The Influence of Situational Threat Cues on Men's Body Shape and Size Preferences

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ABSTRACT

Previous research has examined men's body shape and size preferences concerning waist-to-hip ratio (WHR) and body mass index (BMI). However, such research has failed to account for the impact of external cues or to investigate the influence of immediate situational cues at the individual level. This thesis aims to examine the effects of mortality, masculinity, and pathogen situational threat cues on men's WHR and BMI preferences, as well as on their preferences for specific body areas. To achieve this, we developed computerised stimuli that vary in WHR and BMI and a novel eye-tracking paradigm that measures overt and covert attentional preferences.

We conducted four experiments (experiments one, two, three and five) to investigate our predictions that situational threat cues would increase men's preferences for more attractive WHRs (i.e., 0.7 WHR) and BMIs (i.e., average BMI), as well as increase their preferences for specific body areas. However, we found no evidence to support these predictions across a range of self-report measures and indicators of overt and covert attention. Experiment five, however, produced unexpected results related to pathogen threat. Participants exposed to pathogen threat cues displayed a significantly higher revisit count for the head and breast areas of interest than those in the control condition. This finding suggests that pathogen threat might increase preferences for those specific areas of the body.

Overall, our findings offer interesting insights into the influence of our situational threat cues on men’s body shape and size preferences and expand existing research in those fields. More broadly, our findings also have implications for a context-dependent view of mate selection, potentially suggesting that long-term contextual cues may influence men’s body shape and size preferences more than situational threat cues at the individual level.

We also completed an additional experiment (experiment four) to explore the effect of our masculinity threat prime further. In this, we explored whether threatening men’s masculinity (and women’s femininity) influenced their attitudes toward trans and gender-diverse people. Unlike findings from other countries (e.g., Poland), we found that threatening

UK men's masculinity did not influence their attitudes toward trans and gender-diverse people. Our findings offer important insights into how UK cisgender men may react to a masculinity threat cue.

Keywords: Waist-to-Hip Ratio, Body Mass Index, Body Shape, Body Size, Situational Threat Cues, Context, Priming, Mortality Threat, Masculinity Threat, Pathogen Threat.

Key abbreviations: WHR (Waist-to-Hip Ratio), BMI (Body Mass Index), OSF (Open Science Framework), AOIs (Areas of Interest), TGD (trans and gender diverse).

Data Availability Statement: The anonymised data, R code and knitted output files supporting this thesis's analyses can be found on the OSF. Experiments one, two, three and five: https://osf.io/ax3wp/. Experiment four: https://osf.io/v6gct/.

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For my parents, Gillian and Jason Cahill
For believing in me, ***always***.

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1. CHAPTER 1: THESIS OVERVIEW

In this thesis, we examined the influence of three situational threat cues (i.e., mortality, masculinity and pathogen threat) on men's body shape (i.e., waist-to-hip ratio; WHR) and body size (i.e., body mass index; BMI) preferences. We report several experiments testing whether these three situational threat cues influence men's preferences toward bodies varying in WHR and BMI. This chapter briefly overviews Chapters 2 – 10 in this thesis.

1.1 Chapter 2: Literature Review

Chapter 2 reviewed the existing literature examining men's WHR and BMI preferences. We began by establishing how evolutionary processes influence human mating preference by evaluating how psychological processes adapted to facilitate mating in both men and women. Specifically, we evaluated the selective pressures imposed on men and women and how this shaped preferences toward different traits. In men, this is hypothesised to cause traits that indicate health and fertility benefits to be preferred and viewed as more attractive. We then discuss the *health and fertility hypothesis.* That is, we discuss how variations in women's body shapes (i.e., WHR) and sizes (i.e., BMI) are said to signal health and fertility reliably. We discuss evidence relating to whether WHR and BMI are reliable signals of health and fertility and evaluate which body shapes and sizes men tend to prefer and perceive to be most healthy and fertile. For clarity, we conclude that the evidence supporting the health and fertility hypothesis is limited, but men (and women) appear to perceive certain body shapes and sizes as healthier and more fertile, and this perception influences their attractiveness ratings. We then consider whether men's preferences for certain body shapes and sizes are stable, or whether they are influenced by external cues. We note that most research has evaluated the influence of persistent environmental contexts, which are relatively protracted and long-term. Instead, very little research has explicitly examined the influence of immediate situational threat cues at the level of the individual.

In this thesis, we evaluated the influence of three situational threat cues that represent immediate psychological threats likely to influence men's WHR and BMI preferences:

mortality, masculinity, and pathogen threats. We presented research showing that these threats should increase men's preference for attractive body shapes and sizes. However, to date, no research has examined the influence of each of these situational threat cues on men's WHR or BMI preferences. We concluded this chapter by presenting the rationale for this thesis and the central aims we examined across each of our experiments.

1.2 Chapter 3: Methodological and Statistical Considerations

Chapter 3 outlined the critical methodological and statistical considerations relevant to this thesis. We began by introducing the current methodological limitations with existing research. Specifically, we summarised three primary limitations, including *(1)* existing limitations with the stimuli used in WHR and BMI research, *(2)* how previous research has neglected to examine a broader conceptualisation of men's preferences, *(3)* and the reliance on self-report attractiveness ratings to examine men's WHR and BMI preferences. We commented on how we aimed to resolve these limitations throughout this thesis by creating a new set of 3D-modelled body stimuli varying in WHR and BMI (Chapter 4), explicitly examining a broader conceptualisation of preferences in our online self-report experiments (Chapter 5) and incorporating a combined eye-tracking dot-probe paradigm to examine men's preferences using alternative measures of preference, including measures of attentional bias and visual interest (Chapter 7). We also outlined the methodological approaches we used throughout this thesis. This outline included an overview of the mortality, pathogen and masculinity threat cues we used to prime men for each situational threat cue outlined in Chapter 2. We concluded this chapter by evaluating our statistical approaches (i.e., mixed-effect modelling) and our checks to ensure that our sample viewed our situational threat cues as relevant. This chapter provided essential context for the remainder of this thesis.

1.3 Chapter 4: Stimuli Creation, Validation and Selection

Chapter 4 introduced study 1a and 1b. In this chapter, we developed 3D-modelled female body stimuli that varied in WHR and BMI that were then validated online. We did this for two reasons: *(1)* to create a set of stimuli from which to choose a subset for use in this thesis and *(2)* so that the full set could then be made available on the Open Science Framework for other researchers to use. We outlined the benefits of 3D-modelled stimuli and explained how previous research has rarely validated their stimulus sets.

To validate our stimuli, our participants rated how realistic, attractive, healthy and fertile each stimulus was. These measurements allowed us to see which stimuli were more realistic and validate our stimuli by observing whether they received similar attractiveness, health and fertility ratings as other well-used stimulus sets (e.g., line-drawn stimuli).

We created our stimuli using the 3D-modelling software Daz^{3D}, which consisted of a standardised face, height and skin colour (White/Caucasian). We created clothed and unclothed stimuli to provide variability to the final stimulus set. Our body stimuli ranged across 5 WHR (0.6, 0.7, 0.8, 0.9, 1.0) and 5 BMI categories (emaciated, <15kg/m^2; underweight, 15 - 18.5kg/m^2; average, 18.5 - 24.9kg/m^2; overweight, 25 - 29.9kg/m^2; obese, >30kg/m^2). We then discussed the findings of our validation studies (1a for the clothed stimuli and 1b for the unclothed stimuli).

Our findings generally support the validity of both the clothed and unclothed stimuli. Our participants rated both the clothed and unclothed stimuli moderately realistic, but ratings varied across each stimulus. We also found that our stimuli were rated similarly regarding attractiveness, health and fertility to other well-used stimuli sets, with 0.7 WHR and average BMI (and their combination) rated as the most and 1.0 WHR and emaciated BMI (and their combination) as the least attractiveness, health and fertility. We concluded this chapter by selecting the 25 most realistic clothed stimuli at each WHR and BMI combination (e.g., 0.7| average) we used in this thesis.

1.4 Chapter 5: Self-Report Preferences Under Situational Threat Cues

Chapter 5 introduced experiments 1 – 3. These experiments used self-report attractiveness paradigms to explore the influence of each situational threat cue (i.e., mortality, masculinity and pathogen threat). Participants rated the attractiveness of each stimulus. We used these attractiveness ratings as a proxy for men's preferences toward specific body shapes and sizes (i.e., higher attractive ratings equate to greater preferences). In this chapter, we explicitly explored two preference directions, termed the *avoid unfit* and *approach fit* directions, reflecting whether a situational threat cue increased (i.e., enhanced) preferences toward the most and reduced (i.e., diminished) preferences toward the least attractive WHR and BMI, respectively. Across the three experiments, we found no evidence to suggest that mortality, masculinity or pathogen threat influenced men's body shape or size preferences in either the approach fit or avoid unfit directions of preference. We suggested a potential explanation for our findings is due to the limitations of using attractiveness ratings as the preference indicator. We postulated that alternative measures (e.g., visual interest indicators) may allow us to more conclusively explore the influence of each situational threat cue on men's preferences. We explored these alternative measures in Chapter 7.

1.5 Chapter 6: Masculinity Threat as a Determinant of Attitudes Toward Trans and Gender Diverse People

Chapter 6 introduces an additional experiment (experiment 4) exploring the effect of masculinity threat on UK men. Specifically, we explored a compensatory mechanism for masculinity threat, which has been explored extensively in other cultures. That is, we explored the influence of masculinity threat on UK cisgender men's attitudes toward trans and gender-diverse people (TGD). We also included cisgender women in this experiment as limited research has explicitly explored the effect of a femininity threat on UK women's attitudes toward TGD people. We used the same priming approach as experiment two. We hypothesised that *(1)* cisgender men would show significantly more negative attitudes toward TGD people and less positive gender and sex beliefs following a masculinity threat relative to men who did not receive this threat or who received affirming feedback, *(2)* cisgender women would show no difference in their attitudes towards the TGD community or their gender and sex beliefs following a femininity threat, relative to those who received no threat or who received affirming feedback.

We found that in a sample of UK cisgender men and women, masculinity (or femininity) gender identity threat did not affect attitudes toward TGD people. These findings contrast findings from other countries and cultures, which demonstrate that when primed with masculinity threat, men show worse attitudes toward TGD people. Our findings (along with those from experiment two) suggest that UK men may respond differently to a masculinity threat than men from other sociocultural backgrounds. We discuss this further in Chapters 6 and 8.

1.6 Chapter 7: The Eyes Have It: Eye Tracking Men's Preferences Under Situational Threat Cues

Chapter 7 introduced experiment 5, employing our combined eye-tracking dot-probe paradigm. Our paradigm was novel as it allowed us to measure a range of indicators of men's preferences. For instance, the dot-probe element allowed us to assess whether men showed an attentional bias toward certain stimuli or toward certain areas of the body. We also collected more traditional visual interest indicators (e.g., fixation counts) and an attractiveness rating for each stimulus.

This paradigm allowed us to explore three broad research questions concerning whether men primed with mortality, masculinity or pathogen threat show *(1)* an attentional bias toward more attractive (i.e., target stimuli) bodies relative to less attractive (i.e., neutral) bodies, *(2)* enhanced preferences toward attractive body shapes (i.e., 0.7 WHR) and sizes (i.e., average BMI) and *(3)* different preferences toward specific areas of the body. We conceptualised preferences in this experiment using a variety of outcome measures and made several hypotheses relating to each, which were too plentiful to list here.

We found no evidence that each of our situational threat cues increased men's preferences toward attractive bodies in the manner we expected. We did find some interesting findings concerning pathogen threat. Men in the pathogen threat condition rated 0.6 WHR less attractive than those in the control condition. We also found that pathogen threat influenced men's preferences toward specific body areas. Specifically, men in the pathogen threat condition relative to the control condition were more likely to revisit (return to after viewing another AOI) the head and breast AOIs relative to other body areas. Across each outcome measure, we found that the waist and hip areas of interest received the most visual interest across various visual interest measures (e.g., fixation count). These findings support and expand existing research using eye-tracking methods to examine men's preferences for specific body areas. These findings are interesting, and we offer insights and explanations in this and the subsequent chapter.

1.7 Chapter 8: Summary and General Discussion

Chapter 8 introduced the overall summary and general discussion of the findings of this thesis. We summarised our main findings and drew three main conclusions. We then interpreted our findings for each situational threat cue (i.e., mortality, masculinity and pathogen threat) concerning the wider research literature in each area. We discussed the implications of our findings, considered the strengths and limitations of our research and offered some recommendations for future research.

1.8 Chapter 9: References

Chapter 9 contained the references for the citations used in this thesis.

1.9 Chapter 10: Appendices

Chapter 10 introduced each of this thesis's appendices. In appendices one-four, we provided more information on the priming materials used in this thesis. In appendix five, we provided supplementary analyses. These analyses add to those completed in experiment five by exploring men's WHR and BMI preferences and men's preferences for each AOI depending on WHR and BMI. We believe these additional analyses may be of interest to the reader. The additional analyses are also visible on the OSF.

2. CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This literature review contextualises men's waist-to-hip ratio (WHR) and body mass index (BMI)[1] preferences in broader theory and shows how different situational threat cues influence men's preferences. In this thesis, we investigated the influence of situational threat cues on cisgender heterosexual (i.e., straight)[2] men's body shape and size preferences. As men are reported to place greater importance on potential partners' physical attractiveness (Buss & Schmitt, 2019), we only focused on men's preferences within this thesis. Similarly, it is important to note that most of the research we will refer to used samples from WEIRD (Western, Educated, Industrialised, Rich and Democratic) countries/cultures. In this thesis, we will do the same (sampling from the United Kingdom).

Both men and women experience pressures to identify romantic or sexual partners who are of *good quality*[3] (Bennett, 2018; Buss, 2020; Grammer et al., 2003). Good quality is frequently used to denote potential mates with good quality traits, such as traits that convey heritable or social benefits (e.g., good genes and resource security; Buss & Schmitt, 2019; Kolze et al., 2019). What constitutes good quality differs by gender and what pressures were historically placed on each gender. Women experience pressure to identify men who are willing to provide resources and aid in child-rearing. Alternatively, men are argued to be pressured to identify women with good health and fertility indicators to maximise reproductive outcomes

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[1] Waist-to-hip ratio (WHR) reflects body shape. Body mass index (BMI) reflects body size.

[2] Cisgender refers to "*people who do not identify as trans or who identify with the sex they were assigned at birth*" (McDermott et al., 2018, p. 69). We focus on cisgender straight men due to the limited research concerning body shape and size preferences in non-hetero-cis-normative groups and how these will vary due to the influence of situational threat cues.

[3] Recent events, such as the influence of Andrew Tate, have proliferated the term *high quality* and *high-value* men and women to denote sexual partners with apparent benefits, such as dominance or having a limited number of sexual partners, respectively. This thesis uses the term quality and value to refer to traits, such as WHR and BMI, which may indicate evolutionarily advantageous outcomes. We are not implying that any holder of these traits is necessarily of any greater value than any other person. Equally, whilst we claim that certain WHRs and BMIs are preferred over others, we are not implying that body shapes or sizes that deviate from the ideal WHR and BMI are less attractive from a societal standpoint. Rather, attractiveness within this context indicates preference toward a particular trait or feature. Indeed, as we explain below, while men may perceive certain body shapes and sizes as more attractive, this does not reflect actual coupling decisions, and a large degree of individual and environmental factors may influence men's preferences. A person's attractiveness is not determined purely by their physical characteristics, particularly in a modern context.

(Fieder & Huber, 2022; Furnham et al., 2006). Accordingly, most research has shown that heterosexual men evaluate the quality of a potential partner by observing their physical characteristics (Symons, 1995). For men, two critical indices of physical attractiveness are waist-to-hip ratio (WHR) and body mass index (BMI), which are believed to indicate a person's health and fertility status (see Section 2.3; Furnham et al., 2006; Symons, 1995). Broadly, men are argued to prefer traits that indicate good health and fertility, and they generally consider these more attractive (Buss & Schmitt, 2019; Dixson et al., 2011b). Research indicates that a WHR of 0.7 and an average BMI[4] are typically considered the most attractive on this basis (Holliday et al., 2011; Lassek & Gaulin, 2018; Platek & Singh, 2010; Swami & Tovée, 2006).

Most research (especially evolutionary psychology literature) has argued that men from WEIRD cultures display a permanent, stable preference for specific WHRs and BMIs (as they are said to convey some underlying benefit). In contrast, comparatively little research has explored how these preferences might vary owing to external cues (Maner et al., 2007). Some research has explored how specific contexts and cultural variations influence men's body shape and size preferences, but this research is limited in scope. Specifically, research investigating a context-dependent view of mate preferences has focused predominantly on examining persistent (i.e., long-term and relatively stable) environmental contexts (Al-Shawaf et al., 2019; Dixson, 2022; Sugiyama, 2004, 2015). Despite this focus, little research has explicitly investigated how immediate situational threat cues may influence men's preferences (Maner et al., 2007). This lack of focus is problematic as limited research has illustrated that some immediate situational threat cues alter men's preferences (Ainsworth & Maner, 2014a; Maner et al., 2007).

Given the limitations of the current research base (i.e., a lack of focus on these situational threat cues), in this thesis, we will examine the potential influence of specific

[4] Average BMI refers to one of the World Health Organisation BMI categories. Healthcare and academic literature also frequently use alternative terms (e.g., healthy and normal BMI). While we later suggest that an average BMI is the most healthy and fertile, we avoided using healthy to prevent confusion due to the shared terminology. Similarly, we opted to avoid using normal not to imply that those with a different BMI are abnormal. However, it is also important to note that *average* BMI is misleading. This BMI is less common than other BMIs (e.g., overweight BMI) in the general population and is far from the *average* BMI held by most people.

situational threat cues (e.g., mortality, pathogen, and masculinity threats) on men's WHR and BMI preferences. While arguably more situational threat cues may influence men's preferences, we focus on these as they represent immediate psychological and environmental threat cues likely to influence men's preferences. This chapter will begin by providing a background on human mating preferences from an evolutionary perspective. We will then critically evaluate the claim that certain body shapes and sizes are preferred over others because they convey (or are believed to convey) a benefit. Concerning WHR and BMI, certain body shapes and sizes are believed to indicate good health and fertility. . As we will outline below, men's perceptions regarding what bodies are the most healthy and fertile drive men's preferences. We critically evaluate evidence suggesting certain body shapes and sizes convey actual benefits (e.g., signal health and fertility). We will conclude by presenting evidence that each of our situational threat cues should alter men's preferences for certain body shapes and sizes and explaining the rationale and research aims of this thesis.

2.2 Evolutionary Perspectives

This section briefly introduces evolutionary perspectives on what drives preferences toward a particular trait or quality, providing the necessary context to understand why men may prefer certain traits over others. Importantly, this is a brief introduction as fully evaluating evolutionary models of mate selection is outside the scope of this thesis.

Darwin's (1859) original Theory of Evolution (Natural Selection) provided the first attempt to define the conditions under which mating occurs. Traits are inherited by natural selection if they offer fitness benefits to the organism or aid in its survival (Bortz, 2014). Through this process, more mates with these traits survive to reproduce and consequently pass them on to their offspring (Darwin, 1859; Gregory, 2009). However, a primary criticism of natural selection was that certain traits appeared to be selected (e.g., complex extravagant plumes) that did not provide any observable survival benefit and often reduced the odds of survival (Andersson, 1994; Ryan & Rand, 1993). These inconsistencies led to Darwin (1871) extending natural selection to include sexual selection. Sexual selection refers to the process whereby traits are passed down and inherited by offspring as they provide some benefit during mating, even if their development occurs at the expense of survival and resources (Andersson, 1994; West-Eberhard, 2014). These inherited traits, typically termed secondary sexual characteristics, are sexually dimorphic and indicate some benefit to potential partners (Grammer et al., 2002; Ryan & Rand, 1993).

Dawkins (1976) argued that sexual selection primarily burdened the males of a species (Leigh, 2018). This difference is due to more males competing for a limited number of receptive females (Buss, 1988; Darwin, 1871). In this way, the female of each species acts as the sexual gatekeeper, deciding where and with whom mating will occur (sexual selection). Contrastingly, males typically have to compete amongst themselves for access to certain mates (intrasexual selection; Barber, 1995; Buss & Schmitt, 2019). Thus, males typically carry the burden of advertising their worth and the costs that are associated with this (e.g. increased risk of predation, intra-sexual aggression, shorter life expectancies) to attract females (Dawkins, 1976). In humans, Trivers (1996) argued that disparity in parental investment burdens resulted in women being the choosier sex, primarily owing to the burden of pregnancy and child-rearing being higher for women than for men (Barber, 1995; Buss, 2005).

Of course, in some species, males still contribute significant time, energy, and resources to rearing children (e.g., penguins; Barber, 1995; Geary et al., 2004). While males in most species experience no inherent benefit from being selective, human males do benefit from this and are selective in their mating practices (Barber, 1995). Since human courtship was historically predominantly monogamous, selective men would have been advantageous, allowing them to invest their limited resources in a high-quality partner (Hooper & Miller, 2008; Huchard et al., 2010). Women also participate in intrasexual competition and actively compete with other women to possess and display the most attractive traits (M. L. Fisher, 2004; Rosvall, 2011; Vaillancourt, 2013; Wang et al., 2021). Given that the two components that indicate choice (selectivity and opposite-sex intrasexual competition) are present, this suggests that humans experience mutual sexual selection, whereby both sexes exercise choice (A. G. Jones & Ratterman, 2009; G. F. Miller, 2007; Perper, 2010). This mutual choice illustrates that men are likely choosy and may prefer specific traits over others. It is important to note that mating preferences in humans predominantly refer to selecting a potential romantic or sexual partner and do not necessarily refer to having a desire or intention to reproduce (Fieder & Huber, 2022; Kokko et al., 2003).

While both men and women exercise choice, the expression of this choice is shaped by different selective pressures. Selective pressures refer to the adaptive demands imposed on each sex (Grammer et al., 2003). For example, both sexes would have experienced unique mating selective pressures (Buss, 2020; van Prooijen & van Vugt, 2018). For women, this involved selective pressures towards identifying men with resource access (and a willingness to share) and a desire to contribute to parental investment (Fieder & Huber, 2020; Hopcroft, 2015).

In contrast, men are hypothesised to have experienced selective pressures towards identifying healthy and fertile women, increasing the chances of successful reproduction and their offspring having good health outcomes (Buss, 1988; Furnham et al., 2006). For men, identifying partners with good health provides several benefits. First, healthy mates provide direct benefits as their healthy qualities increase pathogen and disease avoidance, increasing the chances of successful reproduction (Coetzee et al., 2009). Secondly, as immune function is partly heritable, those traits would be passed down to offspring, improving their chances of survival (A. J. Lee et al., 2013; Penke & Asendorpf, 2008). Lastly, romantic and sexual interactions are intimate processes, and interacting with partners with healthy qualities reduces the risk of contracting pathogens and diseases (Bressan, 2021; Sugiyama, 2015). Additionally, men who preferred body types and traits that indicated good fertility would have been in an advantageous position, as this would have increased the chances of long-term reproductive success compared with seeking partners with poorer fertility outcomes (Hooper & Miller, 2008; Huchard et al., 2010).

These selective pressures imposed on men and women could have shaped the creation of solutions to navigate these pressures (Al-Shawaf et al., 2019). Tooby and Cosmides (1990b) theorised that these recurring pressures caused the development of innate, species, and domain-specific psychological adaptations (i.e., a mechanism) that act as information processing units. This mechanism encourages a bias within the perceptual and attentional system for specific stimuli relevant to navigating both sexes' ancestral mating pressures (Buss, 2020; Tooby & Cosmides, 1990b). Specific traits and qualities signal (see below for a definition of signalling) certain information to prospective partners. This mating mechanism then causes traits that signal qualities relevant to each sex to be viewed as more attractive (Lewis & Buss, 2022). In men, this is hypothesised to involve a preference toward traits indicating health and fertility, which are generally perceived as more attractive (Furnham et al., 2006). This preference for health and fertility cues accounts for why men generally place greater importance on women's physical characteristics (e.g., WHR and BMI) because variations in physical features provide information about health and fertility (Symons, 1995).

For specific traits to vary in attractiveness, they need to fluctuate in terms of the information they provide. Traits achieve this by indicating (i.e., signalling) some underlying quality. More broadly, the signalling hypothesis suggests that signals refer to when information is transmitted by a sender (typically outside of conscious control), which produces a response in the receiver (Poggi & Francesca, 2010). Specifically, regarding mating, the signalling hypothesis suggests that certain physical features convey information about the status of one individual to another, which causes motivational and behavioural alterations in the receiver (Candolin, 2003; Krakauer & Johnstone, 1995). Certain traits and features (e.g., WHR and BMI) may indicate some underlying quality relevant to the sex's selective pressures and serve as signals (Garrison et al., 2020).

However, these evolutionary perspectives' limitations are the over-simplification of human mate preferences and coupling decisions (Goetz et al., 2019). Largely, evolutionary theories argue that contemporary human mating actions are determined by their ancestral experiences (Buss, 1988). However, modern humans (and the situations they experience) are quite different from those present in the proposed environment of evolutionary adaptations, and there is a significant evolutionary mismatch (Goetz et al., 2019). Many factors, such as sociocultural circumstances, may significantly influence mating preferences. For instance, Boothroyd et al. (2020) showed that television consumption significantly predicted preferences for slimmer and curvy women's body types in a sample of rural Nicaraguans. Similarly, they showed that experimental exposure to slimmer or heavier bodies increased preference for those body sizes. This shows that sociocultural factors influence people's preferences for particular body types.

As such, for any approach to identifying suitable mates to be effective, it must be flexible and adapt to changing environmental and situational factors. Given the mismatch between men's ancestral pressures (for health and fertility signals) and their current contemporary experiences, men may not always prefer healthy and fertile traits. Conversely, in other situations, they may prefer these traits more. Instead, the attractiveness of qualities and traits may depend on external cues (Lewis & Buss, 2022). For instance, cues which make men's selective pressures a salient concern (i.e., identifying healthy and fertile partners) would cause traits indicating these qualities to be more preferred. In contrast, other cues may increase the importance of other qualities, such as those indicating resource acquisition (Al-Shawaf et al., 2019; Marzoli et al., 2018). In this light, the proposed mating mechanism should itself be adaptive. This flexibility is an argument central to his thesis, as we argue below that men's body shape and size preferences should be contingent on external situational cues. Section 2.6 argues that immediate situational threat cues influence men's WHR and BMI preferences.

2.3 WHR and BMI Preferences

This section contextualises the factors that drive men's WHR and BMI preferences. This context is important, as ongoing debates remain regarding why certain body shapes and sizes are preferred in WEIRD contexts. For transparency, our position is that while certain WHRs and BMIs are *perceived* by men in WEIRD contexts to be more attractive as they are said to be reliable cues for health and fertility, there is conflicting and limited evidence to argue that body shapes and sizes are correlated with *actual* health outcomes. While there is some evidence suggesting that WHR is associated with some fertility outcomes and may be one of many cues for reproductive ability, there is limited consensus concerning this. Regardless, we argue that this perception drives men's preferences for specific body shapes and sizes over others despite these bodies not being associated with actual positive health or fertility outcomes.

WHR refers to the ratio of the circumference of a person's waist relative to the circumference of their hips (producing a ratio, e.g., 0.6 - 1.0). In comparison, BMI refers to a person's weight scaled for height and is derived by taking the adult's weight in kilograms (kg) and dividing it by their height in meters squared (m^2; kg/m^2; Cartwright, 2000). BMI is typically defined by five categories: emaciated ($\leq$15kg/m^2), underweight (15-18.5kg/m^2), average (18.5-24.9kg/m^2), overweight (25-29.9kg/m^2), obese ($\geq$30kg/m^2; Swami & Tovée, 2006; Weir & Jan, 2022). BMI is one of many measures of body fat and weight and is not without limitations. However, it is important to note that while calls for more robust measures exist, alternative body fat and size measures are also fraught with problems (e.g., Body Adiposity Index; Cerqueira et al., 2018). As such, more robust measures are required.

During puberty, body shape and size typically become sexually dimorphic, as the mobilisation of adipose (fatty) tissue occurs differently between men and women (Pulit et al., 2017). Women possess more body fat on average than men, and the distribution is different (Palmer & Clegg, 2015). This difference in body fat distribution is facilitated by variations in sex hormones, with female sex hormones (i.e., oestrogens) mobilising body fat towards the gluteal and hip areas. In contrast, male sex hormones (i.e., androgens) mobilise body fat towards the upper body, waist, and internal organs, particularly around the abdomen (Grammer et al., 2002; Rempala & Garvey, 2007). These differences typically mean that body shape (i.e., WHR) becomes sexually dimorphic, with women developing a body shape resembling an hourglass and a V-shape for men, which becomes particularly pronounced in late teens and early adulthood (Dixson et al., 2015; Henss, 2000; Wetsman & Marlowe, 1999). BMI is less clearly sexually dimorphic as both men and women can have similar BMIs (Pulit et al., 2017). However, even with similar BMI, men and women usually express this in different areas of the body and typically have less body fat around the abdomen (Lassek & Gaulin, 2008).

2.3.1 What Drives Men's WHR and BMI Preferences?

As we have argued, men possess a putative mechanism for identifying mating-relevant signals in potential mates, which is flexible to changing environmental demands. Certain traits, such as WHR and BMI, were initially argued to reliably and honestly signal health and fertility.

For a trait to be categorised in this way, it must provide "*receivers with reliable information about the signaller's quality, allowing the receiver to make adaptive decisions*" (Számadó et al., 2023, p. 4). As such, for WHR and BMI to be honest indicators of women's quality as potential mates, they should reliably signal some quality.

The most prominent evolutionary explanation for what qualities WHR and BMI signal is that they are honest indicators of health and fertility. Singh's (1993a) seminal publications were the first to claim that among a WEIRD, university-aged sample, men reported lower WHR figures (ranging from 0.7-1.0) as more attractive, healthy and fertile relative to a higher WHR. Future research by Singh and others supported the claim that variations in body shape honestly indicate women's health and fertility (e.g., Platek & Singh, 2010; Singh, 1993b). Subsequent claims also implicated BMI as an honest indicator of health and fertility, perhaps more so than WHR (Swami & Tovée, 2006; Tovée et al., 1999). Criticisms of Singh's initial claims were that the line-drawn stimuli used to make their initial assertions confounded body shape with body size (Tassinary & Hansen, 1998). When using stimuli that unconfounded the two, Furnham et al. (2006), with a WEIRD university-aged sample, rated figures with a 0.7 WHR and an average BMI as independently the most attractive and healthy. We explore reported preferences for specific body shapes and sizes in WEIRD samples in Section 2.4.

A key detail of the above research is that it is based on observers' perceptions (i.e., ratings) of a body's attractiveness, health and fertility. While some research has demonstrated that certain body shapes and sizes are associated with health and fertility outcomes, this research has several limitations. Consequently, this *health and fertility hypothesis* has been substantially criticised, and there are several issues with the research literature that claim that specific WHRs and BMIs are associated with actual health and fertility outcomes (see Lassek & Gaulin, 2018). Below, we present evidence for and against the notion that WHR and BMI are associated with actual health and fertility outcomes. We largely conclude that while there is some evidence that WHR is an indicator of some fertility benefits, there is limited conclusive evidence to suggest that variations in body shape or size are associated with actual health and fertility outcomes for women. Instead, it is men's perception that certain body shapes and sizes are linked with these outcomes that is the reason men prefer these bodies over others.

2.3.1.1 Health

Research has repeatedly claimed that a low WHR is associated with better health than a higher WHR. For instance, Singh and Singh (2011) claimed that WHR is a robust predictor of women's health and fertility. They cite, for instance, Spies et al. (2009) to support an association between a higher WHR and a greater risk of poor cardiovascular health. While Spies and colleagues did find this association, their sample consisted of predominantly men (60-90%). Likewise, the age of the population sampled within this study had a mean of 60 years and above. Other research has demonstrated an association between WHR and actual health outcomes for women. Zhang et al. (2021), in a sample of Chinese men and women aged 40+ years, while controlling for several health-related covariates (e.g., exercise), found that participants in the highest WHR quartile were more likely to have diabetes than those in the lowest quartile. This association was stronger for women. However, there are limitations with these studies (e.g., the age of participants), which we consider below.

Similar research has also been conducted on BMI. Health services often use BMI to determine the risk for certain diseases. An average, or healthy BMI, is often claimed to be the healthiest. The National Health Service (NHS) in the United Kingdom (UK) lists obesity as a risk factor for a variety of health complications, such as asthma, liver and kidney disease and cancer (NHS inform, 2023). Research has demonstrated that a higher BMI is associated with certain health conditions, such as diabetes and heart complications. For example, using a large sample of US participants between 1997 and 2004, Narayan et al. (2007) found that being overweight or obese, especially at a younger age, significantly increased a person's lifetime risk of diabetes. Similarly, Kenchaiah et al. (2002) found that in a WEIRD sample of men and women (M_{age} = 55 years), a higher BMI was associated with an increased risk of heart failure., However, this was especially the case for people with very high BMIs (>30kg/m^2).

However, in recent years, it has become clear that BMI is a poor indicator of health, not least since BMI is a poor indicator of overall body fat or weight in certain populations (e.g., non-White people; A. Luke, 2009). While it is true that a higher BMI indicates a greater body size, it is unclear whether this size is due to higher body fat or muscle mass. BMI as a metric cannot distinguish between these (Nuttall, 2015). Many healthy people have a high BMI because they have muscular bodies. This is why many organisations and researchers have called for more accurate measures of body fat (Burkhauser & Cawley, 2008).

The research has several more general limitations, which state a link between BMI, WHR, and health. Most of the research presented thus far does show an association between WHR and BMI and health outcomes. However, it does so with a relatively older age range, typically beyond the reproductive age for women. As such, when focusing on a WEIRD sample of women of reproductive age, Lassek and Gaulin (2018) found no robust association between lower WHR and BMI and health outcomes. They did show that a lower BMI (<20 kg/m^2) often had worse health outcomes across certain measures (e.g., infection risk) than higher (often claimed to be less healthy) BMIs. Further, many health complications associated with a higher WHR are relatively new (in evolutionary terms). They would, therefore, be unlikely to explain why a preference for lower WHR would have been selected (Bovet, 2019).

Many claims that WHR and BMI are associated with health outcomes are based on mortality data from WEIRD cultures. Mortality data is a poor metric for determining whether specific body shapes and sizes are healthier, not least due to the conflicting evidence base. That is, while some studies show an association between a higher WHR and BMI with increased mortality, others do not. Based on data from the Iowa women's health study (a sample of women aged 55-69), Folsom and colleagues (2000) demonstrated that WHR was positively associated with mortality risk for various reasons (e.g., heart disease). Comparatively, Flegal and Graubard (2009) demonstrated that in a similar US sample of men and women with a mean age of 49 and 51, respectively, neither BMI nor WHR were associated with mortality rates. In WEIRD cultures, BMI does not appear to become a mortality risk until very high values (>30kg/m^2). Values below this appear to have similar mortality rates (Visaria & Setoguchi, 2023). This could be due to confusion concerning what BMI represents (body fat vs muscle).

However, other research has demonstrated that a lower BMI is actually predictive of poorer health outcomes and higher mortality risk than a higher BMI (Lassek & Gaulin, 2018).

Additionally, while certain body shapes and sizes may be associated with health outcomes, many of these can be explained by other factors. For instance, after controlling for BMI, Wing et al. (1991) found that a higher WHR is associated with greater rates of smoking. However, it is important to note that both smokers and non-smokers reported a similar WHR (within the 0.7 range), and the causal direction of this finding is unclear. This is nevertheless an important consideration as a higher WHR is associated with a range of negative health behaviours, such as alcohol consumption (Lukasiewicz et al., 2005; Sakurai et al., 1997). A higher BMI is also associated with poverty. Naturally, the less money a person has, the more likely they are to resort to eating cheap, processed foods (Jolliffe, 2011). As such, poor health outcomes for people with a high BMI may be partly due to their poor income status.

Another specific factor that may partially explain the association between WHR and BMI and health outcomes is stigma. Appearance ideals for women emphasise a slim body type with an hourglass shape (Kelley et al., 2010; Tiggemann & Miller, 2010). Women who deviate from this ideal are likely to experience more appearance pressures and body dissatisfaction, which is associated with a range of negative mental health outcomes, such as depression and suicidality (Griffiths et al., 2016; Rodgers et al., 2023).

Fat shaming, defined as a "*mockery or criticism about someone judged to be fat or overweight*" (Schlüter et al., 2023, p. 27), is a common occurrence in WEIRD cultures. Many overweight and obese women (and men) face prejudice and stigma because of their appearance (Puhl & Heuer, 2010). This is especially the case in healthcare settings, which can lead to barriers for overweight/obese people when seeking access to healthcare (Rubino et al., 2020). Furthermore, given the normative pressures faced by people to adhere to societal appearance standards, many men and women in WEIRD cultures experience internalised weight stigma (M. S. Lee et al., 2019). For example, Amy et al. (2006) sampled participants from the US who reported having insurance and access to healthcare and found that 68% of the participants with the highest BMI (>55kg/m^2) compared to 86% of participants with a lower BMI reported accessing pap smear tests. This can negatively impact the quality of healthcare that those with a higher BMI can access (Puhl & Heuer, 2010).

