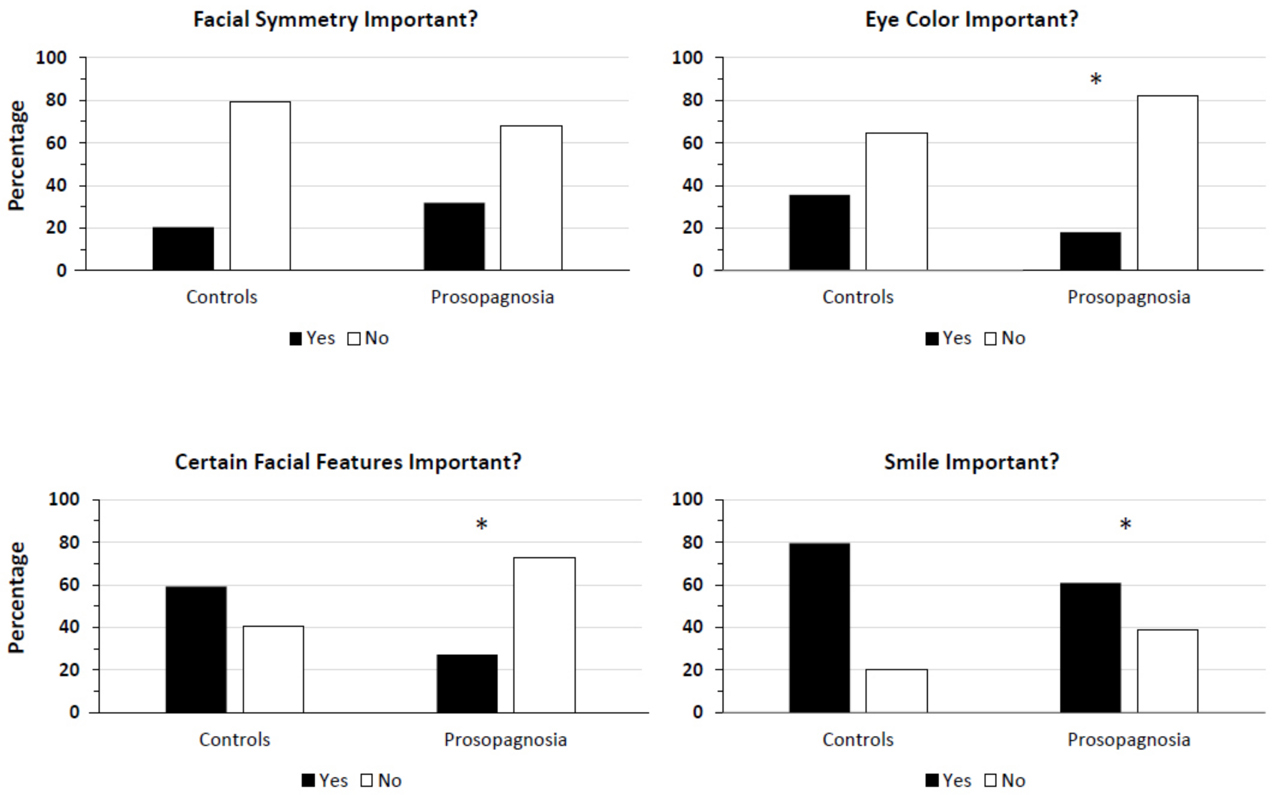
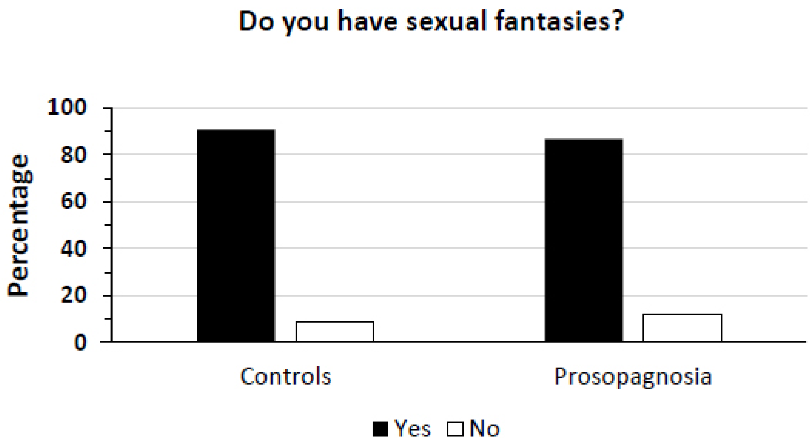
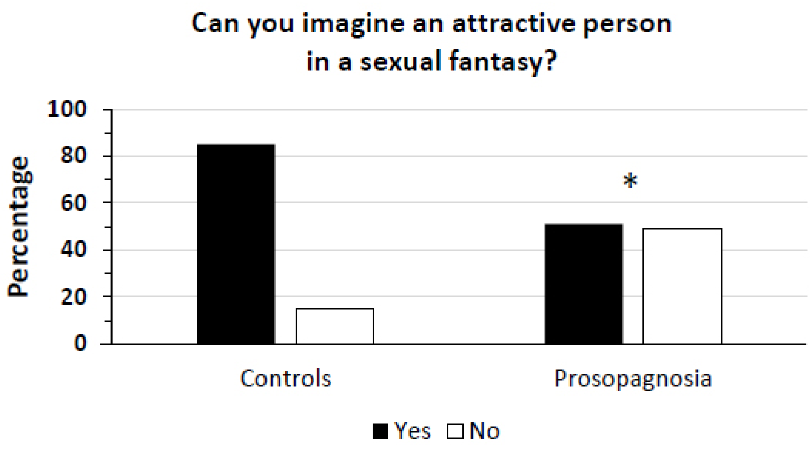


Figure 5: Facial features as important characteristics for attraction. *$p<0.05$ for prosopagnosics vs. controls.

21. ***Hypothesis 4: Participants with prosopagnosia will not be able to picture an attractive person when experiencing sexual fantasy.***

This hypothesis was addressed by Questions 22 and 23, which asked whether participants had sexual fantasies, and whether they imagined an attractive person in their sexual fantasies (Figure 6). Although there was no significant difference in the proportion of participants in either control or prosopagnosia groups that reported having sexual fantasies, $\chi^2 = 0.34$, $p = 0.56$, a significant difference was found between the groups for the proportion of individuals that imagine an attractive person in their sexual fantasies, $\chi^2 = 19.09$, $p = 0.000001$. In this case, significantly fewer participants with prosopagnosia reported imagining an attractive person in their sexual fantasies.





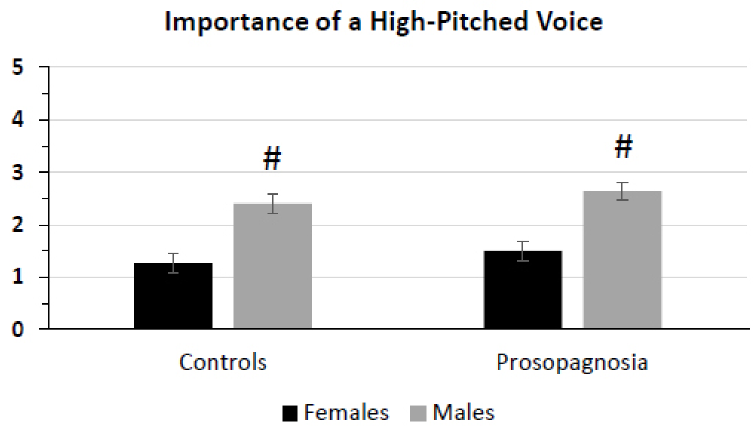
<u>Figure 6</u>: Top: Proportion of individuals in the control and prosopagnosia groups that report having sexual fantasies. Bottom: Proportion of individuals in the control and prosopagnosia groups that report imagining an attractive person in their sexual fantasies. *$p<0.05$ between prosopagnosia and control groups. These findings suggest that the control group not only experiences sexual fantasies somewhat more frequently, but also has a higher capability of imagining someone attractive during these fantasies compared to the face-blind group of respondents. Suggesting that face-blind individuals may face difficulties in visualizing attractive faces during their sexual fantasies.

Table 3 - *Do you experience sexual fantasies? Are u able to picture someone attractive when experiencing sexual fantasy?*

Group	Experiences Sexual Fantasies	Doesn't Experience Sexual Fantasies	Able to Picture Someone Attractive	Unable to Picture Someone Attractive
Face-Blind	87.23%	12.77%	44.68%	42.55%
Control	90.32%	9.68%	78.49%	11.83%

22. Hypothesis 5: Participants with prosopagnosia will emphasize auditory and olfactory cues more than the control group.

This hypothesis was addressed by Questions 19 and 20 of the 5-point Likert scale regarding the importance of voice and smell overall in assessing a person's attractivity, and Questions 15, 19, and 16 of the 9-point Likert scale assessing smell, deep voice, and high-pitched voice as features someone should have to be considered attractive. None of those characteristics differed significantly between the groups, and they were all on the lower end of the Likert scales. Research has shown that prosopagnosic individuals might compensate for their lack of face memory with an enhanced voice recognition skills or at least pay more attention to voice attributes in general. Hoover, Démonet, and Steeves (2010) examined a patient diagnosed with acquired prosopagnosia and object agnosia, and while the patient struggled with visual recognition tasks (faces and cars), he excelled in recognizing voices and car horns. However, the ANOVA detected a significant effect of sex for having a high-pitched voice, $F(1,133) = 47.23$, $p = 0.00001$, with a large effect size, $\eta p^2 = 0.26$. Males in both groups found a high-pitched voice overall more important as an attractive feature than females did (Figure 7).

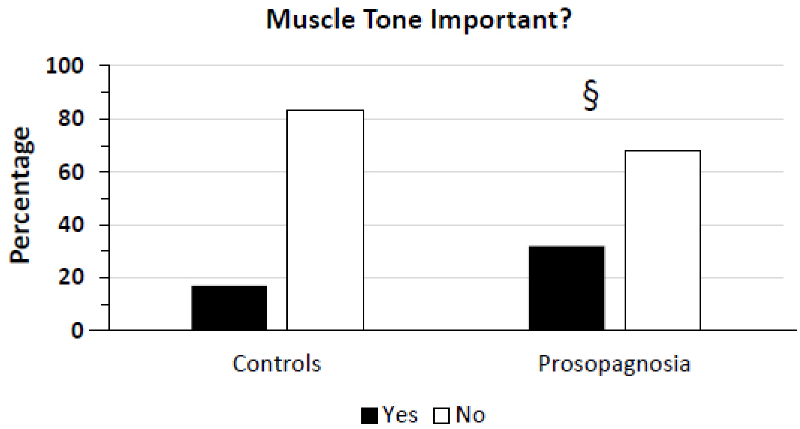


<u>Figure 7</u>: Importance of a high-pitched voice for females and males in the control and prosopagnosia groups on the 5-point Likert scale. #p<0.05.

