UNIWERSYTET WROCŁAWSKI WYDZIAŁ NAUK HISTORYCZNYCH I PEDAGOGICZNYCH INSTYTUT PSYCHOLOGII

UNIVERSITY OF WROCŁAW FACULTY OF HISTORICAL AND PEDAGOGICAL SCIENCES INSTITUTE OF PSYCHOLOGY

Michał Mikołaj Stefańczyk

The Search for Origins of Sex Differences in Disgust Sensitivity

Praca doktorska napisana pod kierunkiem: dr hab. Agnieszka Sorokowska, prof. UWr

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There are four women without whom I would have never completed this work. I would like to express my gratitude to them. I give thanks to my Supervisor, dr hab. Agnieszka Sorokowska, prof. UWr, who from the very beginning guided me in the scientific world.

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Synopsis of the PhD dissertation

The Search for Origins of Sex Differences in Disgust Sensitivity

Disgust sensitivity, understood as a tendency to experience the emotion of disgust (Shook et al., 2019), is as a risk-avoidance mechanism (Sparks et al., 2018) that serves to protect us from potentially threatening objects or people (Curtis et al., 2011). One of the most important factors influencing disgust sensitivity is biological sex, with females being more disgust sensitive than males (for a meta-analysis, see Sparks et al., 2018). However, the reasons for that sex discrepancy remain obscure. In my thesis I tested a number of hypotheses aimed at explaining this phenomenon. The results of my studies have been described in a series of five papers:

- Stefanczyk, M. M., Lizak, K., Kowal, M., & Sorokowska, A. (2022). "May I present you: my disgust!" Declared disgust sensitivity in the presence of attractive models. *British Journal of Psychology*, *113*(*3*), 739-757. https://doi.org/10.1111/bjop.12556.

- Stefanczyk, M. M., Rymaszewska, M., & Lachowicz-Tabaczek, K. (2023). Far from disgusted: The relationships between disgust sensitivity, dark personality traits, and biological sex. *Personality and Individual Differences*, 202, 111983. https://doi.org/10.1016/j.paid.2022.111983.

- Stefanczyk, M. M., &, Zielińska, A. (2024). Are cooks more disgust sensitive? Preliminary examination of the food preparation hypothesis. *Appetite*, *192*, 107117. https://doi.org/10.1016/j.appet.2023.107117.

Stefanczyk, M. M., &, Pieniak, M. (2024). Sex Differences in Pathogen Disgust Sensitivity
Testing the Coalitional Hunting and Warfare Hypothesis. *Evolutionary Behavioral Sciences*, [in print]. doi: 10.1037/ebs0000361.

- **Stefanczyk, M. M.**, Adamczyk, L., Ciniawska, A., Czulak, M., Fuławka, K., Galka, K., Hibino, M. W., Ipnar, P., Jedrusik, P. J., Mikołajewska, Z., Pytlińska, A., Wroblewska, K., Sorokowska, A. Parents are less disgust sensitive than childless individuals, and a child's presence has no effect on disgust sensitivity of a parent. [second round of reviews in *Parenting: Science and Practice*].

So far, no studies empirically addressed the issue of the origins of the sex differences in disgust sensitivity. It may come as a surprise, given how robust this effect is: since the first disgust measures were developed, across various cultures and in different environmental contexts, women report higher disgust sensitivity levels than men. When we consider the substantial size effect of this discrepancy, it is hard to argue that this is merely a coincidence. Having come across this consistent pattern of results, I decided to use a scientific, empirical approach to identify and explain the reasons for it.

However, this matter is not merely an academic dispute on a theoretical subject – it may potentially help understand many issues vital for the modern politics and the Western social environment in general, as disgust sensitivity is robustly linked with phenomena such as xenophobia, homophobia, mental disorders, moral decision-making, or political views and voting behaviours. I argue that getting to understand where the differences between men and women in disgust sensitivity come from may be a step towards scientific, evidence-based approach in addressing the aforementioned social phenomena. This thesis comprises the first studies that aimed at an empirical verification of socio-evolutionary hypotheses on why women and men differ in their disgust sensitivity. Here, I present a synopsis of my research in this field, preceded by theoretical background on disgust and sex differences in disgust, as well as potential explanations of the latter.

Keywords: disgust¹; disgust sensitivity; sex differences; sex;

¹ In the Polish version of the synopsis section, there are more keywords; this is due to the fact that there are two words for "disgust" in Polish ("wstręt" and "obrzydzenie"), one being used as widely and frequently as the other.

Abstrakt pracy doktorskiej

W poszukiwaniu genezy różnic międzypłciowych we wrażliwości na wstręt

Wrażliwość na wstręt, rozumiana jako skłonność do doświadczania emocji obrzydzenia (Shook et al., 2019), to mechanizm służący unikaniu ryzyka (Sparks et al., 2018), którego celem jest ustrzec nas przed potencjalnie zagrażającymi obiektami lub ludźmi (Curtis et al., 2011). Jednym z najsilniej wpływających na wrażliwość na wstręt czynników jest płeć – kobiety są bardziej wrażliwe na obrzydzenie niż mężczyźni (meta-analiza dostępna w Sparks et al., 2018). Powody tej międzypłciowej różnicy pozostają jednak niejasne. W swojej pracy doktorskiej przetestowałem szereg hipotez mających na celu wyjaśnienie tego zjawiska. Wyniki przeprowadzonych przeze mnie badan opisałem w serii pięciu manuskryptów:

- **Stefanczyk, M. M.**, Lizak, K., Kowal, M., & Sorokowska, A. (2022). "May I present you: my disgust!" Declared disgust sensitivity in the presence of attractive models. *British Journal of Psychology*, *113*(3), 739-757. https://doi.org/10.1111/bjop.12556.

- **Stefanczyk, M. M.**, Rymaszewska, M., & Lachowicz-Tabaczek, K. (2023). Far from disgusted: The relationships between disgust sensitivity, dark personality traits, and biological sex. *Personality and Individual Differences, 202, 111983.* https://doi.org/10.1016/j.paid.2022.111983.

- **Stefanczyk, M. M.**, &, Zielińska, A. (2024). Are cooks more disgust sensitive? Preliminary examination of the food preparation hypothesis. *Appetite*, *192*, 107117. https://doi.org/10.1016/j.appet.2023.107117.

- Stefanczyk, M. M., &, Pieniak, M. (2024). Sex Differences in Pathogen Disgust Sensitivity
- Testing the Coalitional Hunting and Warfare Hypothesis. *Evolutionary Behavioral Sciences*,
[przyjęte do publikacji, w druku]. doi: 10.1037/ebs0000361.

- **Stefanczyk, M. M.**, Adamczyk, L., Ciniawska, A., Czulak, M., Fuławka, K., Galka, K., Hibino, M. W., Ipnar, P., Jedrusik, P. J., Mikołajewska, Z., Pytlińska, A., Wroblewska, K., Sorokowska, A. Parents are less disgust sensitive than childless individuals, and a child's presence has no effect on disgust sensitivity of a parent. [druga runda recenzji w: *Parenting: Science and Practice*].

Dotychczas żadne badania empirycznie nie testowały genezy różnic międzypłciowych we wrażliwości na obrzydzenie. Jest to zaskakujące, jeśli weźmie się pod uwagę, że fenomen kobiet będących bardziej wrażliwymi na wstręt niż mężczyźni występuje w różnych kulturach i jest notowany od początku badań nad wrażliwością na obrzydzenie aż po dziś. Kiedy do dopełnienia obrazu doda się także znaczący rozmiar tego efektu, trudno jest wówczas uznać istnienie różnic międzypłciowych we wrażliwości na wstręt za przypadek. Natknąwszy się na ten spójny wzorzec wyników, postanowiłem zastosować naukowe, empiryczne podejście, aby zidentyfikować i wyjaśnić jego przyczyny.