As such, various factors, such as poor access to high-quality healthcare, may also partially explain the association between a higher BMI and negative health outcomes.

2.3.1.2 Fertility

Evolutionary theories have also argued that body shape and size variations are associated with fertility outcomes. Fertility refers to a capacity to reproduce, which would have been an important evolutionary pressure placed on men (Buss, 1988; Furnham et al., 2006). WHR and BMI were initially argued to be a mechanism for men to evaluate the fertility of a potential mate. Unlike for health, there is greater support for WHR and BMI, signalling some benefits concerning fertility. However, this relationship is likely partly explained by various extraneous variables.

Initially, Singh (1993b) claimed that a lower WHR was associated with better fertility outcomes and indicated a higher proportion of circulating oestrogen and progesterone. Conversely, a higher WHR was associated with higher circulating testosterone. However, these claims were largely based on peripheral evidence. Some research does support this, showing that in a sample of young Mexican women (M_{age} = around 22 years), high levels of oestrogen and testosterone were associated with a lower WHR. In contrast, lower levels of oestrogen but higher levels of testosterone were associated with higher WHRs (Mondragón-Ceballos et al., 2015).

Although a lower WHR is often associated with higher oestrogen levels, indicative of better reproductive health, the relationship between oestrogen and fertility is nuanced. For instance, polycystic ovary syndrome (PCOS) is a highly prevalent condition, with around 4 - 20% of women experiencing the condition globally, which is likely underdiagnosed (Deswal et al., 2020). Women with PCOS often have higher levels of oestrogen and testosterone, yet they frequently experience infertility due to irregular ovulation or anovulation. This demonstrates that despite elevated oestrogen levels, other hormonal imbalances and underlying conditions can significantly impair fertility outcomes (Ho, 2003).

Bovet (2019) conducted a review of 104 studies that claim WHR indicates some benefit concerning fertility. Examining each of these benefits in detail is beyond the scope of this thesis. However, they concluded that a preference for WHR in men may have developed and been maintained as WHR serves as a cue for various benefits relating to reproductive ability. For instance, there is some evidence to show that WHR is a cue for biological sex (as WHR is a sexually dimorphic quality) and reproductive age (as WHR increases following menopause). Similarly, other research suggests that a WHR is both an indicator of fertility and an indicator of the number of children a woman has had. Butovskaya and colleagues (2017) investigated several indigenous foraging societies across Sub-Saharan Africa, Western Siberia, South America and East Asia. They found that a higher WHR was associated with more children across cultures. They concluded that this suggests that WHR is a valid cue for reproductive ability but also that a higher WHR may indicate a woman's reproductive history (more children). However, while the authors controlled for age and BMI, other factors (e.g., environmental factors) may likely partly explain these findings.

One benefit that WHR is said to convey is the presence of resources necessary for neurodevelopment. Lassek and Gaulin (2008), using a large sample (based on the NHANES 3) of women, found an association between a mother's WHR and various indicators of cognitive ability. Specifically, they showed that lower WHRs were significantly associated with higher cognitive test scores in children and better cognitive abilities in women. Additionally, teenage mothers with lower WHRs at the time of conception and their children experienced less cognitive impairment compared to those with higher WHRs. These findings suggest that lower WHRs may be a cue for the availability of neurodevelopmental resources (in this case, long-chain polyunsaturated fatty acids), which they stated are essential for neural development. They concluded that this may be one reason why men developed a preference for lower WHRs.

However, it is important to note that these fatty acids can be acquired through dietary means, such as consuming foods high in omega-3 (e.g., fish). Consuming these foods during pregnancy is associated with children having better cognitive ability outcomes (Hibbeln et al., 2007). However, it is important to note that Huerta and Gil (2018), in a review of 51 studies, found no robust evidence that consuming foods high in omega-3 during pregnancy increased the child's cognitive ability. This might be due to the claim that most fatty acids contributing to a child's cognitive development come from maternal fat stores (see Lassek and Gaulin, 2008 for a literature review). As such, there is conflicting evidence concerning the benefit that WHR may signal concerning the availability of maternal fat stores.

Despite these findings, other features (e.g., the face) are also said to signal these qualities, so WHR is not the only quality men might use to determine these factors. According to the redundant signalling hypothesis, having multiple features that signal the same quality would ensure that if one signal is not attended to, another signal could be identified and used (Moller & Pomiankowski, 1993; Wells et al., 2013). As such, WHR is likely one of many features that men can use to determine a woman's current fertility status, but it is not the only one.

BMI has similarly been implicated as an indicator of fertility. Specific BMIs (e.g., emaciated) may indicate significant impairments in fertility. Having an emaciated BMI, typically a symptom of anorexia nervosa, a condition characterised by low weight and restrictive eating, is associated with a complete suspension of the reproductive system. However, it is important to note that this is likely not directly due to a low BMI but rather to individuals with low energy reserves (Coetzee et al., 2009; Furnham et al., 2005).

A higher BMI, in contrast, is not often an automatic reason for poor fertility outcomes. Most research evaluating the effect of a high BMI on fertility outcomes focuses on the effectiveness of assisted fertility treatments (ART). ARTs (e.g., in-vitro fertilisation or IVF) are a collection of medical interventions designed to promote fertility in women with fertility complications (National Health Service, 2017). Some research has demonstrated that having a higher BMI at treatment onset is associated with poorer success (Imterat et al., 2019). In contrast, other research has shown no association between BMI and poorer outcomes for ARTs (Vilarino et al., 2011). However, while this research does suggest that BMI may affect the efficacy of infertility treatments, this does not imply that a higher BMI directly causes fertility issues. Likewise, other research has shown that BMI is not associated with fertility outcomes. For instance, Pawlowski et al. (2008) showed that when examining BMI at age 18, there was no relationship between BMI and reproductive outcomes (e.g., a greater number of children). This may suggest that while BMI may have been important for determining a partner's quality ancestrally, it is not the case in modern societies.

2.3.1.3 Actual vs Perceived Benefits

In summary, the health and fertility hypothesis posits that men's preferences for certain WHRs and BMIs are due to the health and fertility benefits they convey. As we demonstrated, there is limited and conflicting evidence to show that WHR and BMI reliably and honestly signal good health. For fertility, there is some evidence to show that men's preferences for WHRs may be due to WHR signalling some useful information relating to fertility, but further research and a stronger theoretical understanding are needed before it can be said with certainty that WHR is a signal robust and honest signal of fertility. For BMI, there is limited evidence to support variations in BMI being linked to fertility outcomes.

These findings suggest that the health and fertility hypothesis cannot fully explain why men prefer specific WHRs and BMIs. That said, as we will discuss more in the next section, men do still show a relatively consistent preference for a lower (around 0.7) WHR and an average BMI, especially amongst WEIRD cultures. Women also appear to prefer WHR and BMI similarly to men (Dixson, Grimshaw, et al., 2010). As such, there appears to be at least some implicit reason why men (and women) prefer certain body shapes and sizes despite a lack of consistent evidence suggesting these body shapes and sizes are related to actual, tangible health and fertility outcomes. In this thesis, we argue that men still perceive certain body shapes and sizes as indicating greater health and fertility despite the evidence suggesting that certain WHRs and BMI signal actual health and fertility benefits being inconclusive, and it is these perceptions that drive their preferences.

2.4 WHR and BMI Preferences

So far, it has been shown that men are hypothesised to experience selective pressures toward identifying healthy and fertile mates. Men appear to believe that certain body shapes and sizes are reliable indicators of health and fertility, and we argue that this drives their preference for certain WHRs and BMIs. This perception likely explains why men in WEIRD cultures/nations prefer 0.7 WHR and average BMI. It is important to note that the term *preference* largely depends on the methodology used by a particular study. Most self-report methods ask the participants to rate the attractiveness of a particular stimulus, with these ratings being used to indicate a preference. In contrast, other measures (e.g., neurophysiological measures and eye-tracking) rely on more implicit preference indicators. We consider some of this research below.

2.4.1 Preferences in WEIRD Populations

Here, we briefly introduce research that has used various methods to evaluate men's WHR and BMI preferences. The research presented here predominantly uses WEIRD populations (i.e., western, educated, industrialised, rich, democratic). We focus on this research as this thesis will also use a WEIRD population. Most research examining men's WHR and BMI preferences has been done in WEIRD culture and has largely focused on establishing stable preferences for WHR and BMI in these cultures.

Most of this initial research has relied on self-report attractiveness paradigms (e.g., Singh's research). These paradigms ask participants to rate the attractiveness of a particular stimulus (A. J. Lee et al., 2015). Concerning WHR, several studies have demonstrated that men from WEIRD cultures rated 0.7 WHR as the most attractive. For instance, Streeter et al. (2003) and Tovée et al. (1999) demonstrated that a university-aged sample of men from the US and UK rated 0.7 WHR as the most attractive, respectively. However, Tovée and colleagues noted that BMI was a stronger predictor of attractiveness, a consideration discussed below. Other studies have found similar findings with similar populations (e.g., Dixson, Grimshaw, et al., 2010).

Similar research has also explored men's BMI preferences using WEIRD samples. For instance, Swami and Tovée (2006) and Tovée et al. (1999) demonstrated that a university-aged sample of men from the UK rated an average BMI as the most attractive. Conversely, Richmond et al. (2012) found that a higher WHR was associated with a greater probability of being considered unattractive. However, it is important to note that other research has demonstrated that WEIRD samples rate bodies underweight as the most attractive, such as men in Canada (Wilson et al., 2005) and Poland (Kościński, 2013). These discrepancies are likely due to the influence of Western body ideals, which emphasise a thin body ideal for women (Tiggemann & Miller, 2010). However, we note that most research has demonstrated that average BMI is preferred among WEIRD (especially UK) populations of men (Swami & Tovée, 2006). We will explore whether our sample of UK men prefers underweight or average body sizes in Chapter 4.

A consideration that should be noted is ongoing debates within the wider research literature concerning the relative importance of WHR or BMI. That is, certain researchers have suggested that one explains more of the variance relating to attractiveness than the other. Various researchers have claimed that WHR is more important for determining attractiveness than BMI (R. C. Brooks, 2015; Dixson, Li, et al., 2010; Singh, 1993b), whereas others have made similar claims concerning BMI (Swami & Tovée, 2006; Tovée et al., 1999). However, the consensus within the research literature is that BMI plays a more important role. Indeed, Wilson et al. (2005) demonstrated that the association between WHR and attractiveness ratings was contingent on a person's BMI. Deviations from the *ideal* BMI seem also to have a greater influence on people's attractiveness ratings (Kościński, 2013). Previous research has demonstrated that when BMI is controlled for, the effect of WHR on attractiveness ratings is reduced (P. L. Cornelissen, Toveé, et al., 2009). While this is not necessarily a topic we will actively explore within this thesis, it is important to consider when interpreting our findings.

Adding to the findings of self-report paradigms, other paradigms have also explored these preferences. However, this research is more limited in scope. For instance, neuroimaging studies using fMRI have shown that when men view images of women with a 0.7 WHR (Platek

& Singh, 2010) and average BMI (Holliday et al., 2011), they experience greater activation of the areas of the brain associated with processing rewarding information (e.g., nucleus accumbens). However, it is important to note that both studies found conflicting findings. Platek and Singh (2010) found that BMI did not cause the same activation, whereas Holliday et al. (2011) likewise found that WHR did not activate these areas. Del Zotto et al. (2018), using EEG, found that when men view bodies consisting of a 0.7 WHR, they experience greater vertex-positive potentials, indicative of early attentional processing of these body types relative to other WHRs. However, to our knowledge, no research has shown similar findings with BMI.

One promising direction for assessing men's WHR and BMI preferences is eye-tracking studies. Eye-tracking studies have shown that men look more toward the waist and hip area on bodies with 0.7 WHR relative to higher WHR (i.e., 0.8 WHR; Suschinsky et al., 2007). However, to our knowledge, no research has used eye-tracking in conjunction with examining men's BMI preferences. Hall et al. (2014) also showed that men had a higher fixation count and longer dwell times toward the chest and the waist and hip region when viewing women of their preferred age for a sexual partner. Likewise, Dixon et al. (2011b) showed that men rated 0.7 WHR as the most attractive but had higher fixation counts and dwell times toward the upper body, irrespective of WHR. They also found that the breast area of interest received the highest fixation count. However, it is important to note that existing eye-tracking research in this area has several limitations. We discuss these limitations more in Chapter 3. In this thesis, we will use eye-tracking methods to assess how our situational threat cues will influence men's preferences for different body shapes and sizes more using alternative metrics.

As such, we have demonstrated that men in WEIRD cultures prefer 0.7 WHR and average BMI across various measures. However, as mentioned in Section 2.2, the environment of contemporary men differs from that of their ancestral predecessors, and men's preferences for particular signals should instead be contingent on environmental and situational factors (Goetz et al., 2019). Accordingly, we assume that men's preferences for 0.7 WHR and average BMI will be contingent on particular external cues. Put simply, specific situational threat cues may increase or decrease their attractiveness (Maner et al., 2007). The next section introduces research investigating men's WHR and BMI preferences in non-WEIRD populations and introduces the role of context on men's WHR and BMI preferences.

2.4.2 The Role of Context

In this section, we begin introducing the central aim of this thesis. We evaluate how men's body shape and size preferences vary based on contextual factors. We largely focus on research showing differences in men's preferences between WEIRD and non-WEIRD cultures. In the subsequent sections, we expand on this by exploring the influence of situational threat cues. Here, we explore how relatively persistent differences in situational and environmental context may influence men's body shape and size preferences. As such, we will first evaluate how current research has neglected the potential influence of contextual factors. We will then make a case for why men's WHR and BMI preferences may vary depending on broader ecological contexts by introducing a context-dependent approach to mate selection. Lastly, we will evaluate the current limitations of this context-dependent model. This evaluation involves introducing the current over-emphasis on persistent environmental influencers that are relatively consistent and long-term (e.g., protracted environmental pressures) and the lack of focus on the potential influence of immediate situational threat cues. In doing so, we make a case for why an expanded context-dependent model, which includes the influence of situational threat cues, is required.

Some research has aimed to acknowledge the influence of context on men's preferences by promoting a context-dependent approach to mate selection (Sugiyama, 2004, 2015). This model acknowledges that men's preferences for specific traits vary with ecological and environmental factors (Lewis & Buss, 2022; Marzoli et al., 2018). Scott-Phillips et al. (2011) suggested that while it is necessary to explain how selective pressures shape the development of traits (e.g., mechanisms), it is also important to consider how proximate factors, such as culture, determine their expression (e.g., the preference for a specific trait). Under this approach, differing contexts impose varying demands on an individual, and a cost-benefit analysis examines the benefits and trade-offs in pursuing a particular mating strategy while considering broader contextual factors (Watkins et al., 2012). Put another way, preferences towards specific qualities (e.g., health and fertility indicators) would be stronger under contexts where the benefits outweigh the costs (Dixson, 2022; Sugiyama, 2004, 2015).

Some research has explored the role of contextual factors on men's WHR and BMI preferences by explaining the cultural variations in these preferences. As mentioned, most WHR and BMI preference research has been conducted in WEIRD cultures. While some research has argued that men's WHR and BMI preferences are stable in other cultures (Dixson et al., 2007; Singh, 2004; Singh & Luis, 1995), most research suggests that in some cultures (e.g., among Hazda Hunter-Gatherers and Gambians), men show preferences for higher WHRs and higher BMIs (Swami et al., 2009; Swami & Tovée, 2007b, 2007a). For instance, despite the claim by Singh (1993a; 1993b) that a preference for a low WHR was universally stable, in some cultures (e.g., the Hazda), a lower WHR is not preferred (Wetsman & Marlowe, 1999). This indicates that preferences for WHR and BMI may be contingent on external factors, such as environmental influencers.

Several contextual explanations can be provided for why men in some cultures show different preferences than men in WEIRD cultures. The variations between WEIRD and other cultures may be because of socioeconomic status and resource access differences. The distinction in the preferences shown for different WHRs and BMIs between WEIRD and less well-developed countries (e.g., Gambia) may be owing to the former having greater resource access (Mo et al., 2014). When resource scarcity is high, men prefer a higher BMI and a more curvaceous body shape (Mo et al., 2014; Swami, Tovée, et al., 2008). This preference may result from a positive association between body size and resource access. For instance, increased body size may be a reliable signal for a person's ability to access resources, as body size correlates positively with body fat reserves. Higher BMI may visually indicate a person's resource access and ability to meet their immediate nutritional needs (Marlowe & Wetsman, 2001; Swami & Tovée, 2007a).

However, while there is evidence showing that men's preferences vary in non-WEIRD cultures, recent evidence has shown that men's preferences may change depending on the extent to which they are exposed to Westernised appearance ideals for women (Jucker et al., 2017). In WEIRD countries, women are often pressured to have a slim, curvaceous body, which is termed the thin ideal (Kelley et al., 2010). When men in countries with limited knowledge of these Western ideals are exposed to information relating to these ideals (e.g., via television), they show a greater preference for slimmer and more curvaceous women, a finding shown both cross-sectional (via television measuring television consumption) and experimentally (Boothroyd et al., 2020; Thornborrow et al., 2018). These findings illustrate how men's preferences for specific body shapes and sizes can vary due to contextual (in this case, social, visual culture) cues.

WHR and BMI preferences are also influenced by sociocultural gender norms (Swami, Antonakopoulos, et al., 2006). Furnham and Greeves (1994) theorised that in societies where typical gender roles are strong (e.g., Portugal, Japan and Greece), preferences are greater for more traditional gender-typical body types (i.e., an hourglass figure for women, a V-shaped body for men) relative to countries with less typical gender roles (e.g., Britain and Denmark). For example, Furnham and Nordling (1998) compared men from Denmark (a country with less strict gender norms) and Portugal (a country with greater adherence to traditional gender norms) and found that Portuguese men preferred a lower WHR (more gender-typical body type) than Danish men.

When determining gender role adherence in these countries, the researchers observed differences in masculinity and femininity in each country using measures such as the Masculinity-Femininity Dimension, which categorised countries into whether traditional gender roles (i.e., masculinity and femininity) were adhered to (Furnham & Greaves, 1994; Hofstede, 1984). However, it is important to note that since this earlier research, the European Institute for Gender Equality (2021) has shown that Portugal and Greece have improved regarding gender equality and diminishing traditional gender norms. Nevertheless, both remain below the EU average. Japan, on the other hand, maintains highly differentiated gender norms (Statista, 2023). It is important to be mindful that given the evolving nature of gender equality and the concept of gender, since this research was undertaken, the effects may be different if the research was replicated in the current climate. However, this research still supports the claim that gender norms may influence men's WHR and BMI preferences.

Similarly, Swami, Antonakopoulos et al. (2006) showed that both Greek (Greek and Greek-British) and British men preferred a BMI within the average range. However, only Greek participants reported a significant preference for 0.7 WHR. This preference for 0.7 WHR in the Greek but not in the British sample is likely owing to gender norms in Greece being stronger and more traditional, leading to greater preferences for more traditional body shapes (e.g., feminine hourglass figures). Lastly, Swami, Caprario et al. (2006) showed that while Japanese and British men preferred 0.7 WHR, Japanese men placed greater importance on this. Again, this is likely due to traditional gender norms being stronger in Japan. However, we note that this explanation is speculative and was not tested by the authors. Japanese men also reported preferring lower BMI than British men. This finding is likely due to women's body ideals being thinner and smaller in Japan than in Britain.

A more recent study by Pazhoohi et al. (2024) found that Norwegian and Iranian men preferred higher WHRs than Polish and Russian men. While the authors did not explore all potential explanations for these findings, one plausible factor could be the influence of sociocultural differences, such as variations in religious practices and gender norms across these countries. For instance, Poland and Russia might have stricter adherence to traditional gender norms than Norway, potentially influencing preferences for certain body shapes. Nonetheless, it is crucial to acknowledge that these cultural explanations remain speculative. Despite the observed differences, men across all four countries generally preferred WHRs within the range of 0.60 to 0.75. These findings illustrate the dynamic interplay between evolutionary and sociocultural factors in determining WHR and BMI preferences (the reasons for this are explored more fully in Section 2.6.3).

2.5 The Influence of Situational Threat Cues

Applying a context-dependent approach to men's WHR and BMI preferences helps to illustrate the variations in these preferences that may occur depending on sociocultural and environmental factors. Therefore, men's WHR and BMI preferences are not stable. However, there are some limitations to this context-dependent approach. Namely, current research is limited in scope. It focuses on persistent cues present across ecological contexts, with very little focus on how immediate situational threat cues imposed at the level of the individual may influence men's WHR and BMI preferences (Swami, Miller, et al., 2008). This limitation is accurately summarised by Maner (2007), who stated that current "*evolutionary theories of mating, however, have tended to rely on motives presumed to be chronically active and have left relatively unexplored effects of situational activated motivational states*" (p. 389). This issue persists in the current research base.

Specific situational threat cues may influence men's preferences similarly to contextual factors. Some situational threat cues might increase the saliency of men's selective pressures, whereas others increase the importance of other cues (Ainsworth & Maner, 2014a; Maner et al., 2007). In this way, different situational threat cues may alter the costs and benefits of preferring certain signals and influence WHR and BMI preferences (de Barra et al., 2013). Therefore, rather than only investigating persistent environmental contexts, addressing the potential influence of immediate situational threat cues on men's preferences is prudent.

Some research has explored the influence of immediate individual differences in mating preferences. For example, research has explored the role of hunger. Hunger may partly explain the influence of resource scarcity on men's WHR and BMI preferences (discussed above). Nelson and Morrison (2005) postulate that hunger at an individual level serves as a proxy for determining societal and cultural resource access. When someone is hungry, they may use this as a proxy for societal-level resource scarcity. They tested with a WEIRD undergraduate sample, showing that participants preferred heavier bodies before entering a food venue (hungry) than those leaving (satiated). Other research has found similar findings. However, two notable studies found that men from WEIRD cultures preferred heavier bodies while hungry. They also found that men preferred larger non-body objects similarly (Cazzato et al., 2022; Saxton et al., 2020). As such, hunger could simply increase preference for larger objects generally rather than bodies specifically. Indeed, research using samples from rural populations experiencing nutritional distress found limited support for the influence of hunger on body size preferences (Boothroyd et al., 2020; Jucker et al., 2017).

Research has also investigated how men's sociosexual orientations influence their WHR and BMI preferences and has shown greater support (Brase & Walker, 2004). Sociosexual orientation refers to individual differences in mating strategies, typically referring to either an unrestricted (e.g., desiring short-term, casual partners) or a restricted strategy (e.g., desiring a long-term partner). Men guided by a short-term strategy were said to be ancestrally motivated by maximising their reproductive chances and are particularly motivated to identify signals of health and fertility (Buss & Schmitt, 2019). Swami and Miller et al. (2008) demonstrated that straight men from the UK who were motivated by an unrestricted strategy showed greater preferences for lower WHR and BMI than those motivated by a restricted strategy. This preference shift also occurs when men are exposed to situational cues that alter their sexual strategy. Maner et al. (2007) found that priming undergraduate men from the US into a state of sexual arousal (i.e., a short-term strategy) caused them to direct greater attention toward physical attractiveness in opposite-sex partners. In addition, having men consider themselves in a short or long-term mating context influenced their preferences for more attractive qualities (Lu & Chang, 2012). These findings illustrate that specific situational cues may increase preferences for features generally perceived to be more attractive.

As such, some research has aimed to explore the influence of situational cues on men's preferences, but this focus has generally been lacking. This thesis explores the influence of situational threat cues on men's WHR and BMI preferences. We expect that specific situational threat cues will alter the importance of identifying mates with particular signals similarly to broader contextual factors. Specifically, situational threat cues which make men's selective pressures a salient concern will increase the importance of identifying health and fertility signals, which should increase preferences for WHRs and BMIs that men perceive to signal those traits. This would represent a change in mating motivations (Maner et al., 2003).

As we established above, men in WEIRD populations generally prefer 0.7 WHR and average BMI. We are not suggesting that men will cease preferring these body types. Instead, we argue that men influenced by situational threat cues that alter their mating motivations and increase the importance of identifying health and fertility signals will show greater preferences for the WHRs and BMIs perceived to signal these qualities relative to the preferences in the general population. Indeed, research has already established a shift in men’s body shape and size preferences when observing certain contextual and situational threat cues (A. J. Lee et al., 2015; Maner et al., 2007; Swami, Antonakopoulos, et al., 2006).

In summary, this thesis proposes an expanded context-dependent model that includes immediate situational threat cues' influence on men’s WHR and BMI preferences. The following section introduces the specific situational threat cues this thesis will focus on and how they may influence men’s WHR and BMI preferences.

2.6 Situational Threat Cues

The above section showed that in addition to persistent environmental and contextual factors, situational threat cues at the individual level alter the expression of WHR and BMI preferences. Various situational threat cues may influence an individual, such as a person’s immediate hunger levels and cues regarding sociosexual orientations (Cazzato et al., 2022; Maner et al., 2007). This section introduces three situational threat cues that will be the focus of this thesis: mortality, masculinity, and pathogen threat. Each represents a situational threat cue that should alter men’s mating motivations and WHR and BMI preferences (Maner et al., 2007).

We focused on exploring threat cues as we deemed these the most likely to influence men’s WHR and BMI preferences. Specifically, these cues serve as cognitive threats which may make men’s selective pressures a salient concern and change men’s mating motivations by increasing the importance of identifying health and fertility signals relative to those not experiencing this cue (Al-Shawaf et al., 2019; de Barra et al., 2013; B. C. Jones et al., 2013). Put simply, preferences for 0.7 WHR and average BMI would increase in men experiencing these cues relative to the general population's preference level. We also chose these cues because they represent situational encounters that men may be exposed to daily. For instance, men may routinely experience situational threat cues about mortality, pathogens, and masculinity. We provide more information on our priming procedure in Chapter 3 and the exact situational threat cue primes we used in Chapters 5 to 7. As we will argue in the following sections, these situational threat cues should alter men's mating motivations and shift men's WHR and BMI preferences by temporarily increasing the importance of identifying features generally perceived to be the most attractive.

2.6.1 Everyone Knows They Will Die One Day: Mortality Threat

One of the primary and instinctual motivators across all species is avoiding death and reaching a suitable reproductive age to pass on genetic material (Dawkins, 1976). Like all species, humans experience a distinct self-preservation motivation and (typically) actively avoid situations which put them at risk of death or injury (Mobbs et al., 2015). Naturally, in some situations (e.g., cultures), the threat of death is more proximate and immediate. However, unlike other species, higher cognitive functioning allows humans to consider their potential death without a direct, tangible threat (Vaughn et al., 2010). This process of contemplating death is termed mortality salience, and when people consider their demise, they experience a strong behavioural response (Kosloff et al., 2010). This effect was stronger when sampling young participants from WEIRD populations (Burke et al., 2010).

In this section, we begin by considering the nature of mortality threat (i.e., priming men into a state of mortality salience), which is typically examined under the framework of terror management theory (TMT; Greenberg et al., 1986). We will then consider whether mortality threat causes changes to reproductive motivations in men and whether this causes men to shift their preferences towards traits signalling health and fertility. We will do this by integrating current literature within TMT with a novel evolutionary explanation. By drawing on previous research, we conclude by considering how mortality threat may alter men's WHR and BMI preferences.

Some humans likely experience a psychological paradox between recognising death is inevitable and trying to avoid these thoughts (Chonody & Teater, 2016). Under the framework of TMT, when people consider their demise or experience a tangible threat which reminds them of death (i.e., mortality threat), they experience a strong sense of terror, known as death anxiety

(Landau et al., 2006). As explained by TMT, people respond with a dual-defence strategy, including a proximate and distal route (Juhl & Routledge, 2016). The proximate route is used when a threat is immediate, and inside of conscious awareness (e.g., immediately following a cancer diagnosis), people respond with direct compensatory behaviours to reduce mortality risk (e.g., improving health behaviours). In comparison, distal routes reduce concerns about mortality, which are held outside of conscious awareness (e.g., thinking about death), which involves using approaches to reduce death anxiety (Greenberg et al., 1986). The subsequent focus is primarily on thoughts of death (distal cues), as the wider research literature suggests these cues partly explain men's changes in reproductive motivations and behaviour.

As explained within the framework of TMT, when people consider thoughts about death or are primed with information about mortality, they respond with distal defences. Defences in this context refer to psychological approaches aimed toward reducing the distress caused by mortality salience (Pyszczynski et al., 1999). These defences involve attempts to create a sense of meaning and bolster their self-esteem, which buffers against death anxiety (Davis et al., 2016). By encouraging a sense of meaning, people often contribute to structures and ideas (e.g., political systems), which continue post-mortem and symbolically continue the self. Similarly, bolstering self-esteem increases a person's sense of value and gives them a place and purpose in the world (Greenberg et al., 1986).

Previous research has explored different distal responses within the framework of TMT and has suggested that one method of producing a more stable worldview and bolstering self-esteem is by reproduction and having offspring (Vicary, 2011). Consistent with this, Zhou et al. (2009) have shown that when primed for mortality threat relative to another adverse life event (e.g., thoughts of dental pain), both men and women spend longer looking at images of baby humans. Furthermore, in a second experiment, they showed that when primed with mortality threat, both men and women thought less about death-related words and concepts after viewing images of baby animals. It has also been shown that birth rates persistently increase following natural or humanmade disasters (Vaughn et al., 2010). For instance, Nandi et al. (2018) found that following the Gujarat Earthquake (2001) in India, women in affected areas had significantly higher birth rates. As such, it appears that the effect of mortality salience can occur from situations ranging from the mere contemplation of death in WEIRD, university-aged populations to those experiencing actual threat of death from environmental factors. Mortality salience leads to an increased desire for, and copulation to achieve, more children because having children is arguably a direct and natural method of creating symbolic meaning. This is because children inherit fifty percent of a person's genetic material and often grow up to exemplify a person's own characteristics and traits (Vicary, 2011). From this perspective, having children allows people to immortalise their genetic and personal qualities.

The wider TMT literature supports this potential distal response, showing that mortality threat increases the desire to have children and alters reproductive behaviours in both men and women (Plusnin et al., 2018). Fritsche et al. (2007) asked German men and women to state how many children they would like to have and to complete an implicit word-matching task, which involved completing sentences with either death-related or offspring-related words. They found that men and women in a mortality threat condition wanted significantly more children and were more likely to complete sentences with offspring-related words relative to the control condition. Similarly, Zhou et al. (2008) showed that when primed with mortality threat, Chinese men and women were significantly more critical of China's One Child policy (i.e., a restriction placed on the number of children a couple can have). Finally, research by Wisman and Goldenberg (2005) showed that mortality threat in men, but not in women, significantly increased the number of children men self-reported to want. While both sexes may desire offspring following mortality threat, this effect has been shown to occur more in men and causes specific motivational outcomes (Wisman & Goldenberg, 2005; Zhao et al., 2019). This sex difference is likely owing to women acknowledging the significant burden of child-rearing, consistent with parental investment theories (Trivers, 1996; Wisman & Goldenberg, 2005). Consequently, research suggests that mortality threat alters reproductive motivations towards desiring reproduction, particularly in men.

According to TMT, this change in reproductive motivations occurs because children are viewed as a source of symbolic meaning, reducing death anxiety (Zhou et al., 2008). However, this explanation is contestable as it is unclear why humans began viewing children as a means of symbolically continuing one's lineage. An alternative explanation grounded in evolutionary theory is that death anxiety was selected as it served an adaptive purpose (Solomon et al., 1997). Given that a critical evolutionary issue for all organisms is that they manage to reproduce (Dawkins, 1976), death anxiety may serve as a functional, adaptive response that motivates them to reproduce when triggered (Fritsche et al., 2007). This change is adaptive as it would have maximised their chances of successful reproduction (Plusnin et al., 2018). Therefore, contrary to the explanations proposed under TMT, death anxiety may produce a functional, motivational response to ensure reproduction occurs and the individual successfully passes on their genetic qualities (Fritsche et al., 2007). In this regard, this self-preservation mechanism was selected as it benefits reproductive outcomes (Fritsche et al., 2007; Solomon et al., 1997). In support of this explanation, mortality threat shifts preferences in men and women towards qualities in potential mates that maximise their chances of reproductive success. This includes signals of health and fertility in men, as will be argued next (Silveira et al., 2014).

Research has shown that mortality threat is associated with producing specific mating-related behaviours. For instance, mortality threat causes increased activation in the neural regions associated with approach and mating motivations (i.e., the left anterior insula; Silveira et al., 2014). As such, mortality salience in both men and women increases brain activity associated with facilitating mating interactions. However, how these behaviours manifest following mortality threat differs by gender. Following a mortality threat, men display greater interest in romantic and sexual interactions with individuals described to be attractive using vignettes. Women only reported an increased desire for romantic interactions (Birnbaum et al., 2011). Mortality threat also causes men to prefer traits that signal health and fertility over other qualities (Zhao et al., 2019). Little et al. (2011) suggested that this shift likely occurs because traits signalling long-term mating benefits are less immediately crucial than traits signalling good genes and reproductive value when mortality is a salient concern. Silveira et al. (2014) showed that when primed for mortality threat, men, but not women, showed greater preferences for meeting opposite-gender partners with attractive faces relative to when not primed for mortality threat. These findings, taken together, suggest that mortality threat increases men's preferences for traits signalling health and fertility.

Mortality threat also appears to bias men's preferences toward the body relative to other areas. A recent study by Zhao et al. (2019) showed that men in the mortality threat condition, relative to the control condition, showed significantly greater preference for women's bodies and rated the body as a more important feature during mate selection relative to other areas, such as the face. This difference in preference even occurred in men who self-reported preferring long-term qualities, showing the strength of mortality threat in overriding men's sexual strategies and mating motivations (Buss & Schmitt, 2019). This is consistent with the notion that men emphasise physical characteristics more when navigating their selective pressures (Pettijohn & Jungeberg, 2004; Symons, 1995).

In summary, mortality threat shifts men's and women's reproductive motivations, particularly in the former (Wisman & Goldenberg, 2005). This shift in motivations may represent an evolved and adaptive process, which was selected as it was advantageous in facilitating reproduction (Plusnin et al., 2018). Specifically, mortality threat causes men to prefer attractive traits in prospective mates, particularly bodies, relative to other areas such as faces (Silveira et al., 2014; Zhao et al., 2019). However, no research has directly examined whether situational mortality threat cues influence men's body shape and size preferences regarding WHR and BMI. Given that mortality threat increases the importance of health and fertility signals and seems to shift men's preferences toward the qualities they deem to be more attractive, healthy and fertile, men primed with mortality threat should prefer 0.7 WHR and average BMI more than those not experiencing this prime.

2.6.2 The Great Pestilence: Pathogen Threat

An instinctual motivation which coincides with an organism's desire to avoid death is the importance of avoiding pathogens and diseases (Schaller, 2011). Pathogens and diseases were significant complications within the ancestral past (and continue to this day). Like other species, humans developed biological and social methods to reduce the risk associated with pathogens and diseases (Ainsworth & Maner, 2014b; Tooby & Cosmides, 1990a). Like mortality concerns, humans also have higher cognitive abilities and can avoid pathogens before encountering them (Tybur et al., 2009). Humans are postulated to have a prophylactic system called the behavioural immune system, which complements the biological immune system by encouraging pathogen avoidance (Schaller, 2011; Tybur et al., 2009). When situational pathogen cues (i.e., pathogen threat) are encountered, it is argued that people employ a range of behavioural responses and experience motivational changes (Brüne & Wilson, 2020; Tybur et al., 2009), which may also include changes to mating motivations (A. J. Lee et al., 2015; Little et al., 2011). In this section, we introduce how pathogen threat and the behavioural immune system interact to cause changes in mating motivations and behaviour. We then examine how pathogen threat may influence men's preferences for particular traits, drawing on face preferences research. Finally, we consider the potential influence of pathogen threat on WHR and BMI preferences while acknowledging past methodological limitations.

Within everyday environments, an ever-present concern and selective pressure was the presence of pathogens and diseases (Schaller, 2011). When sickness occurs, the biological immune system expends vast energy through immune responses (e.g., producing a fever). To reduce this potential expenditure, humans evolved the behavioural immune system, which aids in preventing exposure to pathogens by encouraging avoidance of stimuli (e.g., open wounds) or situations (e.g., large crowds) which are associated with increasing pathogen risk (Bressan, 2021; Brown & Sacco, 2022). Specifically, the behavioural immune system alters individual motivations and encourages approach behaviours towards stimuli deemed safe and healthy and avoidance behaviours towards stimuli deemed a potential source of pathogen threat (Schaller, 2011). These motivation changes also influence mating behaviour (Little et al., 2011). When pathogens threaten, a cost-benefit analysis is performed, which helps determine the costs of potentially mating with an individual (Gangestad & Grebe, 2014). Specifically, pathogen threat is associated with shifting a person's preferences toward identifying healthy and fertile traits in others, especially potential partners (Prokop et al., 2013).