Regarding olfactory attributes, women in the control group (mean = 4.140845) rated olfactory attributes higher than men (mean = 3.909091). Men in the prosopagnosic group (mean = 4.000000) rated this attribute higher than women (mean = 3.583333). Men in both groups attached similar importance to the smell of their potential partner (mean = 3.909091 vs. mean = 4.000000).

23. Hypothesis 6: Participants with prosopagnosia will emphasize height, muscle tone, and body shape more than the control group.

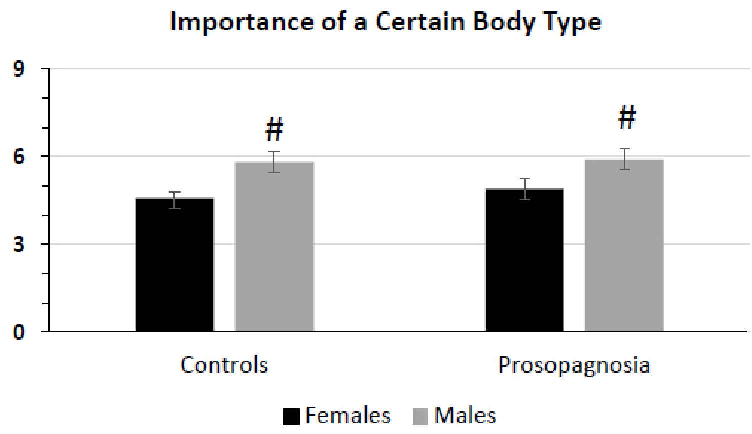
This hypothesis was addressed by Questions 16 and 15 regarding certain body type and preferred height in the 9-point Likert scale, and Questions 14 and 13 regarding body shape, height, and muscle tone in the Yes-No forced choice. As with Hypothesis 5, no significant group differences were found by the ANOVA or χ^2 tests on these measures. However, a trend toward significance between groups was found for muscle tone, $\chi^2 = 3.73$, $p = 0.053$, with a greater percentage of participants in the prosopagnosia group stating this feature was important for attraction (Figure 8).

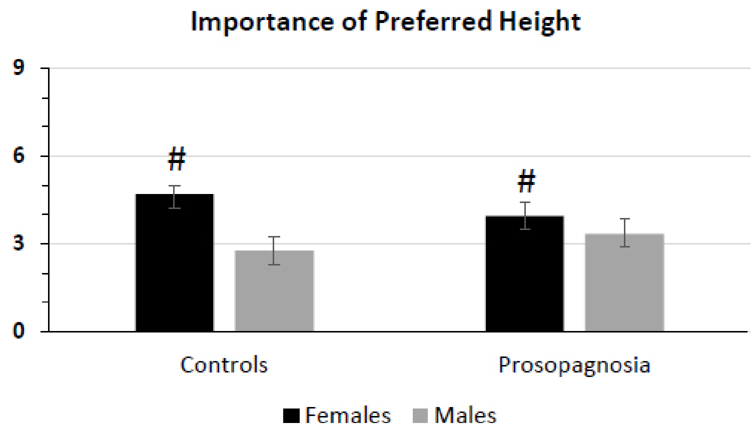


<u>Figure 8</u>: Importance of muscle tone for attraction between controls and prosopagnosics. § = trend toward significance ($p = 0.053$).

Although there were no other group effects, the ANOVA found a significant main effect of sex for certain body type, $F(1,133) = 12.56$, $p = 0.0005$, with a moderate effect size, $\eta p^2 = 0.09$. Significantly more males in both groups found body type important relative to females. There was a significant main effect of sex for preferred height, $F(1,133) = 8.52$, $p = 0.004$, with a moderate effect size, $\eta p^2 = 0.06$. In this case, females in both groups found height to be more important than males. These effects are shown in Figure 9.

<u>Figure 9</u>: Top: Importance of a certain body type for females and males of both groups. Bottom: Importance of preferred height for females and males of both groups. Both assessments made on the 9-point Likert scale. #p<0.05 from the other sex. Body type was rated 6.366197 on average by females and 7.363636 by males from control group. The mean importance of body type for prosopagnosia group females is 5.250000 while for prosopagnosia group males scored 6.350000 on average. Therefore control group males placed the highest importance on body type with mean =





7.363636, while females from prosopagnosia group placed the lowest importance on body type (mean = 5.250000). These results suggest that males, regardless of which group, place mre importance on body type than females.

Studies have consistently proved that women tend to prefer taller men as partners, while men prefer women who are shorter than themselves (Buss, 1989; Pawlowski, 2003; Stulp, Buunk, Verhulst, & Pollet, 2013). Our results on height preferences are consistent with existing literature.

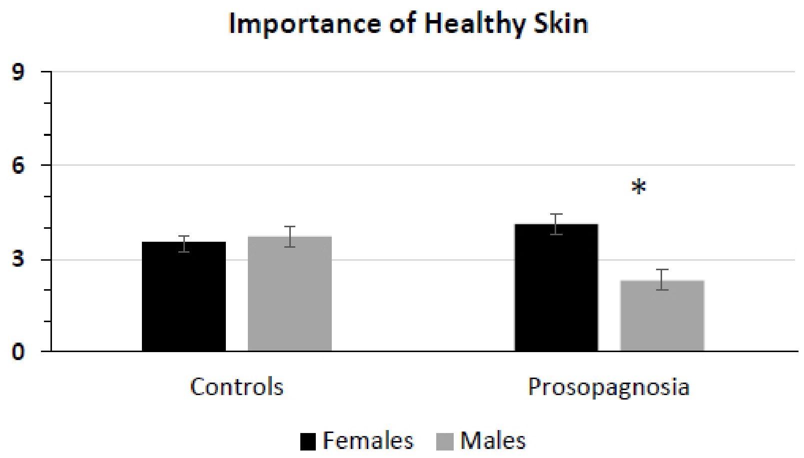
24. Other effects not hypothesized.

The homogeneity of skin color was found to be associated favorably with attractiveness (Fink et al., 2006). Colouration is also closely related to the appearance of the skin plays a significant part in the sexual selection across different species. For example red colouration is often associated with dominance and is used to attract mates (Setchell & Wickings, 2005). Another more recent research, suggests that trichromatic vision in primates can detect skin color changes related to blood flow, helping in making judgments about the mood of other individuals (Changizi et al., 2006) for example in humans, facial redness is commonly associated with anger and confrontation

(Drummond & Quah, 2001). One last significant effect that was not hypothesized therefore concerned healthy skin. This was assessed on Question 16 of the 9-point Likert Scale. The ANOVA found a significant main effect of sex, $F(1,133) = 6.43$, $p = 0.012$, with a small-to-moderate effect size, $\eta p^2 = 0.05$. Overall, females in both groups found healthy skin more important than men. However, the ANOVA also detected a significant Group x Sex interaction, $F(1,133) = 9.73$, $p = 0.002$, with a moderate effect size, $\eta p^2 = 0.07$. Posthoc Tukey HSD tests revealed that females in the

Rank	Attribute	Control Female Mean	Control Male Mean	Prosopagnosic Female Mean	Prosopagnosic Male Mean
1	Compatible Personality	8.633803	8.681818	8.700000	8.666667
2	Good Sense of Humor	7.070423	7.050000	7.050000	6.350000
3	Attractive Face	6.864917	5.800000	6.856818	5.250000
4	Deep Voice	5.535211	5.875000	5.875000	5.350000
5	Certain Body Type	4.754108	5.859091	5.859091	4.916667
6	Preferred Height	4.704225	3.958333	3.958333	3.250000
7	Healthy Skin	3.837148	4.125000	4.125000	2.400000
8	High Pitched Voice	1.383803	2.650000	2.650000	1.500000

prosopagnosia group found healthy skin significantly more attractive than did males in that group, whereas no significant differences were detected between females and males in the control group. This effect is shown in Figure 10.



<u>Figure 10</u>: Importance of healthy skin for females and males in the control and prosopagnosia groups. *p<0.05.

The highest rating for characteristics found attractive for females and males in both groups on the 9-point Likert scale were compatible personality and a good sense of humor (Appendix 2).

These effects did not differ significantly between the groups or by sex. The order of intensity of the features of attractiveness (from highest to lowest) is shown in Table 2. Personality was proved to be an important factor for both groups.

We also ran regression analysis as a part of our study, complete overview can be found in appendix 2, some of the results were following: The regression analysis indicates no significant relationship between gender and orientation, no significant relationship between orientation and relationship status, a moderate, statistically significant positive relationship between orientation and PI 20 but no significant relationship between PI 20 and orientation, a moderate, statistically significant positive relationship between gender and PI 20 but no significant relationship between PI 20 and gender, no significant relationship between gender and relationship status, perfect, expected correlation between sex and gender, as they are essentially the same variable in this context.

Table 4 - What are the main characteristics individuals MUST have for you to consider them attractive?

Table 5 - *Do you experience sexual fantasies? Are u able to picture someone attractive when experiencing sexual fantasy?*

Group	Experiences Sexual Fantasies	Doesn't Experience Sexual Fantasies	Able to Picture Someone Attractive	Unable to Picture Someone Attractive
Face-Blind	87.23%	12.77%	44.68%	42.55%
Control	90.32%	9.68%	78.49%	11.83%

We also used Likert scale to ask our participants about how do their partners usually fit into their reported preferences. There was significant difference between the groups, no significant difference between males and females and the interaction effect between group and sex is was not significant either (appendix 2).

General health of participants

The most common diagnosis in the prosopagnosic group was Depression (52.08%), followed by Anxiety (47.92%), attention deficit disorder (29.17%) and Autism (22.92%). 10.42% of participants reported having some kind of vision disorders. Small percentage of subjects suffered from severe brain damage (4.17%). No participants reported having Schizophrenia, Visual Agnosia, Seizure disorders, Multiple Sclerosis, Parkinson's disease, Alzheimer's, Dementia or seizure disorders. 14.58% of participants didn't report being diagnosed with any of the mentioned health concerns.