Kwestia ta nie jest jednak tylko akademickim sporem na teoretyczny temat - może potencjalnie pomóc w zrozumieniu wielu tematów istotnych dla współczesnej polityki i fenomenów społecznych na Zachodzie, ponieważ wrażliwość na obrzydzenie jest silnie powiązana ze zjawiskami takimi jak ksenofobia, homofobia, zaburzenia psychiczne, podejmowanie decyzji moralnych czy poglądy polityczne i preferencje wyborcze. Suponuję, że zrozumienie, skąd biorą się różnice między mężczyznami i kobietami we wrażliwości na wstręt, może być krokiem w kierunku naukowego, opartego na dowodach podejścia do wyżej wymienionych zjawisk społecznych. Niniejsza rozprawa obejmuje badania, w których po raz pierwszy empirycznie weryfikowano hipotezy społeczno-ewolucyjne dotyczące pochodzenia różnic między kobietami i mężczyznami we wrażliwości na obrzydzenie. Poniżej przedstawiam streszczenie moich badań w tej dziedzinie, poprzedzone teoretycznym wstęp dotyczącym wstrętu i różnic płciowych we wstręcie, a także potencjalnymi wyjaśnieniami tych ostatnich.

Słowa klucze: obrzydzenie; wstręt; wrażliwość na obrzydzenie; wrażliwość na wstręt; różnice międzypłciowe; płeć;

Theoretical background of the thesis

Disgust sensitivity

The importance of disgust for one's survival was first underscored by Charles Darwin (1872). He also pointed out that it can be experienced through various modalities, which was later confirmed in many empirical studies (Croy et al., 2013; Curtis & Biran, 2001; Saluja & Stevenson, 2019). It can be argued that if we evolved a capability to experience disgust through seeing, tasting, smelling, touching and hearing, then it should be extremely adaptive for us to be sensitive to cues of potential contamination or infection. This ability is not yet another WEIRD phenomenon (Henrich et al., 2010) restricted to the Wester culture. Disgust is considered one of the basic emotions (Ekman, 1992), facial expression or vocalisations of which are cross-culturally recognised (Sauter et al., 2010; Srinivasan & Martinez, 2021). Nonetheless, people vary in the degree and frequency they feel disgusted. A trait responsible for that proneness to experience disgust is disgust sensitivity.

Disgust sensitivity operates within three domains – pathogen (related to germs and contamination threats), sexual (related to risky sexual behaviour and suboptimal sexual partners), and moral (related to transgressions of social norms and antisocial behaviour; Tybur et al., 2009). All three domains rely on the same cognitive, emotional and behavioural mechanisms that result in separating or distancing oneself from a disgusting situation/object (Rozin et al., 1999).

Pathogen disgust is argued to be ontogenically the first disgust domain to have evolved (Kelly, 2011), aimed at avoidance of disease or contamination cues. It is often considered a part of behavioural immune system (Schaller & Park, 2011), a set of psychological processes aimed at inferring potential infection risks from cues in the environment. These processes should later lead to implementation of adaptive countermeasures, including, but not limited to expelling an object from one's body (Rozin & Fallon, 1987) or associating previously neutral stimulus with a (potential) threat for the sake of appropriate distancing oneself from it in the future encounters (Fink-Lamotte et al., 2024).

Sexual disgust operates primarily in an interpersonal context, as its purpose is to discourage an individual from potentially maladaptive choices with respect to sexual activities. As de Jong and colleagues (2013) suggest, disgust and sexual arousal play mutually

opposing roles. Indeed, high sexual disgust sensitivity leads to reduced sexual arousal when exposed to sexual images (Wen et al., 2023), sexual content may elicit disgust reactions (Grauvogl et al., 2015), and being disgusted in general is followed with a decrease in sexual arousal (Fleischman et al., 2015). Some authors also consider sexual disgust a part of the behavioural immune system (Wen et al., 2023).

Moral disgust, elicited as a response to social norms' transgressions, is aimed at avoiding the perpetrators of these violated social norms, as they may cause harm by their unethical actions. As such, moral disgust is placed in a sociocultural and interpersonal context to a greater degree than the other disgust domains. For instance, observing violations of moral norms that bring harm to others leads to increased disgust reactions (Molho et al., 2017).

Importantly, in all disgust domains, merely an expected and hypothetical contact with a disgusting stimulus may trigger disgust responses, making disgust also an *anticipatory* reaction to potentially non-existent, imaginary situations (Stevenson et al., 2019). This, in turn, leads to some serious potential consequences. On the one hand, a person completely insensitive to disgust would lead a very risky and, presumably, short life. They would not mind eating spoilt food, approaching people with clearly contaminating diseases, engaging in behaviours that endanger their sexual health or mate value, or interacting with individuals whose self-serving, murky agenda is to use and abuse them at a first possible occasion. On the other hand, oversensitivity to disgust can cause significant damage to one's own psychological life, or may lead to unwanted, antagonistic behaviours in relation to others. As for the psychological well-being, previous studies found disgust sensitivity to be a significant predictor of obsessive-compulsive disorder symptoms (e.g., (Nicholson & Barnes-Holmes, 2012; Olatunji et al., 2010), PTSD (Tull & Kimbrel, 2020), and to be positively linked to anxiety (Qianqian & Olatunji, 2013), intrusion (Bomyea & Amir, 2012), and various phobias (Sawchuk et al., 2000). As for the interindividual social context, people higher in disgust sensitivity tend to be more conservative (Tybur et al., 2016), and to vote for right-wing candidates (Shook et al., 2017). Furthermore, disgust is linked with morality and moral decision-making, with disgust induction leading to more severe moral judgements (Schnall et al., 2008). Scoring high in pathogen disgust is also related to more restricted sociosexuality (i.e., being less permissive towards uncommitted sexual relations, Hlay et al., 2022), mate and mating preferences (Al-Shawaf et al., 2015; White et al., 2022), xenophobia (Zakrzewska et al., 2023), and homophobic attitudes (Van Leeuwen et al., 2023). Given how vital for the modern societies these disgust-related issues are, it seems crucial to explore correlates and

predictors of disgust sensitivity. Since biological sex was found to be a major and robust predictor of disgust sensitivity (e.g., Al-Shawaf et al., 2015, 2019; Sparks et al., 2018; Tybur et al., 2011) in my thesis I thoroughly analysed the relationship between disgust sensitivity and biological sex.

Sex differences in disgust sensitivity

Women are found to be more disgust sensitive than men, and this effect appears robustly both across different cultures (e.g., Van Leeuwen et al., 2023) and different historical periods of measurement (e.g., Schmidt et al., 1970; Wen et al., 2024). Unfortunately, in the decisive majority of the previous studies, sex differences in disgust sensitivity are considered a side finding, and not much attention is given to the matter. This may come as a surprise, given how consistent this sex discrepancy is, and that its aetiology is not as easily explainable (or, at least, it has not been proved to be). In contrast, for example, in the case of sex differences in height or aggression, the difference is rather unambiguously attributed (at least partially) to differences in certain hormones' levels (like somatostatin and testosterone, respectively; Archer, 1991; Handelsman et al., 2018; Simonian et al., 1998). A meta-analysis of sex differences in disgust showed that the effect of women being more disgust sensitive than men is large (or even very large) for sexual disgust (d = 1.17), average-to-large for pathogen disgust (d = .41), and relatively small for moral disgust (d = .20; Sparks et al., 2018). Correspondingly, current research does not provide any theoretical grounds for why men should be more insensitive to moral disgust than women, as compared to the large difference in other disgust domains, given that both sexes may be equally vulnerable to consequences of having a morally disgusting (i.e., social norm-transgressing) individual in their thereabouts. In some studies, even no sex differences in moral disgust are reported (Al-Shawaf et al., 2015). On the other hand, there are solid theoretical grounds, both evolutionand culture-based, that offer explanations for the sex differences in the other two disgust domains, i.e., pathogen and sexual disgust. In line with that, in their thorough review on sex differences in disgust, Al-Shawaf and colleagues (2018), provide a significant number of mutually non-exclusive hypotheses that may explain the origins of sex differences in pathogen and sexual disgust (and they omit the moral domain for the reasons provided above). This particular theoretical work serves as the backbone of this dissertation, as it inspired me to seek for a genesis of sex differences in these two disgust domains. In other

words, in this dissertation I follow the reasoning of Al-Shawaf et al. (2018) and Hlay et al. (2021), and focus on sex differences in pathogen and sexual disgust domains, as these are the primary aspects of disgust in which men and women consistently and robustly differ from each other.