The broader research literature addressing the influence of pathogen threat on preferences towards specific features has primarily focused on preferences for facial femininity, masculinity, and symmetry. Some research has argued that these features are cues for good genes and pathogen resistance and signal health and fertility (Zheng, 2019). However, it is also important to note that, like with WHR and BMI, the association between these facial qualities and actual, robust health and fertility outcomes is contested. For instance, Zaidi et al. (2019) demonstrated after examining a large sample of European participants that there was no evidence to suggest that male facial masculinity serves as a cue for health. Other researchers have also reported similar findings when examining facial masculinity, femininity, and symmetry (e.g., Foo et al., 2017). This is even though participants (specifically a sample of WEIRD university students) rated masculine faces as more attractive and healthy (Boothroyd et al., 2013). Thus, this shares commonalities with men's preferences toward different WHRs and BMIs; rather than being associated with actual health outcomes, preferences for certain facial characteristics may be based more on the observer's perceptions than any actual benefits. Importantly, while we present evidence below showing that pathogen presence or threat increases people's preferences for certain traits, it is likely that this preference is based on the perceived benefit of those traits (e.g., masculinity being perceived as healthier) rather than any robust, tangible benefit.

Before evaluating this research, it is important to note that there are methodological differences within the literature that assess the influence of pathogen threat on an individual's preferences for specific traits. Some studies measuring environment pathogen prevalence (i.e., context-dependent) and others priming for pathogen threat (i.e., situational threat cues). For example, Lee et al. (2013) showed that pathogen sensitivity was associated with men and women displaying a greater preference for attractive faces. Similarly, Ainsworth and Maner (2019) found that when priming men and women with pathogen threats, participants showed greater preference for symmetrical faces but only for opposite-sex faces. Other researchers have shown a similar pattern, with pathogen threat increasing preference for traits indicating good genes, such as symmetrical faces (Brown & Sacco, 2022) and lower facial fatness (C. I. Fisher et al., 2013). In addition, research has also shown a correlation between actual health outcomes and trait preferences. For example, B. C. Jones et al. (2013) showed that increased salivatory cortisol (an indicator of stress) was associated with men showing a greater preference for feminine faces. Additionally, de Barra et al. (2013) showed that illness in childhood (frequency of diarrhoea) increased people's preferences and traits in opposite-sex partners that were exaggerated in terms of their masculinity or femininity. As such, these findings illustrate that both men and women in situations where pathogen threat is high, or when it is primed for, show greater preference for traits indicating health and fertility.

However, it is important to acknowledge that other research has shown dissimilar findings. Several studies have shown no association between environmental pathogen prevalence and women's preferences for facial masculinity (Clarkson et al., 2020; Holzleitner & Perrett, 2017; A. J. Lee & Zietsch, 2015; McIntosh et al., 2017; Tybur et al., 2022). There may be several methodological reasons for these inconsistencies in findings. Studies differ in whether they measure pathogen prevalence (e.g., Lee et al., 2013) or prime directly for pathogen threat (e.g., Ainsworth & Maner, 2019). In addition, studies that employ priming methods differ in terms of what primes are used, with some relying on visual primes (e.g., Culpepper et al., 2018), while others rely on verbal primes (e.g., Watkins et al., 2012). The issue with visual primes is that they are often objectively disgusting (as designed). However, these disgusting stimuli may bias ratings for different face or body stimuli (Park et al., 2012). For example, highly disgusting primes may implicitly become associated with less attractive stimuli, decreasing their ratings. Using verbal primes is more effective as this does not occur, and having participants consider the risk of pathogens is sufficient to prime pathogen threat (Watkins et al., 2012). Furthermore, addressing the role of pathogen threat on facial masculinity, femininity, and symmetry preferences may be limited because these qualities are relatively stable across an individual's lifespan and may not change in response to immediate pathogen threats (Tybur et al., 2022). As such, there are several methodological considerations which may account for the above inconsistencies.

Despite facial features not changing substantially owing to immediate pathogen concerns, women's body shape and size vary for both previous and immediate pathogen loads (Grammer et al., 2002; A. J. Lee et al., 2015). As such, both WHR and BMI would be better indicators of immediate status, and pathogen threat may shift men’s WHR and BMI preferences. At present, only one study has explored this. Lee et al. (2015) investigated the influence of pathogen prevalence on men’s WHR and BMI preferences. They found that higher pathogen sensitivity was associated with significantly greater preferences toward lower WHR and lower BMI (albeit this was not significant). We could speculate that the lack of significant effect of pathogen threat on BMI preferences was because the stimuli only varied BMI within the average range, which has good health and fertility qualities regardless (Sugiyama, 2015). Future explorations of this may find a similar effect on BMI when using a more expansive range of BMI categories. However, these findings suggest that, like faces, there may be a shift in men’s WHR and BMI preferences following pathogen threat towards preferring attractive (i.e., healthier and more fertile) body types.

In summary, research has shown that pathogen threat and the behavioural immune system activate mating motivations, which aim to improve contact with attractive mates (and, by extension, reduce contact with less attractive ones). Specifically, pathogen threat appears to shift men’s mating motivations and increase their preference for traits in opposite-sex partners, which they perceive to signal health and fertility. Currently, most research has focused solely on preferences for different facial features, with only one study investigating WHR and BMI preferences. Additionally, no research has addressed the role of situational pathogen cues on men’s WHR and BMI preferences. Given that pathogen threat increases the importance of health and fertility signals to avoid the risk of pathogens, men primed with pathogen threat should show a greater preference for 0.7 WHR and average BMI relative to those not experiencing this prime. Additionally, as the behavioural immune system aims to promote avoidance of individuals with poor health and fertility primarily, pathogen threat would also be expected to decrease preferences for the bodies that men view as least healthy and fertile (this issue of direction is considered fully in Chapter 3).

2.6.3 Real Men Are Made, Not Born: Masculinity Threat

So far, situational threat cues activating adaptive motivations for ensuring reproduction and avoiding pathogens have been examined. However, it remains important to examine broader sociocultural cues. A prominent sociocultural factor affecting men is how much they adhere to traditional masculine gender norms (Fowler & Geers, 2017). Masculinity is a social construct which defines the gender norms, activities, and expectations associated with men (Vandello et al., 2008). Men experience a strong push towards exhibiting typically masculine traits, and men are socialised from a young age to adhere to traditional gender norms across various cultures (Cohn et al., 2010; Saucier et al., 2018). However, acquiring the status of being a man and being masculine is difficult and can be easily lost (Braly et al., 2018). This process of men feeling their masculinity is being questioned is termed masculinity threat. It has been shown to cause men to use compensatory behaviours and motivations to repair their threatened status (Glick et al., 2007). In this section, we examine the nature and importance of masculinity, and the already-established claims that variations in gender norm adherence influence WHR and BMI preferences at a cultural level are recapped and expanded. We will then present evidence that masculinity is easily threatened, and masculinity threat at an individual level may influence men's WHR and BMI preferences.

Men across different cultures generally strive to be defined as masculine (Vandello et al., 2008). While there has been some evolution in terms of what activities, traits and behaviours define a typical man, the importance of masculinity has remained constant (Vandello & Bosson, 2013). This importance is illustrated by men in the modern day competing intra-sexually to be viewed as more manly (Winegard et al., 2014). This may explain why men are generally shown to have stricter gender norms and prescribe more rigidly to traditional masculine behaviours than women (Harrison & Michelson, 2019).

The nature of masculinity for men is that it is both difficult to attain (elusive) and easy to lose (tenuous), an argument encapsulated under the framework of the precarious manhood hypothesis (Vandello et al., 2008). To be defined as masculine, men must outwardly display typically masculine activities to prove they meet the societal masculine standard (Cheryan et al., 2015). In certain cultures, this involves men proving themselves by undergoing a social test (e.g., withstanding the sting of poisonous insects), while in WEIRD cultures, men still aim to prove their masculinity, but they do so by publicly completing masculine behaviours (e.g., dominance and risk-taking; Parent & Cooper, 2020; Vandello & Bosson, 2013). Consequently, to prove their masculinity and maintain their status as men, men must frequently endorse traditional masculine gender norms (Konopka et al., 2019). In this light, "*real men are made, not born*" (Vandello et al., 2008, p. 1326). Masculinity contrasts femininity and womanhood in which women do not need to pass certain social proofs to be defined as feminine. Instead, femininity is primarily evidenced by physical indications during puberty (e.g., breast development) and life stage changes during motherhood (Bosson et al., 2021).

As a consequence of being elusive, masculinity is also tenuous and easily threatened (Vandello & Bosson, 2013). For example, providing men with personality feedback which suggests they are more feminine than masculine is sufficient to threaten their masculinity (Harrison & Michelson, 2019). Men view masculinity as a binary outcome, either being present or not (Vandello & Bosson, 2013). When men feel threatened, they respond with compensatory behaviours to reaffirm their masculine identity, encapsulated by the overcompensation hypothesis (Scaptura & Boyle, 2020). As the overcompensation hypothesis explains, these compensatory behaviours typically represent men acting in traditionally masculine ways and adhering to traditional masculine gender norms, but to a more extreme degree (Willer et al., 2013). For example, following masculinity threats, men are more likely to administer painful shocks to express their toughness (Fowler & Geers, 2017) and drive recklessly (Braly et al., 2018). Men also overcompensate by expressing a systematic antifemininity bias following masculinity threat. This robustly identified compensatory outcome involves a general opposition to anything deemed feminine (Hunt et al., 2016; Willer et al., 2013). For instance, men are even less likely to learn a second language following a threat to masculinity, as language learning is considered feminine (Chaffee et al., 2020).

In particular, men who experience a masculinity threat also display poorer attitudes toward social groups that deviate from traditional gender norms, such as sexual minoritised men who are perceived to be feminine (Glick et al., 2007; Hunt et al., 2016). One societal group that experiences greater societal pressures are the trans and gender-diverse community (TGD). TGD is an umbrella term referring to anyone who has a gender identity that is incongruent with their sex assigned at birth (McDermott et al., 2018). As TGD people are seen to reject traditional gender norms and ideals, attitudes toward TGD people generally decrease following a masculinity threat. Men in the United States (Harrison & Michelson, 2019), Poland (Konopka et al., 2019) and Italy (Salvati et al., 2021) have been shown to express generally poorer attitudes toward TGD people following a masculinity threat prime. To allow us to explore our masculinity threat prime further, we introduce a study assessing how masculinity threat in a UK population influences men's attitudes toward TGD people in Chapter 6.

Accordingly, the key compensatory response to masculinity threat is an increased adherence to traditional masculine gender norms. The precarious masculinity hypothesis allows us to postulate several reasons why masculinity threat cues may alter men's mating motivations and their preferences for specific body types. First, traditional masculinity is associated with hegemonic ideals, the belief that men are superior to women (Smith et al., 2015; Wassersug & Hamilton, 2018). Greater adherence to traditionally masculine gender norms is associated with greater expression of these ideals either implicitly (e.g., rejecting moves towards equality) or explicitly (e.g., sexual harassment), or both (Alonso, 2018; O'Connor et al., 2017). This trend towards promoting hegemonic masculinity interacts with men's preference for women's body types that are traditionally feminine (i.e., hourglass figures with slim body sizes) because greater deviation from the traditional body ideal is associated with women expressing greater personal and body autonomy. This autonomy directly contradicts traditional masculine gender norms (Kosakowska-Berezecka & Besta, 2018; Swami, Antonakopoulos, et al., 2006). Drawing on the precarious manhood hypothesis, men showing a preference for women's *traditional* body types following a masculinity threat would serve as a way of adhering to their gender norms by promoting the traditional power imbalance between men and women.

Second, and closely related, increased adherence to traditional gender norms is also associated with greater objectification, which reduces a woman's body to a sexual object (Dahl et al., 2015). This objectification removes the individuality associated with women, and men are shown to use this to project traditional power and dominance over women (Bareket & Shnabel, 2020; Gervais et al., 2012). This objectification occurs toward all women but occurs more frequently toward women who possess an attractive body type by ideal societal standards (Riemer et al., 2018). This heightened attention toward attractive bodies may explain the findings above. Men encouraged to adhere to traditional gender norms may be more likely to objectify and prefer traditionally attractive women's bodies (Bareket & Shnabel, 2020). As such, there has been a focus on the broader research literature on sociocultural gender norms rather than gender norms and role adherence at an individual level. Finally, greater adherence to traditional masculine gender norms is associated with men adopting an unrestricted mating motivation. As established above, men expressing an unrestricted mating motivation show greater preferences for having a large number of sexual partners and a marked increase in the importance of identifying attractive body types (Buss & Schmitt, 2019; Seabrook et al., 2018). This greater reported desire for sexual contact with attractive partners may be owing to the status attached to this activity. Under the overcompensation hypothesis, this likely serves as a means of compensating (and expressing) men's masculinity (Sweeney, 2014).

As such, adherence to masculine gender norms is associated with showing greater preferences for traditional (i.e., 0.7 WHR and average BMI) body types (Furnham & Nordling, 1998; Kosakowska-Berezecka & Besta, 2018; Swami, Antonakopoulos, et al., 2006). However, the current research literature has focused on the role of persistent socio-cultural differences in gender norms rather than the possible influence of situational threat cues which trigger gender norms pressures (i.e., masculinity threat) at the individual level. No research to date has addressed the influence of masculinity threat on men's WHR and BMI preferences. Despite this, masculinity threat has been robustly shown to increase adherence to masculine gender norms. This adherence to masculine norms is associated with the above shift in WHR and BMI preferences; there is strong reason to believe that situational threat cues which trigger masculinity threat may alter men's preferences for specific WHRs and BMIs (Hunt et al., 2016; Swami, Antonakopoulos, et al., 2006; Willer et al., 2013). Given this, we should see men primed with masculinity threat expressing greater preferences for the bodies they generally perceive to be most attractive: 0.7 WHR and average BMI. Unlike mortality and pathogen threat, which activate men's selective pressures for specific signals directly, masculinity threat may activate these by promoting socialised gender norms that men are encouraged to adhere to from a young age. This illustrates the dynamic interaction between evolutionary mechanisms and sociocultural situational threat cues (Swami, Antonakopoulos, et al., 2006).

2.6.4 Summary

In summary, mortality and pathogen threat are associated with making men's selective pressures a salient concern and altering their mating motivations. A logical hypothesis that follows is that men exposed to mortality and pathogen threat cues should experience changes in their mating motivations to facilitate reproduction and avoid pathogens, respectively. Masculinity threat differs in that this situational cue could cause men to view acting in traditional, gender-typical ways as a means of overcoming their threatened status, which should alter their mating motivations and shift their preferences to more attractive bodies. It is important to acknowledge that masculinity threat may produce a less significant shift in preferences relative to either pathogen or mortality threat, owing to the latter two likely activating an adaptive response associated with stronger motivational changes. Despite the different motivators underpinning each situational cue, the outcome should be the same: a shift in men's WHR and BMI preferences towards (and by extension away from the least) the bodies men perceive to be the most attractive WHRs (i.e., 0.7 WHR) and BMI (i.e., average BMI), relative to the preferences held by men in the general population. The hypotheses we presented throughout the subsequent chapters follow from this logic.

2.7 Thesis Rationale and Aims

Considering the above, there are limitations with the broader research literature examining men's body shape (i.e., WHR) and size (i.e., BMI) preferences. Given that ancestrally, men are hypothesised to have experienced a selective pressure to identify mates with traits that signal health and fertility, most research has attempted to establish the existence of stable WHR and BMI preferences consistent with which body shapes and sizes signal the most optimal health and fertility (Dixson et al., 2011b; Furnham et al., 2006; Holliday et al., 2011; Lassek & Gaulin, 2018; Platek & Singh, 2010; Singh, 1993a; Sugiyama, 2015). However, given that contemporary men experience different environments, the importance of certain signals and men's WHR and BMI preferences may be contingent on external cues (Al-Shawaf et al., 2019; Dixson, 2022; Goetz et al., 2019; Lewis & Buss, 2022). A small but substantial body of research has shown that preferences for specific traits vary due to external cues. However, the research that examined the context-dependent model of mate selection primarily examined environmental factors that are relatively persistent and long-term (e.g., societal resource access). Comparatively, research has paid limited attention to the influence of immediate situational threat cues imposed at the individual level (Ainsworth & Maner, 2014a; Maner et al., 2007).

Section 2.6 evaluated the three situational threat cues we will examine in this thesis: mortality, pathogens, and masculinity threats. We focus on these three situational threat cues, representing immediate psychological and environmental threat cues, because they likely influence men's preferences. These cues were also chosen because they represent situational encounters that men may be exposed to daily. For instance, men may routinely encounter mortality (e.g., stop smoking adverts), pathogen (e.g., COVID-19 transmission statistics) and masculinity threats (e.g., seeing another man lift heavier weights in the gym) daily. Should these regularly encountered situational threat cues influence men's WHR and BMI preferences, this would have widespread implications. We expect each situational threat cue to influence men's WHR and BMI preferences by increasing the importance of health and fertility signals and shifting preferences toward the bodies they perceive to be more attractive (i.e., healthier and more fertile) WHRs and BMIs. This should shift men's preferences towards (and by extension away from the least) the bodies they perceive to be attractive WHRs (0.7 WHR) and BMI (average BMI) relative to the preferences held by men in the general population. While this list of situational threat cues is by no means exhaustive, by evaluating the influence of mortality, pathogen and masculinity threat, an expanded context-dependent approach to mate selection which addresses the influence of situational threat cues can be explored.

As such, the primary aim of this thesis will be to examine the influence of situational threat cues on men's WHR and BMI preferences by priming men with each of the above situational threat cues (i.e., mortality, pathogen, and masculinity threat) and examining their preferences towards different WHRs and BMIs. The exact nature of priming as a methodological approach is examined in greater detail in Chapter 3. This thesis will contribute to the broader research base in two ways. This thesis will be the first body of work to explicitly evaluate the influence of situational threat cues on men's WHR and BMI preferences and evaluate an expanded context-dependent approach to mate selection. It will also be the first attempt at independently evaluating the influence of mortality, pathogen, and masculinity threat on men's WHR and BMI preference. We will also explore the effect of masculinity threat further in Chapter 6, given the relative recency of this field. Specifically, we will examine whether threatening masculinity (or femininity) in a sample of UK men (and women) will affect their attitudes toward TGD people. This will allow us to further add to the extant research literature concerning masculinity threat.

In addition to the primary aim of this thesis, it is also important to resolve some of the methodological limitations present in previous research. These limitations and the solutions proposed to reduce them are explored in more detail in Chapter 3. In brief, previous research has predominantly relied on using line-drawn stimuli or stimuli with fundamental limitations for various reasons (Kościński, 2013). To overcome this limitation, this thesis also aims to create and validate a set of stimuli varying in WHR and BMI. Additionally, research examining men's WHR and BMI preferences has relied on self-report paradigms, such as attractiveness-rating paradigms, which have numerous limitations (Dixson et al., 2011b). Research has begun to employ eye-tracking methods to overcome these limitations, but these studies also have several methodological drawbacks (e.g., Garza et al., 2016). Therefore, another aim of this thesis is to incorporate an eye-tracking paradigm (see Chapter 3), which rectifies some of these limitations and allows us to more conclusively explore the influence of situational threat cues on men's WHR and BMI preferences.

Including an eye-tracking paradigm also allows us to overcome additional limitations with previous research. Most previous research has explored men's preferences toward faces or bodies, but only limited research has explored what specific areas of the body men prefer. Furthermore, no research has explored whether men's preferences for specific areas of the body are altered by whether men are exposed to situational cues. Previous research has implicated certain body areas, such as the waist and hips, as important when judging a potential partner's attractiveness and quality (Suschinsky et al., 2007). As such, we would expect that each of our situational threat cues would increase men's preferences toward those areas. We provide more information on how we aim to explore men's preferences toward specific areas in the next chapter and Chapter 7.

3. CHAPTER 3: METHODOLOGICAL AND STATISTICAL CONSIDERATIONS

This chapter provides an overview of this thesis's methodological and statistical considerations. Each subsequent chapter details the exact methodological and statistical approaches used. To begin, we consider the current limitations of WHR and BMI research and how we will resolve these issues. Next, we establish each experiment's overarching methodological and statistical approaches.

3.1 Resolving Existing Methodological Limitations

As outlined in Chapter 2, the primary rationale for this thesis is to investigate the influence of situation threat cues on men's body shape (i.e., WHR) and body size (i.e., BMI) preferences. In addition to this primary aim, it is crucial to consider some of the critical methodological limitations concerning existing WHR and BMI research and how we aim to rectify those limitations. Specifically, issues with existing stimuli, how preferences are conceptualised and tested, and the dependency on self-report paradigms. This section examines those limitations and presents how they will be addressed in this thesis.

3.1.1 Stimuli

As illustrated in Chapter 2, there is plentiful research concerning men's WHR and BMI preferences without acknowledging contextual and situational threat cues. However, there are limitations across this research base regarding the WHR and BMI stimuli used. Due to a lack of openly available and validated sets of stimuli varying in WHR and BMI, there are currently inconsistencies between studies. Without consistency in stimuli, this presents issues when comparing studies and their findings (Kościński, 2013; Swami & Tovée, 2013). This sub-section discusses these limitations with existing WHR and BMI stimuli and presents a case for why a new, open-source database of 3D-modelled stimuli varying in WHR and BMI is needed. This forms the basis for Chapter 4, where we create a new set of body stimuli varying in WHR and BMI.

3.1.1.1 Inter-study Variability

A critical limitation of previous research is the general lack of inter-study consistency in the types of stimuli used. For example, previous research has used various stimuli, ranging from line drawings (Furnham et al., 2005) to actual images of women (Dixson et al., 2011a) and computerised images (Swami et al., 2008). In addition, there needs to be more consistency regarding the range of WHR and BMI categories used by previous research. Some research has employed as few as two WHR categories, whereas others have used a more varied range (Dixson et al., 2011b; Furnham et al., 2005). While WHRs below 0.7 are challenging to obtain without surgery and are largely uncommon, it is important to include a WHR lower than 0.7 (Swami, Antonakopoulos, et al., 2006). Including an extremely low WHR will allow us to determine where men's preferences for different WHRs peak.

Likewise, research has used a restricted number of BMI categories, combined multiple or used the complete five BMI categories (Furnham et al., 2005; Swami, Miller, et al., 2008; Weir & Jan, 2022). Arguably, research should use as many WHR and BMI categories as possible to create stimuli that capture the possible variation in women's bodies, and that might more closely represent the ecological validity of body shapes potentially observed and evaluated by men regularly. Similarly, previous research has typically varied bodies along one dimension (WHR or BMI), but women's body compositions may involve different, potentially contrasting WHRs and BMIs (Furnham et al., 2005, 2006). As such, there are two primary cross-research limitations: a lack of consistency in the stimuli and a limited range of body types expressed within the stimuli (Kościński, 2013).

3.1.1.2 Limitations with Different Stimuli

Previous research has often relied on using line-drawn stimuli, which involves varying WHR and BMI by altering the weight of the lines (Furnham et al., 2005; Zelazniewicz & Pawlowski, 2011a). The first research to investigate WHR and BMI preferences used line-drawn stimuli (Furnham et al., 2005; Singh, 1993a). However, these methods have been called unreliable and invalid (Sorokowski et al., 2014). Generally, they lack realism and omit key details in actual photographs or computer-generated stimuli, such as skin tone (Kościński, 2013; A. J. Lee et al., 2015; Moussally et al., 2017; Tovée et al., 1999). They also confound WHR and BMI (Furnham et al., 2005).

More recent research has transitioned towards using actual photographs of women (Del Zotto et al., 2018; Dixson et al., 2011a; Pazhoohi et al., 2020). Using images of real women increases how realistic and representative the stimuli are (Tovée et al., 1999). However, to produce variations in WHR and BMI, these images are either altered in photo-editing software or involve sampling from a large number of different women (Dixson, 2022; Dixson et al., 2011a; Garza et al., 2016; Moussally et al., 2017). Altering the images can cause them to appear distorted and unnatural, as the remainder of the body remains the same. Similarly, using images of different women, even if matched for BMI and WHR, may be confounded by different morphological features (e.g., skin blemishes and loose skin; Moussally et al., 2017).

Computerised stimuli overcome many of these issues, as they are purposefully created to appear naturalistic. However, research that has used these stimuli has opted to present them as either black and white (Del Zotto et al., 2018; Dixson et al., 2011a) or as bodies with the head, arms and lower body removed (Pazhoohi et al., 2020; Swami, Salem, et al., 2008). Studies that omit colour and body parts do so to remove features that may capture attention away from the body (Moussally et al., 2017). However, removing these features compromises the ecological validity of the stimuli, similar to what happens when using line-drawn stimuli (Sorokowski et al., 2014). Full-body stimuli would increase ecological validity, as headless torsos are rarely encountered outside the context of horror films. More importantly, given that mating decisions are made when observing the whole body, using body stimuli that omit these features comprises the ecological validity of these judgements. Not including full-body stimuli also presents a specific problem when evaluating preferences toward different BMIs. As BMI is an estimate of the body's overall size rather than any specific bodily area (Weir & Jan, 2022), removing body parts may impair an individual's ability to accurately estimate a body's BMI. While BMI is primarily determined by examining the stomach and midriff (Cornelissen, Hancock, et al., 2009), having full-body stimuli would enhance the accuracy and validity of BMI judgements.

However, previous computerised stimuli also have limitations because of how WHR and BMI are estimated. Typically, researchers create computerised stimuli in a 2D space (Kościński, 2013; Rilling et al., 2009). Modelling within 2D spaces causes issues when attempting to estimate WHR and BMI. For example, measuring WHR in 2D stimuli involves using point-to-point distance measurements across the waist and hips. However, WHR should be measured using waist and hip circumference rather than distance, as only the former correlates with fertility outcomes (Rilling et al., 2009). As such, this method is arguably less accurate, and an exact, stable ratio is required. Furthermore, BMI in 2D stimuli is measured using a perimeter-area ratio (Moscone et al., 2017). While this ratio correlates with actual BMI values (Tovée et al., 1999), it is less accurate and exact; weight calculations should be used to estimate BMI (Moscone et al., 2017).

These limitations can be resolved by using 3D-modelled stimuli. First, unlike actual images of women, 3D models can vary WHR and BMI independently, reducing the potential for one to appear unrealistic due to alterations of the other (K. K. Cornelissen et al., 2017; Kościński, 2013). Second, this independent manipulation also means that WHR and BMI measurements can be calculated precisely. As 3D models exist in a 3D space, volumetric measurements can be calculated, which can be used to estimate weight, and combined with height, this allows for an exact calculation of BMI (Mutale et al., 2016; Rilling et al., 2009). Similarly, calculating the waist and hip circumference produces an exact, accurate WHR value. Importantly, these benefits would remain even if the intention was to present the final stimuli as a 2D static image (because the benefits of 3D modelling occur when they are being created).

3.1.1.3 Creating New WHR and BMI Stimuli

The current research base has limitations with the stimuli they use. Previous researchers' decisions to use egregious stimuli are likely due to the lack of validated stimuli and the time-consuming nature of stimuli creation. This is especially the case for 3D-modelled stimuli, which require knowledge of specialist programs to create the body stimuli and powerful computational hardware to facilitate this. One objective of this thesis is to create, validate, and make freely available a flexible set of 3D-modelled stimuli varying in WHR and

BMI. We will use clothed stimuli, given that naked bodies elicit unique emotional responses and that first encounters with bodies (where preference judgements occur) predominantly happen when the opposing party is clothed (Hall et al., 2011; Most et al., 2007). Despite this, both clothed and naked stimuli will be created and validated to allow future researchers to draw upon a broader array of potential body types. The stimuli will be full-bodied, colourised, and created using 3D modelling software. As WHR and BMI preferences vary due to ethnicity (Sorokowski et al., 2014; Wetsman & Marlowe, 1999), we opted only to create White body types. However, we acknowledge the lack of research concerning men's WHR and BMI preferences amongst non-White populations and using non-White stimulus sets. We reflect on this issue more in the general discussion (Chapter 8). As such, our stimuli will have standardised White skin tones, faces, hair and height (Moussally et al., 2017).

Additionally, using 3D modelling software will rectify some of the fundamental limitations of previous research. Adipose distribution will be varied systematically across the body. This systematic distribution produces variations in WHRs and BMIs, correlating with actual women's WHR and BMI variations (K. K. Cornelissen et al., 2017; Saxton et al., 2020). This will also mean the stimuli will have precise WHR and BMI estimations, measured using circumference and volumetric assessments, respectively. Like previous studies (e.g., Swami et al., 2008), five WHR (0.6-1.0) and five BMI (emaciated, underweight, normal, overweight, and obese) will be used. This increased range will allow the stimuli to represent a broader array of body types and capture the idiosyncrasies in men's WHR and BMI preferences. The creation of these stimuli is the first objective of this thesis. Chapter 4 (Stimuli Creation, Validation, and Selection) details the aims, stimuli creation, and validation procedures.

3.1.2 Conceptualising Preferences: Approach Fit and Avoid Unfit

There are also limitations to how previous research conceptualised preferences toward specific traits. Previous research has relied on measuring preferences towards a particular WHR and BMI in terms of which is most attractive. This reflects testing an *approach fit* preference (Park et al., 2012). However, very little research has examined how preferences may shift away from specific WHRs and BMIs in terms of which is the least attractive. This shift away, termed an *avoid unfit* preference, would represent men showing less preference for a specific WHR and BMI (Park et al., 2012; Thornhill & Fincher, 2014). This avoid unfit preference is rarely explicitly explored within the research literature. Exploring this direction would provide a more complete understanding as men's mating motivations may be equally guided by a desire to identify suitable mates and avoid mates deemed unsuitable (Grammer et al., 2002; Park et al., 2012). For instance, Singh (1993a) suggested that WHR is a broad first-pass filter that helps men identify signals of poor health and fertility and facilitates avoidance of these indicators.

Importantly, situational threat cues may influence both the approach and avoid direction of preferences (Park et al., 2012). For example, it is reasonable that the avoid unfit shift in preferences would be most substantial for pathogen threat, given that the behavioural immune system has a primary behavioural output of encouraging avoidance of pathogenic stimuli (Little et al., 2011; Schaller, 2011). This means that WHRs and BMIs that signal the worst health and fertility outcomes will likely be avoided when men are primed with pathogen threat (Jaeger et al., 2018; Thornhill & Fincher, 2014). This effect would also be expected with mortality threat, as men are primed to seek good health and fertility. This may also manifest in a preference for avoiding bodies that signal poor reproductive outcomes (Zhao et al., 2019; Zhou et al., 2008).

In contrast, it could be speculated that masculinity threat would see less or no effect towards avoiding unfit mates. The primary motivational feature is encouraging approach behaviours towards attractive mates, with little benefit in actively avoiding unfit features. This difference emphasises the dynamic directional differences each situational cue may produce due to the cost-benefit assessment. Pursuing a particular mating motivation may increase approach preferences, avoid preferences, or both, to varying degrees. This dynamic interplay underlines the need to consider both the approach and avoid directions when examining men's WHR and BMI preferences. We explicitly examine both the approach and avoid unfit directions in Chapter 5 (Self-Report Preferences Under Situational Threats Cues).

3.1.3 Self-Report, Eye Tracking and Dot-Probe Paradigms

The last methodological limitation is relying on self-report attractiveness paradigms within the broader research literature (Dixson et al., 2011b). While research has aimed to resolve these issues by using alternative preference measures, such as eye-tracking, that research also has limitations. This section outlines the limitations of both self-report and existing eye-tracking research. We then introduce the dot-probe paradigm and suggest that creating a combined dot-probe eye-tracking paradigm will allow us to resolve some existing limitations with the research base and collect a broader array of measurements relating to men's preferences.

3.1.3.1 Limitations with Self-Report Attractiveness Paradigms

Previous research has relied on self-report attractiveness paradigms to measure men's WHR and BMI preferences. This trend is present across various subfields that address preferences for faces, voices, and body types (Roberts & Little, 2008). Typically, when assessing preferences for different WHRs and BMIs, different stimuli are presented either independently or in comparison, and participants rate the attractiveness of the stimuli (Swami, Miller, et al., 2008). In this way, attractiveness ratings serve as a proxy for preference (e.g., Lee et al., 2015). Despite their prevalence, self-report paradigms generally have several limitations when used to address men's WHR and BMI preferences.

First, the self-report paradigms are hindered by response biasing (Hofmann et al., 2005). Participants may give socially desirable answers when rating the attractiveness of a prospective partner. For example, participants may be less likely to use the lower range of the attractiveness scale (i.e., very unattractive; Bareket et al., 2019). Individuals are less likely to provide honest answers when the topic is controversial (Dovidio & Fazio, 1992); stating someone is explicitly unattractive is deemed socially unacceptable in a Western context[5]. Second, attractiveness ratings given toward static stimuli may not translate into actual preferences and behavioural intentions (Baumeister et al., 2007). For instance, while a body may be preferred based on attractiveness ratings, the behavioural intentions (i.e., actual courtship) may differ. Finally, attractiveness ratings provide only a snapshot of the outcome of the evaluative process rather than the processes leading to this preference (Saxton et al., 2020).

[5] We present anecdotal evidence to support this claim in Chapter 7.

Self-report paradigms continue to provide informative insights into men's WHR and BMI preferences, but exploring alternative approaches is necessary. The following section introduces how eye-tracking methodologies allow us to collect a broader array of measurements.

3.1.3.2 Eye Tracking (Visual Interest and Attention)

Owing to limitations with self-report paradigms, research addressing men's WHR and BMI preferences has begun using alternative approaches, such as eye tracking. This research has generally shown that areas of the body that are important when evaluating the potential of a future partner receive greater visual attention (see below) relative to other areas of the body (Gervais et al., 2013; Hall et al., 2011). For instance, P. L. Cornelissen et al. (2009) showed that when men viewed bodies and rated their attractiveness, they focused more on the midriff and abdomen, which are important when evaluating WHR and BMI. Before reviewing existing eye-tracking research in this area, it is important to provide a primer on the visual and attentional system and define the terminology used.

Visual and Attentional System. The human visual system broadly consists of a complex network of rods (low-light and peripheral vision), cones (colour vision) and other light-sensitive cells across the retina. The fovea, a small, specialised region in the retina's centre, is responsible for high-acuity vision and sending information from the cones and rods to the optic nerve (Eysenck & Keane, 2020). This network carries information about our visual environment to the visual cortex, allowing humans to interact effectively with their surroundings (van der Heijden, 2004). Examining the various intricacies and specialisms of the visual system is outside the scope of this thesis. However, the visual system allows humans to resolve complex problems, such as mating decisions.

Because of the physical properties of the visual system, visual attention is a key vital process for humans to interact with their environment effectively. Visual attention represents what aspects of the visual field a person directs most of their resources toward and consists of either *overt* or *covert* attention (Styles, 2005). Overt attention refers to when an individual purposefully (*endogenous* attention) or, in response to a sudden change in the environment (attentional capture or *exogenous* attention), moves their fovea (around one visual degree in size) to look at a specific aspect of the visual field (Eysenck & Keane, 2020) to acquire fine details about a particular location in the world. When individuals move their fovea, this process is known as a saccade. The end of each saccade, when the eyes are relatively stable, is referred to as a fixation. During fixations, high-quality visual information is extracted and encoded (Styles, 2005). Typically, these fixation events are used in eye-tracking research to indicate a person's interest in a specific feature of the visual field (Mahanama et al., 2022).

However, while a person may be looking toward a particular feature in the visual field, this does not guarantee that they are attending to this area. Attention is a limited resource, meaning people are selective in where and at what they direct their attention toward. Attentional allocation can also occur to features within the visual field without a person orientating their eyes toward that feature. This process is known as *covert attention,* which is much faster than the overt attentional system (Styles, 2005). For instance, human peripheral vision is a powerful tool that allows individuals to covertly attend to and interpret visual field features when not overtly attending to them. While humans cannot make high-acuity judgements about objects in their peripheral vision, they can encode information and often extrapolate what an object is (Schall & Romano Bergstrom, 2014). Posner (1980) theorised that visual attention acts like a spotlight, whereby objects in the centre of the spotlight (where the fovea is focused) are apparent, whereas objects surrounding this spotlight (peripheral vision) are less transparent but still interpretable covertly. Covert attention indicates a preference within the attentional system for an object within a person's peripheral vision (Schall & Romano Bergstrom, 2014; Styles, 2005). This feature of attention is important for experimental paradigms that aim to identify an attentional bias (see below).