Table 6 - Prosopagnosic Group; Health

Condition	Amount of affected participants	Total amount of participants	Percentage of affected participants.
Depression	25	48	52.08%
Anxiety	23	48	47.92%
Attention Deficit Disorder	14	48	29.17%
Prosopagnosia	22	48	45.83%
Autism	11	48	22.92%
Vision disorders	5	48	10.42%
Schizophrenia	0	48	0.00%
Seizure disorders	0	48	0.00%
Alzhaimer's disease	0	48	0.00%
Multiple sclerosis	0	48	0.00%
Dementia	0	48	0.00%
Severe brain damage	2	48	4.17%
Visual Agnosia	0	48	0.00%
Parkinson's disease	0	48	0.00%

Possible health concerns for prosopagnosic individuals

It has been proved that the social isolation and stress caused by failing to recognize faces may contribute to depressive symptoms. The emotional burden of the social mishaps can lead to chronic stress and anxiety which may further increase the intensity of symptoms (Kitamura et al., 2015). Some studies even suggest an association between prosopagnosia and attention deficit disorder. The cognitive load required to compensate for face recognition deficits may overlap with attention symptoms, complicating diagnosis and treatment (Palmisano et al, 2023).

Our control group shows greatest levels of anxiety diagnosis with leading 35.11%, next most common is depression with 30.85% of our sample, followed by ADHD (3.19%), vision disorders 1.06%, and severe brain damage 1.06%.

Table 7: Control Group; Health

Condition	Amount of affected participants	Total amount of participants	Percentage of affected participants.
Depression	29	94	30.85%
Anxiety	33	94	35.11%
Attention Deficit Disorder	3	94	3.19%
Prosopagnosia	0	94	0.00%
Autism	0	94	0.00%
Vision disorders	1	94	1.06%
Schizophrenia	0	94	0.00%
Seizure disorders	0	94	0.00%
Alzhaimer’s disease	0	94	0.00%
Multiple sclerosis	0	94	0.00%
Dementia	0	94	0.00%
Severe brain damage	1	94	1.06%
Visual Agnosia	0	94	0.00%
Parkinson’s disease	0	94	0.00%

25. Discussion

The results of the present thesis study suggest that individuals with prosopagnosia, whether diagnosed or self-defined, have deficits in their assessment of facial cues that denote attraction, such as eyes and smile, and thus they downplay the importance of those cues in assessing attractivity relative to non-prosopagnosic controls. Although there were no differences in the reported ability of prosopagnosics to engage in sexual fantasy relative to controls, a significant difference was found in their self-reported imagination of attractive persons in their sexual fantasies relative to controls, suggesting that facial cues that normally denote a person's identity and contribute to their attractiveness are not perceived and do not contribute to the sexual fantasies of people with prosopagnosia. We also found that facial symmetry is generally given much less importance than reported in the literature (Buss). In our participants' ratings of attractiveness, facial symmetry did not emerge as a highly rated factor.

It was hypothesized that other cues, such as auditory vocal timbre, olfactory, or visual bodily cues such as body type, height, hair color, and muscle tone, might be used to compensate for the lack of recognition of facial cues in determining attractivity. These hypotheses were not validated in the present study, although a trend toward significance was found for muscle tone as a more important determiner of attraction for individuals with prosopagnosia relative to controls. The significant difference between controls and prosopagnosics in the importance of physical features as determiners of attractivity also suggests that people with prosopagnosia downplay physical features in general relative to controls. However, the highest ratings of attractiveness for both groups came from interpersonal features, such as having a compatible personality and good sense of humor.

Some features were found significantly more salient determiners of attractivity based on sex rather than group. For example, males in both groups found physical features, facial features, high-pitched vocal timbre, and body type, more salient than females, whereas females in both groups found height more salient than males did. Men in both groups also rated visual cues higher than women, these findings are consistent with existing literature. An unexpected sex difference was also found in the prosopagnosia group for healthy skin, in which females valued this as a determiner of attractivity over males, whereas this difference was not observed in the control group.

These findings suggest that there are some compensatory mechanisms in place and that individuals with developmental prosopagnosia adapted by reinforcing reliance on other senses when making judgments of attractiveness. This disorder appears to have surpassed millennia of evolutionary predispositions and influences.

Sexual orientation showed a notable effect, with our prosopagnosic sample reporting a wider variety of orientations compared to the control group. The PI20 scores for the prosopagnosic group were significantly higher, indicating severe face recognition difficulties. This validates our use of PI20 as an effective measure for identifying prosopagnosia within our sample. The relationship between PI20 scores and the de-emphasis on facial cues further supports the notion that facial processing capabilities directly impact attraction criteria. The findings of this study have several important implications: By identifying how prosopagnosic individuals compensate for their impairment, we can gain a better understanding of the flexibility of human attraction mechanisms. The study of attraction has traditionally focused on visual cues, particularly facial features. However, this research highlights the need to consider a broader range of sensory inputs and their importance in attraction, especially for populations with visual and cognitive impairments. Although prosopagnosic participants reported being in relationships as often as their control counterparts, it is clear that individuals with prosopagnosia may encounter distinctive difficulties in social and romantic contexts due to their reliance on non-facial cues. An understanding of these difficulties can contribute to the development of more inclusive approaches in social settings and support systems. While providing valuable insights this study is not without limitation and further research is needed to address the following issues: The sample size, particularly that of the prosopagnosic group, was relatively limited, which may restrict the generalisability of the findings. Furthermore, the use of self-reported data may be susceptible to bias.

Future research should endeavor to replicate these findings with larger, more diverse samples. Longitudinal studies, on the other hand, could provide a more comprehensive understanding of the evolution of attraction preferences and compensatory mechanisms over time. We only scratched the surface with questions about the relationship between facial imagination and sexual fantasies, the findings were interesting enough to inspire future research.This is consistent with the expected result given their impairment in recognizing and remembering faces. The use of an online questionnaire has been a quick and effective method, although it would be valuable to conduct this research using neuroimaging techniques and to divide participants with prosopagnosia into groups based on the severity of their impairment. it would also be interesting to investigate the correlation between autism spectrum disorder and prosopagnosia; several studies have reported that autistic people experience prosopagnosic symptoms more often than neurotypicals. Another possibly intriguing field to examine is the impact of prosopagnosia on romantic relationships. while our participants reported being in relationships as often as our controls, there may be subtleties that we are unaware of. Future study could also further analyze sexual imagination - if prosopagnosic participants have difficulty imagining faces, what do they imagine? What is at the root of their sexual fantasies?

Overall, it is noticeable that participants with prosopagnosia gave higher importance to non-visual stimuli and rated auditory and olfactory stimuli as more important compared to the control group. Interestingly, prosopagnosic participants also placed higher importance on attributes such as height, muscle tone, and body shape. This could indicate a shift towards evaluating more general physical fitness indicators rather than specific facial features, which are challenging to process. These findings suggest that there are compensatory mechanisms in place and that individuals with developmental prosopagnosia adapted by using similar attraction cues, but also reinforcing reliance on other senses when making judgments of attractiveness.

This disorder appears to have been able to surpass millennia of evolutionary predispositions and influence what do individuals with developmental prosopagnosia emphasize and deemphasize when choosing a partner.

Summary

A total of 140 participants were recruited, including individuals with a diagnosis of prosopagnosia, individuals with symptoms but no formal diagnosis, and a control group with no face recognition impairment. The questionnaire consisted of 42 questions covering demographics, health status, importance of various physical attributes and the role of non-visual sensory input in attractiveness. Buss's evolutionary framework suggests that physical attractiveness, particularly facial symmetry, clear skin and youthfulness, is prioritized in mate choice because of its association with genetic quality and reproductive fitness (Buss, 1989). Our study found that people with prosopagnosia place slightly less importance on facial features when judging attractiveness compared to control group. The shift from visual to non-visual cues in prosopagnosics is following Buss's framework that people adjust their strategies to optimize mate choice based on the information available. While Buss emphasizes the importance of visual cues, this study suggests that when there is no reliable face recognition available, individuals are able to adapt by prioritizing other sensory information.

The severity of prosopagnosia was assessed with the PI20. The PI20 scores were used to validate the presence of prosopagnosia in the sample. Subjects with prosopagnosia scored significantly higher on the PI20 than controls. Comprehensive bibliography is included in following pages, it includes studies on prosopagnosia, evolutionary psychology and attraction theories.

Appendix 1 - Complete questionnaire

Introduction: This questionnaire aims to unravel the relationship between facial attractiveness perception and partner selection among individuals with prosopagnosia. Prosopagnosia, commonly known as face blindness, is a condition characterized by an impaired ability to recognize familiar faces, including those of family members, friends, and acquaintances. Despite its well-documented impact on social interactions, little is known about how prosopagnosia influences perceptions of attractiveness and shapes preferences in selecting romantic partners. By sharing your perspectives and experiences, you will contribute invaluable data that can potentially inform future research, therapeutic interventions, and support services for individuals living with prosopagnosia.