In line with the idea that science should take a form of empirically based discourse, with scientists testing each other ideas and suggesting new ones for other independent researchers to test or elaborate on, I decided to follow some of the leads that Al-Shawaf and colleagues offered. It should be noted that they came up with a multitude of hypotheses, and for some of them they suggested a number of ways in which a given hypothesis might be tested. The hypotheses are *not* mutually exclusive, but rather complimentary to each other. Having said that, in this dissertation I investigated *several* hypotheses derived predominantly from Al-Shawaf and colleagues work, guided by their predictions and by assumptions based on theoretical works or empirical findings also from other literature.

In Study 1, I tested predictions behind The Reputational Damage Hypothesis and The Male Mating Hypothesis proposed by Al-Shawaf and colleagues (2018). I conducted an experiment on potential effects of self-presentation in presence of an attractive audience on declared disgust sensitivity levels.

In Study 2, I tested The Dark Personality Hypothesis. I sought for significant correlations between Dark Triad traits – narcissism, Machiavellianism, and Psychopathy – and disgust sensitivity, as both of these groups of constructs share similarities in respect to significant and robust sex differences, and in the *move towards* versus *move away* character of their backgrounds.

In Study 3, I tested The Food Preparation Hypothesis, proposed by Al-Shawaf and colleagues (2018). Through an involvement of a large sample of professional cooks in the study's sample, I tried to answer the question if sex differences in disgust may be a result of the sex roles our ancestors differed in regarding the processes of preparing food for themselves and the others.

In Study 4, I tested **The Coalitional Hunting and Warfare Hypothesis**, proposed by Al-Shawaf and colleagues (2018). In this experiment, I sought for effects of coalitional hunting- or -warfare schemas' activation on disgust sensitivity levels.

In Study 5, I tested The Direct Contagion Hypothesis and The Teaching and Modeling Hypothesis proposed by Al-Shawaf and colleagues (2018). In search of a *parental effect* or a *child presence effect*, *I* compared disgust sensitivity levels between (a) parents and

non-parents, and (b) parents with or without their children by their side at the time of data collection.

In summary, across the five studies that I conducted as a part of the PhD dissertation I sought to answer the question of why men and women differ in disgust sensitivity. My dissertation tests a wide array of hypotheses on the sex differences in disgust, and my studies vary in two functional aspects: (a) focus mostly on men or on women and (b) focus on pathogen and/or on sexual disgust domain (please see Table 1 for visualisation). The five studies I conducted are supported by other disgust-related research that I conducted during my doctoral studies. The manuscripts based on these additional studies are presented as attachments to this dissertation (appendices A to C). These manuscripts may be considered as extensions, follow-ups or alternative approaches to the five main studies discussed here, and they have currently been submitted to international, scientific journals. The reason for conducting these extra studies in general, and for presenting them in an appendix to this dissertation, is to provide a broader perspective on the disgust sensitivity sex differences issue, and to answer some of the questions that arose when the outcomes of the original five studies were being interpreted.

Table 1

| Study | Hypothesis | Disgust Domain focused on | | Focus on | |
|-------|---------------------------------|---------------------------|--------|----------|-------|
| | | Pathogen | Sexual | Men | Women |
| 1 | Reputational Damage | Х | Х | | |
| 1 | Male Mating | Х | Х | Х | |
| 2 | Dark Personality | | Х | Х | Х |
| 3 | Food Preparation | Х | | | Х |
| 4 | Coalitional Hunting and Warfare | Х | | Х | |
| 5 | Direct Contagion | Х | | | Х |
| 5 | Teaching and Modelling | Х | | Х | Х |

Disgust domain and sex that a respective studies focus on.

Note. Uppercase X indicates a Domain or Sex that a given Study/Hypothesis is primarily focused on; lowercase x indicates a Domain or Sex that a given Study/Hypothesis includes, but focuses on only secondarily.

Results and discussion of the findings

Study 1. The Reputational Damage Hypothesis & The Male Mating Hypothesis.

Summary of results presented in: Stefanczyk, M. M., Lizak, K., Kowal, M., & Sorokowska, A. (2022). "May I present you: my disgust!" Declared disgust sensitivity in the presence of attractive models. *British Journal of Psychology, 113*(3), 739-757. https://doi.org/10.1111/bjop.12556

The Reputational Damage Hypothesis and The Male Mating Hypothesis are mutually non-exclusive hypotheses proposed by Al-Shawaf and colleagues (2018). According to the former, it might be adaptive for women to self-present themselves as more disgust sensitive than they really are. Correspondingly, as the second hypothesis suggests, it might be adaptive for men to self-present themselves as *less* disgust sensitivity than they really are. As a result, both sexes might be motivated to declare disgust sensitivity levels that deviate from reality, but in the opposite directions. If confirmed, the hypotheses may at least partially explain why men and women differ in disgust sensitivity.

Importantly, *The Reputational Damage Hypothesis* focuses primarily on sexual disgust, whereas *The Male Mating Hypothesis* focuses primarily on pathogen disgust, yet to a certain degree the two of them can be extended to both of these disgust domains. They were tested simultaneously, *as The Reputational Damage Hypothesis* relates predominantly to women, and *The Male Mating Hypothesis*, as the name suggests, relates predominantly to men, but they both consider self-presentation as a potential key factor that drives the sex differences that have been reported in the previous studies.

Self-presentation may be described as goal-orientated activities serving the purpose of managing self-image and the impression one makes on others (Schlenker, 2003). A successful self-presentation may lead to an acquisition of material or immaterial benefits from an audience (Krumpal, 2013). Due to this dependence of a success on other people's reactions, self-presentation is subjected to social desirability bias, i.e., the inclination for providing information (or exhibiting behaviours) which are expected to be preferred by an audience (Bergen & Labonté, 2020). Crucially, self-presentation is particularly important when that

audience is considered important or attractive to the self-presenting individual (Leary, 2019; Tesser et al., 2000).

Now, if evolutionary perspective is taken into account, an "important and attractive audience" can be understood simply as a potential mate of a high value. In other words, we want to manage our impression particularly well when we are accompanied by a person who has traits preferred in a romantic partner (Schlenker & Pontari, 2000), such as high physical attractiveness (Kowal & Sorokowski, 2022). Previous literature shows some support for this reasoning. For instance, in online dating media people post pictures that adhere to the potential viewers' preferences (Gallant et al., 2011), or, in a dining context, they behave in a particularly socially desirable way in terms of what and how much they eat (Pliner & Chaiken, 1990). Furthermore, they distance themselves from sexually unfaithful same-sex acquaintances when a potential long-term partner is present (Dosmukhambetova & Manstead, 2011). Toma and Hancock (2010) directly suggest that people tend to adjust their own behaviour to what they think might be helpful in achieving mating success.

According to *The Reputational Damage Hypothesis*, women may consider it adaptive to exaggerate their actual disgust sensitivity, especially in the sexual disgust domain (Al-Shawaf et al., 2018). Declaring low sexual disgust could serve as a cue for promiscuity, which in turn may be detrimental for women's own mate value and may limit the available pool of potential partners, especially ones of high mate value (Buss, 2016). In fact, reputational damage is an intra-sexual competitor derogation tactic which is more frequent among women than men (Buss & Dedden, 1990), and being viewed as sexually unfaithful or interested in atypical sexual behaviour is more harmful to reputation of women versus men (Gallup et al., 2009). In general, double standards in sexuality are still persistently found even in modern societies (Marks et al., 2019).