Eye Tracking Research. Current eye-tracking research examining men's WHR and BMI preferences has measured men's overt attention. Typically, researchers use fixation events to indicate what aspect of the visual field a person is most interested in. For instance, a higher overall fixation count toward a particular stimulus indicates that a participant is more interested (Mahanama et al., 2022). Several other fixation-based measures are used in eye-tracking research, which we define in Table 3.1. We only define those measures that we will use in this thesis. Existing research examining men's preferences using eye-tracking methods has predominantly examined preferences toward different WHRs (and breast size). Here, we briefly overview existing eye-tracking research examining men's body shape preferences. We also outline the limitations of this existing research and how we aim to address these limitations.

Most research examining men's body shape and size preferences using an eye-tracking paradigm has used either a free-exploration or attractiveness rating paradigm or both (Wenzlaff et al., 2016). A free-viewing paradigm typically involves asking participants to view the stimuli as they wish without providing instructions (Hall et al., 2014). An eye-tracking attractiveness-rating paradigm involves participants viewing a stimulus (or two) and providing either an attractiveness rating or indicating via forced response which of the two stimuli is more attractive (Garza et al., 2016; Suschinsky et al., 2007). In this way, participants view the stimuli as if they were judging the person's attractiveness and eye movements are interpreted as indicating where people look when judging a body's attractiveness.

Research using free-viewing paradigms has largely examined men's preferences toward specific body areas rather than body shapes or sizes. Lykins et al. (2006) showed that men had a higher fixation count toward the chest and waist-to-hip regions of the body when the stimuli were nude relative to clothed. Hall et al. (2014) also showed that men had a higher fixation count and longer dwell times toward the chest and the waist and hip region when viewing women of their preferred age for a sexual partner.

Suschinsky and colleagues (2007) presented participants with stimuli with an average WHR of 0.71, 0.75 or 0.78 using an attractiveness-rating paradigm. They asked them to select which of the two stimuli presented on the screen was the most attractive. They found that participants fixated more often and spent longer looking (i.e., higher dwell time) on the chest, waist, and hip areas of the body. They suggested these areas are important when evaluating a partner's attractiveness as they represent the *reproductively relevant areas.* This preference for the reproductively relevant areas was stronger when the body had a lower (i.e., 0.71) WHR.

Other research using an attractiveness rating paradigm has evidenced similar findings. Dixon et al. (2011b) showed that men rated 0.7 WHR as the most attractive but had higher fixation counts and dwell times toward the upper body, irrespective of WHR. They also found that the breast area of interest received the highest fixation count. Garza et al. (2016) reported findings similar to those of Dixson and colleagues but also captured additional measurements. For instance, they showed that men had a higher revisit count toward the upper body areas when viewing a 0.7 WHR relative to a higher (i.e., 0.8 or 0.9 WHR).

Capturing similar indicators of overt attention and visual interest would allow us to more thoroughly explore the potential influence of each situational threat cue on men's WHR and BMI preferences or men's preferences toward specific bodily areas. Existing research has demonstrated that individual differences in viewing behaviour and visual interest depend on what information is situationally relevant (Wenzlaff et al., 2016). For instance, priming men with mortality, masculinity, or pathogen threat cues would likely increase their preference for more attractive stimuli (i.e., bodies with 0.7 WHR and average BMI) and toward the areas of the body that are reproductively relevant, such as the waist (Suschinsky et al., 2007). For example, Hall et al. (2014) showed that men who scored higher on sexual compulsivity or desired a high number of sexual partners fixated more on the waist-to-hip region than men expressing a restricted sexual strategy. This emphasises how the waist-to-hip area is important when men are making mating-relevant decisions.

As such, by using an eye-tracking approach, we can gather a broader array of measurements. To summarise, using an eye-tracking attractiveness rating paradigm, we can capture the final evaluative outcome (i.e., the rating given) and where and for how long participants gazed while making this judgement and whether this varies when men are primed with each of our three situational threat cues.

Table 3. 1

Definitions for the Eye Tracking Measures Used in this Thesis and Previous Research.

Measure	Definition
Fixation Count	*Fixation count* refers to the number of times a person looks at a specific stimulus or area of interest. The more fixation events that occur, the higher the overall fixation count. A higher fixation count indicates a person's level of interest and preference towards a particular stimulus or area of interest.
Dwell Time	*Dwell time* refers to a person's time looking at a specific stimulus or area of interest. Dwell time is calculated by summing the duration of all fixation events. A higher total or average dwell time indicates a person is more interested in and prefers a particular stimulus or area of interest. Usually, complex or task-relevant areas of interest with many features receive a higher dwell time.
Revisit Count	*Revisit count* refers to the number of times a person departs from a specific area stimulus or area of interest and then returns to look at it again. For instance, if a participant looks toward the head, the chest, and back to the head, this will be classified as a revisit toward the head. A higher revisit count indicates that a person is more interested in a particular stimulus or area of interest.
First Fixation Count	The *first fixation count* refers to the number of times a person looks at a specific stimulus or area of interest as their first fixation. The more first fixation events occur, the higher the overall first fixation count. A higher first fixation count indicates a person is more interested towards a particular stimulus or area of interest. Specifically, it refers to an initial preference and may indicate some attentional bias towards a particular location.
First Saccade Latency	The *first saccade latency* is used in specific paradigms (e.g., dot-probe paradigm) that measure a preference within the early attentional system. The first saccade latency refers to the time between stimulus onset and the start of the first saccade. A shorter first saccade latency indicates that participants began looking at the stimulus faster after it appeared. A shorter first saccade latency would indicate that participants' covert attention was directed toward that stimulus, facilitating a faster time between stimulus onset and their eye movement toward that stimulus (i.e., an attentional bias).

Notes. We used various sources to inform the definitions presented in this Table (see Garza et al., 2016; Mahanama et al., 2022; Skinner et al., 2018; Trabulsi et al., 2021). We use each of these measures in Chapter 7. We summarise our outcome measures in Section 3.2.1.1.

Limitations with Existing Eye Tracking Research. However, while eye-tracking methods allow us to capture more information about men's preferences, there are limitations with both free-viewing and attractiveness rating paradigms. Despite the belief that free-viewing paradigms are more representative of an individual's natural viewing behaviour (Hall et al., 2014), it is often unclear whether different participants view the stimuli similarly. By this, we mean that if participants are not provided with a task, they may create their own, which may introduce an additional confound. That is, each participant would not be looking at the stimuli in a comparable way. Attractiveness rating paradigms resolve this by having each participant view the stimuli while making an attractiveness judgement (this judgement constitutes the task); participants should view the stimulus similarly (to judge the attractiveness).

Despite these improvements, attractiveness-rating paradigms also have limitations. For instance, having participants view the stimuli in concurrent order can lead to participants becoming aware of the purpose of the task or directing their visual attention toward the parts of the body that are changing. This is problematic when the researchers in previous research only vary the bodies concerning their WHR or breast size (e.g., Dixson et al., 2011; Garza et al., 2016). This may present one reason men viewed the chest, waist, and hip areas more in previous research; men fixated more on the changing body areas, irrespective of their preference. Moreover, suppose the stimuli are consistently presented on the screen at the same vertical distance. In that case, the participant's first fixations (and subsequent fixation patterns) will likely cluster around the body's centre (i.e., the chest and midriff). As such, future research employing an attractiveness rating paradigm should consider these limitations. We resolve these limitations in Chapter 7.

Furthermore, another limitation of existing eye-tracking research is the focus on overt attention and only measuring visual interest. While we suggested above that it is beneficial to gather information about men's overt attention toward specific body shapes and sizes and specific areas of the body, we also acknowledged that people could direct their attention covertly. Eye tracking measures, such as the first saccade latency and count (defined in Table 3.1), can indicate covert attentional bias. By combining an eye-tracking paradigm with a traditional experimental paradigm (e.g., the dot-probe paradigm), we can determine if men also show an attentional bias toward specific body shapes or sizes.

In the next section, we introduce the traditional dot-probe paradigm and how this can be improved by incorporating the first saccade latency as the outcome measure instead of reaction times. We also argue why including a measure of attentional bias is important.

3.1.3.3 Dot-Probe Paradigm

The dot-probe paradigm is an experimental approach that measures a bias within covert attention toward a particular stimuli within a person's peripheral vision (MacLeod et al., 1986). The dot-probe paradigm involves participants fixating on a central fixation cross while presenting two stimuli on either side of the screen. After the initial fixation stage, a probe (e.g., a dot) replaces one of those two stimuli, and participants respond to the dot using a keypress. This reaction time is said to reflect an attentional bias toward specific stimuli. An attentional bias occurs when stimuli automatically capture a person's attention (Skinner et al., 2018). This bias is because attention is reasoned to be orientated towards relevant stimuli, meaning reaction times are faster when a dot replaces that stimulus (MacLeod et al., 1986). To illustrate the dot-probe task, Bradley et al. (1999) investigated whether participants with a generalised anxiety disorder (GAD) relative to controls without GAD had an attentional bias toward threatening faces compared with neutral faces. They showed that participants with GAD responded faster to threatening, relative to neutral faces, indicating the presence of an attentional bias toward threatening facial stimuli.

However, Schmukle (2005) showed that the dot-probe task had limited reliability when the reaction time was the outcome measure. Fortunately, by using alternative outcome measures, such as eye tracking measures (e.g., first saccade latency), the reliability of the task can be improved (Blechert et al., 2010; Skinner et al., 2018). Figure 3.1 depicts how a traditional dot-probe task can be altered to take advantage of eye-tracking methodologies in one of two ways (denoted by the *1* or *2* in Figure 3.1).

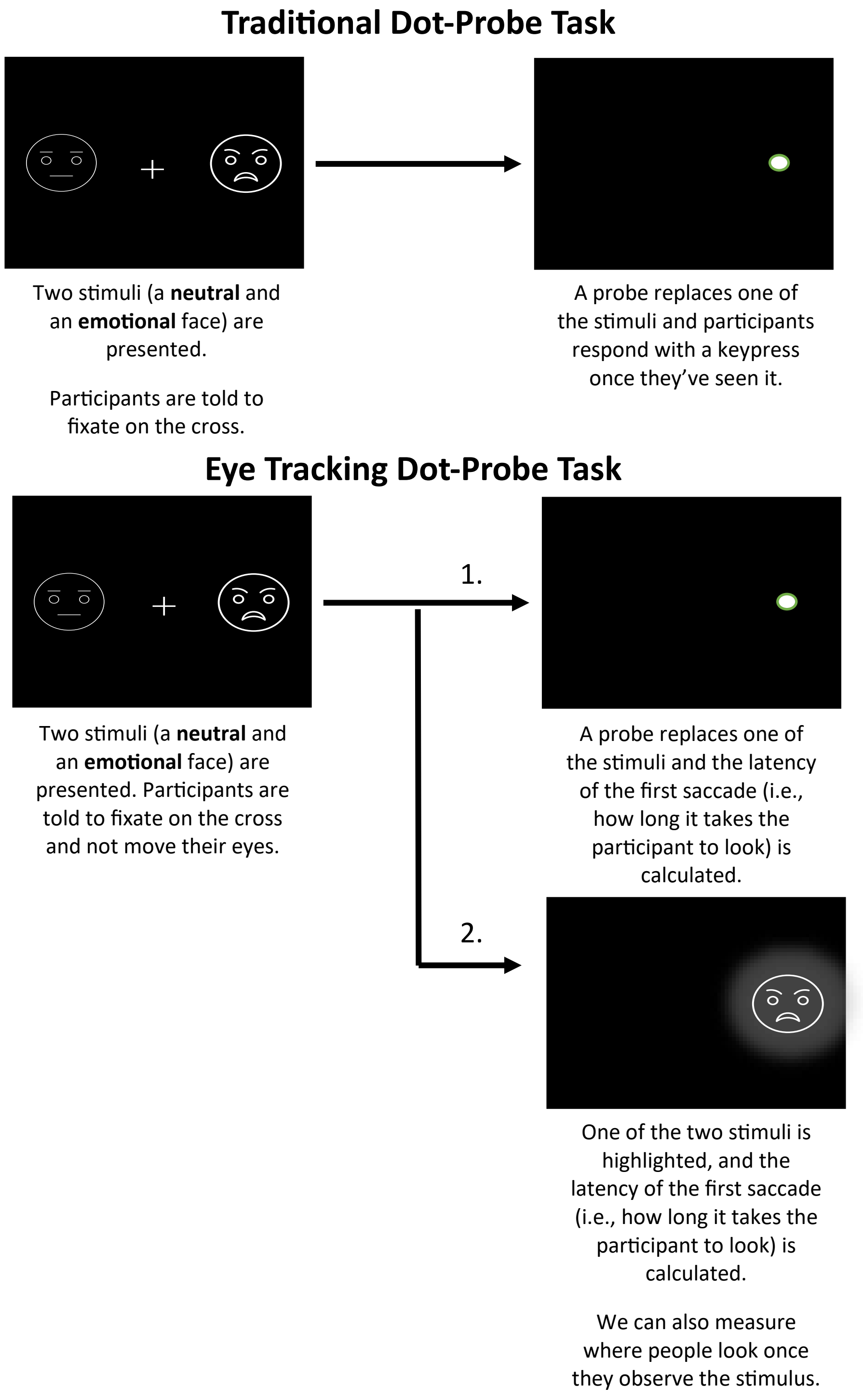
First, researchers could change the outcome measure from a keypress reaction time to the first saccade latency (i.e., the time between stimulus onset and the start of the first saccade). A shorter first saccade latency would indicate that participants were already covertly attending to a specific body or area of the body. This covert attention facilitated a faster time between stimulus onset and when participants began moving their eyes.

Second, the paradigm could be altered by not replacing the stimulus with a probe but keeping the stimuli on the screen once the participant observes the stimulus. This would allow participants to fully observe the stimuli before providing an attractiveness rating. This would allow us to measure the first saccade latency (i.e., attentional bias), where participants look overtly at a stimulus (i.e., indicators of visual interest) and capture a self-report attractiveness rating. Alongside the first saccade latency outcome measure, we can also capture men's first fixation count. That is, how often do they look toward a particular AOI on their first look toward the body? This first fixation frequency indicates men's preferences toward specific body areas in the early attentional system.

Previous research has employed dot-probe paradigms to investigate men's preferences toward specific body types and areas of the body (albeit not including an eye-tracking element). For example, Lu and Chang (2012) used a dot-probe paradigm and showed that relative to the face, men displayed an attentional bias toward the waist and hip area of the body. However, preferences within the attentional system for attractive qualities have also been shown across various attentional paradigms. This preference for attractive qualities within the early attention system would be beneficial from a mating perspective. If people showed a preference within the early attentional system for relevant traits (e.g., attractive qualities), this would be adaptive and advantageous as it would facilitate successful reproduction and the identification of suitable partners (Maner et al., 2007). For instance, using a visual search task, Cloud and colleagues (2023) showed that men were faster (showed an attentional bias) toward identifying a lower WHR than higher WHR bodies.

Research has also shown that external situational cues influence men's early attentional processes. Cues relevant to a person within a given context capture their attention (Lu & Chang, 2012). For instance, two studies by Maner and colleagues found that priming men with situationally relevant cues influenced men's attentional processes toward attractive partners. For instance, one study using a visual cue paradigm showed that when primed with cues that make mating a salient concern, single participants showed an attentional bias toward attractive female targets (Maner et al., 2009). Similarly, using a dot-probe paradigm, they showed that priming single men adopting an unrestricted sexual strategy with cues that made mating a relevant concern found it more difficult to disengage their attention from attractive female targets (Maner et al., 2007). These findings emphasise why including a measure of attentional bias when exploring the influence of situational threat cues on men's body shape and size preferences may allow us to explore more information relative to exploring overt visual interest independently.

Figure 3. 1
A Traditional and Adapted Eye-Tracking Dot-Probe Paradigm.



Notes. The example is based on the work of Bradley et al. (1999) outlined in the text above. The arrows (indicated by a one and a two) represent two possible eye-tracking procedures for the dot-probe task. Faster reaction times (or first saccade latencies) toward the threatening faced stimuli would indicate that participants were covertly attending to this stimulus during the fixation cross phase. This covert attention means participants respond to (or start to look) at the threatening stimuli faster, indicating a bias within the attentional system.

3.1.3.4 Creating a Combined Eye Tracking Dot-Probe Paradigm

As we have highlighted, there is a need to measure men's overt and covert attentional preferences after experiencing a mortality, masculinity or pathogen threat prime. However, current eye-tracking research has several limitations and typically focuses on measuring overt attentional preference. As we have outlined, there are benefits to deploying a combined eye-tracking dot-probe paradigm with an attractiveness rating element.

Creating a combined eye-tracking dot-probe paradigm (henceforth referred to in this format) increases the reliability of the dot-probe paradigm by using the first saccade latency as the outcome measure. It also allows for the collection of a broader array of measurements. These measurements include *(1)* indicators of overt visual attention (e.g., fixation counts), *(2)* an indicator of attentional bias in covert attention (i.e., the first saccade latency), and *(3)* an explicit self-report attractiveness rating. This will allow us to understand better how each situational threat cue may influence men's WHR and BMI preferences. Another benefit of using this approach that we have not yet mentioned is that we can disguise the purpose of the task. Rather than presenting the stimuli in concurrent order, the dot-probe paradigm should prevent participants from immediately fixating on the areas of the body that are changing and will obscure the true meaning of the study.

As such, in Chapter 7, we aimed to rectify some of these issues by creating a combined eye-tracking dot-probe paradigm with an attractiveness rating element. We provide more information on the exact paradigm in Chapter 7 (The Eyes Have It: Eye Tracking Men's Preferences Under Situational Threats).

3.2 Methods

3.2.1 Data Collection Procedure

In this thesis, data for the empirical chapters were collected online using self-report paradigms and in-person eye-tracking methods. We used both online and in-person testing to examine the influence of situational threat cues on men's WHR and BMI preferences. We used an experimental design for each experiment contained within Chapters 5 and 7, and participants were randomly assigned to priming conditions (see below). Specifically, we used a mixed design, whereby WHR and BMI served as the within-subject measurements, and the Condition served as the between-subjects measurement. More information on the exact methods, results, and interpretations for the self-report and eye-tracking experiments are detailed in Chapters 5 and 7, respectively. We used an online between-subjects design for our additional masculinity threat experiment in Chapter 6 (experiment four). We were interested in exploring the influence of masculinity (and femininity) threats on men's (and women’s) attitudes toward TGD people. We present more information on our exact methods in Chapter 6.

Despite the abovementioned limitations, online self-report paradigms for experiments 1-3 were necessary for theoretical and practical reasons. Theoretically, as most research addressing WHR and BMI preferences in men has focused on using self-report paradigms and attractiveness ratings, it was informative to replicate this widespread approach (e.g., Furnham et al., 2006; Singh, 1993). This replication allowed for the potential influence of situational threat cues to be examined and compared with the broader extant research literature that has used these methods (Roberts & Little, 2008; Saxton et al., 2020). Moreover, self-report paradigms allowed for the approach fit and avoid unfit direction of preferences to be tested as the combined eye tracking dot-probe paradigm could not effectively test the avoid unfit direction of preference (more information is provided in Chapter 7).

Practically, initial data collection for Chapters 4 (stimuli creation and validation) and 5 (self-reported preferences) started in April 2021, during which the United Kingdom was experiencing mandatory restrictions due to SARS-CoV-2 (COVID-19). Given these restrictions, online data collection was the only legal and ethical approach available. Previous research has used online data collection methods when measuring attractiveness judgments. This research showed that participants provide similar ratings to bodies when rating them online relative to rating them in person (Saxton et al., 2020). Furthermore, Peyton et al. (2021) illustrated that online experimental data collection during the pandemic produced findings similar to those of experiments conducted before COVID-19. Online relative to in-person experimentation was also comparable during the Many Labs 2 reproducibility project (Klein et al., 2018). Consequently, we determined that online experimental paradigms were an appropriate and effective method, owing to the circumstances.

3.2.1.1 Measures

The measures employed in each of the seven empirical chapters varied. In Chapter 4, participants rated each stimulus for the perceived attractiveness, health, and fertility on a 7-point scale ranging from 1 (very unattractive, unhealthy, unfertile) to 7 (very attractive, healthy, fertile). In Chapters 5 and 7, participants rated the attractiveness of the stimuli. Participants received definitions for each concept, shown in Table 3.2. The attractiveness, health and fertility ratings were the same as those used in previous research (Dixson et al., 2014; Swami, Miller, et al., 2008; Tovée et al., 2017). We used categorical ordered rating scales rather than bounded continuous (e.g., 0-100) sliders. Some research has used continuous attractiveness scales, which allows for effective linear modelling of the data (A. J. Lee et al., 2015). However, ordinal data can be modelled effectively (see Section 3.3). In addition, there are several limitations to continuous response options, including lower response rates and less accurate responses relative to categorical rating scales (Chyung et al., 2018; Funke, 2016). We used ordinal attractiveness ratings to measure men's preferences for these reasons.

Table 3. 2
Definitions of the Attractiveness, Health and Fertility Measures

Term	Definition
Attractiveness	How attractive the person depicted in the image is to you?
Health	The extent to which the person in the image appears to be physically healthy.
Fertility	The extent to which the person in the image appears to be fertile, or whether you believe they have good reproductive capacity.

In Chapter 4, we used attractiveness, health, and fertility ratings to evaluate the validity of the stimuli. They were also used to indicate which stimuli were the most and least healthy and fertile to inform the hypotheses in Chapters 5 and 7. In Chapter 5, we operationalised attractiveness ratings as an indicator of preference, as per previous research (Roberts & Little, 2008). Specifically, consistent with previous research, we defined a higher attractiveness rating as indicating a greater preference toward a specific stimulus. In the subsequent three chapters, we provide further information on the measures and experimental procedures.

In Chapter 7 (eye-tracking), we captured a range of outcome measures. We divided our outcome measures into overall stimulus and area of interest outcome measures. Examining preferences at the level of the whole stimulus allowed us to explore men's WHR and BMI preferences and whether situational threat cues modulate these preferences. Previous research has shown that men view more attractive bodies for longer (Suschinsky et al., 2007). We broadly expected each situational threat cue to enhance men's visual interest (as indicated by our outcome measures) toward more attractive body shapes and sizes overall. We conceptualised preferences toward the overall stimulus using explicit *(1) attractiveness ratings, (2) fixation count, and (3) the first saccade latency.* Specifically, we defined greater preferences as men showing higher attractiveness ratings, more overall fixations and a faster (or lower) first saccade latency toward a specific stimulus.

Additionally, examining preferences toward specific areas of interest allowed us to examine men's preferences toward specific bodily areas and whether situational threat cues modulate these preferences. Previous research has established that certain body areas (e.g., the waist) are important when determining health and fertility (Garza et al., 2016). When primed with situational threat cues, these areas may receive more visual attention and interest than others. Likewise, we conceptualised preferences toward specific areas of interest by examining the *(1) first fixation count (as a proportion), (2) the average first saccade latency toward this location, (3) the fixation count, (4) the average dwell time and (5) the number of revisits.* Specifically, we defined greater preferences as men showing a higher first fixation count, faster (or lower) first saccade latencies, a higher fixation count, a higher average dwell time and a higher number of revisits toward a specific area of interest.

We provide more information on the exact outcome measures and areas of interest in Chapter 7. We also provide more explicit hypotheses.

3.2.1.2 Experimental Conditions

In Chapters 5 (self-report preferences) and 7 (eye-tracking), we randomly allocated participants into experimental conditions comprising situational threat and control conditions. The former received the situational threat primes (see 3.2.2), and the latter received an equivalent neutral, matched control prime. This approach is consistent with previous priming methods (Tulving & Hayman, 1995). We provide further details on the exact priming procedures in Chapters 5 and 7.

Additionally, the self-report paradigms (Chapter 5; experiments one - three) also had a no prime condition, where participants completed no task. To our knowledge, no previous research has included this condition. This additional condition added an extra layer of protection and increased confidence in the experimental procedure. As participants completed the research online, it was impossible to control their immediate environment. Specifically, by comparing participants' average attractiveness ratings in the control prime and no prime conditions, it was possible to determine whether having men complete a control task inadvertently influenced their attractiveness ratings. If no differences were shown between the control and no prime conditions, then the control condition was believed to have served as a suitable baseline, and the primary analysis proceeded with comparing the threat and control conditions per common practice (Tulving & Hayman, 1995).

3.2.2 Experimentally Priming for Situational Threat Cues

Experimental priming was employed to assess the influence of situational threat cues on men's WHR and BMI preferences. The seminal definition of priming was that processing a stimulus makes processing the same stimulus easier after a short delay (Bruner, 1957). Broadly, priming involves presenting a stimulus which causes a concept to become more easily accessible (Sherman & Rivers, 2021). When concepts are primed, *"they become more likely to influence one's subsequent thoughts, feelings, judgments, and behaviors"* (Chartrand & Jefferis, 2004, p. 854). In this thesis, we define priming as the experimental technique of making concepts and thoughts that a person would typically experience through daily interactions salient (Bermeitinger, 2014).

Since the seminal work by Bruner, several other priming approaches have been explored. For example, semantic priming refers to when the act of reading a word (e.g., nurse) facilitates faster recognition of semantically similar words (e.g., doctor) due to the activation of shared memory schemas (Meyer & Schvaneveldt, 1971). Similarly, behaviour and goal priming refer to when a stimulus's processing subsequently influences behavioural output and goal pursuit, respectively (Ferguson & Mann, 2014). Förser et al. (2007) suggested that goal priming causes a person to develop a strong sense of value and emotion towards the primed-for concept. Given that the situational threat cues examined in this thesis were reasoned to cause changes to men's mating motivations, it could be suggested that these situational threat cues serve as goal priming. However, we intentionally used subtle situational primes that were not intended to result in powerful, immediate emotional reactions (see below). In contrast, if the primes were direct, tangible threats, goal priming may represent the underlying process.

The approaches used in this thesis may be best defined as evaluative priming. This type of priming addresses how evaluating one stimulus can influence the evaluative processing of another (Ferguson & Mann, 2014). The seminal work by Fazio et al. (1986) adapted the traditional semantic priming paradigm to produce an evaluative prime. Rather than using semantically similar or dissimilar words, they varied words based on evaluative congruency. For example, participants responded faster at rating targets (e.g., repulsive) as good or bad when an evaluatively congruent prime preceded them (e.g., spider; Herring et al., 2013). The priming methods used in the subsequent experiments involved participants completing a series of questionnaires to evaluate their risk of death, pathogens, and masculinity. These situational threat cues were intended to alter evaluations (i.e., the attractiveness) of particular WHRs and BMIs. Together, evaluative priming may best describe the underlying action of each situational cue.

Large amounts of research in cognitive and social psychology have employed priming methods. However, these are not without controversy, with some researchers claiming that priming effects are unreliable and cannot be replicated (Chivers, 2019; Molden, 2014). Indeed, some research has failed to replicate well-established effects, such as the hostile priming effect

(McCarthy et al., 2018, 2021) and action-in-action goal priming (Corker et al., 2020). A recent meta-analysis of 246 studies investigating money priming also failed to replicate well-established effects and found evidence for publication bias (Lodder et al., 2019).

Sherman and Rivers (2021) argued that these failures in replication are primarily due to methodological factors, such as low statistical power. Several appropriately powered studies have replicated priming effects, particularly when incorporating within-subject elements (Payne et al., 2016; Rougier et al., 2020). A recent meta-analysis of 23 studies showed that priming for an achievement goal significantly improved job performance relative to a control prime (X. Chen et al., 2021). Similarly, a meta-analysis of 133 studies evidenced a small priming effect (with minimal publication bias) for achievement priming (Weingarten et al., 2016). Ferguson and Mann (2014) also concluded that evaluative priming effectively influences future evaluations. Given this, recent research has supported priming, arguing that it is an effective experimental paradigm (Albarracin & Dai, 2021; Bargh, 2021). Despite this, there remains ongoing controversy around the effectiveness of priming methods[6]. To combat this, we chose mortality, pathogen and masculinity priming methods, which have established and replicated priming effects in their own right. In the next section, we evaluate these primes and present evidence supporting their effectiveness.

3.2.2.1 Priming Methods Used in this Thesis

This section provides a specific justification for the mortality, pathogen and masculinity threat primes used in this thesis. In Chapters 5, 6 and 7, we provide further information on the

[6] After the open email by Daniel Kahneman (2012), priming methodologies became a critical topic within the *replication crisis* (Chivers, 2019). Research has failed to replicate specific priming effects, such as the well-cited findings by Bargh et al. (1996) that people walk slower after being primed with words associated with the elderly (Doyen et al., 2012). Despite these findings, this failure in replication is likely due to variations in experimental paradigm and methodological limitations (e.g., sample size; Sherman & Rivers, 2021). There is also a fallacy in assuming that cognitive psychology findings should be replicable under all situations; priming effects, like all findings, are subject to individual differences and subtle distinctions in experimental tasks (Stroebe & Strack, 2014). Using replicability as the benchmark for whether an effect exists is arguably flawed or at least problematic (Bargh, 2021). One of the leading factors contributing to this fallacy is that there is no meta-theory detailing the mechanism for priming effects (Cesario, 2014). Therefore, any research using priming needs to be mindful of these factors. Despite this, current priming research has primarily focused on replicating the findings of earlier studies (Chivers, 2019), but priming remains an effective method when accounting for the mentioned factors (Albarracin & Dai, 2021; Bargh, 2021). For a review of this controversy, see Sherman and Rivers (2021).

exact priming procedures and the control conditions used. Broadly, we aimed for the primes to be subtle and represent possible everyday experiences that men may experience. This subtlety contrasts previous approaches, which often aim to produce a priming effect by using stimuli so irregular that this effect would not occur in naturalistic settings (e.g., Reeve et al., 2019). For example, some pathogen primes involve presenting participants with extremely disgusting imagery (e.g., ingesting faecal matter; Culpepper et al., 2018), which is not representative of pathogen threats men may frequently experience (e.g., thinking about disease risk). As illustrated below, the primes used throughout this thesis represent situational threat cues that cause men to consider situations of mortality, pathogen, and masculinity threat. In this way, our primes were intended to encourage participants to consider information relevant to them, reducing the chances that specific subject matters (e.g., using cancer statistics to prime for mortality threat) were not relevant. Instead, the primes in this thesis were intended to make participants consider the situational cue topics and conjure their own relevant, salient thoughts.

Mortality Threat. Within the broader research literature concerning Terror Management Theory (TMT), priming for mortality threat is a common approach (Burke et al., 2010; Cox et al., 2019). There are several ways to prime for mortality threat, such as using implicit word-matching tasks (Cox et al., 2019; Silveira et al., 2014). However, the most common mortality threat primes typically include asking open and closed-ended questions about death (Burke et al., 2010). Open-ended questions involve asking participants about their thoughts and feelings surrounding their death (Vaughn et al., 2010; Vicary, 2011). For example, Kosloff et al. (2010) asked participants to "*Please briefly describe the feelings that the thought of your own death arouses in you*." (p. 1039). The second prime involved participants completing close-ended survey questions using fear-of-death questionnaires (Cox et al., 2019; Davis et al., 2016). For example, research has administered various items from the Fear of Personal Death scale, which asks participants to rate statements such as, "*Death frightens me because I will be forgotten*." (Davis et al., 2016; Florian & Kravetz, 1983). Both closed and open-ended questions are frequently used by researchers aiming to prime for mortality threat (Burke et al., 2010; Cox et al., 2019). A crucial element of priming for mortality threat is to employ a distractor task following the onset of the prime (Davis et al., 2016). This delay is required to cause thoughts to be consolidated outside of a person's conscious awareness (Vaughn et al., 2010). The effect size of the threat prime increases proportionally to the length of the delay (Burke et al., 2010).

In this thesis, we used a combination of both open and closed-ended questions. Specifically, participants completed items from the Fear of Personal Death scale and answered an open-ended question about the feelings the thought of their death arouses. This approach ensured that participants considered their thoughts and feelings regarding their death (rather than death as a general concept). We avoided questions if they required a prerequisite level of religiosity (e.g., "*Death frightens me because of punishment in the hereafter*."), to ensure we did not impose any subject matters that participants may not identify with ((Florian & Kravetz, 1983). We used both open and closed-ended questions, rather than just one, as has been typical in previous research (Davis et al., 2016; Vaughn et al., 2010; Vicary, 2011). We opted for both types of questions to increase participant engagement with the task and to maximise the chances of the mortality prime having an effect.

Pathogen Threat. Researchers have relied on diverse methods to prime for pathogen threat, typically focusing on one specific sensory system. Previous research has used visual, a range of written, auditory, tactile, and olfactory pathogen primes (Brown & Sacco, 2022; Michalak et al., 2020; Tybur et al., 2022; Watkins et al., 2012), but typically, pathogen threat is primed using visual stimuli. For instance, Little et al. (2011) gave participants images of a cloth containing a bodily fluid or a benign blue liquid stain. Similarly, Ainsworth and Maner (2019) gave participants a slideshow of images of diseases and pathogens or non-pathogenic hazards. Often, research will draw images from validated disgust image sets, such as the Disgust-Related Image set (DIRTI; Haberkamp et al., 2017) and the Culpepper Disgust Image Set (C-DIS; Culpepper et al., 2018). However, there are some limitations to using visual pathogen primes. First, the stimuli are inconsistent with the pathogen stimuli men may frequently encounter (e.g., reading about an increase in flu cases). Second, many of the stimuli used are intentionally highly disgusting, which may bias men's preferences to a degree that is not ecologically valid (Park et al., 2012). Third, pathogen sensitivity is subject to individual variation, meaning that some of the priming stimuli used, such as images containing blood-soaked rags (despite being rated as disgusting), may not be relevant to all individuals (C. I. Fisher et al., 2013).

Given these limitations, we have used a more subtle and less graphic pathogen prime, similar to the prime used in previous research. For instance, Watkins et al. (2012) used a written pathogen threat prime with participants completing the Perceived Vulnerability to Disease scale (PVD). This task involved participants considering their vulnerability to diseases, such as "*In general, I am very susceptible to colds, flu and other infectious diseases.*" (Duncan et al., 2009). This method was beneficial, as it encouraged participants to think about their own disease risk and consider pathogen concepts relevant to them (e.g., COVID-19). Other researchers have also used this approach (A. J. Lee & Zietsch, 2011). As such, we employed the PVD to prime for pathogen concerns. We also asked participants a further open-ended question, asking them to explain whether they had any risk factors for getting sick. Using both approaches would also allow participants more opportunities to consider concepts relating to their health. Similar to our reasoning for mortality threat, we believed both approaches would maximise participant engagement and the chances that the prime would be effective.

Masculinity Threat. Like the above, masculinity threat primes are frequently used in various fields (e.g., gender research) and are shown to have replicated effects (Glick et al., 2007; Wellman et al., 2021). Gender self-concepts in men and women can be manipulated and threatened using priming methods (Harrison & Michelson, 2019; McCall & Dasgupta, 2007). However, according to the precarious manhood hypothesis, as masculinity is tenuous, it is more readily and easily threatened than femininity (Vandello & Bosson, 2013). Priming for masculinity threat typically involves using one of two methods. In the first method, men receive personality feedback that suggests they are feminine (Harrison & Michelson, 2019; B. A. Jones et al., 2023b). In the second method, men complete a typically feminine activity (e.g., braiding hair; Bosson et al., 2009). While both methods are effective at priming for masculinity threat, giving fake personality feedback is more representative of men's everyday experiences. All men will likely be exposed to messaging (primarily through advertisement and popular media) that idealises hyper-masculinity and potentially places the individual in a lower-status masculinity position. For instance, men's bodies are often compared to the unrealistic societal mesomorphic ideal, leading to feelings of inadequacy (Blashill, 2011). Similarly, with the recent increase of hyper-masculine messages proliferated by certain online personalities (e.g., Andrew Tate; Rich & Bujalka, 2023), exposing men to feedback that questions their masculinity would represent a more ecologically valid approach relative to actual engagement in more feminine tasks, which represent a less common daily experience.

To conclude, we determined that providing men with feedback which suggests they are feminine may serve as a more naturalistic masculinity threat prime. This type of prime has been used consistently in previous research and has produced a reliable effect among men in the general population (Ching, 2022; Harrison & Michelson, 2019; Konopka et al., 2019; Salvati et al., 2021; Wellman et al., 2021). In summary, the masculinity threat prime used within this thesis focused on providing men with bogus personality feedback indicating they were feminine. Prior research has generally ensured this feedback is broad (e.g., "*Your score falls within the feminine range of responses*."). This feedback is intended to make men's masculinity a more salient concern and cause men to consider masculinity concerns more relevant to them.