Anonymous and Confidential Data Collection: All data collection will be completed without the use of names to keep the participants from being identified with their evaluation responses. The data will be used in a Veronika Trnková's bachelor thesis, conducted under the mentorship of Dr. James Pfaus at Charles University's Faculty of Humanities

Estimated duration: 7 minutes

1. Do you consent to participate?
    - YES
    - NO
2. Are you over 18 years old?
    - YES
    - NO
3. Please state your age.
4. I am attracted to:
    - Women
    - Men
    - Both women and men
    - Gender non-conforming individuals
    - I don’t experience attraction
5. What is your sex?
    - Male

- Female
- Intersex
- Other

6. What's your sexuality?

- Heterosexual
- Homosexual
- Bisexual
- Asexual
- Pansexual

7. What is your completed highest degree of education?

- Less than high school
- High school
- Bachelor
- Masters
- Doctorate

8. What's your racial and ethnic background? (Select one or more answers)

- American Indian or Alaska Native
- Asian
- Black or African American
- Hispanic or Latino
- Native Hawaiian or other Pacific Islander
- White
- Other

9. What's your relationship status at the moment?

- Single
- Dating
- Engaged
- Married

10. Have you ever been diagnosed with any from the following list? (Select one or more answers)

- Depression
- Anxiety
- Prosopagnosia
- Autism
- Schizophrenia
- Alzheimer
- Dementia
- Visual agnosia
- Attention deficit disorder
- Vision disorders
- Seizure disorders
- Parknison's disease
- Multiple sclerosis

- None

11. Have you ever experienced any severe brain damage?

    - Yes
    - No

12. Which type of prosopagnosia have you been diagnosed with?

    - Developmental
    - Acquired
    - None but I have symptoms
    - None and I don't have symptoms

13. What part of your cycle are you currently at?

    - Luteal
    - Ovulating
    - Follicular
    - Menstruation
    - I don't know
    - I don't have a cycle

14. How important are physical attributes in determining whether you find someone attractive?

    - Not at all important
    - Slightly important
    - Moderately important
    - Very important
    - Extremely important

15. Which of the following physical attributes do you find most attractive in a potential partner? (Select all that apply)

    - Facial symmetry
    - Certain facial features
    - Clear skin
    - Body shape
    - Height
    - Eye color
    - Smile
    - Hair color
    - Muscle tone
    - Other

16. What are the main characteristics individuals MUST have for you to consider them attractive?

    - Compatible Personality
    - Attractive face
    - Certain body type

- Must smell good
- Deep voice
- High pitched voice
- Good sense of humor
- Healthy skin
- Preferred height

17. On a scale 0-5 how important do you consider the facial features of a potential partner?

    - 0 (not important) to 5 (extremely important)

18. On the scale 0-5 how important do you consider the personality of a potential partner?

    - 0 (not at all important) to 5 (extremely important)

19. On the scale 0-5 how important do you consider olfactory attributes (smell, odor) in a potential partner?

    - 0 (not at all important) to 5 (extremely important)

20. On the scale 0-5 how important do you consider voice attributes of a potential partner?

    - 0 (not at all important) to 5 (extremely important)

21. How does your partner usually fit into your attraction preferences?

    - 1 (not at all) to 5 (my partners check all the boxes)

22. Do you experience sexual fantasies?

    - Yes
    - No

23. Are you able to picture someone attractive when experiencing a sexual fantasy?

    - Yes
    - No

24. My face recognition ability is worse than most people.

    - 1 (Strongly Disagree) to 5 (Strongly Agree)

25. I have always had a bad memory for faces.

    - 1 (Strongly Disagree) to 5 (Strongly Agree)

26. I find it noticeably easier to recognize people who have distinctive facial features.

    - 1 (Strongly Disagree) to 5 (Strongly Agree)

27. I often mistake people I have met before for strangers.

    - 1 (Strongly Disagree) to 5 (Strongly Agree)

28. When I was at school I struggled to recognize my classmates.

    - 1 (Strongly Disagree) to 5 (Strongly Agree)

29. When people change their hairstyle, or wear hats, I have problems recognizing them.

    - 1 (Strongly Disagree) to 5 (Strongly Agree)

30. I sometimes have to warn new people I meet that I am 'bad with faces'.

    - 1 (Strongly Disagree) to 5 (Strongly Agree)

31. I find it easy to picture individual faces in my mind.

    - 1 (Strongly Disagree) to 5 (Strongly Agree)

32. I am better than most people at putting a 'name to a face'.

    - 1 (Strongly Disagree) to 5 (Strongly Agree)

33. Without hearing people's voices I struggle to recognize them.

    - 1 (Strongly Disagree) to 5 (Strongly Agree)

34. Anxiety about face recognition has led me to avoid certain social or professional situations.

    - 1 (Strongly Disagree) to 5 (Strongly Agree)

35. I have to try harder than other people to memorize faces.

    - 1 (Strongly Disagree) to 5 (Strongly Agree)

36. I am very confident in my ability to recognize myself in photographs.

    - 1 (Strongly Disagree) to 5 (Strongly Agree)

37. I sometimes find movies hard to follow because of difficulties recognizing characters.

    - 1 (Strongly Disagree) to 5 (Strongly Agree)

38. My friends and family think I have bad face recognition or bad face memory.

    - 1 (Strongly Disagree) to 5 (Strongly Agree)

39. I feel like I frequently offend people by not recognizing who they are.

    - 1 (Strongly Disagree) to 5 (Strongly Agree)

40. It is easy for me to recognize individuals in situations that require people to wear similar clothes (e.g. suits, uniforms, swimwear).

- 1 (Strongly Disagree) to 5 (Strongly Agree)

41. At family gatherings I sometimes confuse individual family members.

    - 1 (Strongly Disagree) to 5 (Strongly Agree)

42. I find it easy to recognize celebrities in 'before-they-were-famous' photos, even if they have changed considerably.

    - 1 (Strongly Disagree) to 5 (Strongly Agree)

43. It is hard to recognize familiar people when I meet them out of context (e.g. meeting a work colleague unexpectedly while shopping).

    - 1 (Strongly Disagree) to 5 (Strongly Agree)

Appendix 2 - Statistical analyses

Demographics Group x Sex factorial ANOVA

Group, 1 = control, 2 = prosopags

Sex, 1 = female, 2 = male

PI 20 Scale

Univariate Tests of Significance for PI20 (prosopagnosia data for statistica)
Sigma-restricted parameterization
Effective hypothesis decomposition

Effect	SS	Degr. of Freedom	MS	F	p
Intercept	362842.0	1	362842.0	3346.155	0.000000
Group	37518.9	1	37518.9	346.002	0.000000
Sex	402.1	1	402.1	3.708	0.056291
Group*Sex	347.9	1	347.9	3.208	0.075536
Error	14421.9	133	108.4		

Trend for Sex (M > F) and Group x Sex

Group:

Group; Unweighted Means (prosopagnosia data for statistica)
Current effect: F(1, 133)=346.00, p=0.0000
Effective hypothesis decomposition

Cell No.	Group	PI20 Mean	PI20 Std.Err.	PI20 -95.00%	PI20 +95.00%	N
1	1	39.72759	1.270447	37.21470	42.24049	93
2	2	77.38750	1.576382	74.26948	80.50552	44

Group x Sex:

Group*Sex; Unweighted Means (prosopagnosia data for statistica)
Current effect: F(1, 133)=3.2084, p=.07554
Effective hypothesis decomposition

Cell No.	Group	Sex	PI20 Mean	PI20 Std.Err.	PI20 -95.00%	PI20 +95.00%	N
1	1	1	39.59155	1.235824	37.14714	42.03596	71
2	1	2	39.86364	2.220109	35.47235	44.25493	22
3	2	1	73.62500	2.125593	69.42066	77.82934	24
4	2	2	81.15000	2.328470	76.54438	85.75562	20

Prosopagnosia subgroups on the PI-20

Effect	Univariate Tests of Significance for Var2 (Prosopagnosia subgroups Sigma-restricted parameterization Effective hypothesis decomposition SS	Degr. of Freedom	MS	F	p
Intercept	275802.7	1	275802.7	2633.347	0.000000
"Var3"	1562.3	1	1562.3	14.916	0.000357
Error	4713.1	45	104.7		

"Var3"; Unweighted Means (Prosopagnosia subgroups)
Current effect: $F(1, 45)=14.916$, $p=.00036$
Effective hypothesis decomposition

Cell No.	Var3	Var2 Mean	Var2 Std.Err.	Var2 -95.00%	Var2 +95.00%	N
1	1	72.86207	1.900405	69.03446	76.68968	29
2	2	84.72222	2.412176	79.86385	89.58059	18

Orientation

Univariate Tests of Significance for Orientation (prosopagnosia data for statistica)
Sigma-restricted parameterization
Effective hypothesis decomposition

Effect	SS	Degr. of Freedom	MS	F	p
Intercept	332.3195	1	332.3195	265.0757	0.000000
Group	11.9588	1	11.9588	9.5390	0.002449
Sex	17.4636	1	17.4636	13.9299	0.000280
Group*Sex	2.4475	1	2.4475	1.9523	0.164667
Error	166.7392	133	1.2537		

Group

Group; Unweighted Means (prosopagnosia data for statistica)
Current effect: $F(1, 133)=9.5390$, $p=.00245$
Effective hypothesis decomposition

Cell No.	Group	Orientation Mean	Orientation Std.Err.	Orientation -95.00%	Orientation +95.00%	N
1	1	1.435980	0.136604	1.165782	1.706177	93
2	2	2.108333	0.169500	1.773070	2.443597	44

Sex

Sex; Unweighted Means (prosopagnosia data for statistica)
Current effect: $F(1, 133)=13.930$, $p=.00028$
Effective hypothesis decomposition

Cell No.	Sex	Orientation Mean	Orientation Std.Err.	Orientation -95.00%	Orientation +95.00%	N
1	1	2.178404	0.132187	1.916942	2.439865	95
2	2	1.365909	0.172966	1.023789	1.708030	42

Relationship Status

Effect	SS	Degr. of Freedom	MS	F	p
	Univariate Tests of Significance for Rel Stat (prosopagnosia data for statistica) Sigma-restricted parameterization Effective hypothesis decomposition				
Intercept	255.7463	1	255.7463	1006.479	0.000000
Group	0.1451	1	0.1451	0.571	0.451182
Sex	0.0023	1	0.0023	0.009	0.924768
Group*Sex	0.0178	1	0.0178	0.070	0.791677
Error	33.7953	133	0.2541		

Group x Sex:

Cell No.	Group	Sex	Rel Stat Mean	Rel Stat Std.Err.	Rel Stat -95.00%	Rel Stat +95.00%	N
	Group*Sex; Unweighted Means (prosopagnosia data for statistica) Current effect: F(1, 133)=.07005, p=.79168 Effective hypothesis decomposition						
1	1	1	1.535211	0.059824	1.416882	1.653540	71
2	1	2	1.500000	0.107471	1.287427	1.712573	22
3	2	1	1.583333	0.102896	1.379810	1.786857	24
4	2	2	1.600000	0.112716	1.377051	1.822949	20

Multiple regression:

Orientation → Attraction***

```
   Multiple Regression Results

  Dependent: Attract            Multiple R =  .68434641      F = 121.5595
                                        R²=  .46833002     df =    1,138
  No. of cases: 140             adjusted R²=  .46447733      p = 0.000000
               Standard error of estimate:  .688309300
  Intercept:  1.162408297  Std.Error: .1019659  t(  138) = 11.400   p =
0.0000
```

    Orientation beta=.684

Gender → Orientation

```
Multiple Regression Results

  Dependent: Orientation        Multiple R =  .00837698      F = .0096847
                                        R²=  .00007017     df =    1,138
  No. of cases: 140             adjusted R²= -.00717569      p =  .921749
               Standard error of estimate: 1.279350670
  Intercept:  1.856164384  Std.Error: .3005114  t(  138) = 6.1767   p =
.0000
```