As for self-presentation and pathogen disgust in women, it can be argued that declaring greater sensitivity to contamination-related cues could serve as an honest-signalling behaviour (Pentland, 2010). Namely, considering that women across time and cultures are predominantly the primary guardians of an offspring (Craig, 2006), they should be sensitive to even subtle and nuanced cues for pathogen threat, as children's immune system is particularly underdeveloped (Ygberg & Nilsson, 2012). Thus, children may need an ever-present protector who is aware of and sensitive to disease cues. Perhaps, when the right and *important* audience is present, women would declare greater sensitivity to pathogen disgust in order to manifest how well-suited they are for their potential future role of caregivers?

According to *The Male Mating Hypothesis*, it should be adaptive for men to declare greater *insensitivity* to disgust (Al-Shawaf et al., 2018). There are several potential reasons for that. First, not caring for pathogens, either in the environment or even directly related to (or perceived in) a potential mate, increases the array of potential mates. Considering the extensive character of men's sexual reproduction strategy and their greater focus on shortterm mating (e.g., Al-Shawaf et al., 2015; Trivers, 1972), it may be beneficial to ignore cues of contamination in order to find a mating partner. The same can be applied to sexual disgust, namely that direct declarations of willingness to perform certain activities may be considered an honest signalling that may attract potential mates who may openly or secretly share this sociosexual preference. Second, previous studies show that women prefer partners whose characteristics imply they might have a robust immunological system (e.g., Gangestad & Thornhill, 1997). For instance, traits such as facial symmetry or facial masculinity are considered morphological indicators of such immune system robustness (DeBruine et al., 2010; Gangestad & Thornhill, 1997). Al-Shawaf and colleagues (2018) argue that certain behaviours may also serve as such indicators, thus enacting these behaviours can serve as a signal for individuals nearby. This claim should be considered from the perspective of behavioural immune system (Schaller & Park, 2011), mentioned in the introduction of this dissertation. This set of mechanisms, with disgust sensitivity being an important one, can be compared to a wall that surrounds and protects a medieval city from external threats. The more vulnerable the citizens are, the less fire-proof the buildings within the city are, the taller and the widder the city wall should be, as this is the pivotal element of defence system for that particular, rather weak settlement and its people. But what if the brave people of that city are powerful, mighty, and health-wise robust? Then the city council does not have to spend that significant amount of resources on building the wall, and may invest these resources somewhere else, which will allow the citizens to thrive, and not merely fight for survival. This metaphor may be applied to the behavioural immune system in humans, and thus, explain the system of adaptive mechanisms relating to the male disgust sensitivity levels. Expressing low levels of disgust sensitivity may inform others of rather robust levels of actual immunity (Fessler et al., 2004), whereas being highly sensitive to disgust may suggest that someone has an inferior immunity, and that his genetic quality may possibly be poorer. Thus, a man may declare lower sensitivity to disgust when accompanied by an *important* audience, in order to suggest to that *important audience* that he is immunologically robust and genetically superior – a good partner to father a child.

In conclusion, it can be hypothesized (Al-Shawaf et al., 2018) that sex differences in disgust are at least partially explainable by opposite directions of image management in men and women. For women, it might be evolutionarily adaptive to declare oversensitivity to disgust when attractive audience is present, whereas for men, it might be evolutionarily adaptive to do otherwise and declare suppressed levels of disgust sensitivity when accompanied by attractive audience. Following these two hypotheses, we run an experimental study to test them simultaneously.

In a pilot study, 30 young heterosexual men and 30 young heterosexual women rated attractiveness levels of models who starred in short videos which were presented to the participants. Participants of each sex watched videos solely of models of the opposite sex. We identified a male and a female model that were attractive above average and did not differ in terms of their attractiveness from each other. Thus, we found the experimenters/research assistants, consecutively acting as "attractive audience" in the main study.

In the main study, we assessed disgust sensitivity of 299 heterosexual men and women. They were asked to fill the Three Domains Disgust Scale (Tybur et al., 2009), along with rating of a set of 13 multi-sensory disgust elicitors (e.g., they were shown fake faeces in a box, they were asked to touch oiled-up noodles without seeing what is being touched, they were presented with foul odours, etc.). This procedure could have happened in three possible conditions. In the control condition, the participants completed the disgust sensitivity assessment by themselves in solitude. In the two experimental conditions, they were accompanied by one of the models selected in the pilot study (either male or female one). The model read all the survey items out loud to them and aided the participants in the multi-sensory disgust assessment, and then asked to provide a response also out loud (so that the models could type in the answer on the computer). As such, participants from the two experimental groups were put in a self-presentation situation with an attractive member of their or opposite sex acknowledging their reported disgust sensitivity levels.

Contrary to the hypotheses, we found no effect of self-presentation on pathogen disgust, as measured both by the questionnaire's items or by the sensorial experiences. However, we found a significant effect of female model's presence on declared sexual disgust sensitivity. Regardless of their sex, the participants declared greater sensitivity to sexual disgust when being interviewed by the female attractive model in comparison to control group or the participants performing the study in a presence of an attractive male model (see Figure 1 for visualisation; for details, please see pages 8-11 in Manuscript 1).

Figure 1





Note. Standard error are depicted as error bars.

Overall, the results of this study did not provide support for *The Male Mating Hypothesis*. Men did not declare lower disgust sensitivity in sexual or pathogen domain when an attractive member of the other sex was present (i.e., when accompanied by the important audience), nor they did that in the presence of a same-sex model. Also *The Reputational Damage Hypothesis* was not supported by our results, yet the aforementioned, significant effect of female model led us to suggest certain interpretations. Since this effect was present in both men and women, there are two possible approaches to this outcome: either men and women were driven to the distortion of their sexual disgust declarations for the same reasons, or perhaps different psychological mechanisms that were activated in men and women led to the same result. If the former is true, we reason that perhaps a stereotype of fragile, sensitive, and sexually pure female was activated (Ashmore & Tumia, 1980; Glick & Fiske, 1996). In other words, people assumed that the attractive female model most probably is sensitive to sexual disgust and they responded in accordance with their assumption, in order to not

alienate the model or avoid making her feel uncomfortable. Alternatively, men and women might have differed in their reasons of their inaccurate declarations. For men, it might have been a "play it safe" behaviour, as they did not want to scare off the attractive woman, thus they provided more toned-down answers. For women, the female interviewer could be considered a threat, given that gossiping and reputational damage is a method of intra-sexual competition more frequently used by women (Buss & Dedden, 1990). In other words, female participants might have avoided admitting to the actual (perhaps more promiscuous) attitudes in front of a potential rival, so they precautionary lied. Interestingly enough, in another study I asked a question whether transgressors of various disgust domains' norms are judged equally severely (Stefanczyk et al., under review, see appendix A). In contrast to the findings of the Study 1 reported here, participants in that study considered sexual disgust norms transgressors as the most attractive and the least disgusting, and they passed the most lenient judgement over them in comparison to pathogen or moral disgust norms transgressors. It seems that even though sexual disgust is considered the least punishable, an attractive audience's presence can make it a particularly embarrassing disgust domain to be involved in. In yet another study (Stefanczyk et al., under review, see appendix B), I asked participants to play a date simulator game in which they could interact with a potential, attractive date picking various dialogue options from a pre-determined set of responses. Their ultimate goal was to impress their date and persuade him/her to agree to another date. However, from time to time, the participants had to confess to committing a violation of disgust norm pertaining to one out of the three possible disgust domains (e.g., they were forced to admit to either regularly spitting phlegm, having sex with strangers, or lying to police officers). I found that participants differed sexwise in terms of to what kind of disgust transgressions they would rather concede. Women preferred to admit to moral disgust transgressions, whereas men preferred to admit to pathogen disgust transgressions. The results from these three studies suggest that there is a significant link between self-promotion, mating and transgressing disgust norms, with men and women having different preferences and opinions on what is "the least bad" behaviour option, and on what is perceived as the most abominable. I recommend future research in this regard, especially when the weight given to self-presentation is considered. Namely, some researchers claim self-presentation occurs constantly and often unconsciously, being an indispensable part of human interaction (Goffman, 2005; Schlenker, 1980), in the ever-lasting struggle to avoid being negatively perceived by others (Watson & Friend, 1969).