An important concern could be that men may not believe their feedback. This may especially be a concern if the participant considered their responses to our measure to be typically *masculine.* The established priming approach for masculinity threat is to use the Bem Sex Role Inventory (Bem, 1974; BSRI). The BSRI contains items that, at first glance, might be challenging for a layperson to identify as particularly masculine or feminine (e.g., "*I see myself as someone who is outgoing, sociable*"). This contrasts with other measures, such as the Traditional Masculinity-Femininity Scale, which asks participants to state whether they consider themselves masculine or feminine concerning a range of items (Kachel et al., 2016). As such, we believed this would ensure that the true nature of the feedback was not immediately obvious to participants. Furthermore, we received anecdotal evidence of this effect during our testing for experiment five. Our participants frequently exclaimed surprise at their score. While it was not a part of the experimental procedure, the researcher also asked all participants following the debrief if they believed their feedback, and all stated it was believable.

3.2.2.2 Summary

In summary, the mortality, pathogen, and masculinity primes used within this thesis broadly represent a form of robust evaluative priming. Each priming approach has previously been successful in producing a prime effect. The three priming methods used within this thesis were intended not to rely on extreme cues. Instead, they were designed to make mortality, pathogen, and masculinity threat concerns salient and encourage participants to consider information that is relevant to them, thus making each a more ecologically valid prime. Chapters 5, 6 and 7 provide more information on the specifics of each priming task and the control groups used.

3.2.3 Sampling Procedure

Online data collection was conducted through Prolific (https://prolific.co/), a participant crowdsourcing service. Prolific was used as the data quality, and the participant pool was significantly higher than other crowdsourcing platforms (e.g., Amazon Mechanical Turk; Peer et al., 2021). If a participant completed one of our online experiments, they were excluded from completing either of the other two. Participants recruited through this medium were paid above the national minimum rate at the time of testing (the exact amount is reported for each experiment). Participants were recruited via snowballing and opportunity sampling for the lab-based, eye-tracking data collection and compensated appropriately.

During our online studies, we used attention checks to ensure participants paid attention while engaging in the task. We used attention checks that complied with Prolific's policies, asking participants at randomised points throughout each study to select a specific option on the attractiveness rating scale. For instance, participants could be asked to "*please select strongly agree for this question*". Participants who failed two or more attention checks were removed from our final dataset.

Across all studies, participants were recruited from the United Kingdom (UK)[7]. This restriction replicates the testing of participants from WEIRD countries, which has predominantly occurred in previous research. Studies 1a and 1b had no additional exclusion criteria to validate the stimuli amongst a representative sample. Strict exclusion criteria were followed in the remaining experiments in Chapters 5 and 7. Participants were restricted to men currently residing in the UK who were White and self-identified as heterosexual (straight). These exclusion criteria were intended to reduce potential confounds. As WHR and BMI preferences vary across cultures, it was necessary to restrict participants by nationality (Furnham et al., 2002; Swami et al., 2006; Swami et al., 2008). In addition, research has shown that WHR and BMI preferences may vary by ethnicity (Sorokowski et al., 2014; Wetsman & Marlowe, 1999). As the body stimuli used within this thesis had a White skin tone, participants who were not White were excluded on the above grounds. Finally, participants who did not identify as heterosexual were excluded to avoid additional confounds.

For Chapter 6, we used different inclusion criteria because that study was initially separate from this thesis and had different aims. For this study, we continued to restrict our sample to heterosexual (i.e., straight) cisgender participants who reside in the UK. However, we did not restrict ethnicity or binary cis-gender identity; we recruited cisgender men and women. We did this because this experiment aimed to further investigate the influence of masculinity threat by exploring whether threatening men's masculinity (and women's femininity) influenced participant's attitudes toward the trans and gender-diverse community. For this purpose, we recruited men and women but had no reason to restrict our sample because of ethnicity. We provide more information on our exact sampling approach in Chapter 6.

3.2.4 Open Research Commitment

This thesis is also committed to Open Research principles and implements best practices by ensuring full transparency and accessibility using the Open Science Framework (OSF; Dirnagl, 2020; Lindsay et al., 2016; Vicente-Saez & Martinez-Fuentes, 2018). We

[7] For Studies 1a and 1b the participants were also recruited from the Republic of Ireland (ROI). We expanded our criteria for this study as the lead author had contacts for opportunity sampling in both the UK and ROI and because we aimed to get a large, relatively representative sample to rate our female body stimuli.

accomplished this by using preregistration and ensuring that the methods, data and reproducible R script were fully accessible[8]. Given the evolving nature of this piece of research and the ongoing development of the lead researcher, several amendments were made to the data analysis approaches initially pre-registered. To ensure transparency, amendments to the analysis methods and hypotheses were illustrated on the sub-components of the OSF. The subsequent experiments contain links to each associated sub-repository. All figures which contained colour used the Okabe-Ito colour-vision deficiency-friendly palette (Dunn & Darlington, 2016; Okabe & Ito, 2008). We also provided our computed output files for each analysis on the OSF.

3.2.5 Ethical Considerations

The present research design and use of situational threat cues necessitate several careful ethical considerations. First, it was necessary to deceive participants as to the true nature of the experiment for the situational prime to be successful. This deception was per British Psychological Society (BPS) guidelines, and participants were fully debriefed as to the true nature of the experiment (Oates et al., 2021). Second, it was important to give a comprehensive debrief as the primes had participants consider uncomfortable topics (e.g., death). Third, due to COVID-19 restrictions and the necessity to conduct the initial experiments online, we provided relevant sources of support detailing current lockdown guidelines and viral prevention measures consistent with best practices. Finally, data was held in accordance with GDPR and a predetermined Data Management Plan, which included storing participants' data safely, ensuring the anonymity of participants, and facilitating the withdrawal of participants' data upon request before the communicated withdrawal deadline. Nottingham Trent University's ethics committee approved this research under approval code CAHILL2022/35 (amended from CAHILL2021/423, 2021/106). The same ethics board also approved the studies presented in Chapter 6.

[8] An overall thesis repository can be found at https://tinyurl.com/OSF-LCC2023. Please note that this does not contain any of the data or analyses for Chapter 6. The experiment shown in Chapter 6 was also not pre-registered, as it was a body of work completed independently of this thesis. However, the data and analysis script remain openly available and can be found here: https://osf.io/v6gct/.

3.2.6 Effect of COVID-19

Given the potency of COVID-19 during the initial data collection stages, it was important to reflect on how this may have influenced the methods and results of this thesis (especially the self-report experiments in Chapter 5). Concerning pathogen threat, it could be argued that the ongoing pandemic served as a pathogen threat cue (Boggs et al., 2022). However, Tybur et al. (2022) found little increase in pathogen disgust in collected data in May 2021 versus data from 2009. One potential explanation for this is that the observable symptoms of COVID-19 (e.g., coughing) are synonymous with other regular respiratory illnesses (e.g., the common cold), meaning the potential for pathogen threat would be no greater than would be expected given typical ambient pathogen threats (Tybur et al., 2022). Furthermore, the transmission of COVID-19 predominantly occurs due to invisible respiratory droplets, and individuals are often infectious before they become symptomatic, meaning the behavioural immune system may show limited effectiveness in responding to COVID-19 (Ackerman et al., 2021). Based on this, though we are mindful that it might, we reasoned that COVID-19 would not negatively impact the effectiveness of the pathogen threat prime.

Similarly, COVID-19 has been responsible for many deaths both directly and indirectly; by September 2022, over 6,400,000 have reportedly lost their lives (World Health Organization, 2022). During the pandemic, there was an omnipresence of death-related news in the media (e.g., BBC daily death counter), and it could be reasoned that this may have acted as a mortality threat cue. Some research within the terror management theory literature has suggested that COVID-19 may cause heightened mortality salience and activate certain responses to combat this anxiety (Pyszczynski et al., 2021). However, in earlier work investigating terror management, Becker (1973) suggested that death anxiety is emotionally demanding and is unlikely to occur long-term. Given the long-term nature of COVID-19, it is unlikely that it would have served as a persistent mortality salience cue. Indeed, recent research has also shown that mortality-related thoughts regarding the pandemic must be made salient with mortality threat primes (Sonmez, 2021). It can be reasoned that if participants were concerned about death due to COVID-19, these thoughts would need to be activated before causing death anxiety, which was the aim of our prime.

Despite the above arguments, we reasoned that COVID-19 would unlikely affect our methods negatively. However, we were mindful of the possibility it would and duly took precautions to mitigate any possible interference. First, our priming methods consisted of questionnaires designed to make participants consider their pathogen and mortality risks. If COVID-19 were a relevant pathogen or mortality concern, priming for pathogen and mortality threat would facilitate greater access to those thoughts relative to those held by the comparison (i.e., control) condition. Second, testing for the experiments in Chapter 5 occurred when rates of COVID-19 infections and deaths were lower. We reasoned that this would reduce the negative pathogenic and mortality concerns relating to COVID-19. Taking these steps was deemed appropriate to mitigate any adverse effects of COVID-19.

3.3 Analytical Considerations

Finally, it is necessary to consider the statistical approaches used throughout this thesis. Here, we outline the primary analyses conducted in experiments one, two, three and five. As experiment four was added post-hoc to this thesis and completed as a standalone project, the analytical procedure is somewhat different. We outline this more in Chapter 6. We provide more specific model specifications in each experiment and study. We also outline how we explored the relevance and appropriateness of our situational threat cues. Since no established procedure exists for examining this, we explored our participants' responses to closed and open-ended questions. We outline these *relevance and appropriateness* checks below.

3.3.1 Mixed-Effect Modelling

Research with experimental repeated measures designs involves each participant completing several individual trials. This repetition means that the observations for each participant are not independent, and the data from individual trials (level 1) is nested within each participant (level 2; Lee et al., 2015). To acknowledge this and account for the variance attributed to each participant, they were treated as a random effect in the model (Baguley et al., 2022). In contrast, the manipulated variables of interest (e.g., WHR, BMI and condition) should be treated as fixed effects. Another argument is that experimental cognitive psychology should enter their stimuli as random effects (Baguley et al., 2022). Treating stimuli as fixed effects assumes that the stimuli used within any given study account for the variability present in the population (DeBruine & Barr, 2021). However, as our stimuli only varied in WHR and BMI (the factors of interest), modelling stimuli as random effects would not have improved our model fit.

Mixed effect modelling is a statistical approach which allows for both random and fixed effects to be modelled (Field et al., 2012). When the outcome variable is continuous, linear mixed-effect models can be easily accommodated using the *lme4* or *lmertest* packages (Bates et al., 2022; Kuznetsova et al., 2017). Another benefit of mixed effect modelling is that it allows the modelling of outcome variables with alternative data types (e.g., ordinal or frequency data). We used a general and generalised mixed effect model in Chapter 7.

As mentioned, attractiveness ratings within this thesis were captured using categorical rating scales, meaning they reflect naturally ordered data (e.g., very unattractive followed by unattractive and so on). Research has previously modelled ordinal data as continuous or interval data using ANOVA or regression (Baguley et al., 2022). However, treating ordinal data as interval or continuous can be problematic as it assumes that the magnitude between each ordinal point is equal and does not maintain the order of the categories (Bürkner & Vuorre, 2019; Parra et al., 2011). One way of correctly modelling ordinal data is to use ordinal logistic regressions, which maintain the natural order categories using a cumulative probability function (Warner, 2008). For example, the cumulative probability of participants rating a body as *neither attractive nor unattractive* would be modelled as $\hat{p}_{\text{very unattractive}} + \hat{p}_{\text{unattractive}} + \hat{p}_{\text{neither attractive nor unattractive}}$. Therefore, this cumulative probability function assumes that the predictors (e.g., WHR, BMI and conditional allocation) either increase or decrease the probability of greater attractiveness ratings (Baguley, 2012). Importantly, this can be easily modelled using a multilevel approach using mixed-effect ordinal logistic regressions facilitated by the *ordinal* package in RStudio (Christensen, 2019). We used this approach to model our ordinal attractiveness rating data.

3.3.2 Relevance and Appropriateness Checks

We also conducted an assessment to determine the relevance and appropriateness of each of our manipulations. We intentionally avoid the term "*manipulation check*" due to several limitations associated with such checks (see Chapter 8). By relevance and appropriateness, we mean that we examined whether our primes were likely pertinent and impactful for our population. While this will not affect our analyses, it will allow us to interpret our findings more nuancedly. We used two methods for this assessment: *(1)* evaluating participants' average responses to the scales we administered and *(2)* analysing participants' free-text responses. For clarity and transparency, we only conduct this assessment for two of our primes: mortality and pathogen threat in Chapters 5 and 7. The reasoning for this is presented below.

As we administered a scale for each priming approach, we summarised the mean rating for each scale. This indicates the degree to which a person is fearful of death (mortality threat) and perceives themselves as vulnerable to disease. It could be argued that for our manipulations to be most effective, our participants should generally score highly on these measures. We also asked our mortality and pathogen threat condition participants to answer a free-text question. We used participants' responses to this measure to address our manipulation's appropriateness.

For mortality threat, the participants responded to an emotive question asking them to describe what thoughts and feelings occur when considering death. As this was an emotional question, it was possible to categorise the emotional sentiment each participant expressed in their response. We conducted a sentiment analysis on the free text responses using the *SentimentAnalysis* package in R. This package analyses free text responses to determine the general sentiment displayed by the writer. The words expressed by the participant are compared against validated word sets rated for their emotional valence (negative to positive). This function assigns a sentiment score ranging from -1 to +1, where -1 represents a negative emotional sentiment, whereas +1 represents a positive emotional sentiment. We calculated a sentiment score for each participant in the mortality threat condition and compared these with the sentiment scores for each participant in the control condition. For our mortality threat prime to be appropriate, we expected the sentiment of those in the mortality threat condition to be more negative than those in the control condition. We examined this at both the participant level and, on average, for each condition.

For pathogen threat, we determined that conducting a sentiment analysis was inappropriate. This was because our question asking participants to "*Briefly explain whether you have any risk factors (e.g., your environment, hobbies) which make you susceptible to getting sick."* was unsuitable for sentiment analysis. Sentiment analysis is only appropriate for questions likely to produce a strong emotive response. The current question reflected more of a factual response. For this question, we were interested in determining whether participants had or did not have any risk factors for getting sick. To achieve this, we created a function in R to parse the participant's responses and create a binary indicator of risk (no risk factors/ has risk factors)[9]. Any responses the function could not parse were flagged for manual review and categorised by the researcher. For transparency, we attempted to apply other automatic procedures (such as text mining), but these were unsuccessful. As such, we opted for this manual function approach.

We also aimed to do the same appropriateness check for masculinity threat. Recall that participants in the masculinity threat condition only completed the BSRI measure. They did not answer any free-text responses. As such, we had no free-text responses to analyse for this condition. While we could have analysed the participant's responses to the BSRI, we determined this was inappropriate. For clarity, we never intended to use this measure to assess men's gender norms. We explain the benefits of using this measure within our manipulation check relative to other measures, which is explained in Section 3.2.2.1. The BSRI has been criticised for not reflecting gender norms. For instance, researchers have claimed that the BSRI measures instrumentality (e.g., agency) and expressiveness (e.g., empathy), concepts that are distinct from masculinity and femininity (Hoffman & Borders, 2001; Spence, 1991). As such, a higher score on the *masculine* and *feminine* domains would reflect higher instrumentality and expressiveness and would not serve to assess the appropriateness of our manipulation. Put simply, a person may score highly on the instrumentality items, but this might not mean they

[9] More information on this function can be found on the OSF analysis files for experiment three.

inherently view masculinity as important for themselves. If we were to conduct an appropriateness check for our masculinity threat prime, a more direct measure of gender norms would need to be used (e.g., the Traditional Masculinity-Femininity Scale), but this would compromise the appropriateness of our priming technique. As such, we did not conduct an appropriateness check on this analysis.

3.4 Summary

This chapter highlighted the critical methodological and statistical considerations relevant to this thesis. We outlined the current methodological limitations with existing research regarding the types of stimuli used, how preferences were conceptualised and the reliance on self-report attractiveness ratings to examine men's preferences, and how we aim to resolve these limitations within this thesis. Specifically, we will create a new set of 3D-modelled body stimuli varying in WHR and BMI in Chapter 4, explicitly examine the *approach fit* and *avoid unfit* direction of preferences in Chapter 5's experiments and incorporate a combined eye-tracking dot-probe paradigm to examine men's preferences using alternative measures of preference in Chapter 7. We also outlined the methodological approaches used in the subsequent chapters, including providing an overview of the mortality, pathogen and masculinity situational threat cues that will prime participants with specific topics. We showed that each priming method we will use in the subsequent chapters represents evaluative primes used extensively in previous research. We concluded this chapter by evaluating the analytical approaches we will use.

4. CHAPTER 4: STIMULI DEVELOPMENT, VALIDATION AND SELECTION

4.1 Introduction

As outlined in Chapter 3, there are several limitations to the current stimuli used in WHR and BMI research. The availability of certain stimuli largely influences researchers' stimuli choices. For instance, real body photographs and line-drawn stimuli are relatively easy to create and use. However, generating and manipulating (e.g., changing body part size and shape) computer-generated 3D-modelled stimuli is time-consuming, computationally demanding and challenging. It has, however, recently become more accessible. Nevertheless, decisions about which stimuli are used are still heavily impacted by the lack of validated stimulus sets available. With this in mind, in this chapter, we created a set of 3D-modelled female body stimuli that varied in WHR and BMI that were then validated online. We did this for two purposes: *(1)* to create a set of stimuli from which to choose a subset for use in this thesis and *(2)* so that the full set could then be made available on the OSF for other researchers to use.

We begin by introducing our objectives for this chapter in more detail. We then outline the procedures for creating our clothed and unclothed female body stimuli before presenting the validation findings for both Study 1a (clothed) and Study 1b (unclothed). Finally, we use these findings to inform the selection of the stimuli used in this thesis.

4.1.1 Stimuli Development

To meet our purposes (see above) and to overcome some of the limitations outlined in Chapter 3, we created our stimuli using 3D modelling software. Whilst these bodies are not identical to real women’s bodies, which vary naturally in size, shape and relative distributions of adiposity across a population, they are a convenient way to generate sufficiently realistic stimuli that vary in WHR and BMI while allowing us to control extraneous factors. Thus, we can accurately manipulate WHR and BMI (relative shape and adiposity) to produce bodies that correlate with actual women’s WHRs and BMIs (K. K. Cornelissen et al., 2017; Saxton et al., 2020). This will also allow the stimuli to have precise WHR and BMI values, measured using circumference and volumetric assessments, respectively. Consistent with other work (e.g., Swami et al., 2008), we generated five WHR (i.e., 0.6, 0.7, 0.8, 0.9 and 1.0) and five BMI (i.e., emaciated, underweight, average, overweight, and obese), thereby allowing our stimuli to represent a broader array of body types and that can capture the idiosyncrasies in participant's WHR and BMI preferences.

Unlike other stimuli that have been used, the stimuli we created were full-bodied (head to feet) and colourised. The skin tone, face, hair, and height were standardised to mitigate concerns that other body parts (i.e., colour and other body parts) would capture attention away from the body shape and size (Moussally et al., 2017). In addition, we generated both clothed and unclothed versions to provide variability to the final stimulus set. This also allowed us to compare the clothed and unclothed stimuli. This ensured that the appropriate stimuli were selected for the remainder of the thesis.

4.1.2 Stimuli Validation

A recurring issue with research using body stimuli is that they are rarely validated (Kim et al., 2018). By validating our stimuli, we were ensuring that they were suitably realistic. We also directly compared whether they were rated and interpreted similarly to previously used stimuli sets (e.g., line-drawn stimuli). We proceeded to validate our stimuli in two ways.

First, participants rated the realism of each stimulus. Creating stimuli that are generally realistic is vital as previous stimulus sets (e.g., line-drawn stimuli) are regarded as not representative of actual body types (Kościński, 2013). Given that we aim to create various body shapes, we anticipate that some stimuli would be more realistic than others. For example, atypical or irregular stimuli which fall outside of the media ideal (i.e., thin, hourglass bodies) or are less frequently encountered (e.g., emaciation) are likely to receive lower realism ratings than those that are more commonly seen (Tovée et al., 1999). Since our stimuli are combinations of different WHRs and BMIs, certain combinations will likely be rated more or less realistic than others. For instance, a 0.6| obese (i.e., a 0.6| WHR with obese BMI; henceforth referred to in this format) represents a narrow waist with a high body fat distribution). Whilst this is a possible body type, the combination is far less likely to be encountered in real life and more likely to appear unrealistic or odd. Although we acknowledge that a disparity in realism ratings is possible, it is essential for us to include a range of body types to capture their variability (Salusso-Deonier et al., 1991), and this is our attempt to capture the degree of perceived realism.

Second, participants rated the stimuli for their attractiveness, health, and fertility. We collected these to determine the validity of the stimuli by comparing the pattern of ratings to the patterns shown using other stimuli (e.g., line-drawn stimuli). Research examining men's WHR and BMI preferences without the influence of situational threat cues has shown that attractiveness, health, and fertility ratings follow an inverted-U-shaped or inverted bell-shaped pattern (Streeter, 2003; Tovée et al., 1999), with preference ratings peaking for combinations of 0.7| average and decreasing as WHR and BMI move away from this combination. If our stimuli are valid, we expect their ratings to follow a similar attractiveness, health, and fertility pattern. We examine this individually for each WHR and BMI category and the combination of each WHR and BMI.

As such, the *first* objective of this chapter is to develop a computerised set of 3D-modelled stimuli varying across five WHR and BMI categories. Within this objective, we also aim to validate our stimuli to ensure they are deemed realistic and follow a similar attractiveness, health, and fertility pattern to previously used stimulus sets (e.g., line-drawn stimuli).

4.1.3 Stimuli Selection for Future Experiments

The *second* objective of this chapter is to select the stimuli to be used in the remainder of this thesis. As previous research has largely used clothed stimuli and mating decisions typically occur when a partner is clothed, we opted to use clothed stimuli within this thesis (Boothroyd et al., 2012; Hall et al., 2011). To select our stimuli, we will observe differences in the realism ratings provided by participants and select a subset comprising the 25 stimuli (5 WHR categories x 5 BMI categories) most realistic (mean score) stimuli for each WHR and BMI category combination.

4.2 Stimuli Development

Similar to previous research (Boothroyd et al., 2012; Crossley et al., 2012; Mutale et al., 2016), the 3D modelling software Daz^{3D} (version: 4.15.0.2) was used to create the stimuli. Daz^{3D} is free modelling software that manipulates 3D objects (including bodies). The stimuli were created on a Windows 10 computer running on an AMD Ryzen 7 5800x paired with an Nvidia RTX 3060ti. This combination permitted the stimuli to be rendered in real-time using the Nvidia Iray technology, allowing adjustments to the stimuli to occur in parallel with the rendering process. A template model (Genesis 3 female) was imported as the base stimuli; all alterations were made to this stimulus. Two packages, *body morph* (https://www.daz3d.com/genesis-3-female-body-morphs) and *measurement metric* (https://www.daz3d.com/measure-metrics-for-daz-studio), were used to alter the stimuli and take measurements, respectively. Alterations to the body stimuli occurred over several stages.

To begin with, we created an unclothed base stimulus with standardised features. Each stimulus had the same pose, a full-frontal centred stimulus, with the arms maintained at a stable angle. This stance is used commonly in the literature (K. K. Cornelissen et al., 2017; Saxton et al., 2020). We modelled the stimuli to have the same hairstyle and blank facial expression. Using the measurement metrics package, we also standardised the height of the stimuli to be 1.66m (5ft 5in). This height was the lowest the software would allow, making it as close to the UK average height for women (1.64m; 5ft 4in) as possible (NCD.RisC, 2019). The stimuli's skin tone was maintained as White/Caucasian using the software's preset options. No alterations were made to breast size intentionally, but the size of breasts did increase somewhat as BMI increased. These changes were minor but necessary to ensure the stimuli appeared natural. Most research has found no influence of breast size on perceived attractiveness (Dixson et al., 2011a; Furnham et al., 2006), and we were not concerned by these relatively minor inter-stimulus differences. A clothed stimulus was then created by adding the base clothing options in Daz^{3D} to the standardised unclothed stimuli. This process produced two standardised template stimuli: clothed and unclothed.

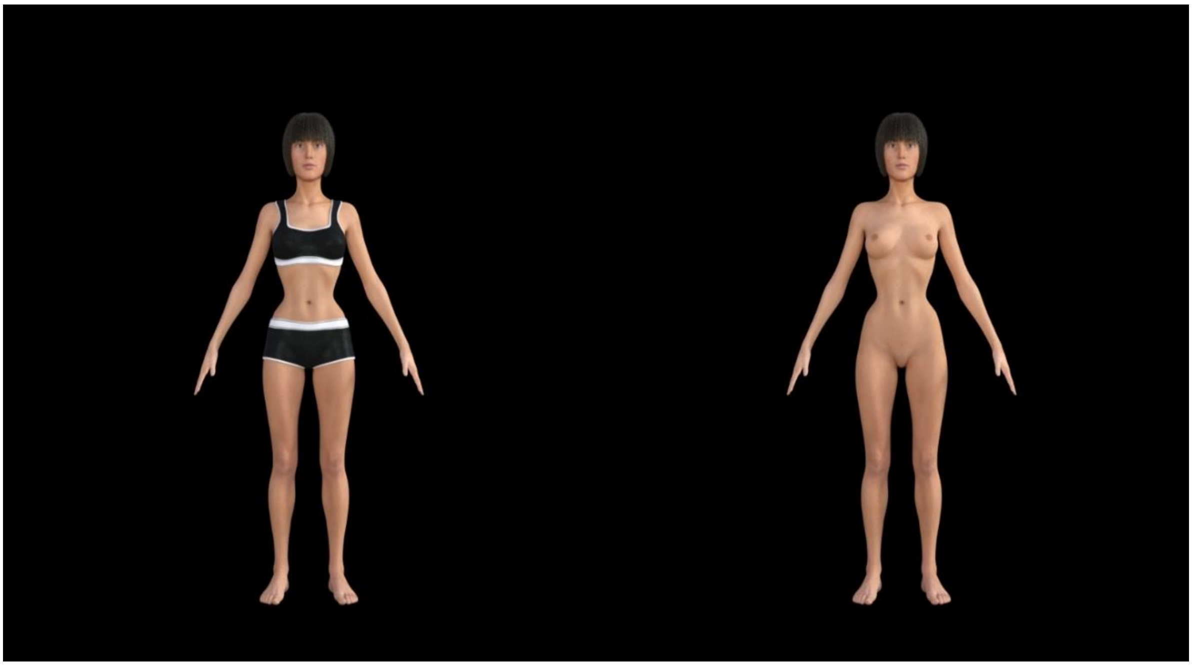
Next, we altered the WHR of these standardised template stimuli, using the base Daz^{3D} waist-to-hip slider to increase or decrease WHR as required. Initially, we created a stimulus with a 0.6 WHR, and we then progressively increased the ratio to create five WHR variations: 0.6, 0.7, 0.8, 0.9, and 1.0. We used the measurement metric tool to measure WHR. This tool allowed for the waist and hip area circumference to be measured rather than the point-to-point distance used when measuring the 2D stimuli (Moscone et al., 2017). We continued this process until we had created 5 WHR categories (i.e., 0.6, 0.7, 0.8, 0.9 and 1.0).

Following this, we then manipulated the body fat distribution to vary the BMI of the stimuli. We did this using the body morph package, which varies the body fat using custom slider options. The bodies were then exported to Autodesk 3Ds Max (version: 23.0.0.915) to obtain individual BMI values. Autodesk 3Ds Max calculates the volume (*V*) of the object in cm^3. By taking the volume (*V*cm^3) of the stimulus and the average young woman's body density (1.4 g/cm^3), we were able to calculate the mass of the body (kg): $kg = (1.4\ g/cm^3 / Vcm^3)/1000.$ Using the mass, we calculated the BMI of the body by dividing the mass (kg) by the height of the image squared (m^2), resulting in BMI measurements in kg/m^2. This calculation has been used previously (e.g., Mutale et al., 2016). This process resulted in five BMI categories: emaciated (<15kg/m^2), underweight (15 - 18.5kg/m^2), average (18.5 - 24.9kg/m^2), overweight (25 - 29.9kg/m^2), obese (>30kg/m^2).

Owing to the extensive range of BMIs we included (<15kg/m2 - >30kg/m2), we created multiple stimuli within each BMI category and paired these with each of the five WHR categories. BMI was increased by 1kg/m^2 (±0.1), starting from 13.6kg/m^2 and ending at 34.7kg/m^2. This range represented the maximum and minimum BMI that the software could produce. Initially, this resulted in 110 stimuli. We determined that validating this number of stimuli would be challenging due to the demand it would place on the participants (as the survey would take around 1 hour to complete), and a reduced sample of 60 stimuli was selected to be validated. This sample included two emaciated (13.6kg/m^2, 14.6kg/m^2), two underweight (15.6kg/m^2, 17.6kg/m^2) and two overweight (25.6kg/m2, 29.6kg/m^2) stimuli. We selected three average (18.6kg/m^2, 21.6kg/m^2, 24.6kg/m^2) and three obese (30.6kg/m^2, 32.6kg/m^2, 34.6kg/m^2) stimuli because of the larger BMI range for these categories (relative to the remaining three categories).

Finally, the stimuli were rendered in Daz^{3D}. The stimuli had a plain black background, thereby helping to reduce background noise effects (Minami et al., 2018). We selected 60 clothed and 60 unclothed stimuli to be validated. Each stimulus combined a WHR and a BMI category (e.g., 0.7| average, 0.6| Obese). See Figure 4.1 for an example. The complete set comprising the created body stimuli is accessible on the OSF sub-repository (https://tinyurl.com/LCC2023-stimuli).

Figure 4. 1
An Example of the Clothed (Left) and Unclothed (Right) Stimuli.



Note: The stimuli shown consist of a 0.6 WHR and a BMI of 18.6 (i.e., average BMI)

4.3 Stimuli Validation

4.3.1 Design, Participants, and Procedure

The validation studies comprised two online surveys run using Qualtrics (www.qualtrics.co.uk). Data collection occurred between May and July 2021. Initially, 314 participants were recruited through snowball sampling (n = 141; 44.91%) and crowdsourcing methods through Prolific (n = 173; 55.10%). Participants from Prolific received £1.88 (£7.50/hr) in compensation for participating. Per Prolific's recommendation policies, we used attention checks to reduce lazy responses. Participants resided in the UK or Ireland, but unlike the subsequent experiments, we did not restrict participants' ethnicity, gender, or sexual identity. We did this to capture a diverse range of responses. As each survey required 25 minutes, we determined that two surveys would increase participant engagement. To this end, we created one survey for the clothed stimuli (Study 1a) and another for the unclothed stimuli (Study 1b). Participants were able to complete both surveys should they wish. Each survey contained the same procedure and content (but different stimuli). Of the 314 participants, we excluded 52 participants for providing poor-quality data (i.e., failed the attention checks, completed the survey unrealistically quickly, or responded with the same response to each question) or failing to meet the study's inclusion criteria. The final sample comprised 262 participants.

The sample that rated the clothed stimuli in Study 1a consisted of 127 participants aged 18-55 (M_{age}= 28.94, SD_{age}= 8.79). The sample comprised 67 women (M_{age}= 28.15, SD_{age}= 9.13) and 60 men (M_{age}= 29.83, SD_{age}= 8.39) defined by their sex assigned at birth. The sample that rated the unclothed stimuli in Study 1b consisted of 134 participants aged 18-54 (M_{age} = 29.46, SD_{age} = 9.14). The sample comprised 74 women (M_{age} = 28.96, SD_{age} = 9.11) and 60 men (M_{age} = 30.07, SD_{age} = 9.21) defined by their sex assigned at birth. Table 4.1 provides more information on the demographic details for both samples.

Initially, the participants were greeted with an information screen before being asked to provide informed consent. Following this, the participants completed the demographic questions. Next, they received an instruction screen which contained the definitions shown in Table 3.2 and an additional definition for the realism ratings ("*To what extent do you believe the person depicted in the image is realistic?*"). This question was intentionally left as open as possible to avoid participants rating the stimuli on any specific characteristic, such as whether it represented a *real woman's* body. This definition, for instance, may have caused the stimuli to be rated as generally unrealistic purely because they were digitally created. Participants then rated the 60 stimuli for their realism, attractiveness, health, and fertility in randomised order.

We used a 7-point rating scale to capture these ratings, ranging from 1 (*very unattractive, unhealthy, unfertile, unrealistic*) to 7 (*very attractive, healthy, fertile, realistic*).

Table 4. 1
Demographic Information for the Sample that Rated the Clothed and Unclothed Stimuli.

Demographic question	Clothed (N = 127)	Unclothed (N = 134)
Gender identity		
Cis man	59 (46.5%)	61 (45.5%)
Cis woman`	63 (49.6%)	70 (52.2%)
Non-binary	3 (2.4%)	3 (2.2%)
Prefer not to indicate	2 (1.6%)	-
Ethnicity		
White	96 (75.6%)	103 (76.9%)
Asian or Asian British	12 (9.5%)	10 (7.5%)
Black, African, Caribbean, or Black British	8 (6.3%)	1 (.8)
Multiple or Mixed	7 (5.5%)	4 (3.0%)
Other	1 (.8%)	3 (2.2%)
Prefer not to indicate	1 (.8%)	2 (1.5%)
Not listed	2 (1.6%)	11 (8.2%)
Sexual orientation		
Straight	108 (85.0%	108 (80.6%)
Gay	4 (3.2%)	9 (6.7%)
Bisexual	10 (7.9%)	14 (10.5%)
Pansexual	3 (2.4%)	1 (.8%)
Other	-	1 (.8%)
Prefer not to indicate	2 (1.6%)	1 (.8%)
Relationship status		
Single	45 (35.4%)	46 (34.3%)
Dating	34 (26.8%)	31 (23.1%)
Married	29 (22.8%)	31 (23.1%)
Civil partnership	4 (3.2%)	6 (4.5%)
Divorced (single)	2 (1.6%)	-
Divorced (in a relationship)	1 (.8%)	-
Separated	1 (.8%)	1 (.8%)
Unmarried but in a relationship not listed	11 (6.2%)	19 (14.2%)
Relationship length		
Less than 2 years	22 (27.9%)	21 (24.1%)
Between 2 – 5 years	17 (21.5%)	19 (21.8%)
Greater than 5 years	40 (50.6%)	46 (52.9%)

Notes. Only the demographic options that participants used are illustrated. Information regarding relationship length only includes participants who indicated being in a relationship.

4.3.2 Analysis Plan

Validation of the stimuli began by examining the mean realism ratings for each of the individual 60 clothed and 60 unclothed stimuli. Examining realism ratings at the stimulus level was necessary to check which specific stimuli were more or less realistic. We used these individual ratings when selecting the stimuli for use in the remainder of this thesis. Next, we examined the attractiveness, health, and fertility ratings. First, we calculated mean ratings for each WHR and BMI category by averaging across levels of the other factor. Second, we examined mean ratings for each WHR and BMI combination. The patterns of mean ratings were interpreted together to determine the validity of the stimuli (i.e., how consistent are stimuli rated when considering previous findings). The mean ratings can be interpreted by transposing directly onto the ordinal scale (e.g., 1 = *very unattractive*).

Finally, we calculated inter-rater reliability separately for the realism, attractiveness, health, and fertility ratings to determine agreement in the participants' ratings. To achieve this, we used the Intraclass Correlation Coefficient (ICC). Consistent with previous approaches, an absolute agreement for a mean of *k* raters was used (Swami, Antonakopoulos, et al., 2006; Swami, Caprario, et al., 2006). Higher ICC values indicate greater agreement (ranging from 0 – 1; Koo & Li, 2016) than lower ICC values. We pre-registered the analysis methods used in this chapter (and subsequent amendments) on the OSF (https://tinyurl.com/LCC2023-stimuli).

4.4 Study 1a: Clothed stimuli

4.4.1 Realism Ratings

We began by examining the realism ratings for the clothed stimuli. Overall, the average realism rating for all 60 clothed stimuli was just above the scale midpoint of *neither realistic nor unrealistic*, *M* = 4.13, *SD* = 1.70. The mean realism ratings for each stimulus, shown in Table 4.2, illustrate that some stimuli were more realistic than others, consistent with the initial prediction. Stimulus 27 (0.7| average) was rated as the most realistic, followed closely by stimulus 38 (0.8| overweight), falling just below the *realistic* boundary. In contrast, stimulus 6 (0.6| emaciated) was rated as the lowest in terms of realism, falling just higher than the *unrealistic* boundary. Similar low realism ratings were observed for stimulus 14 (0.9| underweight) and stimulus 15 (1.0| underweight), which fell between the *unrealistic* and *somewhat unrealistic* boundaries. This pattern supports the prediction that some stimuli would be rated more realistic. We found excellent agreement between raters for the realism ratings, $r = .93$, 95% CI [.90, .94], $p < .001$.

Table 4. 2
Means and Standard Deviations (SD) for Realism Ratings (Clothed Stimuli).