        Gender beta=-.01

Orientation → Relationship Status

```
   Multiple Regression Results

  Dependent: Rel Stat          Multiple R =  .06740639     F = .6298818
                                       R²=  .00454362    df =   1,138
  No. of cases: 140            adjusted R²= -.00266983     p =  .428761
               Standard error of estimate:  .500615554
  Intercept:  1.591196560  Std.Error: .0741610  t(  138) = 21.456  p =
0.0000
```

```
    Orientation beta=-.07
```

Orientation → PI 20 Scale***

```
   Multiple Regression Results

  Dependent: PI20              Multiple R =  .29006273     F = 12.67746
                                       R²=  .08413639    df =   1,138
  No. of cases: 140            adjusted R²=  .07749970     p =  .000508
               Standard error of estimate:19.899517408
  Intercept: 43.708196307  Std.Error: 2.947908  t(  138) = 14.827  p =
0.0000
```

```
    Orientation beta=.290
```

PI 20 → Orientation

```
   Multiple Regression Results

  Dependent: Orientation       Multiple R =  .06740639     F = .6298818
                                       R²=  .00454362    df =   1,138
  No. of cases: 140            adjusted R²= -.00266983     p =  .428761
               Standard error of estimate: 1.276485707
  Intercept:  2.093750000  Std.Error: .3511099  t(  138) = 5.9632  p =
.0000
```

```
       Rel Stat beta=-.07
```

Gender → PI 20***

```
   Multiple Regression Results

  Dependent: PI20              Multiple R =  .32353410     F = 16.13386
                                       R²=  .10467432    df =   1,138
  No. of cases: 140            adjusted R²=  .09818645     p =  .000097
               Standard error of estimate:19.675132411
  Intercept: 35.008371385  Std.Error: 4.621564  t(  138) = 7.5750  p =
.0000
```

```
         Gender beta=.324
```

PI 20 → Gender

```
   Multiple Regression Results

  Dependent: Gender            Multiple R =  .02927098     F = .1183384
                                        R²=  .00085679    df =   1,138
  No. of cases: 140            adjusted R²= -.00638338     p =  .731367
               Standard error of estimate:  .521360336
  Intercept:  1.389802632  Std.Error: .1434053  t(  138) = 9.6914  p =
.0000
```

____

```
       Rel Stat beta=-.03
```

Gender → Relationship Status

```
   Multiple Regression Results

  Dependent: Rel Stat          Multiple R =  .02927098     F = .1183384
                                        R²=  .00085679    df =   1,138
  No. of cases: 140            adjusted R²= -.00638338     p =  .731367
               Standard error of estimate:  .501541752
  Intercept:  1.580669711  Std.Error: .1178090  t(  138) = 13.417  p =
0.0000
```

____

```
         Gender beta=-.03
```

Sex → Gender***

```
   Multiple Regression Results

  Dependent: Gender            Multiple R = 1.00000000     F =  --
                                        R²= 1.00000000    df =   1,138
  No. of cases: 140            adjusted R²= 1.00000000     p =  --
               Standard error of estimate:     --
  Intercept:  0.000000000  Std.Error: 0.000000  t(  138) = 0.0000  p =
1.0000
```

____

```
            Sex beta=1.00
```

<u>Likert Scale Data (0-5 pt)</u> Group x Sex factorial ANOVA

Group, 1 = control, 2 = prosopags

Sex, 1 = female, 2 = male

<u>Importance of physical attractiveness overall</u>

901.2406	1	901.2406	1826.240	0.000000
15.3521	1	15.3521	31.109	0.000000
3.4897	1	3.4897	7.071	0.008794
0.0386	1	0.0386	0.078	0.780131
65.6349	133	0.4935		

Group: F1,133 = 31.11, P= 0.000001

Control > Prosopags, 3.30 + 0.08, 2.54 + 0.11

Sex: F1,133 = 7.07, p = 0.0088

Males > Females: 3.10+ 0.11, 2.74 + 0.11

<u>Group x Sex:</u> F1,133 = 0.078, NS

1	1	3.098592	0.083370	2.933688	3.263495	71
1	2	3.500000	0.149772	3.203757	3.796243	22
2	1	2.375000	0.143396	2.091369	2.658631	24
2	2	2.700000	0.157082	2.389298	3.010702	20

<u>Importance of facial features overall</u>

1135.883	1	1135.883	1729.920	0.000000
13.690	1	13.690	20.850	0.000011
8.323	1	8.323	12.676	0.000514
0.296	1	0.296	0.450	0.503275
87.329	133	0.657		

Group: F1,133 = 20.85, p= 0.000011

Control > Prosopags 3.64 +0.09, 2.92 + 0.12

Sex: F1,133 = 12.68, p = 0.000514

Males > Females 3.56 + 0.13, 2.99 +0.09

Group x Sex: F1,133 = 0.45, NS

1	1	3.408451	0.096167	3.218237	3.598665	71
1	2	3.863636	0.172760	3.521924	4.205348	22
2	1	2.583333	0.165405	2.256169	2.910498	24
2	2	3.250000	0.181192	2.891609	3.608391	20

Importance of smell overall

1616.335	1	1616.335	1818.056	0.000000
1.440	1	1.440	1.620	0.205371
0.226	1	0.226	0.254	0.614860
2.781	1	2.781	3.128	0.079266
118.243	133	0.889		

Group: F1,133 = 1.62, p = 0.21 NS

Sex: F1,133 = 0.2, NS

Group x Sex: F1,133 = 3.13, P = 0.07 (TREND)

1	1	4.140845	0.111901	3.919510	4.362180	71
1	2	3.909091	0.201025	3.511471	4.306711	22
2	1	3.583333	0.192467	3.202641	3.964026	24
2	2	4.000000	0.210837	3.582972	4.417028	20

Importance of voice overall

871.3754	1	871.3754	667.5537	0.000000
0.0002	1	0.0002	0.0001	0.991412
2.7833	1	2.7833	2.1323	0.146586
2.9505	1	2.9505	2.2604	0.135092
173.6084	133	1.3053		

1	1	2.873239	0.135591	2.605046	3.141433	71
1	2	2.863636	0.243584	2.381837	3.345435	22
2	1	2.541667	0.233214	2.080379	3.002954	24
2	2	3.200000	0.255473	2.694685	3.705315	20

How do your partners usually fit into your attraction preferences?

1427.839	1	1427.839	1882.817	0.000000
1.835	1	1.835	2.420	0.122168
0.008	1	0.008	0.010	0.920585
0.266	1	0.266	0.351	0.554807
100.861	133	0.758		

1	1	3.746479	0.103349	3.542059	3.950899	71
1	2	3.863636	0.185662	3.496403	4.230870	22
2	1	3.583333	0.177758	3.231734	3.934932	24
2	2	3.500000	0.194724	3.114843	3.885157	20

<u>Likert Scale Data (0-9 pt)</u> Group x Sex factorial ANOVA

Group, 1 = control, 2 = prosopags

Sex, 1 = female, 2 = male

"What are the main characteristics individuals MUST have for you to consider them attractive?"

<u>COMPATIBLE PERSONALITY</u>

7955.130	1	7955.130	9380.971	0.000000
0.017	1	0.017	0.020	0.886859
0.044	1	0.044	0.052	0.820634
0.001	1	0.001	0.002	0.967356
112.785	133	0.848		

1	1	8.633803	0.109288	8.417636	8.849969	71
1	2	8.681818	0.196331	8.293484	9.070153	22
2	1	8.666667	0.187972	8.294865	9.038469	24
2	2	8.700000	0.205913	8.292711	9.107289	20

<u>Attractive Face</u>

4243.229	1	4243.229	1760.183	0.000000
30.000	1	30.000	12.445	0.000576
29.094	1	29.094	12.069	0.000692
0.070	1	0.070	0.029	0.865367
320.620	133	2.411		

<u>Group:</u>

1	6.864917	0.189426	6.490239	7.239595	93
2	5.800000	0.235042	5.335096	6.264904	44

<u>Sex:</u>

1	5.808099	0.183302	5.445535	6.170662	95
2	6.856818	0.239849	6.382406	7.331230	42

<u>Group x Sex:</u>

1	1	6.366197	0.184264	6.001730	6.730664	71
1	2	7.363636	0.331023	6.708886	8.018387	22
2	1	5.250000	0.316930	4.623124	5.876876	24
2	2	6.350000	0.347180	5.663292	7.036708	20

Certain Body Type

Effect	Univariate Tests of Significance for M Cert Body Type (prosopagnosia data for statistica) Sigma-restricted parameterization Effective hypothesis decomposition SS	Degr. of Freedom	MS	F	p
Intercept	2979.781	1	2979.781	1158.597	0.000000
Group	1.095	1	1.095	0.426	0.515171
Sex	32.300	1	32.300	12.559	0.000545
Group*Sex	0.391	1	0.391	0.152	0.697050
Error	342.061	133	2.572		

Sex:

1	4.754108	0.189332	4.379618	5.128598	95
2	5.859091	0.247739	5.369073	6.349109	42

Group x Sex:

1	1	4.591549	0.190325	4.215093	4.968006	71
1	2	5.818182	0.341912	5.141893	6.494471	22
2	1	4.916667	0.327356	4.269169	5.564164	24
2	2	5.900000	0.358601	5.190702	6.609298	20

Smell Good

3250.393	1	3250.393	1069.644	0.000000
0.521	1	0.521	0.171	0.679467
2.804	1	2.804	0.923	0.338512
1.052	1	1.052	0.346	0.557228
404.155	133	3.039		

1	1	5.535211	0.206880	5.126010	5.944412	71
1	2	5.409091	0.371652	4.673977	6.144205	22
2	1	5.875000	0.355830	5.171182	6.578818	24
2	2	5.350000	0.389792	4.579006	6.120994	20

Deep Voice

3250.393	1	3250.393	1069.644	0.000000
0.521	1	0.521	0.171	0.679467
2.804	1	2.804	0.923	0.338512
1.052	1	1.052	0.346	0.557228
404.155	133	3.039		

1	1	3.281690	0.168213	2.948971	3.614409	71
1	2	2.545455	0.302188	1.947738	3.143171	22
2	1	3.375000	0.289323	2.802730	3.947270	24
2	2	3.250000	0.316938	2.623109	3.876891	20