Importantly, there are two recent studies that followed the publication of Study 1 that potentially shed more light on the preliminary results that I present here. First, the original author of the tested hypotheses run a similar study and found no effect of self-presentation on pathogen disgust sensitivity (Al-Shawaf et al., 2023), similarly to us. However, sexual disgust was not analysed independently in that study. Second, I myself run a study on self-presentation in sociosexuality, i.e., presenting oneself as being more versus less restricted sexually (Stefanczyk, 2023). I reported that participants, regardless of their sex, declared decreased levels of sociosexual desire (i.e., how frequent they want to have sex with people with whom they are not in a relationship) both in front of an attractive male and an attractive female. This result supports the main finding of Study 1 of my PhD dissertation, namely that one's sexuality in general is subjected to self-presentation. However, even if there is a relationship between self-presentation and sexual disgust, as Study 1 suggests, it most probably does not explain the origins of sex differences in this disgust domain.

Study 2. The Dark Personality Hypothesis.

Summary of results presented in: Stefanczyk, M. M., Rymaszewska, M., & Lachowicz-Tabaczek, K. (2023). Far from disgusted: The relationships between disgust sensitivity, dark personality traits, and biological sex. *Personality and Individual Differences*, 202, 111983. https://doi.org/10.1016/j.paid.2022.111983.

In this study we explored a potential relationship between disgust sensitivity and Dark Triad traits, namely narcissism, Machiavellianism, and psychopathy. Individuals who score high in these traits tend to be emotionally cold and exploitative, meaning that they take advantage of others (Paulhus & Williams, 2002). This can be clearly seen in their sociosexuality, as the Dark Triad was found to be related with promiscuity and short-term mating (Sevi, 2019). In general, the Dark Triad is often understood as a set of socially malevolent characteristics which can be adaptive within a short-term perspective, as a part of fast life history strategy (Birkás & Csathó, 2015).

Importantly, previous studies found robust sex differences in Machiavellianism and psychopathy (Czarna et al., 2016; Jonason & Webster, 2010), with men scoring higher than women. We considered it a promising clue, as these two traits seems to be antithetic to disgust sensitivity, at least in the sexual and moral domains. Adhering to the "murky" antisocial tendencies of Machiavellians and psychopaths means transgressing social norms related to sexuality and morality (e.g., infidelity, Jones & Weiser, 2013). In other words, acting on malevolent tendencies of dark personalities is the very essence of what triggers disgust responses in sexual and moral domains. Thus, we assumed that ones who frequently violate disgust-related rules should be rather insensitive to disgust themselves, in order to uncompromisingly benefit from these transgression and not to suffer from experiencing selfdisgust on the way. Apart from that, frequent exposure to disgusting circumstances may lead to habituation (Edgar et al., 2024). Furthermore, agentic social exploitation demands initiating interactions and risk-taking (and indeed the Dark Triad traits are positively related to selfpromotion and risk-taking, Crysel et al., 2013; Monteiro et al., 2017), i.e., "move towards" behaviour, which is the very opposite of avoidance and "move away" preference that characterizes disgust. The results of Burtăverde and colleagues (2021) showed preliminary

support for our reasoning, as the authors reported sexual disgust sensitivity being negatively related to the Dark Triad.

We argued that sex differences in the Dark Triad may at least partially explain the sex differences in disgust sensitivity. We focused particularly on the expected relationship between psychopathy, Machiavellianism, and sexual disgust. As for the Dark Triad, results concerning the existence of sex differences in narcissism are mixed (e.g., Czarna et al., 2016). Since, as mentioned in the introductory pat of this summary, the sex differences in moral disgust are small in size, and were non-significant in our previous studies (Stefanczyk et al., 2022), we also excluded this domain of disgust from our research inquiry. Last but not least, we argue that although being insensitive to sexual and moral domains of disgust may be adaptive for "dark individuals", the same is not true for pathogen disgust. As narcissists, Machiavellians and psychopaths need to self-present successfully in order to gain initial trust from others, they should not be insensitive to pathogens, as if they inadvertently were a source of physiology-based pathogen disgust, it might possibly jeopardise their efforts of initial self-promotion. Thus, we concluded with a research question focusing solely on sexual disgust, Machiavellianism, and psychopathy. We reasoned that perhaps higher scores in the latter two constructs in men (compared to women) could explain lower sexual disgust in men, which would suggest that there might be biological fundaments of decreased sexual disgust in men.

To seek for the expected relationships, we conducted an online study on 481 participants. We implemented the Three Domains Disgust Scale (Tybur et al., 2019) to measure disgust sensitivity, and the Dirty Dozen scale (Czarna et al., 2016) to measure narcissism, Machiavellianism, and psychopathy. We showed that narcissism and Machiavellianism are negatively related to sexual and moral disgust, and that psychopathy is negatively related to all three disgust domains. However, we found no sex differences in narcissism and, unexpectedly, in Machiavellianism, which limited our following analyses with regards to sexual disgust sensitivity solely to psychopathy. We reported psychopathy being a partial mediator of the relationship between biological sex and sexual disgust, but this effect was of minimal size (please see Figure 2 for a visualisation; for details, see pages 3-4 in Manuscript 2).

In conclusion, sex differences in sexual disgust sensitivity are to a very limited degree a result of higher psychopathy levels among men. It should be noted that this finding is by no means sufficient in the search for the origins of sex differences in disgust, where the size effect of these discrepancies in sexual disgust domain can be as high as d = 1.54 (Al-Shawaf et al., 2015). Nonetheless, it can be considered a valuable step for the future researchers to consider the antagonistic nature of psychopathy and disgust, especially that all three disgust domains negatively correlated with psychopathy, adding to the literature on how psychopathic individuals have a lower tendency to experience avoidant emotions (Durand & Plata, 2017). One can infer that seeking a deeper, biological basis for the sex differences in disgust sensitivity, such as neural foundations of psychological traits like psychopathy (Blair, 2007), may be a promising lead.

Figure 2

Effect of sexual disgust in the relationship between sex and psychopathy, with the standardized β values.



Note. a - effect of independent variable on mediator, *b* - effect of mediator on dependent variable, *c* - total effect, *c*' - direct effect; *p < .05, **p < .01. The biological sex of the participant was dummy coded (0 = woman, 1 = man).

Study 3. The Food Preparation Hypothesis.

Summary of results presented in: Stefanczyk, M. M., &, Zielińska, A. (2024). Are cooks more disgust sensitive? Preliminary examination of the food preparation hypothesis. *Appetite*, *192*, 107117. https://doi.org/10.1016/j.appet.2023.107117.

The third study takes the evolutionary and cultural perspective on addressing the sex differences in pathogen disgust sensitivity, with a focus on men's and women's sex roles in our ancestral past. *The Food Preparation Hypothesis* tested here is one of many proposed by Al-Shawaf and colleagues (2018), and it assumes that due to the responsibilities that women historically had in regards to food preparation, we can observe today a tendency of women being more sensitive than men to cues of spoilt food and meal contamination (i.e., food-related pathogen and parasite threats; Newell et al., 2010).

Classical publications point out that the primary task of disgust was to keep one safe from poisonous or inedible objects (Darwin, 1872; Rozin & Fallon, 1987; for a more recent work please see Tybur et al., 2016). Anthropological research shows that in foragerhorticultural societies women more often than men engage in hygiene-related behaviours and in food preparation (Draper, 1975; Gurven et al., 2009; Johnson, 1975). Thus, as Al-Shawaf and colleagues (2018) argue, women should be particularly sensitive to cues of pathogens during food inspection, in order to accurately discriminate between food that seems safe and edible versus food that raises suspicion of being contaminated. We follow their line of argumentation, as the consequences of being not sufficiently sensitive during the food preparation can be easily imagined. Suppose there are two groups of our potential ancestors. In the first one, the primary meal-maker, i.e., most probably a woman, is not particularly sensitive to cues of pathogens and does not react with repulsion when food of questionable pathogen-related acceptability is offered to her for preparation. She then serves the meal to everyone in the group, which in turn leads to food poisoning, or even death. Alternatively, in the second group, a meal-making woman is aware of the dubious nature of the food presented to her (e.g., by her insensitive and uninterested hunter-partner), and decides to throw it away, thus potentially saving lives of her compatriots and passing the disgust-sensitive genes to the next generation.