Stimulus number	BMI	WHR	Mean	SD	Stimulus number	BMI	WHR	Mean	SD
1	Emaciated	0.6	2.65	1.56	31	Average	0.6	4.08	1.65
2	Emaciated	0.7	3.19	1.56	32	Average	0.7	5.55	1.05
3	Emaciated	0.8	3.61	1.60	33	Average	0.8	5.57	1.10
4	Emaciated	0.9	3.02	1.50	34	Average	0.9	5.14	1.14
5	Emaciated	1	2.65	1.38	35	Average	1	4.70	1.33
6	Emaciated	0.6	2.20	1.35	36	Overweight	0.6	4.13	1.60
7	Emaciated	0.7	3.59	1.61	37	Overweight	0.7	5.49	1.17
8	Emaciated	0.8	3.61	1.48	38	Overweight	0.8	5.65	1.06
9	Emaciated	0.9	2.90	1.48	39	Overweight	0.9	5.20	1.31
10	Emaciated	1	2.81	1.41	40	Overweight	1	4.50	1.45
11	Underweight	0.6	2.49	1.28	41	Overweight	0.6	3.46	1.74
12	Underweight	0.7	4.38	1.49	42	Overweight	0.7	5.28	1.08
13	Underweight	0.8	4.19	1.27	43	Overweight	0.8	5.07	1.22
14	Underweight	0.9	2.77	1.44	44	Overweight	0.9	4.75	1.28
15	Underweight	1	2.51	1.34	45	Overweight	1	4.26	1.47
16	Underweight	0.6	2.60	1.49	46	Obese	0.6	3.45	1.57
17	Underweight	0.7	4.92	1.25	47	Obese	0.7	4.99	1.44
18	Underweight	0.8	4.79	1.23	48	Obese	0.8	5.02	1.25
19	Underweight	0.9	3.42	1.53	49	Obese	0.9	4.60	1.35
20	Underweight	1	2.80	1.45	50	Obese	1	4.45	1.46
21	Average	0.6	3.39	1.48	51	Obese	0.6	3.43	1.63
22	Average	0.7	4.98	1.31	52	Obese	0.7	4.80	1.26
23	Average	0.8	5.12	1.10	53	Obese	0.8	5.00	1.26
24	Average	0.9	3.93	1.40	54	Obese	0.9	4.61	1.46
25	Average	1	3.21	1.43	55	Obese	1	3.89	1.63
26	Average	0.6	4.06	1.63	56	Obese	0.6	2.83	1.71
27	Average	0.7	5.67	1.07	57	Obese	0.7	4.13	1.49
28	Average	0.8	5.57	1.07	58	Obese	0.8	4.80	1.22
29	Average	0.9	5.20	1.13	59	Obese	0.9	4.61	1.37
30	Average	1	4.00	1.58	60	Obese	1	4.04	1.77

Notes. Mean values can be interpreted on the ordinal scale. 1 = *very unrealistic*, 2 = *unrealistic*, 3 = *somewhat unrealistic*, 4 = *neither unrealistic nor realistic*, 5 = *somewhat realistic*, 6 = *realistic*, 7 = *very realistic*. Stimulus numbers reflect those given to each stimulus on the OSF.

4.4.2 Attractiveness, Health, and Fertility Ratings

We next examined the attractiveness, health, and fertility ratings to assess the validity of our stimuli. First, the mean ratings for each WHR and BMI category averaged across the other were examined (Table 4). As expected, 0.7 WHR received the highest mean rating across the three measures. In contrast, 1.0 WHR received the lowest mean ratings across the three measures. Similarly, as predicted, average BMI received the highest mean rating across the three measures, whereas emaciated BMI received the lowest mean rating across the three measures. As shown in Table 4.3, the mean ratings across each WHR and BMI category support the predicted pattern.

Table 4. 3
Means and Standard Deviations of Ratings for Each WHR and BMI Category (Clothed Stimuli).

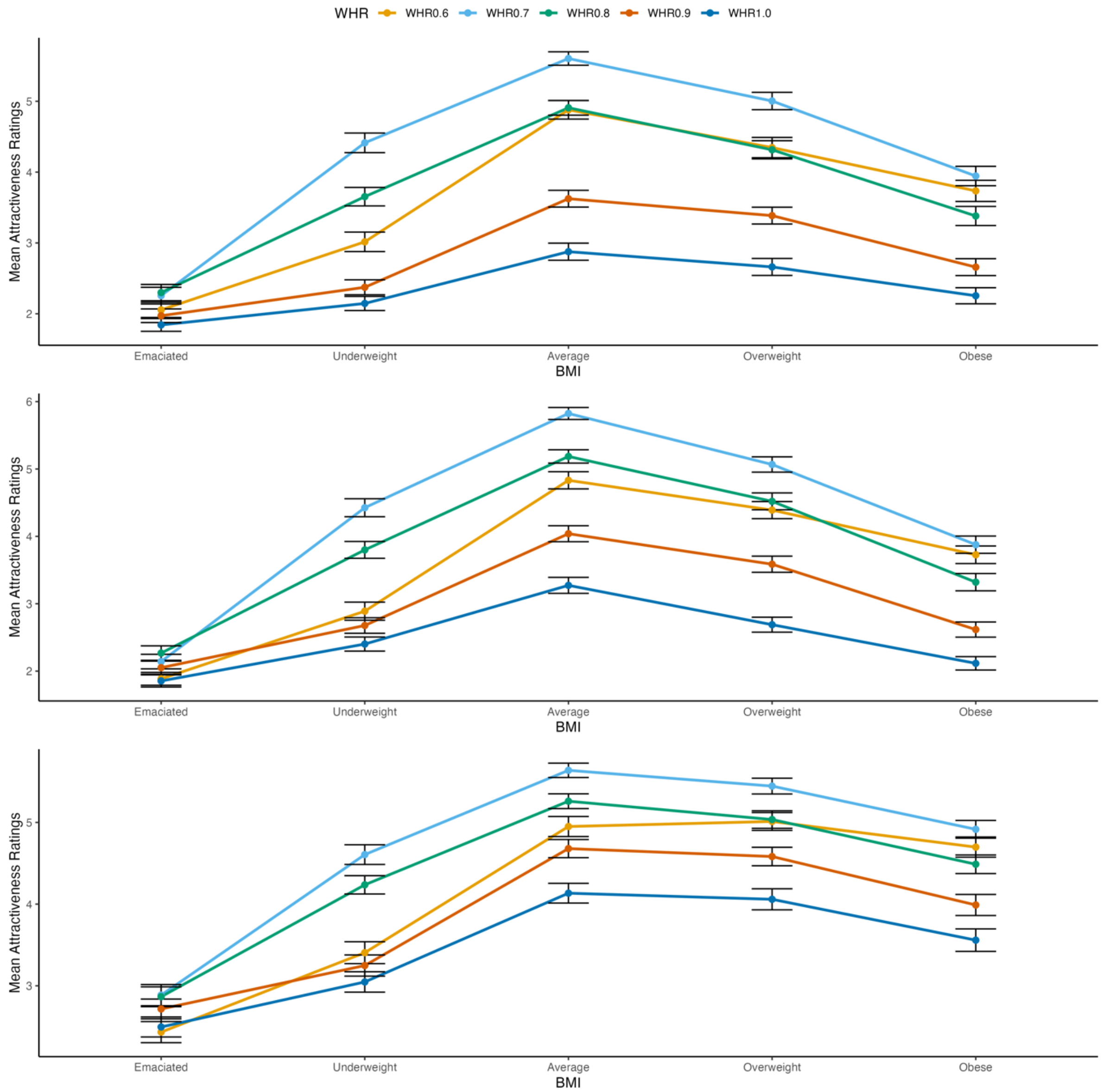
	Outcome		
	Attractiveness	Health	Fertility
BMI			
Emaciated	2.09 (1.20)	2.04 (1.13)	2.68 (1.42)
Underweight	3.12 (1.62)	3.24 (1.58)	3.71 (1.53)
Average	**4.38 (1.62)**	**4.63 (1.54)**	**4.93 (1.32)**
Overweight	3.94 (1.65)	4.05 (1.58)	4.83 (1.34)
Obese	3.19 (1.61)	3.13 (1.51)	4.33 (1.47)
WHR			
0.6	3.72 (1.81)	3.67 (1.74)	4.22 (1.70)
0.7	**4.33 (1.77)**	**4.36 (1.78)**	**4.79 (1.53)**
0.8	3.78 (1.64)	3.89 (1.66)	4.46 (1.46)
0.9	2.86 (1.41)	3.05 (1.47)	3.93 (1.55)
1.0	2.39 (1.30)	2.50 (1.30)	3.52 (1.55)

Notes. Standard deviations are represented in parentheses. **Bold** indicates the highest mean rating.

Second, the mean attractiveness, health, and fertility ratings were examined for each combined WHR and BMI category. These are shown in Figure 4.2, plots A, B and C, respectively. Again, we found the predicted inverted U-shaped pattern. The ratings across the three measures peaked at 0.7| average, indicating this combination of WHR and BMI was most attractive, healthy, and fertile. In comparison, the lowest attractiveness and health ratings occurred for 1.0| emaciated, while the lowest fertility ratings occurred for 0.6| emaciated. Ratings across the three measures were generally lower when the bodies had emaciated BMI, regardless of the WHR. In summary, we found the predicted inverted U-shaped pattern across all three plots.

Finally, we calculated the ICC for each of the three measures. Excellent agreement was found between the raters for attractiveness, $r = .93$, 95% CI [.91, .95], $p < .001$, health, $r = .92$, 95% CI [.90, .94], $p < .001$, and fertility ratings, $r = .95$, 95% CI [.93, .96], $p < .001$.

Figure 4. 2
Mean Attractiveness, Health, and Fertility Ratings for each Clothed WHR and BMI Combination.



Notes. Error bars indicate the standard error.

4.5 Study 1b: Unclothed Stimuli

4.5.1 Realism Ratings

We next analysed the realism ratings for the unclothed stimuli. Descriptive statistics for each stimulus are shown in Table 4.4. Overall, the ratings for the unclothed stimuli were similar to the clothed stimuli, falling just above the *neither realistic nor unrealistic* boundary, M = 4.16, SD = 1.74. Examining the distribution of realism ratings for each stimulus revealed a similar trend to the clothed stimuli. Stimulus 27 (0.7| average) was rated as the most realistic, followed closely by stimulus 33 (0.8| average), 32 (0.7| average) and 37 (0.7| overweight), falling just below the *realistic* boundary. In contrast, stimuli 6 (0.6| emaciated) and 10 (1.0| emaciated) were the least realistic. The mean ratings fell just higher than the *unrealistic* boundary. This pattern supported the prediction that some stimuli would be rated more realistic than others and is comparable to the pattern for the clothed stimuli. Finally, we calculated the ICC for realism ratings. We found excellent agreement between the raters for the realism ratings, r = .91, 95% CI [.88, .93], p <.001.

Table 4. 4
Means and Standard Deviations (SD) for Realism Ratings (Unclothed Stimuli).

Stimulus number	BMI	WHR	Mean	SD	Stimulus number	BMI	WHR	Mean	SD
1	Emaciated	0.6	2.73	1.57	31	Average	0.6	3.92	1.62
2	Emaciated	0.7	3.28	1.55	32	Average	0.7	5.67	1.03
3	Emaciated	0.8	3.19	1.59	33	Average	0.8	5.71	1.02
4	Emaciated	0.9	2.87	1.37	34	Average	0.9	5.08	1.12
5	Emaciated	1	2.49	1.40	35	Average	1	4.25	1.53
6	Emaciated	0.6	2.37	1.41	36	Overweight	0.6	4.05	1.72
7	Emaciated	0.7	3.54	1.54	37	Overweight	0.7	5.67	1.03
8	Emaciated	0.8	3.31	1.45	38	Overweight	0.8	5.63	0.97
9	Emaciated	0.9	2.82	1.43	39	Overweight	0.9	5.14	1.20
10	Emaciated	1	2.37	1.19	40	Overweight	1	4.28	1.51
11	Underweight	0.6	2.91	1.52	41	Overweight	0.6	3.78	1.66
12	Underweight	0.7	3.72	1.45	42	Overweight	0.7	5.26	1.20
13	Underweight	0.8	3.60	1.44	43	Overweight	0.8	5.21	1.21
14	Underweight	0.9	2.72	1.47	44	Overweight	0.9	5.02	1.28
15	Underweight	1	2.42	1.33	45	Overweight	1	4.38	1.59
16	Underweight	0.6	3.34	1.59	46	Obese	0.6	3.85	1.56
17	Underweight	0.7	4.88	1.32	47	Obese	0.7	5.31	1.14
18	Underweight	0.8	4.40	1.45	48	Obese	0.8	5.23	1.09
19	Underweight	0.9	3.37	1.57	49	Obese	0.9	4.96	1.30
20	Underweight	1	2.40	1.24	50	Obese	1	5.25	1.27
21	Average	0.6	3.37	1.60	51	Obese	0.6	3.41	1.58
22	Average	0.7	5.41	1.16	52	Obese	0.7	5.00	1.29
23	Average	0.8	4.99	1.20	53	Obese	0.8	5.12	1.33
24	Average	0.9	3.54	1.41	54	Obese	0.9	4.90	1.40
25	Average	1	3.01	1.52	55	Obese	1	4.37	1.67
26	Average	0.6	3.84	1.65	56	Obese	0.6	3.07	1.61
27	Average	0.7	5.84	0.95	57	Obese	0.7	4.44	1.45
28	Average	0.8	5.63	1.02	58	Obese	0.8	5.22	1.22
29	Average	0.9	5.04	1.28	59	Obese	0.9	4.98	1.29
30	Average	1	3.40	1.61	60	Obese	1	4.56	1.60

Notes. Mean values can be interpreted on the ordinal scale. 1 = *very unrealistic*, 2 = *unrealistic*, 3 = *somewhat unrealistic*, 4 = *neither unrealistic nor realistic*, 5 = *somewhat realistic*, 6 = *realistic*, 7 = *very realistic*. Stimulus numbers reflect those given to each stimulus on the OSF.

4.5.2 Attractiveness, Health, and Fertility Ratings

First, the mean attractiveness, health, and fertility ratings for each WHR and BMI category averaged across the other were examined. These ratings are illustrated in Table 4.5. As predicted, 0.7 WHR received the highest mean rating across the three measures. In contrast, 1.0 WHR received the lowest mean ratings across the three measures. This distribution of ratings was like that shown for the clothed stimuli. While average BMI was shown to have in attractiveness and health ratings, overweight BMI was highest for fertility. However, it is important to note that this difference is slight. Bodies with emaciated BMI received the lowest mean rating across the three measures, like the patterns shown for the clothed stimuli. As such, the distribution of mean ratings supports the predicted inverted U-shaped pattern for WHR but less for BMI.

Table 4. 5

Means and Standard Deviations of Ratings for Each WHR and BMI Category (Unclothed Stimuli).

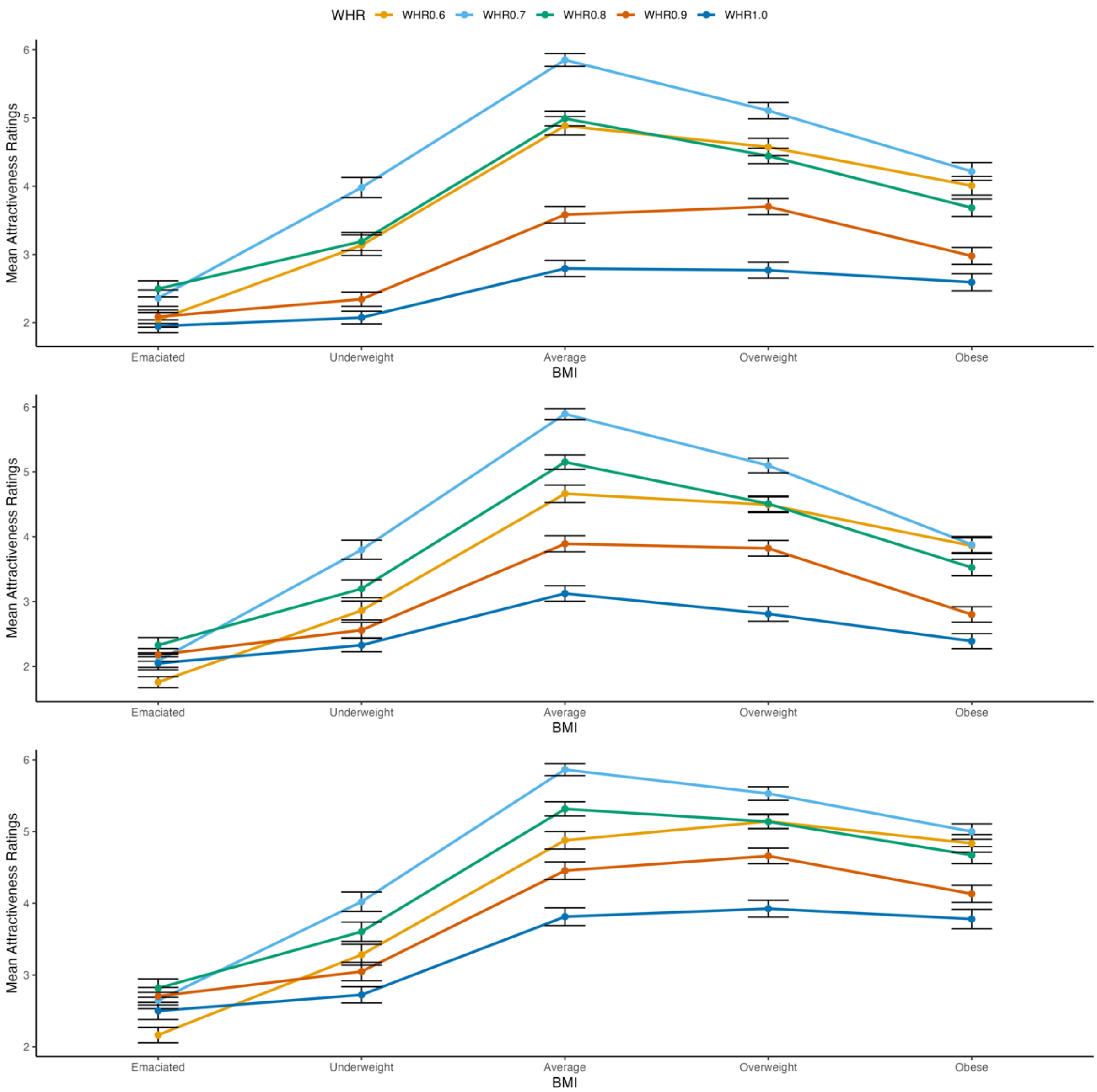
	Outcome		
	Attractiveness	Health	Fertility
BMI			
Emaciated	2.19 (1.23)	2.08 (1.15)	2.57 (1.35)
Underweight	2.94 (1.58)	2.95 (1.56)	3.34 (1.55)
Average	**4.42 (1.70)**	**4.54 (1.62)**	4.87 (1.43)
Overweight	4.12 (1.57)	4.15 (1.53)	**4.88 (1.29)**
Obese	3.5 (1.58)	3.29 (1.49)	4.48 (1.44)
WHR			
0.6	3.85 (1.80)	3.65 (1.74)	4.19 (1.75)
0.7	**4.42 (1.80)**	**4.27 (1.81)**	**4.75 (1.64)**
0.8	3.86 (1.61)	3.84 (1.69)	4.42 (1.59)
0.9	3.00 (1.44)	3.10 (1.48)	3.88 (1.54)
1.0	2.48 (1.31)	2.58 (1.31)	3.42 (1.50)

Notes. Standard deviations (SD) are represented in parentheses. **Bold** indicates the highest mean rating.

Second, the mean attractiveness, health, and fertility ratings were examined for each combined WHR and BMI category. These are shown in Figure 4.3, plots A, B and C, respectively. Again, these ratings were expected to adopt an inverted U-shaped distribution, which was largely the case. The ratings across the three categories peaked at 0.7| average, indicating that this combination of WHR and BMI was viewed most favourably. The lowest attractiveness occurred for 1.0| emaciated, while the lowest health and fertility ratings occurred for 0.6| emaciated. The ratings across the three constructs were generally lower when the bodies represented emaciated BMI, regardless of the WHR. Across all three plots, an inverted U-shaped pattern was evident.

Figure 4. 3

Mean Attractiveness, Health, and Fertility Ratings for each Unclothed WHR and BMI Combination.



Notes. Error bars indicate the standard error.

Finally, the ICC was calculated for each of the three measures. Excellent agreement was found between the raters for attractiveness, $r = .93$, 95% CI [.90, .95], $p < .001$, health, $r = .92$, 95% CI [.89, .94], $p < .001$, and fertility ratings, $r = .92$, 95% CI [.89, .94], $p < .001$.

4.6 Discussion

Our findings generally support the validity of both the clothed and unclothed stimuli. Our participants rated both the clothed and unclothed stimuli moderately realistic, but ratings varied across each stimulus. We also found general support for our prediction that our clothed stimuli would follow an inverted U-shaped attractiveness, health, and fertility ratings pattern. Whilst there was also a similar predicted inverted U-shaped pattern for the unclothed stimuli for the attractiveness and health ratings, there were noticeable differences for fertility ratings. Our findings have implications for existing WHR and BMI stimuli and support using a subset of clothed stimuli in the remainder of the thesis.

4.6.1 Realism

Our participants generally reported both the clothed and unclothed stimuli as moderately realistic on the 1 - 7 scale, with ratings clustering around the scale midpoint (i.e., *neither realistic nor unrealistic*). Certain stimuli were rated less realistic (e.g., 1.0| emaciated; 0.6| underweight), while others were rated more highly (e.g., 0.7| average; 0.8| overweight). Generally, lower realism ratings could be seen for bodies with lower BMI (i.e., emaciated and underweight), particularly when paired with a low or high WHR (i.e., 0.6 or 1.0 WHR). Conversely, bodies with an average or higher BMI received higher realism ratings. As such, BMI seemed to have the greatest influence on realism ratings. Despite some stimuli being rated less realistic than others, the clothed and unclothed stimuli were rated moderately realistic overall. For this reason, we deemed our stimuli to be appropriate. We used these realism ratings to select the specific stimuli we used in this thesis in Section 4.6.3.

4.6.2 Validity

In addition to realism, we were also interested in how our stimuli compared with other stimuli (e.g., line-drawn stimuli) without the influence of situational threat cues. Research examining men's WHR and BMI preferences without the influence of situational threat cues has shown that attractiveness, health, and fertility ratings follow an inverted-U-shaped or inverted bell-shaped pattern for both WHR and BMI independently and in combination (Streeter, 2003; Tovée et al., 1999). When we examined the combination of each WHR and BMI category, we found that our stimuli followed this expected pattern. We also found a similar pattern when we examined WHR and BMI independently for the clothed stimuli and WHR alone for unclothed stimuli. However, when we examined BMI independently for the unclothed stimuli, the pattern deviated from expectations for the fertility ratings.

Across both the clothed and unclothed stimuli, we found that when examining each combination of WHR and BMI, 0.7| average was rated the highest. The lowest combination did vary across each of the three ratings. However, emaciated BMI combined with each of the five WHR categories was generally perceived as the least attractive, healthy and fertile. The importance of BMI is consistent with some research suggesting that BMI is most associated with influencing attractiveness, health, and fertility ratings (Swami, Antonakopoulos, et al., 2006).

When examining the ratings for each WHR and BMI category averaged across each other, we found that average BMI and 0.7 WHR were rated independently as the most attractive, healthy and fertile for clothed stimuli. In contrast, emaciated BMI and 1.0 WHR were rated as the least attractive, healthy and fertile. For the unclothed stimuli, 0.7 WHR was rated as the most attractive, healthy, and fertile for the unclothed stimuli relative to any other WHR. However, average BMI was rated as the most attractive and healthy but shared similar (albeit only slightly lower) scores in terms of fertility. A potential reason for this discrepancy is that the unclothed stimuli provide more immediate visual information (e.g., protruding bones), and overweight BMI may have been interpreted as more fertile for this reason. Generally, fertility does not decrease as BMI increases and is primarily impacted when BMI decreases (Coetzee et al., 2009; Furnham et al., 2005), so this preference would not negatively impact reproductive capacity.

4.6.3 Summary and Stimuli Selection

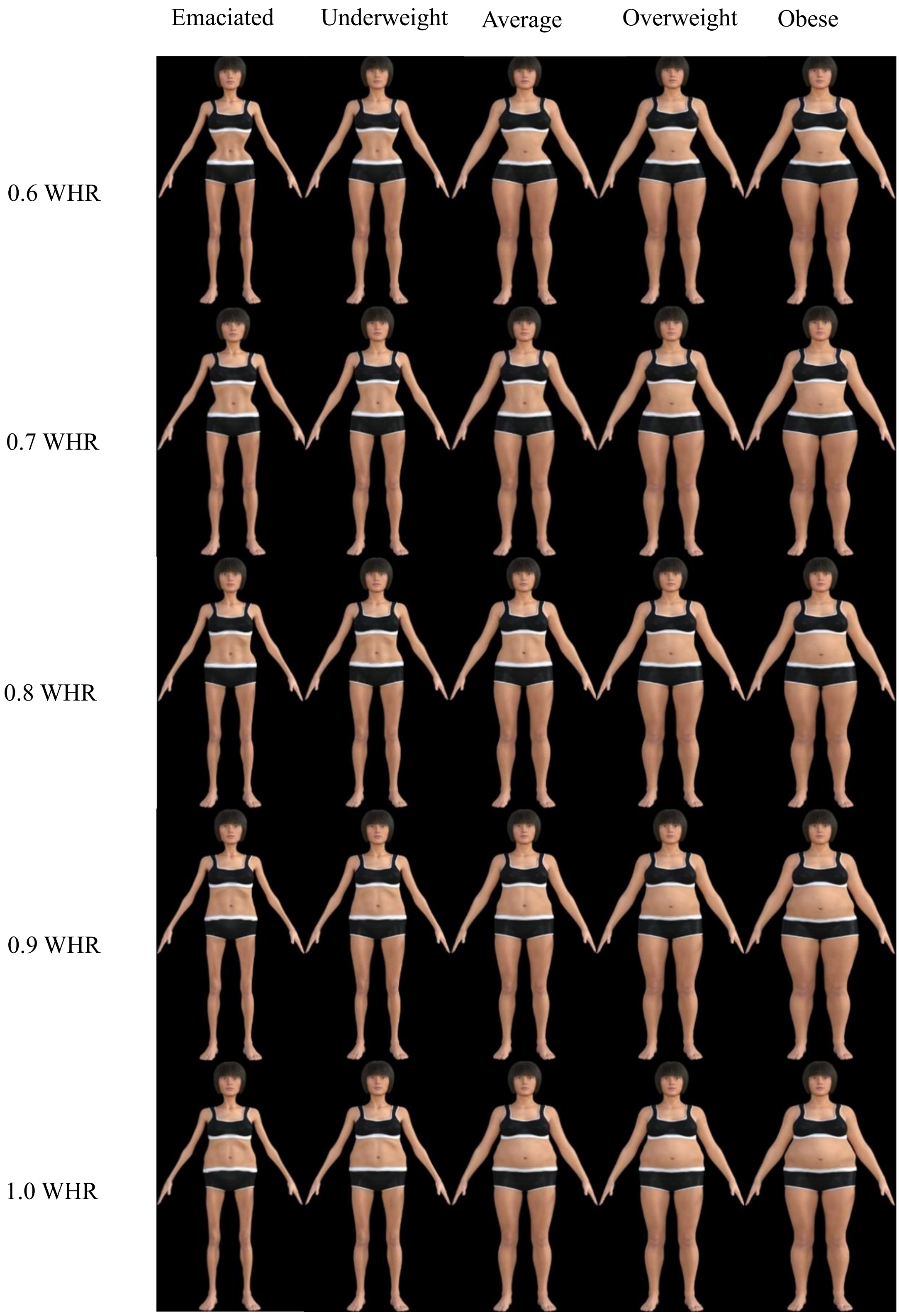
The first objective of this chapter was to create and validate an open-source set of 3D-modelled stimuli ranging in WHR and BMI. Despite some stimuli being rated less realistic than others, the clothed and unclothed stimuli were rated moderately realistic overall. Further, despite some variations in the fertility ratings for the unclothed stimuli, our stimuli received comparable ratings to previous research examining men's WHR and BMI preferences without the influence of situational threat cues. Together, these findings point to the appropriateness of these stimuli for use in this thesis and present a promising new direction for WHR and BMI research. These findings have important implications and differ from previous research that relied on flawed line-drawn or 2D computerised stimuli. Our stimuli help to address some of these limitations and provide more realistic representations of women's WHR and BMI.

The second objective of this chapter was to select the stimuli to be used in the remainder of this thesis. The clothed and unclothed stimuli had similar realism ratings overall, but the latter deviated on a key measure of validity (i.e., fertility ratings). Similarly, previous research has primarily used clothed stimuli (e.g., Boothroyd et al., 2012; Swami & Tovée, 2013). Clothed stimuli may better encapsulate actual mating decisions, as most romantic interactions typically occur when a potential partner is clothed (Hall et al., 2011). Clothed and unclothed stimuli are interpreted differently, with the latter eliciting greater emotional reactions and arousal (Hall et al., 2011; Lykins et al., 2008). For these combined reasons, we opted to use clothed stimuli in the remainder of this thesis. To this end, we selected the 25 most realistic stimuli at each WHR and BMI combination (e.g., 0.7| average). Figure 4.4 presents the 25 stimuli used in the self-report (Chapter 5) and the eye-tracking experiments (Chapter 7).

Based on the findings of this chapter, participants rated 0.7 WHR and average BMI as the most attractive stimuli we selected. Similarly, they rated the combination of 0.7| average as the most attractive relative to other body types. Conversely, they rated 1.0 WHR and emaciated BMI as the least attractive (and, by extension, 1.0| Emaciated). Given this, we conceptualise the most and least attractive WHRs and BMIs along these lines in the subsequent chapters.

Figure 4. 4

The 25 (5 BMI x 5 WHR) Body Stimuli used in this Thesis.



Notes. The stimuli selected were: 6, 9, 12, 13, 15, 26, 27, 28, 29, 30, 47, 48, 49, 61, 65, 66, 76, 68, 69, 70, 91, 92, 93, 95 and 114. Stimulus numbers match those in Table 3 and the OSF (https://tinyurl.com/LCC2023-stimuli). The stimuli presented here are not to scale.

5. CHAPTER 5: SELF-REPORT PREFERENCES UNDER SITUATIONAL THREAT CUES

5.1 Introduction

In the previous chapter, we created, validated, and selected the stimuli for this thesis. This chapter explores the influence of situational threat cues on men's preferences using the selected stimuli. Specifically, we evaluate whether priming men with subtle situational cues influences their WHR and BMI preferences, as indicated by self-report attractiveness ratings.

In this chapter, we investigate the influence of our three situational threat cues. These experiments are the first step toward evaluating an expanded context-dependent model of mate preferences, which examines the influence of immediate situational threat cues on men's body shape and size preferences. These situational threat cues represent potential daily occurrences and are intentionally subtle; any observed experimental effects upon mate preferences might represent an effect that occurs in the natural environment.

Based on previous research, we believed that men exposed to subtle situational mortality, masculinity and pathogen threat cues would experience a change in their mating motivations and a greater preference for traits that men perceived as more attractive than those not experiencing this cue. Conversely, this would decrease preferences for traits generally perceived as less attractive. These different directions would allow us to investigate whether men's preferences increase toward body shapes and sizes perceived as more attractive (i.e., an enhancement effect) or decrease toward body shapes and sizes perceived as less attractive (i.e., a diminishment effect), or both. These changes reflect the *approach fit* and *avoid unfit* directions introduced in Chapter 3, respectively (see Park et al., 2012). We conceptualised the most attractive WHRs and BMIs based on the findings of Study 1a (Chapter 4).

In this chapter, we use the self-report attractiveness paradigm outlined in Chapter 3. This approach involves the participants rating the attractiveness of each stimulus. In this way, attractiveness ratings serve as a proxy for preference (e.g., Lee et al., 2015). As such, higher attractiveness ratings would indicate greater preferences toward a particular body shape or size.

We also report the same broad hypotheses for each experiment. Specifically, considering previous evidence examining preferences for other traits, we hypothesised the following for each of our experiments in this chapter:

1. A significant *two-way interaction between WHR and condition*, such that men in the threat condition (mortality, masculinity and pathogen threat) relative to the control condition would show significantly greater (enhanced) preferences for 0.7 WHR and significantly lower (diminished) preferences for 1.0 WHR.
2. A significant *two-way interaction between BMI and condition*, such that men in the threat condition (mortality, masculinity and pathogen threat) relative to the control condition would show significantly greater (enhanced) preferences for average BMI and significantly lower (diminished) preferences for emaciated BMI.
3. A significant *three-way interaction between WHR, BMI and condition*, such that men in the threat condition (mortality, masculinity and pathogen threat) relative to the control condition would show significantly greater (enhanced) preferences for 0.7 | average and significantly lower (diminished) preferences for 1.0 | Emaciated.

5.2 Experiment 1: Mortality Threat

5.2.1 Introduction

This section investigates whether mortality threat is a situational threat cue influencing men's WHR and BMI preferences. Men primed with mortality threat cues (e.g., using questionnaires regarding death), relative to those that are not, show an increased desire to have children (Fritsche et al., 2007), an enhanced preference for attractive traits (Silveira et al., 2014), and activations in the brain associated with facilitating mating motivations (Plusnin et al., 2018). Based on these findings, we believed that our mortality threat prime would increase men's preferences for the body shapes and sizes they perceive most and decrease their preferences for those they generally perceive as the least attractive, healthy and fertile. Considering previous research, we make the hypotheses listed in Section 5.1 for our mortality threat prime.

5.2.2 Method

5.2.2.1 Design and Participants

We used an online experimental design and randomly assigned participants into one of three conditions: mortality threat condition, control condition and no prime condition. We pre-registered our hypotheses, methods and data analysis approaches on the OSF (https://tinyurl.com/LCC2023-mort). A-priori sample size estimations for ordinal mixed effect models are challenging, and no standardised method exists. As such, we aimed for our sample size to be greater than previous research, which found a mortality threat prime effect (N = 74, Davis et al., 2016; N = 75, Zhao et al., 2019). To this end, we recruited the maximum number of participants our resources would allow (N = 150).

Participant recruitment occurred between August and September 2021. In total, 159 participants were sampled on Prolific and were compensated £1.44 (10 minutes at £8.64/hr[10]). We used relevant attention checks to ensure participants engaged with the task, and we removed nine participants as they failed them (i.e., they failed two or more attention checks). Consequently, 150 participants remained (M_{age} = 35.56, SD_{age} = 9.80), with 50 participants randomly allocated into the mortality threat condition (M_{age} = 34.76, SD_{age} = 9.04), 50 into the control condition (M_{age} = 35.02, SD_{age} = 10.41) and 50 into the no prime condition ($\mathrm{M_{age}}$ =36.9, $\mathrm{SD_{age}}$ = 9.95). A one-way ANOVA revealed no significant age differences across the three conditions, $F(2, 147) = .71$, $p = .494$.

5.2.2.2 Materials

Priming Methods. We randomly assigned our participants to one of the three above conditions. Those in the mortality threat condition received ten items from the Fear of Personal Death Scale (Florian & Kravetz, 1983), in which participants placed "*Death frightens me because*" before each of the ten statements (e.g., "*I will be forgotten*"). The participants rated how accurately the statement related to them on a 5-point rating scale, ranging from 1 (*Untrue*) to 5 (*True*). The participants also completed a free text question asking them, "*Briefly explain*

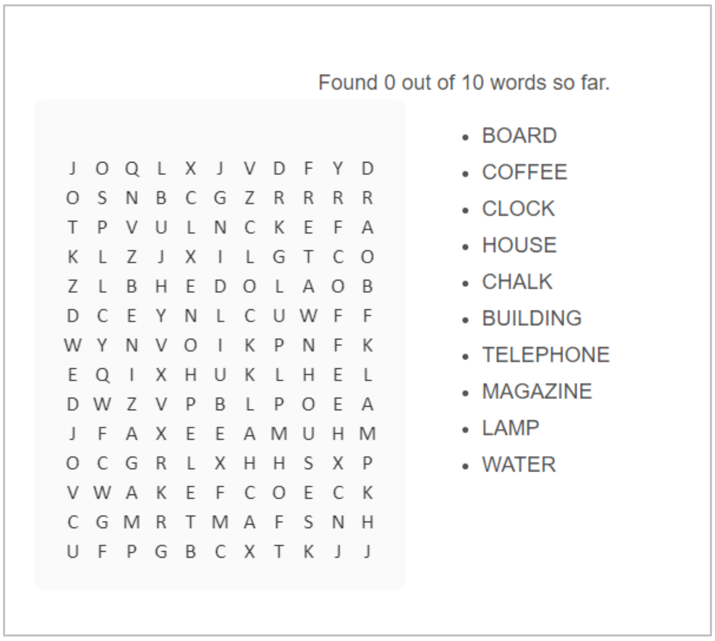
[10] We initially planned and pre-registered paying participants 88p based on our study taking an estimated 7 minutes. However, our experiment took 10 minutes on average, and we increased our payment to £1.44 to ensure participants were fairly compensated.

what feelings the thought of death arouses”. These methods have been used in prior research to elicit responses consistent with death anxiety (Davis et al., 2016; Grabe et al., 2005). We used both methods to increase the prime’s effect and ensure the participants engaged with the task.