High-pitched voice

405.1247	1	405.1247	551.0285	0.000000
1.4815	1	1.4815	2.0151	0.158081
34.7269	1	34.7269	47.2336	0.000000
0.0005	1	0.0005	0.0007	0.979664
97.7837	133	0.7352		

Sex:

1	1.383803	0.101229	1.183576	1.584030	95
2	2.529545	0.132457	2.267550	2.791541	42

Group x Sex:

Group*Sex; Unweighted Means (prosopagnosia data for statistica)
Current effect: F(1, 133)=.00065, p=.97966
Effective hypothesis decomposition

Cell No.	Group	Sex	M High Pitch Voice Mean	M High Pitch Voice Std.Err.	M High Pitch Voice -95.00%	M High Pitch Voice +95.00%	N
1	1	1	1.267606	0.101760	1.066328	1.468883	71
2	1	2	2.409091	0.182808	2.047503	2.770679	22
3	2	1	1.500000	0.175026	1.153806	1.846194	24
4	2	2	2.650000	0.191731	2.270763	3.029237	20

Good sense of humor

Univariate Tests of Significance for M Good Sense of Humor (prosopagnosia data for statistica)
Sigma-restricted parameterization
Effective hypothesis decomposition

Effect	SS	Degr. of Freedom	MS	F	p
Intercept	5084.185	1	5084.185	1821.185	0.000000
Group	7.156	1	7.156	2.563	0.111749
Sex	7.729	1	7.729	2.768	0.098493
Group*Sex	1.750	1	1.750	0.627	0.429955
Error	371.295	133	2.792		

Sex:

Sex; Unweighted Means (prosopagnosia data for statistica)
Current effect: F(1, 133)=2.7685, p=.09849
Effective hypothesis decomposition

Cell No.	Sex	M Good Sense of Humor Mean	M Good Sense of Humor Std.Err.	M Good Sense of Humor -95.00%	M Good Sense of Humor +95.00%	N
1	1	7.201878	0.197256	6.811713	7.592043	95
2	2	6.661364	0.258108	6.150835	7.171892	42

Group x Sex:

Group*Sex; Unweighted Means (prosopagnosia data for statistica)
Current effect: F(1, 133)=.62676, p=.42996
Effective hypothesis decomposition

Cell No.	Group	Sex	M Good Sense of Humor Mean	M Good Sense of Humor Std.Err.	M Good Sense of Humor -95.00%	M Good Sense of Humor +95.00%	N
1	1	1	7.070423	0.198292	6.678209	7.462636	71
2	1	2	6.272727	0.356223	5.568131	6.977323	22
3	2	1	7.333333	0.341058	6.658734	8.007933	24
4	2	2	7.050000	0.373610	6.311014	7.788986	20

Healthy skin

Effect	Univariate Tests of Significance for M Healthy Skin (prosopagnosia data for statistica) Sigma-restricted parameterization Effective hypothesis decomposition SS	Degr. of Freedom	MS	F	p
Intercept	1259.762	1	1259.762	511.8075	0.000000
Group	3.736	1	3.736	1.5177	0.220141
Sex	15.828	1	15.828	6.4305	0.012375
Group*Sex	23.950	1	23.950	9.7301	0.002223
Error	327.366	133	2.461		

Sex:

Cell No.	Sex; Unweighted Means (prosopagnosia data for statistica) Current effect: F(1, 133)=6.4305, p=.01237 Effective hypothesis decomposition Sex	M Healthy Skin Mean	M Healthy Skin Std.Err.	M Healthy Skin -95.00%	M Healthy Skin +95.00%	N
1	1	3.837148	0.185220	3.470790	4.203506	95
2	2	3.063636	0.242359	2.584259	3.543013	42

Group x Sex:

Cell No.	Group*Sex; Unweighted Means (prosopagnosia data for statistica) Current effect: F(1, 133)=9.7301, p=.00222 Effective hypothesis decomposition Group	Sex	M Healthy Skin Mean	M Healthy Skin Std.Err.	M Healthy Skin -95.00%	M Healthy Skin +95.00%	N
1	1	1	3.549296	0.186192	3.181014	3.917577	71
2	1	2	3.727273	0.334487	3.065670	4.388876	22
3	2	1	4.125000	0.320247	3.491563	4.758437	24
4	2	2	2.400000	0.350813	1.706105	3.093895	20

Preferred Height

Effect	Univariate Tests of Significance for M Pref Height (prosopagnosia data for statistica) Sigma-restricted parameterization Effective hypothesis decomposition SS	Degr. of Freedom	MS	F	p
Intercept	1445.743	1	1445.743	288.6449	0.000000
Group	0.188	1	0.188	0.0375	0.846661
Sex	42.662	1	42.662	8.5175	0.004132
Group*Sex	11.579	1	11.579	2.3117	0.130777
Error	666.161	133	5.009		

Sex:

Cell No.	Sex; Unweighted Means (prosopagnosia data for statistica) Current effect: F(1, 133)=8.5175, p=.00413 Effective hypothesis decomposition Sex	M Pref Height Mean	M Pref Height Std.Err.	M Pref Height -95.00%	M Pref Height +95.00%	N
1	1	4.331279	0.264217	3.808668	4.853890	95
2	2	3.061364	0.345726	2.377531	3.745196	42

Group x Sex:

Cell No.	Group*Sex; Unweighted Means (prosopagnosia data for statistica) Current effect: F(1, 133)=2.3117, p=.13078 Effective hypothesis decomposition Group	Sex	M Pref Height Mean	M Pref Height Std.Err.	M Pref Height -95.00%	M Pref Height +95.00%	N
1	1	1	4.704225	0.265604	4.178871	5.229580	71
2	1	2	2.772727	0.477147	1.828949	3.716506	22
3	2	1	3.958333	0.456834	3.054734	4.861933	24
4	2	2	3.350000	0.500436	2.360157	4.339843	20

Yes-No χ^2 data

Top: prosopags, Bottom: controls

Left: yes, Right: No

Do you have sexual fantasies?

	2 x 2 Table (prosopagnosia data for statistica) Column 1	Column 2	Row Totals
Frequencies, row 1	41	6	47
Percent of total	29.078%	4.255%	33.333%
Frequencies, row 2	85	9	94
Percent of total	60.284%	6.383%	66.667%
Column totals	126	15	141
Percent of total	89.362%	10.638%	
Chi-square (df=1)	.34	p=.5623	
V-square (df=1)	.33	p=.5637	
Yates corrected Chi-square	.08	p=.7720	
Phi-square	.00238		
Fisher exact p, one-tailed		p=.3774	
two-tailed		p=.5721	
McNemar Chi-square (A/D)	19.22	p=.0000	
Chi-square (B/C)	66.86	p=.0000	

Can you imagine an attractive person in sexual fantasy?***

	2 x 2 Table (prosopagnosia data for statistica) Column 1	Column 2	Row Totals
Frequencies, row 1	24	23	47
Percent of total	16.901%	16.197%	33.099%
Frequencies, row 2	81	14	95
Percent of total	57.042%	9.859%	66.901%
Column totals	105	37	142
Percent of total	73.944%	26.056%	
Chi-square (df=1)	19.09	p=.0000	
V-square (df=1)	18.95	p=.0000	
Yates corrected Chi-square	17.35	p=.0000	
Phi-square	.13442		
Fisher exact p, one-tailed		p=.0000	
two-tailed		p=.0000	
McNemar Chi-square (A/D)	2.13	p=.1443	
Chi-square (B/C)	31.24	p=.0000	

Which of the following physical attributes do you find most attractive in potential partner? (Select all that apply)

<u>Facial Symmetry</u>

	2 x 2 Table (prosopagnosia data for statistica)		
	Column 1	Column 2	Row Totals
Frequencies, row 1	19	74	93
Percent of total	13.869%	54.015%	67.883%
Frequencies, row 2	14	30	44
Percent of total	10.219%	21.898%	32.117%
Column totals	33	104	137
Percent of total	24.088%	75.912%	
Chi-square (df=1)	2.12	p= .1455	
V-square (df=1)	2.10	p= .1470	
Yates corrected Chi-square	1.54	p= .2144	
Phi-square	.01546		
Fisher exact p, one-tailed		p= .1082	
two-tailed		p= .1986	
McNemar Chi-square (A/D)	2.04	p= .1531	
Chi-square (B/C)	39.56	p= .0000	

<u>Certain Facial Characteristics*</u>**

	2 x 2 Table (prosopagnosia data for statistica)		
	Column 1	Column 2	Row Totals
Frequencies, row 1	55	38	93
Percent of total	40.146%	27.737%	67.883%
Frequencies, row 2	12	32	44
Percent of total	8.759%	23.358%	32.117%
Column totals	67	70	137
Percent of total	48.905%	51.095%	
Chi-square (df=1)	12.14	p= .0005	
V-square (df=1)	12.05	p= .0005	
Yates corrected Chi-square	10.90	p= .0010	
Phi-square	.08860		
Fisher exact p, one-tailed		p= .0004	
two-tailed		p= .0005	
McNemar Chi-square (A/D)	5.56	p= .0183	
Chi-square (B/C)	12.50	p= .0004	

Clear Skin

	2 x 2 Table (prosopagnosia data for statistica)		
	Column 1	Column 2	Row Totals
Frequencies, row 1	25	68	93
Percent of total	18.248%	49.635%	67.883%
Frequencies, row 2	10	34	44
Percent of total	7.299%	24.818%	32.117%
Column totals	35	102	137
Percent of total	25.547%	74.453%	
Chi-square (df=1)	.27	p= .6026	
V-square (df=1)	.27	p= .6040	
Yates corrected Chi-square	.10	p= .7559	
Phi-square	.00198		
Fisher exact p, one-tailed		p= .3825	
two-tailed		p= .6783	
McNemar Chi-square (A/D)	1.08	p= .2976	
Chi-square (B/C)	41.65	p= .0000	

Body Shape

	2 x 2 Table (prosopagnosia data for statistica)		
	Column 1	Column 2	Row Totals
Frequencies, row 1	51	42	93
Percent of total	37.226%	30.657%	67.883%
Frequencies, row 2	23	21	44
Percent of total	16.788%	15.328%	32.117%
Column totals	74	63	137
Percent of total	54.015%	45.985%	
Chi-square (df=1)	.08	p= .7784	
V-square (df=1)	.08	p= .7792	
Yates corrected Chi-square	.01	p= .9221	
Phi-square	.00058		
Fisher exact p, one-tailed		p= .4604	
two-tailed		p= .8550	
McNemar Chi-square (A/D)	11.68	p= .0006	
Chi-square (B/C)	4.98	p= .0256	