Here, we hypothesized that this ancestral sex-based social role division led to consistent sex differences between men and women in pathogen-, and especially food-related pathogen disgust sensitivity. We expected to find an increased level of sensitivity to disgust among people whose occupation is to prepare food for others. We concluded that if the effect was found, it could serve as a preliminary support for *The Food Preparation Hypothesis*.

We collected data from 493 individuals, 280 of whom were professional cooks working in the restaurant industry. They filled the pathogen subscale of the Three Domain Disgust Scale (Tybur et al., 2009), which served as a general pathogen disgust measure, and the Food Disgust Scale (Hartmann & Siegrist, 2018), which concentrates particularly on food-based contamination. We performed two symmetrical analyses, one being preregistered, and the other serving as a supporting analysis. Namely, we considered either the actual role of a professional cook, with all its social responsibilities with regards to the safety of the food provided, or the weekly time spent on cooking as our predictors of disgust sensitivity.

We found a significant effect of the occupation (i.e., being a cook) on food-related disgust sensitivity, but not on the generalised disgust sensitivity. People who worked as cooks were found to be more disgust sensitive to food-related stimuli than those who did not work within the restaurant industry (please see Figure 3 for visualisation; for details, see pages 4-5 of the Manuscript 3). Furthermore, time spent on cooking (i.e., the actual experience in cooking meals, but not necessarily as a part of an official social role/occupation with certain social responsibilities) predicted neither of the two disgust sensitivity measures. Women scored higher than men in both generalised and strictly food-related disgust sensitivity.

In conclusion, it seems that *The Food Preparation Hypothesis* was preliminarily supported. Its effect, however, was limited only to a very specific subtype of pathogen disgust, i.e., the food-related disgust. This suggests that mechanisms that relate to disgust sensitivity can be more specific than previously thought, and as such, less generalised measurement tools in disgust sensitivity research seem to be necessary in further investigations. Similar conclusions have been reached in other studies. For instance, in a study on various aspects of pathogen sensitivity in the context of the COVID-19 pandemic, I found that disgust response measured by the Three Domain Disgust Scale was not influenced by the external environmental factors, whereas a different pathogen-related scale – the Perceived Vulnerability to Disease (Duncan et al., 2009) – was (Stefanczyk et al., 2024). Other labs also reported this tendency, for instance Dlouhá et al. (2024) found the Three Domain Disgust Scale being insufficiently sensitive to nuanced changes in disgust during pregnancy, in

comparison to alternative tools, such as the Disgust Scale – Revised (Olatunji et al., 2007). Nonetheless, it should be stressed out that *The Food Preparation Hypothesis* was preliminary supported, and there is possibility that at least a partial reason for sex differences in disgust might have been identified.

Figure 3

Sensitivity to food-related and generalised pathogen disgust, for people working in or outside restaurant industry, for men and women separately



Note. Plotted are marginal effects of the regression model with disgust sensitivity regressed on sex, time spent cooking, and occupation, controlling for participants' vegetarianism, and work environment's pathogen level.

Study 4. The Coalitional Hunting and Warfare Hypothesis.

Summary of results presented in: Stefanczyk, M. M., &, Pieniak, M. (2024). Sex Differences in Pathogen Disgust Sensitivity - Testing the Coalitional Hunting and Warfare Hypothesis. *Evolutionary Behavioral Sciences*, [in print].

The fourth study may be considered a male-centred equivalent of Study 3. Again, I have taken the evolutionary and cultural perspective, and considered the sex roles that men were taking in our ancestral past. As Al-Shawaf and colleagues (2018) argue, there was a significant distinction between men and women in terms of their involvement in coalitional activities such as hunting or warfare.

It was mainly men who participated in wars with other tribes or big game hunting (Joseph, 2000; Van Vugt, 2009). What is characteristic of the hunting and warfare environments is that they are pathogen-abundant, with abundance of blood, body envelope violations, open wounds, or dead bodies (Al-Shawaf et al., 2018; Haidt et al., 1994; McNally, 2002). As such, it would be beneficial for the individuals who need to frequently take part and succeed in such enterprises – i.e., men – to evolve certain mechanisms that would be adaptive in that gore-and-blood environment. According to *The Coalitional Hunting and Warfare Hypothesis*, disgust *ins*ensitivity might possibly be one of such mechanisms. If one could become desensitised to images of chopped limbs or to the touch of raw, bloody meat, it would be adaptive for them; such an insensitive individual should operate more successfully and effectively in the hunting or warfare contexts.

Crucially, becoming disgust insensitive to the sight of meat or wounds is adaptive only in certain contexts, whereas it may be proven maladaptive in others, such as during food preparation or, in fact, regular dwelling. As outlined in the previous sections of this PhD dissertation summary, disgust sensitivity serves the very useful purpose of avoiding unnecessary risks and correctly identifying pathogen threats, so outside the contexts of coalitional hunting and warfare ignoring cues of potential contamination should not be overused. For this reason, the hypothesis refers particularly to men, who might have, through generations of evolutionary changes, become more and more insensitive to disgust (and differ in this regard from women). Moreover, this effect of insensitivity should be especially robust when the actual war- or hunting-circumstances occur – in other words, in these circumstances disgust *in*sensitivity of men should increase even further. The original authors referred to it as "coalitional hunting and war psychology activation" (Al-Shawaf et al., 2018), which I operationalized as activating schemas of coalitional hunting and warfare. I expected that activating these schemas will lead to a decreased disgust sensitivity, especially (or at least) among men.

I recruited 627 participants who watched either video clips depicting close-distance battles (e.g., an opening scene from "The Revenant"; Iñárritu, 2015), big game hunting (e.g., a bison hunting scene from "Dances with Wolves"; Costner, 1990), or, in a control condition, groups of people performing coalitional activities unrelated to the hostile contexts of the experimental groups, such as flash-mobs. Then, participants completed the Disgust Scale – Revised (Olatunji et al., 2007), which captures three subtypes of disgust: Core Disgust, Animal Reminder Disgust, and Contamination-Based Disgust. Core Disgust captures reactions to sensory offensiveness; Animal Reminder Disgust captures reactions to reminders of human mortality, such as blood or death; Contamination-Based Disgust captures reactions to potential contagion transmissions. Overall, all three subscales can be considered subdomains of what Tybur et al. (2009) would consider to be the pathogen disgust. I decided to use this particular measure given the strictly pathogen-related character of *The Coalitional Hunting and Warfare* hypothesis, and considering that previous studies found Olatunji et al.'s (2007) scale to be more nuanced and sensitive to temporary changes in pathogen-related disgust proneness (Dlouhá et al., 2024).

The results showed no significant differences between the three experimental conditions (hunting vs. warfare vs. control) in neither of the three subscales. However, I implemented a manipulation check in the study, i.e., I asked participants about the level of their stress experienced after watching the video clips. The manipulation check proved successful, with participants in the group that watched coalitional warfare videos and in the group that watched coalitional hunting videos assessing the levels of experienced stress as significantly higher than the control group. Thus, the manipulation used in the study did have a psychological effect on participants, but not on their disgust sensitivity levels.

Primarily, I concluded that *The Coalitional Hunting and Warfare* was unambiguously not supported by the evidence. Regardless, I decided to conduct a follow-up study that approached the specificity of the hunting or warfare context from a different angle. Namely, I asked a question "what if the hypothesis is true, but the effect of decreased disgust sensitivity is not due to a certain "psychological activation", but rather due to a physiological effect?".