Those in the control prime condition received the same procedure, completing ten items regarding their leisure time activities. The participants placed “*My leisure time activities excite me because*” before each of the ten statements (e.g., “*I get to spend time with relatives*”) and rated how accurately the statement related to them on a 5-point rating scale ranging from 1 (*Untrue*) to 5 (*True*). The statements used thematically matched those given to the mortality prime condition. The participants also answered, “*Briefly explain what feelings typically occur during your leisure time activities*”. This control prime has been used previously by Davis et al. (2016). Those in the no prime condition received no content and immediately started the distraction task. Appendix one provides a more thorough description of this experiment's mortality and control primes.

Distraction Task. All three conditions were presented with a distraction task, as previous evidence has suggested that mortality threat occurs subconsciously and requires a brief delay to cause death anxiety. This is because death anxiety requires time to incubate. Accordingly, a word-search paradigm was used, similar to previous research (Grabe et al., 2005). The participants received a word search adapted from Cusack et al. (2015), consisting of an 11 x 14 grid of letters. The task was embedded into our Qualtrics task so participants could drag their mouse to identify a word. Each participant received the same puzzle, with the same ten words to identify, to ensure the difficulty was comparable across the sample (see Figure 5.1). When the participants identified a word, it was crossed out from the list, and a performance indicator on the screen (“*Found [number] out of 10 words so far*”) was updated. A three-minute timer was also visible, and the participants could not proceed (even if they identified all ten words) until the timer had ended. The time limit was the same as Grabe et al. (2005) used previously.

Figure 5. 1
Word Search Distractor Task for Experiment 1.



5.2.2.3 Procedure

Upon opening the experiment, the participants were automatically allocated into one of the three conditions in a double-blind fashion. The participants reported their age, sex assigned at birth, gender identity, sexuality, ethnicity, and country of residence. The participants then received the relevant priming materials and the distraction task. Those in the no prime condition completed the distraction task directly after the demographic questions. Once the three-minute time limit had expired, the participants proceeded to the body stimuli rating task. They were presented with the 25 body stimuli in randomised order and rated each for their attractiveness[11]. The participants were then thanked, debriefed, and redirected to Prolific to claim compensation for their participation at the end of each full experiment run.

5.2.2.4 Analysis Plan

In this chapter, we define our modelling approach for this and subsequent experiments. To examine the hypotheses, we used mixed-effect ordinal logistic regressions employing the *ordinal* package (Christensen, 2019), modelling participants as a random effect and WHR, BMI, and condition modelled as fixed-effect predictors. Attractiveness ratings were modelled

[11] For transparency, our participants also rated each stimulus for their health and fertility (alongside attractiveness ratings) for experiments one – three. We initially aimed to report these values, but for brevity, we opted not to repeat these findings as the patterns shown were the same as those we reported in Chapter 4. However, the health and fertility ratings for each stimulus for experiments one – three are available on the OSF for scrutiny.

as the outcome variable. We modelled the interaction effects for the predictors using the *drop1* function. This function drops each effect in turn in a type II Likelihood Ratio Test (LRT), allowing for effects to be estimated (Baguley et al., 2022). Pairwise comparisons employed the more powerful Holm correction method (Field et al., 2012). In the subsequent analyses, we focused on the two- and three-way interaction effects between WHR, BMI and condition. However, we present the main effects for completeness.

We summarise any effects using predicted probabilities from the ordinal model (ranging from 0 - 1). Specifically, these estimates reflect the probability of a participant providing a particular response on the ordinal scale (i.e., range of 1 – 7) and can be directly transposed onto the ordered category labels (i.e., very unattractive – very attractive). These provide a more nuanced interpretation of any effect. Additionally, we also provide estimated marginal means. These can similarly be interpreted as representing responses on the ordinal scale and can be directly compared to the category labels (see Baguley et al., 2022).

As discussed in Chapter 3, we included a no prime condition within this experiment (and experiments two and three). To our knowledge, no previous research has included this condition. This additional condition added an extra layer of protection and increased confidence in the experimental procedure. As participants completed the research online, it was impossible to control their immediate environment. Specifically, by comparing participants' average attractiveness ratings in the control prime and no prime conditions, it was possible to determine whether having men complete a control task inadvertently influenced their attractiveness ratings. If no differences were present between the control and no prime conditions, then the control condition was believed to have served as a suitable baseline, and the primary analysis proceeded with comparing the threat and control conditions per common practice (Tulving & Hayman, 1995).

Finally, we used our participants' responses to the Fear of Personal Death Questionnaire and their free-text responses to conduct a relevance and appropriateness check.

5.2.3 Results

We completed all analyses in R. The anonymised data, R code, and data analysis outputs are available on the OSF[12]. We later amended our pre-registration on the OSF. These changes were necessary due to the ongoing development of the lead researcher and their greater appreciation of how to address the research question. In the next section, we introduce the preliminary and primary analyses for experiment one.

5.2.3.1 Preliminary Analysis

Descriptive statistics for the attractiveness ratings given to each WHR and BMI category are shown in Table 5.1. The participants rated 0.7 WHR and average BMI as the most attractive. In contrast, on average, 1.0 WHR and Emaciated BMI were rated as the least attractive. These patterns are consistent with Chapter 4.

Table 5. 1
Attractiveness Ratings for each WHR and BMI Category (Experiment 1).

	M	*SD*
WHR		
0.6	3.74	1.74
0.7	**4.43**	**1.70**
0.8	3.71	1.58
0.9	2.72	1.38
1.0	2.16	1.12
BMI		
Emaciated	2.12	1.22
Underweight	3.57	1.59
Average	**4.33**	**1.66**
Overweight	3.91	1.58
Obese	2.83	1.57

Notes. N = 150. *SD* = Standard Deviation. **Bold** values indicate the highest rating for WHR and BMI.

We next examined the main effect of condition to determine whether having men complete a priming task (mortality threat or control prime tasks) influenced their pattern of attractiveness ratings relative to having completed no task. This analysis showed no significant

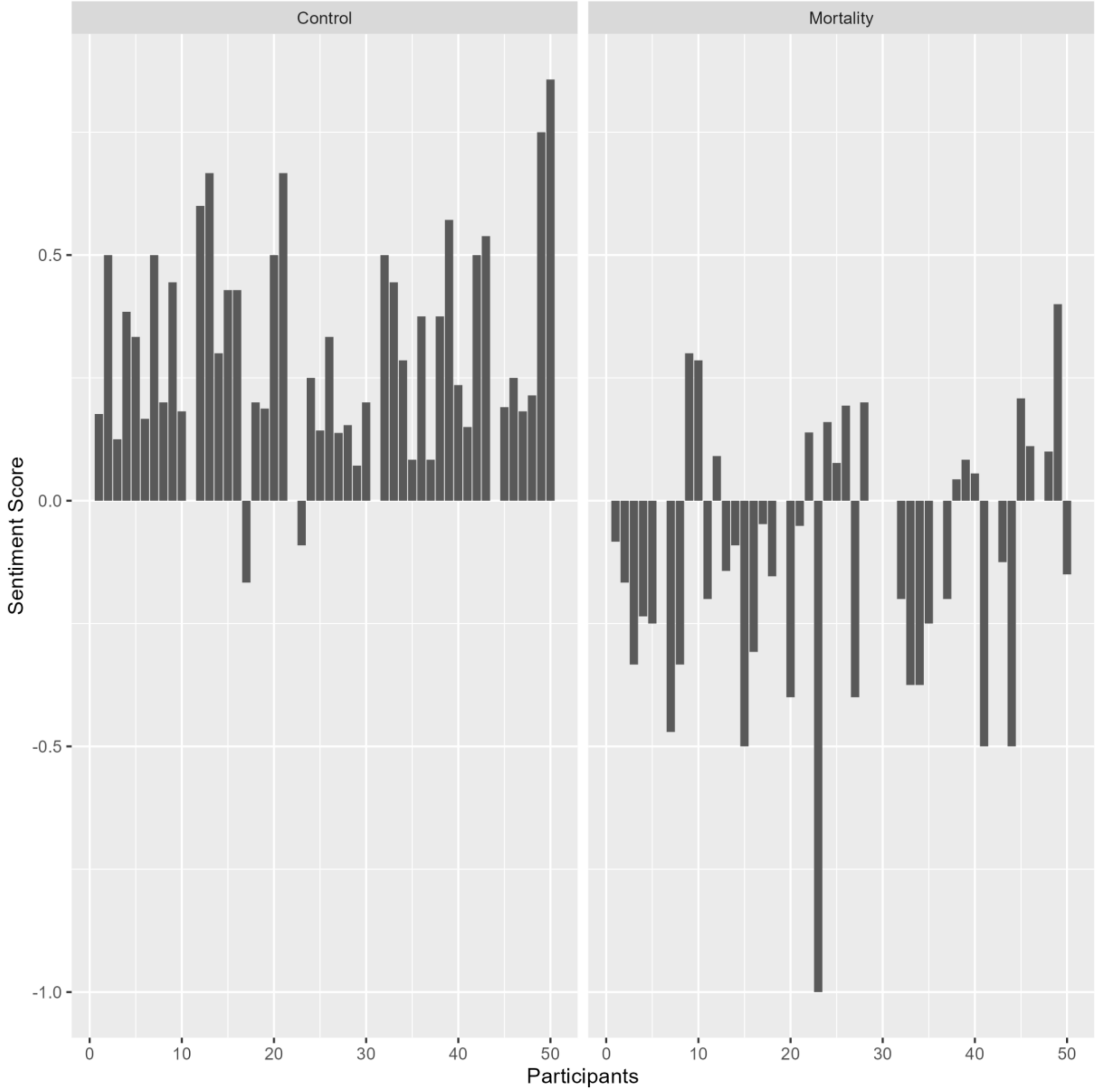
[12] The findings from experiment one were published as a conference poster: Cahill, L., Cristino, F., Marriott, M., Baguley, T., & Dunn, A.K. (2022, July). *The influence of mortality threat on waist-to-hip ratio and body mass index preferences.* [Poster presentation]. International Society for Human Ethology (ISHE), Würzburg, Germany.

differences in attractiveness ratings between the three conditions, $\chi 2(2, 150) = 2.34$, $p = .310$. Given this, we proceeded with the primary analyses as planned by comparing the mortality and control primes and excluding data from the no prime condition as explained above.

To explore our mortality threat manipulation further and conduct our appropriateness check, we assessed our participant's responses to the Fear of Personal Death Questionnaire and their free-text responses. We note that we did not pre-register these analyses, so they should be interpreted as exploratory. Importantly, we used the same morality priming approach as previous research, which did not have participants complete the full questionnaire. Rather, our participants completed ten items. As such, we do not make any claims regarding this, as selecting a subset of items can impair the validity and reliability of a measure. However, for our purposes, this was appropriate. Recall that scores on this measure can range from 5 to 50, with a higher score indicating greater fear of personal death. Our participants generally reported high scores on the measure ($M = 40.56$, $SD = 9.84$). This indicates that our sample reported a high fear of personal death.

We also assessed the free-text responses for the mortality and control conditions. Figure 4.2 demonstrates those responses per participant. As shown, our participants in the mortality threat condition expressed predominantly negative sentiments in their free-text responses, compared with predominantly positive responses for the control condition. We also found that the sentiments expressed in the mortality threat condition were significantly more negative ($M = -.11$, $SD = .26$) than those in the control condition ($t(98) = 8.28$, $p < .001$, $M = .29$, $SD = .22$).

Figure 5. 2
Free-Text Response Sentiment Score for the Control and Mortality Conditions.



Notes. Sentiment scores range from -1 (negative) to +1 (positive). Each data point represents a participant. Sentiment scores of 0 are not missing data; they represent a participant who gives a neutral (i.e., 0) sentiment score.

Our participants reported a high fear of personal death, and when asked to "*Briefly explain what feelings the thought of death arouses",* they discussed death in predominantly negative (fearful terms). For instance, participant one, in the mortality threat condition (shown in the negative direction in Figure 5.2), reported, "*Fear of missing out on what could have been. I haven't achieved what I want to achieve yet. I don't want to miss out on having a family and a career*". Together, the above findings support the appropriateness and relevance of our manipulation measure for the current sample. However, to further support this, we present some exploratory analyses in section 5.2.3.3, removing participants who expressed a positive sentiment (n = 15).

5.2.3.2 Primary Analysis

Table 5.2 summarises the primary analyses for experiment one. There was no evidence for a (predicted) significant two-way interaction effect between WHR and condition or a three-way interaction effect between WHR, BMI and condition. However, there was evidence for a significant BMI by condition interaction.

Table 5. 2
Main Effects, Two and Three-Way Interactions for WHR, BMI and Condition (Mortality Threat).

	df	LRT_{stat}	*p*
Condition	1	.82	.365
WHR	**4**	**1004.76**	**<.001**
BMI	**4**	**969.94**	**<.001**
WHR x Condition	4	7.73	.102
BMI x Condition	**4**	**28.26**	**<.001**
WHR X BMI	**16**	**199.18**	**<.001**
WHR x BMI x Condition	16	21.12	.174

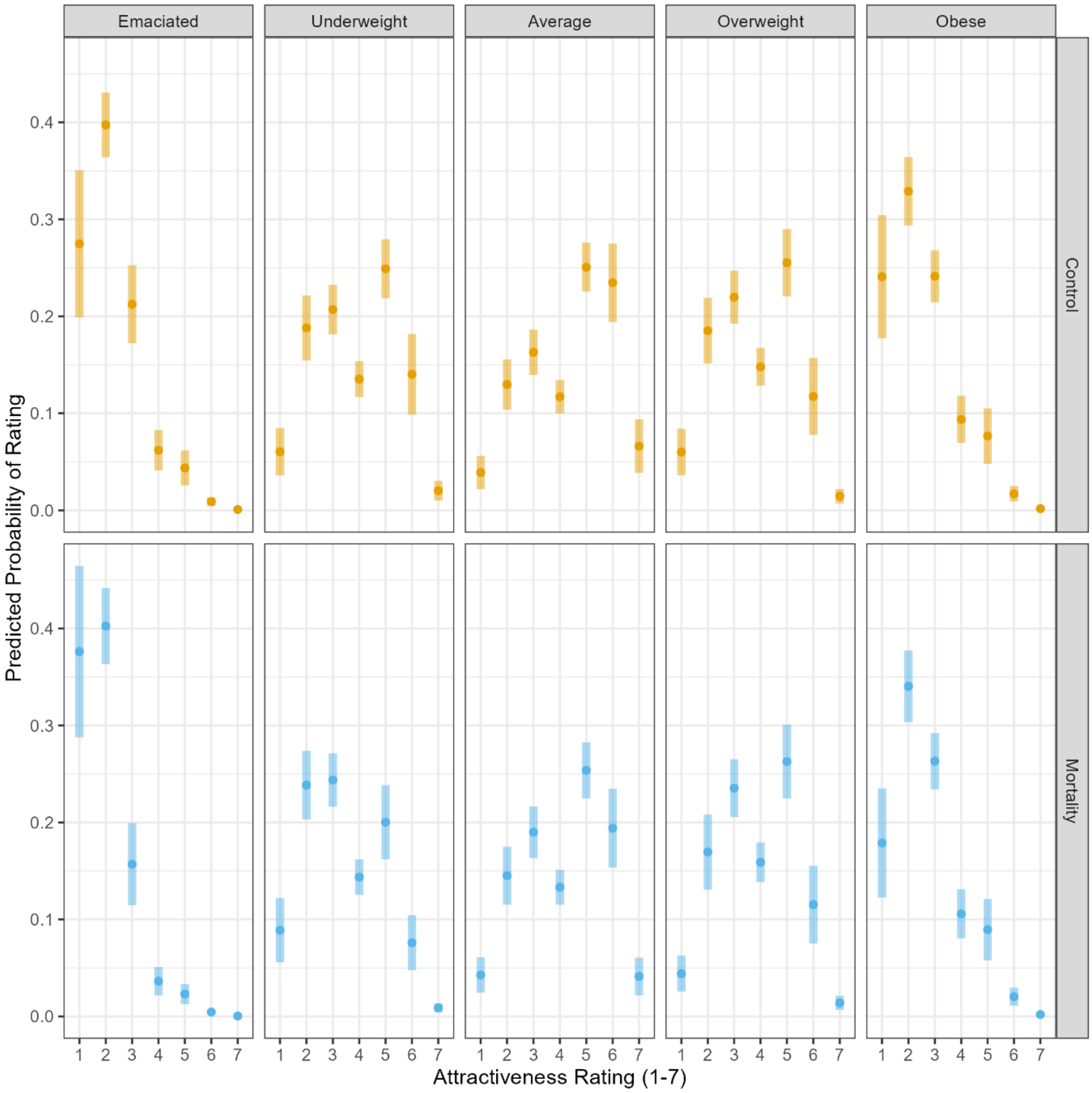
Notes. N = 100. **Bold** values indicate significant effects at $p < .05$.

Table 5.3 shows the predicted probabilities across each of the seven attractiveness rating points, the estimated marginal means, and the contrasts for BMI x condition. In summary, there was evidence of a significant difference in preferences for underweight BMI and emaciated BMI between both conditions. However, there was no evidence of significant differences when examining any other BMI category.

Examining the predicted probabilities (illustrated in Figure 5.3 and summarised in Table 5.3) shows that the participants in the mortality threat condition were likelier to give lower attractiveness ratings for emaciated and underweight BMI than those in the control condition. The pattern was also shown when examining the estimated marginal means. As noted above, these means can be directly transposed onto the original ordinal scale. As shown, the participants in the mortality gave lower average attractiveness ratings for emaciated and underweight BMI relative to the control condition. However, we interpret these differences cautiously, owing to the overlapping confidence intervals for the predicted probabilities at each response option and the mean attractiveness ratings.

Figure 5. 3

Predicted Probabilities (0-1) for the BMI x Condition (Mortality Threat) Interaction.



Notes. Error bars reflect the 95% CI. 1 = *very unattractive*, 2 = *unattractive*, 3 = *somewhat unattractive*, 4 = *neither unattractive nor attractive*, 5 = *somewhat attractive*, 6 = *attractive*, 7 = *very attractive*. The vertical panels represent each BMI category. The horizontal panels represent the condition (mortality and control conditions).

Table 5. 3

Predicted Probabilities (0 - 1), Estimated Marginal Means and Contrasts for the BMI x Condition (Mortality Threat) Interaction.

Contrasts	**Attractiveness Rating**									
	1	*2*	*3*	*4*	*5*	*6*	*7*	*Mean*	*z*	*p*
Emaciated										
Control	.28	.40	.21	.06	.04	.01	<.01	2.23	**1.98**	**.047**
	[.20, .35]	[.36, .43]	[.17, .25]	[.04, .08]	[.03, .06]	[.01, .01]	[<.01, <.01]	[2.02, 2.45]		
Mortality	.38	.40	.16	.04	.02	<.01	<.01	1.94		
	[.29, .47]	[.36, .44]	[.12, .20]	[.02, .05]	[.01, .03]	[<.01, .01]	[<.01, <.01]	[1.75, 2.13]		
Underweight										
Control	.06	.19	.21	.14	.25	.14	.02	3.83	**2.37**	**.018**
	[.04, .09]	[.15, .22]	[.18, .23]	[.12, .15]	[.22, .28]	[.10, .18]	[.01, .03]	[3.57, 4.08]		
Mortality	.09	.24	.24	.14	.20	.08	.01	3.39		
	[.06, .12]	[.20, .27]	[.22, .27]	[.13, .16]	[.16, .24]	[.05, .10]	[<.01, .01]	[3.14, 3.65]		
Average										
Control	.04	.13	.16	.12	.25	.24	.07	4.38	1.27	.205
	[.02, .06]	[.10, .16]	[.14, .19]	[.10, .13]	[.23, .28]	[.19, .28]	[.04, .09]	[4.14, 4.62]		
Mortality	.04	.15	.19	.13	.25	.19	.04	4.16		
	[.03, .06]	[.12, .18]	[.16, .22]	[.12, .15]	[.23, .28]	[.15, .24]	[.02, .06]	[3.91, 4.41]		
Overweight										
Control	.06	.19	.22	.15	.26	.12	.02	3.76	-.35	.727
	[.04, .08]	[.15, .22]	[.19, .25]	[.13, .17]	[.22, .29]	[.08, .16]	[.01, .02]	[3.51, 4.02]		
Mortality	.04	.17	.24	.16	.26	.12	.01	3.83		
	[.03, .06]	[.13, .21]	[.21, .27]	[.14, .18]	[.23, .30]	[.08, .16]	[.01, .02]	[3.57, 4.09]		
Obese										
Control	.24	.33	.24	.09	.08	.02	<.01	2.49	-.96	.338
	[.18, .30]	[.29, .36]	[.22, .27]	[.07, .12]	[.05, .11]	[.01, .03]	[<.01, <.01]	[2.26, 2.72]		
Mortality	.18	.34	.26	.11	.09	.02	<.01	2.66		
	[.12, .24]	[.30, .38]	[.23, .29]	[.08, .13]	[.06, .12]	[.01, .03]	[<.01, <.01]	[2.42, 2.89]		

Notes. 95% CI is shown in square brackets. 1 = *very unattractive*, 2 = *unattractive*, 3 = *somewhat unattractive*, 4 = *neither unattractive nor attractive*, 5 = *somewhat attractive*, 6 = *attractive*, 7 = *very attractive*. Estimated marginal means are on the ordinal scale. Pairwise comparisons were corrected using the Holm method. **Bold** values indicate comparisons significant at p <.05.

5.2.3.3 Exploratory Analysis

We removed all participants who responded positively when answering the free-text question (*n* = 15). For clarity, we also ran a model in which we removed those participants with a sentiment score of 0, which indicates neither a positive nor negative response (*n* = 23). The findings below were largely the same. We label this analysis exploratory as we did not pre-register it. We also acknowledge that our removal of participants may reduce the statistical power of this analysis below .80.

We found that when removing the 15 participants mentioned above, our findings were largely the same, including similar main effects mentioned above: *Condition*, $\chi 2(1, 135) = .54$, $p = .461$, *WHR*, $\chi 2(4, 135) = 845.04$, $p < .001$, *BMI*, $\chi 2(4, 135) = 852.20$, $p < .001$. We also found similar interaction effects between WHR and BMI, $\chi 2(16, 135) = 199.23$, $p < .001$, and no evidence of a three-way interaction effect, $\chi 2(16, 135) = 14.32$, $p = .575$. However, we did find that the interaction between WHR and condition was now significant, $\chi 2(4, 135) = 11.39$, $p = .023$. Despite this, upon correcting for familywise error rates, we found no significant comparisons. Interestingly, the interaction between BMI and condition was still significant ($\chi 2(4, 135) = 11.84$, p = .019). Still, after correcting for familywise error rates, we found that only the comparison between the attractiveness ratings given to underweight bodies differed between both conditions ($p = .045$). We note that no comparisons were significant when we removed the 23 participants after correcting for familywise error rates. As such, our results remained relatively consistent even when removing the participants who reported generally positive views of death.

For transparency, while we could have used the participants' scores on the Fear of Personal Death Questionnaire to classify participants defined by high or low perceived mortality fear, we deemed this inappropriate. This is because conventional grouping methods (e.g., k-means clustering) often place participants into arbitrary conditions. We also acknowledge that removing participants this way is problematic, as it can lead to incorrect conclusions and is often a strategy employed when using questionable research practices (e.g., *p-hacking*).

5.2.4 Discussion

Using a self-report attractiveness paradigm, experiment one investigated the influence of mortality threat cues on men's body shape and size preferences. Based on previous research, we predicted that a subtle mortality threat cue would increase preferences for the WHRs and BMIs generally deemed most attractive by men in WEIRD cultures. Conversely, we predicted decreased preferences for those deemed least attractive.

Similar to our findings from Chapter 4, we found that men rated 0.7 WHR and average BMI as the highest in terms of attractiveness on average. Conversely, 1.0 WHR and emaciated BMI received the lowest ratings (Table 5.1). These findings confirm the patterns in Chapter 4 and illustrate that our current sample rated our body stimuli similarly concerning attractiveness.

Regarding our *first hypothesis*, we observed that priming men with mortality threat did not shift their WHR preferences. While we predicted that men would show enhanced preferences for 0.7 WHR and diminished preferences for 1.0 WHR, we did not find evidence for those shifts. Concerning our *second hypothesis*, we found evidence for a significant influence of mortality threat on men's BMI preferences. Men in the mortality threat condition did not show enhanced preferences toward the most attractive BMI (i.e., average BMI) but did show significantly diminished preferences for emaciated and underweight BMI. These findings partially support hypothesis two in the *avoid unfit* direction of preferences (i.e., men would show diminished preferences toward less attractive body types). Despite this, we acknowledge that this difference is weak. Examining the confidence intervals for the predicted probabilities at each attractiveness rating and the mean attractiveness rating reveals an overlap between the mortality and control conditions. Consequently, while we identified a difference, we interpreted the implications of this finding with caution.

Finally, we found no support for our *third hypothesis*, with no three-way interaction between WHR, BMI and condition. This absence of effect is likely unsurprising given the lack of interaction between WHR and condition. We predicted that men would show enhanced preferences toward the combined most attractive body type on average (i.e., 0.7| average) and diminished preference for the least body type (i.e., 1.0| emaciated). We found no evidence for these differences.

Based on our appropriateness check, our sample generally reported being quite fearful of mortality overall, and the majority of individual participants expressed some concern and negative emotion when discussing the topic of death. This allows us to make a more nuanced interpretation of our findings. Given this, we could conclude that we found no influence of our mortality threat prime, even in a sample that seemed quite susceptible to such a prime.

In summary, experiment one provides limited support for the influence of mortality threat cues on men's body shape (i.e., WHR) preferences. However, there is some, albeit weak, evidence for mortality threat diminishing preferences toward less attractive body sizes (i.e., emaciated and underweight BMI). We interpret these latter findings with caution.

5.3 Experiment 2: Masculinity Threat

5.3.1 Introduction

This section investigates whether masculinity threat is a situational cue that influences men's WHR and BMI preferences. As we demonstrated in Chapter 2, no research to date has addressed the influence of masculinity threat on men's WHR and BMI preferences. Considering previous research, we present the same hypotheses as experiment one.

We also included a masculinity-affirming condition in this experiment. Previous masculinity threat research has included a condition where men receive feedback that they are masculine, affirming their manhood (Ching, 2022; Harrison & Michelson, 2019). We included this group to assess whether affirming men's masculinity influenced their WHR and BMI preferences. However, we make no formal hypotheses for this as it is unclear whether or how affirming feedback would influence men's WHR or BMI preferences. We include this as an exploratory analysis.

The masculinity-affirming condition also allowed us to include a direct manipulation check. This check involved comparing whether the self-reported accuracy of the masculinity threat or affirm score differed between the threat and affirm conditions, similar to prior research (Ching, 2022). We predicted that if the masculinity threat prime were successful, participants in the masculinity threat condition would report their score as significantly less accurate than the masculinity-affirm condition. However, while this manipulation check indicates that participants are dissatisfied with their feedback, it may not necessarily indicate they were threatened. Research rarely uses manipulation checks in masculinity threat experiments. However, this approach is consistent with the limited research that includes one (Ching, 2022).

5.3.2 Method

5.3.2.1 Design and Participants

We again used an online experimental design hosted through Qualtrics. We randomly allocated the participants into one of four conditions: masculinity threat condition, masculinity affirm condition, control condition and the no prime condition. We pre-registered our hypotheses, methods, and data analysis procedures on the OSF (https://tinyurl.com/LCC2023-masc). We aimed for the same sample size as experiment one, with 50 participants in each condition. Given the resources available, this was the maximum we could achieve and exceeded the sample sizes used in previous masculinity threat research (e.g., Harrison & Michelson, 2019).

Participant recruitment occurred in November 2021. Overall, 216 participants were recruited through Prolific and paid £1.32 (9 minutes @ £8.80/hr[13]). Participants could not complete this study if they completed experiment one. We used attention checks to ensure participant engagement and removed 12 participants as they failed these checks (i.e., they failed two or more attention checks). The final sample comprised 204 participants (M_{age} = 36.83, SD_{age} = 9.82), with 51 participants allocated to the masculinity threat condition (M_{age} = 36.98, SD_{age} = 9.99), 51 to the masculinity affirm condition (M_{age} = 36.43, SD_{age} = 9.06), 51 to the control condition (M_{age} = 38.33, SD_{age} = 10.44) and 51 to the no prime condition (M_{age} = 35.59, SD_{age} = 9.84). A one-way ANOVA showed no significant age differences across each condition, $F(3, 200) = .70$, $p = .554$.

5.3.2.2 Materials

Priming methods. We randomly allocated participants into one of the four conditions, with three conditions receiving priming content. These primes were taken from work by Harrison and Michelson (2019) with the author's permission. Previous research has widely used this masculinity threat prime (Parent & Cooper, 2020; Salvati et al., 2021). Appendix two provides further information on the priming content used in this section.

Those in the masculinity threat and affirm conditions completed the 60-item Bem Sex Role Inventory (BSRI; Bem, 1974). The BSRI measures how well individuals adhere to traditional gender norms by having the participants rate how well typically masculine (e.g., *"Acts as a leader"*), typically feminine (e.g., *"Affectionate"*), and typically neutral (e.g., *"Adaptable"*) statements describe them on a 7-point rating scale ranging from 1 (*Never*) or 7

[13] We initially planned to pay participants £1.14. However, we increased this to £1.32 to ensure that participants were compensated fairly.

(*Always or almost always true*). Those in the control condition completed the 10-item Big Five Inventory (BFI-10; Rammstedt & John, 2007). The statement, "*I see myself as someone who*" preceded each item (e.g., "*is outgoing, sociable*"). This measure incorporated items relating to a person's extraversion, agreeableness, conscientiousness, neuroticism and openness to experience. The participants responded on a 5-point rating scale ranging from 1 (*Strongly disagree*) to 5 (*Strongly agree*). Participants in the control prime condition received similar feedback. However, this feedback did not mention gender norms or provide threatening or affirming feedback, creating a suitable control condition (Harrison & Michelson, 2019).

The participants in the threat and affirm conditions received a BSRI score between 0-50, with 0 reflecting a masculine score. In contrast, a score of 50 represented a feminine score. The participants in the masculinity threat condition received visual on-screen feedback that their score was within the feminine range of responses. Conversely, those in the affirm condition received feedback that their score was within the masculine range of responses. Visual aids accompanied the scores (see appendix two). Those in the control condition also received feedback on their big five personality measures, with each participant receiving moderate or average scores (e.g., "*Extraversion: 38% - moderate*").

The participants were then presented with an onscreen message that read, "*Please wait while we analyse your results. This may take up to 30 seconds*", alongside a non-visible 20-second timer, which advanced the page automatically. We used this message to make it appear that a score was being calculated and to improve the realism of the task. The no prime condition received no content and proceeded directly to the stimuli rating task.

Manipulation check. We also included a manipulation check. This check allowed us to determine whether the priming process had any influence. The participants in the two masculinity priming conditions (i.e., threat and affirm) rated the accuracy of the score they received on a 5-point rating scale ranging from 1 (*Not accurate*) to 5 (*Very accurate*). We did not present the check with the control prime condition participants because the feedback they received was neither threatening nor indicative of any individual personality type. We deemed this to be an appropriate manipulation check.

5.3.2.3 Procedure

We used a similar procedure to experiment one. The participants in the masculinity prime conditions completed the 60-item BSRI, while those in the control prime condition completed the 10-item BFI-10. The participants were then told that their score was being calculated and that this process would take up to 30 seconds. Unknown to the participants, we coded the screen to proceed automatically after 20 seconds. Then, the participants were shown their feedback alongside the visual indicator (appendix two). The participants could not proceed to the next screen until 30 seconds had passed. After this, the participants completed the manipulation check. The no prime condition skipped these steps and continued immediately to the stimuli rating task. After completing the priming tasks, those in the remaining conditions viewed the 25 body stimuli, one at a time, in randomised order and were asked to rate each for their attractiveness. The participants were debriefed, thanked, and redirected to Prolific to claim their reward at the end of each full experiment run.

5.3.2.4 Analysis Plan

The preliminary, main, and exploratory analyses comprised the same statistical approaches outlined in experiment one. We completed an additional preliminary analysis to confirm the effectiveness of our manipulation. We also conducted an exploratory analysis that compared preferences across the masculinity threat, affirm and control conditions. As this was an exploratory analysis, we tested no formal hypotheses at this stage.

5.3.3 Results

The anonymised data, R code, and analysis output are available on the OSF. We amended the pre-registration form for experiment two to include the same changes as experiment one. The same changes were required because, due to financial and time constraints, we pre-registered experiment two and collected the data before finalising the analysis for experiment one. We present these amendments on the OSF.

5.3.3.1 Preliminary Analysis

Table 5.4 shows the attractiveness ratings given to each WHR and BMI category. Similar to experiment one, the participants rated 0.7 WHR and average BMI as the most and 1.0 WHR and Emaciated BMI as the least attractive.

Table 5. 4
Attractiveness Ratings for each WHR and BMI Category (Experiment 2).

	M	*SD*
WHR		
0.6	3.68	1.71
0.7	**4.35**	**1.71**
0.8	3.75	1.58
0.9	2.76	1.36
1.0	2.18	1.08
BMI		
Emaciated	2.20	1.23
Underweight	3.54	1.60
Average	**4.32**	**1.63**
Overweight	3.89	1.55
Obese	2.77	1.50

Notes. $N = 204$. *SD* = Standard Deviation. **Bold** values indicate the highest rating for WHR and BMI.

We next examined the effectiveness of our masculinity threat manipulation. An independent-samples t-test showed evidence for significant differences in the mean accuracy rating by condition, $t(100) = 11.04$, $p < .001$, Cohen's $d = -2.21$, 95% CI: -2.70, -1.71. Those in the masculinity threat condition reported viewing their scores as significantly less accurate relative to the masculinity affirm condition (masculinity threat condition: $M = 2.18$, $SD = .89$; control condition: $M = 3.86$, $SD = .63$). Given that no differences existed between the control and no prime conditions, this analysis continued as planned by excluding the data from the no prime condition.

Finally, we examined the mean attractiveness ratings across the three conditions (i.e., masculinity threat, control and no prime conditions). The analysis revealed a significant main effect for condition, $\chi2(2, 153) = 7.94$, $p = .019$. Holm-corrected pairwise comparisons and estimated marginal means showed that this difference occurred between the control and threat conditions (*p* = .014), with no differences shown between either the control and no prime (*p* = .299) or the threat and no prime conditions (*p* = .149). This was an interesting finding. Men in the threat condition displayed lower attractiveness ratings overall regardless of the body shape and size (*M* = 3.08, 95% CI: 2.88, 3.29) relative to men in the control condition (*M* = 3.51, 95% CI: 3.29, 3.72). While we made no hypothesis about this, we discuss this further below. As we found no difference between the control and no prime conditions, we continued with the analysis as planned.

5.3.3.2 Primary Analysis

Table 5.5 summarises the primary analyses for experiment two. There was no evidence of a significant two-way interaction between WHR and condition or BMI and condition. Nor was there evidence for a significant three-way WHR x BMI x condition interaction.

Table 5. 5
Two and Three-Way Interactions for WHR, BMI and Condition (Masculinity Threat).

	df	LRT_{stat}	*p*
Condition	**1**	**6.79**	**.009**
WHR	**4**	**977.30**	**<.001**
BMI	**4**	**1012.46**	**<.001**
WHR x Condition	4	2.14	.711
BMI x Condition	4	5.10	.277
WHR X BMI	**16**	**205.25**	**<.001**
WHR x BMI x Condition	16	8.21	.943

Notes. N = 102.

5.3.3.3 Exploratory Analysis

We then examined our exploratory analysis, which included the masculinity threat, masculinity affirm and control conditions. Table 5.6 summarises the results of this analysis. Similar to the primary analysis, we found no evidence for a two, or three-way interaction between WHR, BMI or condition.

Table 5. 6
The Exploratory Two and Three-Way Interactions for WHR, BMI and Condition (Masculinity Threat and Affirm).

	df	LRT_{stat}	*p*
Condition	**3**	**8.29**	**.040**
WHR	**4**	**1968.20**	**<.001**
BMI	**4**	**2005.34**	**<.001**
WHR x Condition	12	16.18	.183
BMI x Condition	12	9.21	.685
WHR X BMI	**16**	**422.19**	**<.001**
WHR x BMI x Condition	48	26.70	.995

Notes. N = 153.