Height

	2 x 2 Table (prosopagnosia data for statistica)		
	Column 1	Column 2	Row Totals
Frequencies, row 1	54	37	91
Percent of total	40.000%	27.407%	67.407%
Frequencies, row 2	30	14	44
Percent of total	22.222%	10.370%	32.593%
Column totals	84	51	135
Percent of total	62.222%	37.778%	
Chi-square (df=1)	.99	p= .3207	
V-square (df=1)	.98	p= .3225	
Yates corrected Chi-square	.65	p= .4215	
Phi-square	.00731		
Fisher exact p, one-tailed		p= .2114	
two-tailed		p= .3495	
McNemar Chi-square (A/D)	22.37	p= .0000	
Chi-square (B/C)	.54	p= .4636	

Eye Color***

	2 x 2 Table (prosopagnosia data for statistica)		
	Column 1	Column 2	Row Totals
Frequencies, row 1	33	60	93
Percent of total	24.088%	43.796%	67.883%
Frequencies, row 2	8	36	44
Percent of total	5.839%	26.277%	32.117%
Column totals	41	96	137
Percent of total	29.927%	70.073%	
Chi-square (df=1)	4.26	p= .0389	
V-square (df=1)	4.23	p= .0397	
Yates corrected Chi-square	3.48	p= .0622	
Phi-square	.03112		
Fisher exact p, one-tailed		p= .0288	
two-tailed		p= .0464	
McNemar Chi-square (A/D)	.06	p= .8097	
Chi-square (B/C)	38.25	p= .0000	

Smile***

	2 x 2 Table (prosopagnosia data for statistica)		
	Column 1	Column 2	Row Totals
Frequencies, row 1	74	19	93
Percent of total	54.015%	13.869%	67.883%
Frequencies, row 2	27	17	44
Percent of total	19.708%	12.409%	32.117%
Column totals	101	36	137
Percent of total	73.723%	26.277%	
Chi-square (df=1)	5.11	p= .0238	
V-square (df=1)	5.07	p= .0243	
Yates corrected Chi-square	4.21	p= .0401	
Phi-square	.03730		
Fisher exact p, one-tailed		p= .0214	
two-tailed		p= .0366	
McNemar Chi-square (A/D)	34.46	p= .0000	
Chi-square (B/C)	1.07	p= .3020	

Hair Color

	2 x 2 Table (prosopagnosia data for statistica)		
	Column 1	Column 2	Row Totals
Frequencies, row 1	27	66	93
Percent of total	19.708%	48.175%	67.883%
Frequencies, row 2	8	36	44
Percent of total	5.839%	26.277%	32.117%
Column totals	35	102	137
Percent of total	25.547%	74.453%	
Chi-square (df=1)	1.85	p= .1739	
V-square (df=1)	1.84	p= .1755	
Yates corrected Chi-square	1.32	p= .2502	
Phi-square	.01349		
Fisher exact p, one-tailed		p= .1241	
two-tailed		p= .2111	
McNemar Chi-square (A/D)	1.02	p= .3135	
Chi-square (B/C)	43.91	p= .0000	

Muscle Tone* (trend)

	2 x 2 Table (prosopagnosia data for statistica)		
	Column 1	Column 2	Row Totals
Frequencies, row 1	16	77	93
Percent of total	11.679%	56.204%	67.883%
Frequencies, row 2	14	30	44
Percent of total	10.219%	21.898%	32.117%
Column totals	30	107	137
Percent of total	21.898%	78.102%	
Chi-square (df=1)	3.73	p= .0535	
V-square (df=1)	3.70	p= .0543	
Yates corrected Chi-square	2.92	p= .0873	
Phi-square	.02722		
Fisher exact p, one-tailed		p= .0456	
two-tailed		p= .0757	
McNemar Chi-square (A/D)	3.67	p= .0553	
Chi-square (B/C)	42.24	p= .0000	

Bibliography

APA Dictionary of Psychology. (n.d.). https://dictionary.apa.org/prosopagnosia

APA Dictionary of Psychology. (n.d.-b). https://dictionary.apa.org/attraction

Archer, J. (2006). Testosterone and human aggression: An evaluation of the challenge hypothesis. *Neuroscience & Biobehavioral Reviews, 30*(3), 319-345. https://doi.org/10.1016/j.neubiorev.2004.12.007

Ainsworth, M. D. S., Blehar, M. C., Waters, E., & Wall, S. (1978). *Patterns of attachment: A psychological study of the strange situation*. Erlbaum.

Arrington, J., Duchaine, B., & Nakayama, K. (2022). The Cambridge Face Memory Test. *Journal of Vision, 6*(7), 837-859. https://doi.org/10.1167/6.7.837

Baron-Cohen, S., Wheelwright, S., Skinner, R., Martin, J., & Clubley, E. (2001). The autism-spectrum quotient (AQ): Evidence from Asperger syndrome/high-functioning autism, males and females, scientists and mathematicians. *Journal of Autism and Developmental Disorders, 31*(1), 5–17. https://doi.org/10.1023/a:1005653411471

Barton, J. J. S. (2008). Structure and function in acquired prosopagnosia: Lessons from a series of 10 patients with brain damage. *Journal of Neuropsychology, 2*(1), 197–225. https://doi.org/10.1348/174866407x214172

Barton, J. J., et al. (2002). Structural and functional imaging of prosopagnosia. *Journal of Clinical and Experimental Neuropsychology, 24*(6), 782-791.

Barton, J., Corrow, S., & Dalrymple, K. (2016). Prosopagnosia: Current perspectives. *Eye And Brain, Volume 8*, 165–175. https://doi.org/10.2147/eb.s92838

Behrmann, M., & Avidan, G. (2005). Congenital prosopagnosia: Face-blind from birth. *Trends in Cognitive Sciences, 9*(4), 180-187. https://doi.org/10.1016/j.tics.2005.02.011

Bentin, S., DeGutis, J. M., D'Esposito, M., & Robertson, L. C. (1999). Neural basis of developmental prosopagnosia. *Nature Neuroscience, 2*(7), 655-659. https://doi.org/10.1038/10227

Benton, A. L., & Van Allen, M. W. (1968). Prosopagnosia and facial discrimination. *Journal of Neurological Sciences, 6*(1), 69-74. https://doi.org/10.1016/0022-510X(68)90048-3

Berscheid, E., & Walster, E. (1978). *Interpersonal attraction*. Addison-Wesley.

Booth, A., Granger, D. A., Mazur, A., & Kivlighan, K. T. (2006). Testosterone and social behavior. *Social Forces, 85*(1), 167-191. https://doi.org/10.1353/sof.2006.0113

Bowles, D. C., McKone, E., Dawel, A., Duchaine, B., Palermo, R., Schmalzl, L., ... & Yovel, G. (2009). Diagnosing prosopagnosia: Effects of ageing, sex, and participant-stimulus ethnic match on the Cambridge Face Memory Test and Cambridge Face Perception Test. *Cognitive Neuropsychology, 26*(5), 423-455. https://doi.org/10.1080/02643290903343149

Bressler, E. R., & Balshine, S. (2006). The influence of humor on desirability. *Evolution and Human Behavior, 27*(1), 29–39. https://doi.org/10.1016/j.evolhumbehav.2005.06.002

Bodamer, J. (1947). Die Prosop-Agnosie. Archiv Für Psychiatrie Und Nervenkrankheiten, 179(1–2), 6–53. https://doi.org/10.1007/bf00352849

Buss, D. M. (1989). Sex differences in human mate preferences: Evolutionary hypotheses tested in 37 cultures. *Behavioral and Brain Sciences, 12*(1), 1-14. https://doi.org/10.1017/S0140525X00023992

Buss, D. M. (1999). Evolutionary psychology: The new science of the mind. Allyn & Bacon.

Buss, D. M. (2003). The evolution of desire: Strategies of human mating (Revised edition). Basic Books.

Buss, D. M., & Schmitt, D. P. (1993). Sexual strategies theory: An evolutionary perspective on human mating. *Psychological Review, 100*(2), 204-232. https://doi.org/10.1037/0033-295X.100.2.204

Cabrero, F. R., & De Jesus, O. (2023, May 1). Prosopagnosia. StatPearls - NCBI Bookshelf. https://www.ncbi.nlm.nih.gov/books/NBK559324/

Cloutier, J., Heatherton, T. F., Whalen, P. J., & Kelley, W. M. (2008). Are attractive people rewarding? Sex differences in the neural substrates of facial attractiveness. *Journal of Cognitive Neuroscience, 20*(6), 941-951. https://doi.org/10.1162/jocn.2008.20062

Collins, S. A., & Missing, C. (2003). Vocal and visual attractiveness are related in women. *Animal Behaviour, 65*(5), 997-1004. https://doi.org/10.1006/anbe.2003.2123

Dalrymple, K. A., Garrido, L., & Duchaine, B. (2014). The 20-item prosopagnosia index (PI20): A self-report instrument for identifying developmental prosopagnosia. *Royal Society Open Science, 2*(6), 140343. https://doi.org/10.1098/rsos.140343

Damasio, A. R. (1985). Prosopagnosia. *Trends in Neurosciences, 8*, 132–135. https://doi.org/10.1016/0166-2236(85)90051-7

DeGutis, J., Bahierathan, K., Barahona, K., Lee, E., Evans, T. C., Shin, H. M., Mishra, M., Likitlersuang, J., & Wilmer, J. B. (2023). What is the prevalence of developmental prosopagnosia? An empirical assessment of different diagnostic cutoffs. *Cortex, 161*, 51–64. https://doi.org/10.1016/j.cortex.2022.12.014

Drummond, P. D., & Quah, S. H. (2001). The effect of expressing anger on cardiovascular reactivity and facial blood flow in Chinese and Caucasians. *Psychophysiology, 38*(2), 190–196. https://doi.org/10.1111/1469-8986.3820190

Duchaine, B., & Nakayama, K. (2006). The Cambridge Face Memory Test: Results for neurologically intact individuals and an investigation of its validity using inverted face stimuli and prosopagnosic participants. *Neuropsychologia, 44*(4), 576–585. https://doi.org/10.1016/j.neuropsychologia.2005.07.001

Duchaine, B., & Nakayama, K. (2006). Developmental prosopagnosia: A window to content-specific face processing. *Current Opinion in Neurobiology, 16*(2), 166-173. https://doi.org/10.1016/j.conb.2006.03.003

Duchaine, B. C., & Weidenfeld, A. (2003). An evaluation of two commonly used tests of unfamiliar face recognition. *Neuropsychologia, 41*(6), 713-720. https://doi.org/10.1016/S0028-3932(02)00181-8

Eastwick, P. W., & Finkel, E. J. (2008). Sex differences in mate preferences revisited: Do people know what they initially desire in a romantic partner? *Journal of Personality and Social Psychology, 94*(2), 245-264. https://doi.org/10.1037/0022-3514.94.2.245

Feinberg, D. R., Jones, B. C., Little, A. C., Burt, D. M., & Perrett, D. I. (2005). Manipulations of fundamental and formant frequencies influence the attractiveness of human male voices. *Animal Behaviour, 69*(3), 561-568. https://doi.org/10.1016/j.anbehav.2004.06.012

Feingold, A. (1990). Gender differences in effects of physical attractiveness on romantic attraction: A comparison across five research paradigms. *Journal of Personality and Social Psychology, 59*(5), 981-993. https://doi.org/10.1037/0022-3514.59.5.981

Fink, B., Grammer, K., & Matts, P. (2006). Visible skin color distribution plays a role in the perception of age, attractiveness, and health in female faces. *Evolution and Human Behavior, 27*(6), 433–442. https://doi.org/10.1016/j.evolhumbehav.2006.08.007

Fink, B., & Matts, P. J. (2008). The effects of skin colour distribution and topography cues on the perception of female facial age and health. *Journal of the European Academy of Dermatology and Venereology, 22*(4), 493-498.