Previous literature shows that there might be some hormonal foundations behind disgust sensitivity. Studies focused primarily on female sexual hormones, and reported disgust sensitivity being positively correlated with progesterone (Bressan & Kramer, 2022; Żelaźniewicz et al., 2016) and negatively with oestradiol levels (Liu et al., 2023). Taken together, these findings offered a consistent picture of women being particularly disgust sensitive when their disgust sensitivity immune system was compromised during luteal phase of menstrual cycle. This is in line with the theoretical frameworks of both the behavioural immune system and the compensatory prophylaxis hypothesis, the latter stating that if the actual immunity is temporarily decreased, other mechanisms, such as disgust sensitivity, are turned on to compensate for the general greater vulnerability. However, other studies showed no relationship between progesterone and disgust sensitivity (Jones et al., 2018; Rafiee et al., 2022). In conclusion, although an effort to link disgust sensitivity with sexual hormones was made, the results were rather ambiguous. Thus, I decided to extend this line of research with a search for a relationship between disgust sensitivity and *male* sexual hormones, which were predominantly neglected in previous studies. The only two studies that actually addressed this issue comprised a solely female sample, which was not sufficient nor satisfying to address the The Coalitional Hunting and Warfare Hypothesis, focused on men. As such, I tested a hypothesis that perhaps elevated levels of testosterone are connected with decreased levels of disgust sensitivity, at least among men, who evolutionary should be the preliminary beneficiaries of this mechanism in testosterone-elevating circumstances like warfare or hunting. There are few cues supporting this reasoning. One, testosterone is 15 times higher in men than women, so it is men who may be the sole bearers of The Coalitional Hunting and Warfare Hypothesis effect. Two, testosterone is positively related with aggression, sexual behaviour, competition, over-confidence in war-related games, and even moral decisionmaking (Archer, 2006; Carney & Mason, 2010; Johnson et al., 2006), and negatively with risk-taking (Nofsinger et al., 2018). In other words, testosterone is associated with a multitude of variables directly related to disgust (and all its domains), but in the opposite direction, promoting "move towards" behaviour, in contrast to disgust's "move away". Three, indirect evidence suggests a correlation between disgust sensitivity and testosterone, with physical strength (useful in a hunt or a battle) being negatively related with the former, but positively with latter (Auyeung et al., 2011; Żelaźniewicz et al., 2019).

To test this alternative approach to *The Coalitional Hunting and Warfare Hypothesis*, I conducted a study on 106 young men who underwent an acute physical exercise (Stefanczyk

et al., under review, see appendix C). The procedure was a replication of previous studies that all showed a significant increase in testosterone level after the physical activity (Crewther et al., 2014; Kowal et al., 2020, 2021; Thomas et al., 2021; for a meta-analysis of the robust effect of physical activity on testosterone levels, please see D'Andrea et al., 2020). Prior to the exercise and after completing it, the participants filled the survey. They completed the Three Domains Disgust Scale twice, and they were given two equivalent versions of the Sounds of Disgust Scale (Stefanczyk & Mahmut, in progress), which comprises auditory disgust stimuli. The results, however, showed no significant difference in disgust sensitivity before and after the participation in the acute physical activity. Thus, again, I found no support for *The Coalitional Hunting and Warfare Hypothesis*.

In conclusion, in two independent studies that have taken distinct approaches to testing *The Coalitional Hunting and Warfare Hypothesis*, no evidence was reported that would support this hypothesis. Neither cognitive-, nor physiology-centred experimental operationalisation led to any significant findings. Although there are other ways of further examination of this hypothesis, I rather recommend focusing on different hypotheses that try to explain the existence of sex differences in disgust. If one is decided on hormonal approach to the subject, it seems that focusing on female sexual hormones is a slightly more promising research direction.

Study 5. The Direct Contagion Hypothesis. The Teaching and Modelling Hypothesis.

Summary of results presented in: Stefanczyk, M. M., Adamczyk, L., Ciniawska, A., Czulak, M., Fuławka, K., Galka, K., Hibino, M. W., Ipnar, P., Jedrusik, P. J., Mikołajewska, Z., Pytlińska, A., Wroblewska, K., Sorokowska, A. Parents are less disgust sensitive than childless individuals, and a child's presence has no effect on disgust sensitivity of a parent. [under second round of reviews in *Parenting: Science and Practice*].

The fifth study addresses simultaneously two hypotheses proposed by Al-Shawaf and colleagues (2018). *The Direct Contagion Hypothesis* and *The Teaching and Modelling Hypothesis* relate to child-rearing and protecting infants from pathogens. The phenomena these hypotheses are based on can be considered as co-occurring and difficult to separate from each other. However, they rely on different theoretical backgrounds, so they should be distinguished in scientific works that cover this subject. Both of these hypotheses share not one, but two predictions, to which I will relate as a "parental effect" and a "child presence effect".

The reasoning for this study derives from the fact that children do not have a fully developed immune system (Ygberg & Nilsson, 2012). Moreover, feelings of disgust, along with responses to disgust elicitors, are absent in young children (Herz, 2012; Rozin & Fallon, 1987). As such, infants are left defenceless towards pathogens during their most vulnerable years. Pivotal for their survival is to be constantly accompanied by a disgust sensitive guardian, who – on the one hand – will protect an infant from pathogen threats, and – on the other – will teach an infant how (and when) to react to stimuli that are pathogenically threatening. The former path again relates to the behavioural immune system (Schaller and Park, 2011), this time extended to protect also a significant other individual (an infant), whereas the latter path is based on mechanisms described by Kavaliers et al.(2019), namely that assimilation of disgust and disgust-related behaviours is acquired through social learning.

Considering that an infant's guardian should be constantly near it, who if not a parent fits this role perfectly? Moreover, if we consider that cross-culturally and historically it was particularly mothers who were the primary caregivers for the children (Craig, 2006), it can be hypothesized that parents, and especially (or: at least) mothers should be more sensitive to

disgust, since they "should be disgusted enough for two" (Curtis et al., 2011). The robust sex differences in pathogen disgust may be, as Al-Shawaf and colleagues (2018) argue, an indirect evidence supporting that hypothesis, with women evolving greater sensitivity to disgust due to their caregiving function in a society. According to *The Direct Contagion Hypothesis*, this expected effect of increased levels in parents/mothers is triggered by the need to protect infants from pathogens. According to *The Teaching and Modelling Hypothesis*, the same effect is triggered by the need to show to an infant how to react when pathogens are nearby, and to pass knowledge on what should trigger that reaction.

There are two levels of possible specificity of this particular sensitivity to disgust context. On a general level, one could expect a "parental effect", meaning that just by becoming a parent, an individual would become more disgust sensitive. On a more specific level, a parent should become more disgust sensitive when certain external circumstances demand it, i.e., the increased sensitivity should occur solely (or especially) when one's child is present just next to a parent.

Some of the previous studies showed preliminary support for the reasoning behind these hypotheses. For instance, mothers' expression of disgust associated with a toy was found to lead to a decrease in infants' playtime with that toy (Hornik et al., 1987). Similarly, infants were less willing to explore a box that was connoted with a female adult's disgust reaction (Repacholi, 1998). Furthermore, a child's presence positively influences the magnitude of their mothers' disgust expression (Stevenson et al., 2010), and mothers vocalize and emote disgust to a greater extend when accompanied by their younger children (Oaten et al., 2014). As such, in my study I hypothesized that (1) parents should be more disgust sensitive than non-parents (*parental effect*), and that (2) parents should be more disgust sensitive when their child is present than when it is nowhere nearby (*child presence effect*). Importantly, one's sex should be a significant predictor of the expected effect sizes, as on the basis of the evolutionary backgrounds of the hypothesis, these effects should be more pronounced among mothers than fathers.