Fink, B., Grammer, K., & Thornhill, R. (2001). Human (Homo sapiens) facial attractiveness in relation to skin texture and color. *Journal of Comparative Psychology, 115*(1), 92-99.

Fisher, M. L. (2004). Female intrasexual competition decreases female facial attractiveness. *Proceedings of the Royal Society B: Biological Sciences, 271*(5), 283-285. https://doi.org/10.1098/rspb.2003.2567

Fisher, M. L. (2013). Women's voices: Preferences for sexual dimorphism in pitch. *Evolutionary Psychology, 11*(1), 147470491301100115. https://doi.org/10.1177/147470491301100115

Foo, Y., Simmons, L., & Rhodes, G. (2017). Predictors of facial attractiveness and health in humans. *Scientific Reports, 7*, 39731. https://doi.org/10.1038/srep39731
Gettler, L. T., McDade, T. W., Feranil, A. B., & Kuzawa, C. W. (2011). Longitudinal evidence that fatherhood decreases testosterone in human males. *Proceedings of the National Academy of Sciences, 108*(39), 16194-16199. https://doi.org/10.1073/pnas.1105403108

Hadjikhani, N., & De Gelder, B. (2002). Neural basis of prosopagnosia: An fMRI study. *Human Brain Mapping, 16*(3), 176–182. https://doi.org/10.1002/hbm.10043

Havlíček, J., Dvořáková, R., Bartoš, L., & Flegr, J. (2006). Non-advertized does not mean concealed: Body odour changes across the human menstrual cycle. *Ethology, 112*(1), 81-90.

Havlíček, J., Roberts, S. C., & Flegr, J. (2005). Women's preference for dominant male odour: Effects of menstrual cycle and relationship status. *Biology Letters, 1*(3), 256-259.

Herz, R. S., & Inzlicht, M. (2002). Sex differences in response to physical and social factors involved in human mate selection: The importance of smell for women. *Evolution and Human Behavior, 23*(5), 359-364.

Hoover, A. E. N., Démonet, J. F., & Steeves, J. K. E. (2010). Superior voice recognition in a patient with acquired prosopagnosia and object agnosia. *Neuropsychologia, 48*(13), 3725-3732. https://doi.org/10.1016/j.neuropsychologia.2010.09.008

Hume, D. (1757). *Of the standard of taste*. In *Four dissertations* (p. xx). London: A. Millar.
Jones, D., Braun, H. A., & Petrie, M. (1995). Facial attractiveness, developmental stability, and fluctuating asymmetry. *Ethology and Sociobiology, 16*(2), 145-158.

Kamensek, T., Susilo, T., Iarocci, G., & Oruc, I. (2023). Are people with autism prosopagnosic? *Autism Research, 16*(11), 2100–2109. https://doi.org/10.1002/aur.3030

Li, N. P., Bailey, J. M., Kenrick, D. T., & Linsenmeier, J. A. (2002). The necessities and luxuries of mate preferences: Testing the trade-offs. *Journal of Personality and Social Psychology, 82*(6), 947-955. https://doi.org/10.1037/0022-3514.82.6.947

Liu, X., Li, X., Song, Y., & Liu, J. (2021). Separate and shared neural basis of face memory and face perception in developmental prosopagnosia. *Frontiers in Behavioral Neuroscience, 15*. https://doi.org/10.3389/fnbeh.2021.668174

Little, A. C., Jones, B. C., & DeBruine, L. M. (2011). Facial attractiveness: Evolutionary based research. *Philosophical Transactions of the Royal Society B: Biological Sciences, 366*(1571), 1638-1659.

Montoya, R. M., Horton, R. S., & Kirchner, J. (2008). Is actual similarity necessary for attraction? A meta-analysis of actual and perceived similarity. *Journal of Social and Personal Relationships, 25*(6), 889-922.

Murray, E., & Bate, S. (2020). Diagnosing developmental prosopagnosia: Repeat assessment using the Cambridge Face Memory Test. *Royal Society Open Science, 7*(9), 200884. https://doi.org/10.1098/rsos.200884

Pawlowski, B. (2003). Variable preferences for sexual dimorphism in height as a strategy for increasing the pool of potential partners in humans. *Proceedings of the Royal Society of London. Series B: Biological Sciences, 270*(1516), 709-712. https://doi.org/10.1098/rspb.2002.2294

Perrett, D. I., May, K. A., & Yoshikawa, S. (1994). Facial shape and judgments of female attractiveness. *Nature, 368*(6468), 239-242.

Puts, D. A., Gaulin, S. J. C., & Verdolini, K. (2006). Dominance and the evolution of sexual dimorphism in human voice pitch. *Evolution and Human Behavior, 27*(4), 283-296. https://doi.org/10.1016/j.evolhumbehav.2005.11.003

Roberts, S. C., Gosling, L. M., Carter, V., & Petrie, M. (2009). MHC-correlated odour preferences in humans and the use of oral contraceptives. *Proceedings of the Royal Society B: Biological Sciences, 275*(1652), 2715-2722.

Rhodes, G. (2006). The evolutionary psychology of facial beauty. *Annual Review of Psychology, 57*, 199-226.

Rhodes, G., Yoshikawa, S., Clark, A., Lee, K., McKay, R., & Akamatsu, S. (2001). Attractiveness of facial averageness and symmetry in non-Western cultures: In search of biologically based standards of beauty. *Perception, 30*(5), 611-625.

Scheib, J. E., Gangestad, S. W., & Thornhill, R. (1999). Facial attractiveness, symmetry and cues of good genes. *Proceedings of the Royal Society of London. Series B: Biological Sciences, 266*(1431), 1913–1917. https://doi.org/10.1098/rspb.1999.0866

Setchell, J. M., & Wickings, E. J. (2005). Dominance, status signals and coloration in male mandrills (Mandrillus sphinx). *Ethology, 111*(1), 25–50. https://doi.org/10.1111/j.1439-0310.2004.01054.x

Schultz, R. T. (2005). Developmental deficits in social perception in autism: The role of the amygdala and fusiform face area. *International Journal of Developmental Neuroscience, 23*(2-3), 125-141.

Shah, P., Gaule, A., Sowden, S., Bird, G., & Cook, R. (2015). The 20-item prosopagnosia index (PI20): A self-report instrument for identifying developmental prosopagnosia. *Royal Society Open Science, 2*(6), 140343. https://doi.org/10.1098/rsos.140343

Smith, C. S. (n.d.). *With prosopagnosia, does your idea of who is attractive generally conform with that of the general population?* Quora. https://www.quora.com/With-prosopagnosia-does-your-idea-of-who-is-attractive-generally-conform-with-that-of-the-general-population

Stulp, G., Buunk, A. P., Verhulst, S., & Pollet, T. V. (2013). Human height is positively related to interpersonal dominance in dyadic interactions. *PLoS ONE, 8*(2), e54633. https://doi.org/10.1371/journal.pone.0054633

Swann, W. B., Jr., De La Ronde, C., & Hixon, J. G. (1994). Authenticity and positivity strivings in marriage and courtship. *Journal of Personality and Social Psychology, 66*(5), 857-869. https://doi.org/10.1037/0022-3514.66.5.857

Tsantani, M., Vestner, T., & Cook, R. (2021). The Twenty Item Prosopagnosia Index (PI20) provides meaningful evidence of face recognition impairment. *Royal Society Open Science, 8*(11), 202062. https://doi.org/10.1098/rsos.202062

Thibaut, J. W., & Kelley, H. H. (1959). *The social psychology of groups*. John Wiley & Sons.
Trivers, R. L. (1972). Parental investment and sexual selection. In B. Campbell (Ed.), *Sexual selection and the descent of man* (pp. 136-179). Aldine.

Wedekind, C., Seebeck, T., Bettens, F., & Paepke, A. J. (1995). MHC-dependent mate preferences in humans. *Proceedings of the Royal Society B: Biological Sciences, 260*(1359), 245-249. https://doi.org/10.1098/rspb.1995.0087

Willis, J., & Todorov, A. (2006). First impressions: Making up your mind after a 100-ms exposure to a face. *Psychological Science, 17*(7), 592-598. https://doi.org/10.1111/j.1467-9280.2006.01750.x

Young, A. W., Ellis, A. W., Flude, B. M., McWeeny, K. H., & Hay, D. C. (1986). Face–name interference. *Journal of Experimental Psychology: Human Perception and Performance, 12*(4), 466–475. https://doi.org/10.1037/0096-1523.12.4.466

Zajonc, R. B. (1968). Attitudinal effects of mere exposure. *Journal of Personality and Social Psychology, 9*(2), 1-27.

Zäske, R., et al. (2017). The impact of voice quality on the perception of personality. *Journal of Research in Personality, 70*, 102-113.

Zuckerman, M., & Driver, R. E. (1989). What sounds beautiful is good: The vocal attractiveness stereotype. *Journal of Nonverbal Behavior, 13*(2), 67-82.