I collected data from 995 adult individuals, 369 of them being childless. I asked them to complete the pathogen subscale from the Three Domains Disgust Scale (Tybur et al., 2009), and Food Disgust Scale (Harmann & Siegrist, 2018), with parents additionally declaring if their child was by their side during the survey's completion. For Food Disgust Scale, no effect reached statistical significance (except for women being more sensitive than men). For pathogen subscale from the Three Domains Disgust Scale, I found both a similar

sex-related effect, but also a significant, small-size effect of the parental status. Contrary to the hypotheses, parents were shown to be *less* disgust sensitive than non-parents.

Study 5 definitely does not support *The Direct Contagion Hypothesis* or *The Teaching and Modelling Hypothesis*. It provided preliminary evidence for the effect opposite to the expected one, i.e., that parents are actually less disgust sensitive. This result is, however, in line with work of Prokop & Fančovičová (2016), who showed that mothers are less disgust sensitive than childless women. It seems that a habituation effect of frequent exposure to disgust stimuli related to child-rearing, such as dirty diapers, illness symptoms etc., leads to a general decrease in disgust sensitivity among parents (e.g., Tsao & McKay, 2019). The expected *parental effect* or the *child presence effect* may be trumped by that opposite habituation effect, however, it is also possible that either the two effects simple do not exist, or perhaps that a different operationalization would show certain significant effects. Future studies could address not just disgust sensitivity levels as a proxy for the *parental effect* or the *child presence effect*, but perhaps an increased levels of vigilance in monitoring for pathogens.

Summary

In the search for the origins of sex differences in disgust sensitivity I conducted a series of studies, five of which make up this PhD dissertation thesis.

The most important findings are as follows:

Study 1 showed that men and women declare heightened sensitivity to sexual disgust in a presence of an attractive woman. Although this interesting finding inspired further studies (on severity of judgements of disgust norms' transgressors, Stefanczyk et al., under review, A; and on self-promotion in a dating context with respect to the three disgust domain, Stefanczyk et al., under review, B; studies on self-presentation in other sex-related traits, Stefanczyk, 2023), it can be concluded that I found no support for *The Male Mating Hypothesis*. As for *The Reputational Damage Hypothesis*, it was primarily not supported. However, taking a slightly different perspective on this hypothesis than the original authors of the hypothesis did allows for considering the results of Study 1 as ambiguous with regards to *The Reputational Damage Hypothesis*. Nonetheless, the general hypothesis that sex differences in disgust sensitivity are a by-product of self-presentation mechanisms was predominantly not supported in Study 1.

Study 2 showed that out of the three Dark Triad traits only psychopathy may, to a very small degree, partially explain the existence of sex differences in the sexual disgust domain (but not in the pathogen disgust domain). As such, *The Dark Personality Hypothesis* is supported in a very small degree.

Study 3 showed preliminary evidence for *The Food Preparation Hypothesis* being supported. Individuals who were professional cooks and held responsibility for the food served to others were more sensitive to food-related disgust, but not to the general pathogen disgust. The results also suggests that there is a significant sub-domain specificity in the way that disgust-related mechanisms function.

Study 4 showed no support for *The Coalitional Hunting and Warfare Hypothesis*. Activating cognitive schemas related to coalitional hunting or warfare did not influence one's disgust sensitivity level. A follow-up study that addressed the potential hormonal foundations of *The Coalitional Hunting and Warfare Hypothesis* also showed null results (Stefanczyk et al., under review, C). The results suggest that sex differences in disgust sensitivity are plausibly caused by other factors than evolutionary pressures put on human males with regards to participation in tribal battles or big game hunting.

Study 5 showed that neither a status of a parent nor a child's presence increases disgust sensitivity, as proposed by *The Direct Contagion Hypothesis* and *The Teaching and Modelling Hypothesis*. On the contrary, parents reported significantly lower sensitivity to general pathogen disgust. The results suggest that child-rearing responsibilities may not have a sensitising effect on parents' disgust levels.

All these studies took different approaches to answering the same question: why are there sex differences in disgust sensitivity? Regardless of consistent and robust results in this matter observed for more than three decades, there were no empirical attempts to directly address this phenomenon. In my PhD dissertation I took social, cultural, and evolutionary perspectives, and tried to identify a solid explanation for the differences between men and women in disgust sensitivity. Although some studies led to interesting findings, some of them even in line with the hypotheses that inspired the studies in the first place, overall, no decisive answer can be provided. The reported effects, if statistically significant, were predominantly of small sizes. Experimental manipulations I performed, or social and psychological variables I analysed along with disgust sensitivity levels did not provide satisfactory answers or satisfying magnitude of effects. The only effect that appeared throughout the five main studies of this PhD dissertation, and also in the following four secondary studies I conducted, is the effect of biological sex. Consistently, across all my work in this field, I find women largely and significantly more disgust sensitive than men.

List of attachments

There are eight attachments to this PhD dissertation. The first five of these attachments are the manuscripts that are a basis and an inherent part of this dissertation, i.e., they describe Studies 1-5. At the moment of the submission of this dissertation, three of them are published, one has been accepted for publication, and one is under the second round of reviews. The last three attachments are the manuscripts of the additional disgust-related studies that I conducted, which can be considered as follow-ups or reimaginations of some of the ideas primarily discussed in Studies 1-5 (i.e., in Manuscripts 1-5). I refer to them in the main body of the dissertation as Appendices A-C. Appendices B and C are under the second round of reviews. Appendix A is under the first round of reviews. Given their current public unavailability, they are presented here as attachments in case the Reviewers were interested in these particular positions from the general reference list of this PhD dissertation. However, the three Appendices are not a part of the dissertation *per se*.

- **Manuscript 1.** Stefanczyk, M. M., Lizak, K., Kowal, M., & Sorokowska, A. (2022). "May I present you: my disgust!" Declared disgust sensitivity in the presence of attractive models. *British Journal of Psychology*, *113*(3), 739-757. https://doi.org/10.1111/bjop.12556.

- **Manuscript 2.** Stefanczyk, M. M., Rymaszewska, M., & Lachowicz-Tabaczek, K. (2023). Far from disgusted: The relationships between disgust sensitivity, dark personality traits, and biological sex. *Personality and Individual Differences*, 202, 111983. https://doi.org/10.1016/j.paid.2022.111983.

- **Manuscript 3.** Stefanczyk, M. M., &, Zielińska, A. (2024). Are cooks more disgust sensitive? Preliminary examination of the food preparation hypothesis. *Appetite*, *192*, 107117. https://doi.org/10.1016/j.appet.2023.107117.

- **Manuscript 4.** Stefanczyk, M. M., &, Pieniak, M. (2024). Sex Differences in Pathogen Disgust Sensitivity - Testing the Coalitional Hunting and Warfare Hypothesis. *Evolutionary Behavioral Sciences*, [in print].

Manuscript 5. Stefanczyk, M. M., Adamczyk, L., Ciniawska, A., Czulak, M., Fuławka, K.,
 Galka, K., Hibino, M. W., Ipnar, P., Jedrusik, P. J., Mikołajewska, Z., Pytlińska, A.,
 Wroblewska, K., Sorokowska, A. Parents are less disgust sensitive than childless individuals,

and a child's presence has no effect on disgust sensitivity of a parent. [second round of reviews in *Parenting: Science and Practice*].

- **Appendix A.** Stefanczyk, M. M., Kowal. M., Sorokowska, A. The impact of transgressing disgust-related norms in different social contexts. [under review in *Personality and Individual Differences*].

- **Appendix B.** Stefanczyk, M. M., Conroy-Beam, D., Walter, K., Ujma, B., Zborowska, Z., & Sorokowska, A. Disgust in the mating context – choosing the best and the least bad self-presentation option in a date simulation game. [second round of reviews in *Telematics and Informatics*].

- Appendix C. Stefanczyk, M. M., Żurek, G., Zielińska, A., Jastrzębska, A., Ochman, A., Czajka, K., Tyliszczak, M., & Sorokowska, A. Disgust sensitivity is independent from testosterone levels in males. [second round of reviews in *Personality and Individual Differences*].

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