5.3.4 Discussion

Using a self-report attractiveness paradigm, experiment two replicated a similar procedure to experiment one. We investigated the influence of masculinity threat cues on men's body shape and size preferences. Our results were broadly consistent with experiment one. Men showed similar attractiveness ratings for each WHR and BMI category. We found no support for hypothesis one, with no effect of masculinity threat on men's WHR preferences. However, in contrast to experiment one, we also found no influence of masculinity threat on men's BMI preferences, providing no support for hypothesis two. We likewise found no support for hypothesis three, with no evidence of a three-way WHR, BMI and condition interaction.

One interesting finding that we did not make any hypotheses about is that men in the masculinity threat condition gave lower attractiveness ratings overall relative to the control condition. This is interesting as it might suggest that masculinity threat decreases men's preferences toward all bodies. Given that masculinity threat has been shown to generate anti-feminine and hegemonic masculine beliefs (Alonso, 2018; O'Connor et al., 2017), viewing all women as less attractive may be a compensatory mechanism not yet explored. Interestingly, men in the threat condition displayed differences concerning the control condition but not the no prime condition. You would expect this difference to be consistent as the control and no prime should be similar. We do not have an explanation for this. It could be a chance difference, especially as the control and no prime conditions were comparable. This could be a direction for future research. Researchers could see whether priming for masculinity threat causes men to rate women as less attractive or desirable persistently. This would also help to explain one of the reasons why men are inclined to make negative and derogatory comments toward women following a masculinity threat.

In contrast to experiment one, we included an additional exploratory condition in this experiment. The participants in this condition received feedback which affirmed their masculinity. Minimal research in the wider masculinity threat literature has included this affirming condition. Similarly, it was unclear how masculinity affirmations would (if at all) influence men's WHR or BMI preferences. We found no significant differences in men's WHR or BMI preferences, regardless of whether they received the masculinity threat, masculinity affirm or control primes.

This inclusion of the affirm condition did allow us to conduct a manipulation check. We compared how satisfied men were with their feedback on the masculinity threat relative to the masculinity-affirm condition and found the latter were significantly more satisfied. From this, we can be more confident that men in the masculinity threat condition found their masculinity threat feedback incongruent with how they perceive their masculinity. However, we acknowledge that this does not necessarily indicate that men were threatened by this incongruence. This manipulation check is consistent with the limited research which has deployed one and increases the confidence (but not certainty) that our manipulation was effective (Ching, 2022).

In summary, experiment two provides limited support for the influence of masculinity threat cues on men's body shape (i.e., WHR) and size (i.e., BMI) preferences, as indicated by self-reported attractiveness ratings. Together, these findings suggest that neither a masculinity threat nor masculinity affirmation influences men's WHR or BMI preferences when using attractiveness ratings as the outcome. However, there was some evidence that masculinity threat might decrease men's preferences (i.e., the extent they view women as attractive) overall. In the next chapter, we further explore the effect of masculinity threat on UK men's preferences by exploring whether masculinity threat results in UK men expressing more negative attitudes toward the TGD community, a phenomenon evidenced in other cultures.

5.4 Experiment 3: Pathogen Threat

5.4.1 Introduction

In this section, we investigate our final situational threat cue. Pathogens represent a prominent evolved concern for all species, not just humans, and creating resistance to pathogens represents the greatest evolutionary arms race. However, unlike other species, humans possess higher cognitive abilities and can avoid pathogens before encountering them (Tybur et al., 2009). It is likely that humans evolved some approach to avoid pathogen transmission during mating.

Previous research has demonstrated that a pathogen threat may cause changes to an individual's mating motivations (A. J. Lee et al., 2015; Little et al., 2011). Specifically, research has established that exposure to environmental pathogen cues, or direct pathogen threat primes, causes increased preference for traits that signal health and greater self-reported preference for physically attractive traits that signal these qualities (DeBruine et al., 2010; Little et al., 2011; Prokop et al., 2013). Only one study has explicitly investigated pathogen prevalence (but not priming for pathogen threat) on men's WHR and BMI preferences (A. J. Lee et al., 2015).

There is currently a dearth of research investigating the effect priming for pathogen threat cues has on men's body shape and size preferences. This section explores whether priming men with subtle pathogen threat cues alters their preferences for different WHRs and BMIs. Considering previous research, we present the same hypotheses as experiments one and two.

5.4.2 Method

5.4.2.1 Design and Participants

Qualtrics was again used to host our online experimental design. We randomly allocated the participants into pathogen threat, control, and no prime conditions. We pre-registered our hypotheses, methods and data analysis procedures on the OSF (https://tinyurl.com/LCC2023-path). Based on the available resources, we used the same sample size-stopping rules as the above two experiments. We also aimed to achieve a higher sample size (n = 50 per group) than previous research, which primed for pathogen threat (*n* = 25 per group; Ainsworth & Maner, 2019).

Participant recruitment took place in January 2023 using Prolific. There were 153 total participants paid £1.20 (8 minutes @ £9.00/hr). Participants could not complete this study if they completed experiments one or two. We removed three participants because they failed our attention checks (i.e., they failed two or more attention checks). The final sample comprised 150 participants (M_{age} = 36.75, SD_{age} = 10.17), with 50 participants allocated to the pathogen threat condition (M_{age} = 35.80, SD_{age} = 9.12), 50 to the control condition (M_{age} = 36.74, SD_{age} = 10.68), and 50 to the no prime condition (M_{age} = 37.72, SD_{age} = 10.74). A one-way ANOVA showed no significant age differences across each condition, $F(2, 147) = .44$, $p = .643$.

5.4.2.2 Materials

As mentioned, we randomly allocated the participants into one of the three conditions, with two receiving priming content (i.e., the pathogen threat and control conditions). To prime for pathogen threat and to make disease-related cues a salient concern, the participants completed the Perceived Vulnerability to Disease questionnaire (PVD; Duncan et al., 2009). This priming approach has been used previously by Watkins et al. (2012). The PVD is a 15-item measure which captures a person's self-reported risk of diseases and pathogens. The participants respond to each of the 15 items (e.g., *"In general, I am very susceptible to colds, flu and other infectious diseases"* and *"I am comfortable sharing a water bottle with a friend"*) on a 7-point rating scale ranging from 1 (*Strongly disagree*) to 7 (*Strongly agree*). The participants also responded, "*Briefly explain whether you have any risk factors (e.g., your environment, hobbies) which make you susceptible to getting sick*". We used both priming methods to increase the participant's engagement with the task and to strengthen the priming effect.

We altered the original PVD measure to reflect more general topics to create our control prime. Each statement's general structure and length were consistent with the original PVD to create a comparable task. For example, "*I am more likely than the people around me to catch* *an infectious disease*" was changed to "*I am more likely than the people around me to attend a party*". Appendix three provided further details on the priming methods used in this section.

5.4.2.3 Procedure

We used a similar procedure to experiments one and two. The participants in the pathogen and control prime conditions immediately completed the PVD and adapted PVD, respectively. The participants in the no prime condition proceeded immediately to the stimulus rating task. After completing the priming tasks, those in the remaining conditions viewed the 25 body stimuli, one at a time, in randomised order and rated each for their attractiveness. The participants were debriefed, thanked, and redirected to Prolific to claim their reward at the end of each full experiment run.

5.4.3 Results

The preliminary and main analyses comprised the same statistical approaches outlined in experiments one and two. We pre-registered our analysis plan on the OSF. The anonymised data, R code, and analysis output are available on the OSF[14].

5.4.3.1 Preliminary Analysis

The descriptive statistics for the attractiveness ratings reported by the total are shown in Table 5.7 and confirm the patterns identified in the previous experiments. We next examined the mean attractiveness ratings across the three conditions (i.e., pathogen threat, control, and no prime conditions). This analysis revealed no significant main effect for condition, $\chi2(2, 150) = 3.64$, $p = .162$; we identified no significant differences across the three conditions for attractiveness ratings. Given this, we determined that the control prime was effective, and the analysis continued as planned.

[14] The findings of experiment three were published as a conference poster: Cahill, L., Cristino, F., Marriott, M., & Dunn, A.K. (2023, May). *The influence of pathogen threat on waist-to-hip ratio and body mass index preferences.* [Poster presentation]. Human Behaviour and Evolution Society, Palm Springs, California, United States of America.

Table 5. 7
Attractiveness Ratings for each WHR and BMI Category (Experiment 3).

	M	*SD*
WHR		
0.6	3.62	1.59
0.7	**4.29**	**1.61**
0.8	3.76	1.50
0.9	2.85	1.24
1.0	2.34	1.06
BMI		
Emaciated	2.26	1.15
Underweight	3.62	1.46
Average	**4.28**	**1.51**
Overweight	3.84	1.47
Obese	2.87	1.38

Notes. N = 150. *SD* = Standard Deviation. **Bold** values indicate the highest rating for WHR and BMI.

We did a similar series of checks to experiment one to explore our pathogen threat manipulation and conduct our relevance and appropriateness check. To begin, we assessed our participant's responses to the Perceived Vulnerability to Disease Questionnaire (PVD) and their free-text responses. As our participants completed all 15 items on the PVD scale, scores on this measure can be directly compared to other studies using this scale. Recall that scores on this measure can range from 15 to 105, with a higher score indicating greater perceived vulnerability to disease. Our participants generally reported moderate scores on the measure (*M* = 58.24, *SD* = 6.41). This indicates that our sample scored somewhat in the middle of the possible range of scores, indicating moderate perceived vulnerability to disease.

To assess our free-text responses, we could not use the same sentiment analysis used to assess the mortality threat responses. This was because our question asking participants to "*Briefly explain whether you have any risk factors (e.g., your environment, hobbies) which make you susceptible to getting sick."* was inappropriate for sentiment analysis. Sentiment analysis is only appropriate for questions likely to produce a strong emotive response. The current question reflected more of a factual response. For this question, we were interested in determining whether participants had or did not have any risk factors for getting sick. We created a function that parsed the participant's responses to create this binary operator (no risk factors/ has risk factors). Any responses the function could not parse were flagged for manual review and categorised by the researcher. This resulted in 19 participants responding that they had no risk factors, and 26 responded that they had risk factors. Five participants' responses could not be categorised because they were unclear.

Taken together, our findings suggest that our sample likely did not have a significant perceived risk of disease sickness and largely reported comparable levels of whether risk factors were or were not present. This might suggest that our sample could not have responded to our manipulation in the way we expected. We comment on this more below. As we did for experiment one, we also present some exploratory analyses below where we remove all participants who reported they had no risk factors.

5.4.3.2 Primary Analysis

Table 5.8 summarises the primary analyses. The analysis showed no evidence of a significant two or three-way interaction between WHR, BMI and condition.

Table 5. 8
Two and Three-Way Interactions for WHR, BMI and Condition (Pathogen Threat).

	df	LRT_{stat}	*p*
Condition	1	2.66	.103
WHR	**4**	**951.51**	**<.001**
BMI	**4**	**1067.49**	**<.001**
WHR x Condition	4	5.14	.274
BMI x Condition	4	7.48	.113
WHR X BMI	**16**	**205.28**	**<.001**
WHR x BMI x Condition	16	6.01	.988

Notes. N = 100.

5.4.3.3 Exploratory Analyses

We removed all participants who responded that they either had no risk factors or their response could not be categorised (n = 24). This significantly reduces the number of participants in pathogen threat condition. However, our findings are similar despite removing these participants. We found similar main effects: *Condition*, $\chi2(1, 135) = 2.10$, $p = .147$, *WHR*,

$\chi 2(4, 135) = 685.91$, p <.001, *BMI*, $\chi 2(4, 135) = 823.79$, p <.001; two-way interaction effects for WHR and condition, $\chi 2(4, 135) = 3.01$, p =.556, BMI and condition, $\chi 2(4, 135) = 3.88$, p = .422, and WHR and BMI, $\chi 2(16, 135) = 157.86$, p <.001; and no evidence for a three-way interaction effect, $\chi 2(16, 135) = 6.82$, p = .977. As such, we found similar findings regardless of whether participants reported risk factors.

5.4.4 Discussion

Using the self-report attractiveness paradigm, experiment three replicated a similar procedure to experiments one and two. We investigated the influence of pathogen threat cues on men's body shape and size preferences. Our results were broadly consistent with experiment one and comparable to experiment two. Men showed similar attractiveness ratings for each WHR and BMI category. We found no support for hypothesis one, with no effect of pathogen threat on men's WHR preferences. However, in contrast to experiment one but similar to experiment two, we found no influence of pathogen threat on men's BMI preferences, providing no support for hypothesis two. We likewise found no support for hypothesis three, with no evidence of a three-way WHR, BMI and condition interaction.

One important consideration is the findings from our appropriateness check. Our sample generally reported a low perceived vulnerability to disease, and most participants did not report themselves as having distinct risk factors. We tested the effect of this on our findings by removing the participants who did not report risk factors and found no differences, but we noted that this likely underpowered any comparison. As such, this raises the question of whether our results may have been different if we had a larger sample of participants who perceived themselves at risk (e.g., immunocompromised participants). This may be an interesting direction for future research. We discuss this more in Chapter 8.

In summary, experiment three provides limited support for the influence of pathogen threat cues on men's body shape (i.e., WHR) and size (i.e., BMI) preferences, as indicated by self-reported attractiveness ratings.

5.5 General Discussion

This chapter investigated the influence of situational threat cues on men's body shape and size preferences as indicated by self-reported attractiveness ratings. Our findings provide limited support for the influence of mortality, masculinity and pathogen threat cues on men's body shape (i.e., WHR) and size (i.e., BMI) preferences. We provide a brief interpretation of the findings from each experiment here. However, Chapter 8 expands on these interpretations in more detail.

The findings from experiment one are inconsistent with the broader research literature investigating the effects of mortality threat. For instance, research has shown that men primed with mortality threat report changes to their coupling motivations (Fritsche et al., 2007; Wisman & Goldenberg, 2005; Zhou et al., 2008) and a greater preference for traits signalling health and fertility, such as attractive faces (Silveira et al., 2014; Zhao et al., 2019). Our findings indicate that this shift did not occur when examining men's self-reported preference for women's body shapes and sizes. Mortality threat did not alter men's WHR preferences, despite 0.7 WHR being rated as the most and 1.0 WHR rated as the least attractive on average across each sample. We also found no change in preferences toward each combination of WHR and BMI, again inconsistent with the predicted effect of mortality threat. Our findings are particularly interesting considering our sample that received the mortality threat prime generally reported themselves fearful of death.

Whilst we found no difference in WHR preferences, mortality threat did influence BMI preferences. Men in the mortality threat condition showed diminished preferences for emaciated and underweight BMI relative to the control condition. One explanation for why we only identified diminished preferences for the less attractive BMIs may be due to how mortality threat influences men's mating motivations. As mortality salience may serve an adaptive purpose by increasing the importance of health and fertility signals, this may manifest in avoiding traits that signal poor outcomes (Plusnin et al., 2018; Silveira et al., 2014). BMI seemed to influence our participants' ratings of health and fertility more than WHR in Chapter 4.

A potential reason why mortality threat interacted only with BMI and not WHR might be the relative importance of body shape and size concerning attractiveness. Research has repeatedly shown that BMI is a greater predictor of attractiveness and provides more information relating to health and fertility relative to WHR (Swami, Antonakopoulos, et al., 2006). Indeed, the pattern of findings shown in Chapter 4 showed that BMI seemed to influence attractiveness, health and fertility ratings more than WHR. However, while we did identify this difference, we acknowledge that it is weak. The 95% Confidence Intervals shown in Table 5.3 display an overlap between the predicted probabilities at each response option and the mean attractiveness ratings between the mortality threat and control conditions. For this reason, we interpret these findings tentatively in Chapter 8.

Experiment two revealed similar findings to experiment one, which is inconsistent with the predicted effect of masculinity threat. Men's WHR and BMI preferences vary depending on societal sociocultural gender norms (Kosakowska-Berezecka & Besta, 2018; Swami, Antonakopoulos, et al., 2006). In cultures where traditional gender norms are promoted and adhered to more (e.g., Greece) relative to countries with less gender-role adherence (e.g., Britain), men display greater preferences for traditional body shape (i.e., 0.7 WHR) and body size (i.e., average BMI; Furnham & Greaves, 1994; Furnham & Nordling, 1998). Men who experience masculinity threats promote greater adherence to traditional gender norms (Hunt et al., 2016; Willer et al., 2013). For this reason, we expected men primed with mortality threats to show enhanced preferences for more traditional (i.e., more attractive) WHRs and BMIs. We also predicted diminished preferences, but as argued in Chapter 2, we believed the primary action of masculinity threat would be to increase preferences for the most attractive WHRs and BMIs. Contra to our predictions, we found no evidence to suggest that masculinity threat influenced men's WHR and BMI preferences in either direction.

One explanation for our findings is that our sample did not respond to a masculinity threat prime in the manner we expect. As mentioned, given the nature of our masculinity threat prime, we could not conduct an appropriateness and relevance check for our prime. Given that masculinity is a social construct and adherence to masculine norms varies across both individuals and cultures, it may be that our sample simply did not respond to the masculinity threat prime in the manner we expected. Because of this, we explore the effects of masculinity threat further in the following chapter by exploring a similar sample. Specifically, we aim to explore men's reactions to masculinity threat using an outcome already established to be affected by masculinity threat in previous samples: attitudes toward trans and gender diverse people.

An interesting finding from this experiment is that men in the masculinity threat condition gave lower attractiveness ratings overall. This could be an indication that men viewed women less favourably following a masculinity threat. This would be consistent with the wider literature on this situational threat cue, which argues that men respond in negative ways (e.g., by being sexist) following a masculinity threat (O'Connor et al., 2017). This viewing women less attractive may be a similar compensatory behaviour. Future research should explore this possibility.

The findings from experiment three were comparable to those of experiment two and were most surprising given that pathogen threat has been directly implicated in altering preferences toward specific qualities (Prokop et al., 2013; Zheng, 2019). Lee et al. (2015) found that higher pathogen sensitivity was associated with greater preferences (i.e., higher attractiveness ratings) toward lower WHR and lower BMI (albeit this latter association was not significant). Our findings do not support this, showing that when examining pathogen threat (rather than prevalence), we found no shift in (enhanced/diminished preferences) men's WHR or BMI preferences. Our findings are particularly surprising given the evolutionary importance of avoiding pathogens and the persistence of this concern in modern society, particularly in recent years (Ainsworth & Maner, 2014b; Tooby & Cosmides, 1990a).

One explanation for our findings is that our sample generally seemed to report themselves as not perceiving themselves vulnerable to pathogens (across their closed and open-ended responses). As such, a possible explanation is that our sample did not view a pathogen threat as relevant, meaning that our situational threat cue may not have triggered a pathogen threat response. Our results may have been different had we targeted groups with higher pathogen prevalence. We consider this more in Chapter 8.

In summary, our findings provide limited support for the influence of mortality, masculinity and pathogen threat cues on men's WHR and BMI preferences. A potential explanation for our findings may be that we used attractiveness ratings as the preference indicator. Despite this approach being widely used in research examining preferences toward faces and bodies, there are limitations. We evaluated the limitations of this approach in more detail in Chapter 3. As indicated in Chapter 3, alternative approaches could provide more information concerning men's preferences. For instance, a combined eye-tracking dot-probe paradigm would provide more information on visual interest and attentional allocation. It may be possible that the preference shift occurs before the final evaluative judgement (i.e., final attractiveness rating) and may instead shift visual interest and attention. We explore this possibility in greater detail in Chapter 8. In the next chapter, we further explore our masculinity threat situational threat cue.

6. CHAPTER 6: MASCULINITY THREAT AS A DETERMINANT OF ATTITUDES TOWARD TRANS AND GENDER DIVERSE PEOPLE

6.1 Introduction

Given the emerging field of masculinity threat research, we aimed to explore this priming method further and add to the broader literature examining the potential effects of threatening men's masculinity[15]. One potential explanation for experiment two's lack of a significant effect of masculinity threat is that our sample (UK men) does not view a threat to their masculinity as a particular concern. Indeed, some research (which we explore more in Chapter 8) shows that UK men generally do not endorse strict and traditional masculine gender norms. As masculinity is a social construct that varies within and across sociocultural contexts, here, we further explore the effect of masculinity threat by investigating whether masculinity threat in a UK context significantly affects attitudes toward trans and gender-diverse people. This effect has been firmly established in other sociocultural contexts. For context, we provide a brief literature review and introduce this topic next.

6.2 Experiment 4: Masculinity Threat as a Determinant for TGD Attitudes in a UK Sample

6.2.1 Introduction

Trans and gender diverse (TGD) is an umbrella term used to describe people who experience an incongruence between the gender they were assigned at birth and their current gender identity, the latter of which may reside in or outside the gender binary (i.e., man and woman). Gender incongruence is not a new human experience. Before colonial influence, Indigenous communities worldwide accepted genders outside what is now understood as the gender binary (Robinson, 2020). Today it is estimated that around 600,000 TGD people are residing in the UK (Stonewall, 2017), with recent census data indicating that 262,000 people

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[15] The findings presented in this chapter represent study two of a two study paper published independent to this thesis. The two initial authors are joint first authors on this piece of work. The full paper can be found here: *Jones, B. A., *Cahill, L., & McDermott, D. T. (2023). Gender, traditional gender ideology, gender essentialist beliefs, and masculinity threat as determinants of attitudes toward trans and gender diverse people in a U.K. sample. *Psychology of Sexual Orientation and Gender Diversity*. https://doi.org/10.1037/sgd0000658. * Indicates joint first authorship.

identified as trans in England and Wales (Office for National Statistics, 2021). However, this is likely to be severely underestimated, considering many will conceal their gender identity due to fear of trans negativity (Government Equalities Office, 2018, [GEO]); Hendricks & Testa, 2012). Concealment of gender identity is not surprising given the uniquely hostile societies many TGD people are exposed to (e.g., Winter et al., 2016). In 2021, 2630 Hate Crimes against TGD people were reported in England (Home Office, 2022), although this number is likely to be much higher given the reluctance to report crimes to the police (i.e., 88% of TGD people were found not to report the most serious crimes in one UK-based survey, GEO, 2018). Despite this, trends demonstrate that the community, or at least those in the community who are able to live authentically, is growing (e.g., Arcelus et al., 2015), which has been attributed to the increases in visibility and acceptability of TGD people due to greater opportunity in learning about gender diversity (i.e., via the media; Gillig et al., 2018; Orellana et al., 2022). Therefore, it is important to ascertain why opposition to TGD people persists in the UK population.

Minority Stress Theory (Brooks, 1981; Hendricks & Testa, 2012; Meyer, 2003) provides a clear association between experiences of minority stress (i.e., discrimination, prejudice and stigma) and poor mental health, with symptoms of anxiety, depression and suicidality commonplace (e.g., Drabish & Theeke, 2022). Hendricks and Testa (2012) suggest that gender identity concealment is a minority stressor, with research supporting the negative mental health implications of this intended protective mechanism (Brennan et al., 2021; Livingston et al., 2020; Rood et al., 2017). Depression is also a risk factor for suicidality. Concerningly in 2012, 45% of TGD people in the UK were found to have attempted suicide at least once, and 84% had suicidal thoughts (Bailey et al., 2014). These alarming statistics and the growing community of TGD people in the UK make ‘minority stress’ a public health concern.

The distress that TGD people experience has been attributed, at least in part, to negative societal attitudes (Richards et al., 2015). However, population-level interventions to improve attitudes have not been widely empirically supported (Cramwinckel et al., 2018). For example, diversity training successfully increases knowledge but does not change attitudes (Bezrukova et al., 2016). Instead, it is believed to be more effective when paired alongside other strategies such as ‘social contact’ (Cramwinckel et al., 2018). According to the Contact Hypothesis (Allport, 1954), inter-group contact (e.g., contact between TGD people and the cisgender community) is required to improve relations, which typically are aimed at ‘disproving’ negative attitudes and encouraging positive judgments. However, the efficacy of social contact interventions is mixed (Cramwinckel et al., 2018), which Michelson and Harrison (2022) hypothesised was a result of the type of contact participants were exposed to and in their US survey of 3043 people found that only close, voluntary, and consistent relationships were positively associated with improving attitudes towards TGD people. However, a TGD identity is not always actively visible, as may be the case with other stigmatised groups (e.g., people with a disability, ethnic minorities), and therefore, inter-group contact between TGD people, and the cisgender population can be hard to come by. Additionally, many TGD people will be reluctant to reveal their TGD identity, especially among those whom they perceive as potentially unsupportive (Rood et al., 2017).

However, contact can also be achieved remotely through people not personally known to the target group. The Parasocial Contact Hypothesis (Schiappa et al., 2005) claims that contact can be experienced through positive portrayals of the minority group via mass media in both real and fictional observations and can be effective in improving attitudes when an affinity between the character and the group in question. Research has shown that parasocial contact with TGD characters reduces negative attitudes, providing empirical support for the PCH (Y. A. Chen & Zhang, 2022; Massey et al., 2021; McDermott et al., 2018; P. R. Miller et al., 2020). For example, Massey et al. (2021) found that observing a fictional trans character was associated with a reduced desire to distance themselves from TGD people, as observing this character increased feelings of empathy and reduced intergroup anxiety. In contrast, when parasocial contact was poor quality, they found it had negative implications for attitudes towards the TGD community.

Despite these encouraging findings, interventions based on the contact and parasocial hypotheses do not address ‘readiness to change’ by considering the full breadth of the cognitive determinants of negative attitudes towards the TGD population and, therefore, currently take a one-size-fits-all approach. Interventions must be sensitive to all known cognitive determinants and may require tailoring to known problematic groups (i.e., those that appear to have especially negative attitudes) to enhance their effectiveness. As such, it is vital to determine what factors may promote negative attitudes towards TGD people.

A potential determinant which may contribute to men's heightened negative attitudes is the integrity of their gender identity. As outlined in Chapter 2, men's masculinity is easily threatened. As mentioned, men who feel their masculinity is threatened respond predominantly in negative ways, including adopting an anti-femininity bias to compensate for this threat (Cheryan et al., 2015; Fowler & Geers, 2017; Willer et al., 2013). This overzealous response is termed the 'Masculine Overcompensation Hypothesis'. This bias may manifest in negative attitudes towards gender minority groups as they are considered antagonistic to traditional gender identities (Broussard et al., 2018). For instance, TGD people inherently oppose the traditional binary gender system and seek to redefine the conceptualisation of gender, which threatens the traditional patriarchal social structure of gender (Ching, 2022; Harrison & Michelson, 2019; Konopka et al., 2021), leading to men expressing negative attitudes to demonstrate their masculinity and reaffirming their manhood (Ching, 2022).

However, research concerned with the consequences of masculinity threat for trans negativity is in its infancy, having only been tested in a small number of countries such as the US (Harrison & Michelson, 2019), China (Ching, 2022) and Poland (Konopka et al., 2021). Given the social constructionism of gender, examining the role of masculinity threat in a more diverse range of countries is needed to see whether findings replicate cross-culturally. Men's responses to masculinity threat may vary depending on cultural factors. For example, Polish men conform more to traditional, hegemonic masculine ideals than British men (Fiałkowska, 2019). As such, it is vital to examine whether implicit threats to gender identity help explain transnegativity, especially among a sample of UK cisgender men.

Replicating existing findings in the UK is essential, given the differing attitudes toward TGD people in the US, China and Poland (Flores et al., 2016; Harrison & Michelson, 2019;

Konopka et al., 2021). In addition, except for Harrison and Michelson (2019), no research has explicitly included a sample of cisgender women who experience a femininity threat. While the 'Precarious Manhood Hypothesis' and evidence suggest that threatening femininity should not negatively influence attitudes toward TGD people, it is critical to elucidate whether this is the case in a UK sample (Bosson et al., 2009; Harrison & Michelson, 2019; Willer et al., 2013). Finally, to our knowledge, no research has directly investigated whether threatening men's masculinity would influence their endorsement of the traditional binary gender system. As such, we aimed to examine two outcome processes: attitudes towards TGD people generally and holding positive gender and sex beliefs (i.e., acceptance of identities outside of the binary and gender fluidity). Our findings would also further explore the effect of masculinity threat by investigating whether masculinity threat in a UK context has a significant effect on TGD attitudes. This effect has been firmly established in other sociocultural contexts.

We aimed to investigate the influence of gender identity threat. We examined whether threatening men's and women's traditional gender identity would influence their attitudes towards TGD people and their endorsement of the traditional binary gender identity in a sample of cisgender men and women in the UK. We also include another condition that received a gender identity-affirming cue, as per previous research (Willer et al., 2013). For experiment four, we hypothesised that *(1)* cisgender men would show significantly more negative attitudes toward TGD people and less positive gender and sex beliefs following a masculinity threat relative to men who did not receive this threat or who received affirming feedback, *(2)* cisgender women would show no difference in their attitudes towards the TGD community or their gender and sex beliefs following a femininity threat, relative to those who received no threat or who received affirming feedback.

6.3.1 Method

6.3.1.1 Design and Participants

Participants for this experiment were similarly sampled using the online crowd-sourcing platform Prolific and were paid £1.00 (£7.50/hr) for their participation. Our inclusion criteria required participants to identify as cisgender men or women, be straight (heterosexual), and reside within the United Kingdom. Participants were required to identify as straight. This was because sexual minority people (e.g., lesbian, gay, bisexual [LGB] people) may be more likely to have had contact with TGD people by being part of the LGBTQ+ community and, according to the contact hypothesis, be influential on TGD attitudes (i.e., more positive attitudes relative to straight people; Earle et al., 2021). According to Stone (2009), attitudes are more likely to be positive, and LGB people adopt ally identities by drawing parallels with experiences of oppression (i.e., similar lived experiences). As such, our inclusion criteria differed from those of our other experiments. We did this to replicate existing masculinity threat research as closely as possible (e.g., Harrison & Michelson, 2019).

In total, 330 participants were recruited, who were majority White (n = 298; 89.49%) and aged between 19 and 82 (M_{age} = 41.8, SD_{age} = 13.6). Of the total sample, 165 identified as men (M_{age} = 44.44, SD_{age} = 14.18) and 165 identified as women (M_{age} = 39.22, SD_{age} = 12.52). Participants were then randomly allocated into one of three experimental conditions (n = 110; 55 men, 55 women): masculinity/femininity threat, masculinity/femininity affirmation and control conditions. Demographic details separated by condition and gender are shown in Table 6.1. An a-priori power analysis using the *pwr* package in RStudio indicated a sufficient sample size to detect a moderate effect size (f = .25) with a power of .80.

Table 6. 1
Demographic Information by Gender and Experimental Condition for Experiment 4.

	Men			Women		
	Threat	Affirmation	Control	Threat	Affirmation	Control
Age	45.8	42.6	45.0	39.8	39.1	38.8
	(14.1)	(13.7)	(14.8)	(13.0)	(13.4)	(11.3)
Relationship						
Single	18	20	18	20	23	20
Never married	11	10	8	11	7	8
Married	22	21	24	20	24	22
Divorced	1	3	2	3	1	4
Widowed	2	-	1	1	-	-
Separated	1	-	1	-	-	-
Remarried	-	1	1	-	-	1
Ethnicity						
White	48	48	49	51	53	49
Asian or Asian British	3	1	3	3	-	1
Black, African, Caribbean, or Black British	3	1	-	1	2	-
Mixed	-	5	3	-	-	5
Other	1	-	-	-	-	-
Education						
Doctorate	5	1	2	2	-	1
Postgraduate	7	10	5	7	12	9
Undergraduate	20	19	24	22	21	22
A-level/BTEC	16	15	13	20	16	15
GCSE	7	10	10	4	5	7
No formal education	-	-	1	-	1	1

Notes. Age reflects the mean, and the parentheses represent the standard deviation. Only the demographic options that participants used were included. *n* in each condition = 55.

6.3.1.2 Materials

Manipulation measures. We used the same manipulation as experiment two. We also used a femininity threat condition in this experiment. This manipulation procedure was the same for the cisgender women who received this threat relative to men in the masculinity threat condition. Specifically, they received a message stating that their score was 13, within the "*masculine range of responses*". In the affirm condition, participants received the opposite feedback, such that men were informed that their responses were within the masculine range. In contrast, women were informed that their responses were within the feminine range.

Masculine feedback was presented in blue, and feminine feedback was presented in pink text to reinforce the gender associated with each score (Salvati et al., 2021).

Manipulation check. We used manipulation checks to determine whether the prime was effective. We expanded on our manipulation check administered in experiment two by using the same one with an additional check. For our additional check, we asked participants in each of the three conditions to rate five emotional adjectives concerning how they felt at that moment, using a five-point rating scale ranging from *not at all* (1) to *extremely* (5). The items included "*sad*", "*nervous*", "*annoyed*", "*threatened*", and "*discomforted*". A total score was produced by summing the five items, with higher scores indicating negative affect. We reasoned that men in the threat condition would show *(1)* more negative emotion scores relative to the affirm and control conditions and *(2)* less satisfied with their score relative to the affirm condition. We predict that regardless of condition, women will show no differences in emotion or satisfaction scores.

Post-manipulation measure. Following the manipulation check, we asked participants to complete the Trans Attitudes and Beliefs Scale (B. A. Jones et al., 2023a)[16]. We created this scale in a previous iteration of this programme of work.

The Trans Attitudes and Beliefs Scale (TABs) measured participants' attitudes and beliefs toward the TGD community. The measure consisted of 29 items and three subscales: interpersonal comfort, human value, and gender and sex belief. Items included "*I would feel comfortable if my next-door neighbour was trans*" and "*all adults should identify as either male or female*." Participants responded on a 7-point scale ranging from *strongly disagree* (1) to *strongly agree* (7). The overall TAB's score indicated general attitudes toward TGD people. The gender and sex belief subscale scores indicated a participant's endorsement of traditional gender and sex beliefs. Higher scores indicate more positive attitudes and less traditional views surrounding sex and gender. The possible raw ranges of each questionnaire domain are 5–35

[16] This study represents an earlier phase in this research project. This open access paper can be found here: Jones, B. A., Cahill, L., & McDermott, D. T. (2023). Assessing Attitudes Toward Trans and Gender Diverse People: Adapting the 'Transgender Attitudes and Beliefs' Scale. *Journal of Homosexuality*, *0*(0), 1–12. https://doi.org/10.1080/00918369.2023.2245524

for human values, 14–98 for interpersonal comfort, and 10–70 for sex and gender beliefs. The overall measure (α = .95) and the gender and sex belief subscale (α = .93) had excellent internal consistency and validity.

6.3.1.3 Procedure

Participants were initially directed to Qualtrics (www.qualtrics.com), presented with an information sheet, and asked to provide informed consent. We used the same procedure outlined for experiment two.

6.3.2 Results

Before conducting any analyses, the assumption of normality was confirmed by examining the absolute values of skewness and kurtosis, revealing that both did not exceed ±2 (George & Mallery, 2010). Second, Levene's Test of equality of variance revealed no significant departures from the homogeneity of variance assumption. Given this, the analysis was conducted as intended.

6.3.2.1 Manipulation check

Before examining the primary hypotheses, we conducted preliminary analyses to assess the effectiveness of our manipulation. Firstly, two separate one-way ANOVAs were completed for men and women, examining whether there were any differences in scores on the emotion measure between groups. The results revealed no evidence for significant differences between conditions for men, $F(2, 162) = 2.75$, $p = .067$, $\eta^2 = .03$. However, there was evidence for significant differences between conditions for women, $F(2, 162) = 6.16$, $p = .003$, $\eta^2 = .07$. Holm-corrected pairwise comparisons revealed that women in the threat condition showed significantly more negative affect ($t(162) = 3.51$, $p = .002$; $M = 7.60$, $SD = 3.34$) relative to women in the affirmation condition ($M = 5.82$, $SD = 1.99$), but no difference was shown with women in the control condition ($t(162) = 1.61$, $p = .120$; $M = 6.78$, $SD = 2.49$), or between the affirm and control conditions ($t(162) = 1.90$, $p = .120$).

Second, independent samples t-tests were used to assess differences in satisfaction scores. This revealed evidence of significant differences for men, $t(108) = 5.36$, $p < .001$, Cohen's $d = 1.03$, 95% CI [.63, 1.43], with men in the threat group showing significantly lower satisfaction with their masculinity score (*M* = 3.75, *SD* = 2.21) relative to the affirm condition (*M* = 5.58, *SD* = 1.24). Similarly, there was evidence for a significant difference in satisfaction ratings for women with regards to their femininity score, $t(108) = 5.83$, $p <.001$, Cohen's $d = 1.12$, 95% CI [.72, 1.52], with those in the threat condition showing significantly less satisfaction, (*M* = 3.27, *SD* = 1.28), relative to those in the affirm condition, (*M* = 6.29, *SD* = 3.62). These findings partially support that our manipulation was successful, and explanations for this are provided in the discussion.

6.3.2.2 Primary analyses

We began by testing the effect of masculinity threat on men's attitudes towards the TGD community and beliefs surrounding gender and sex as a construct. For this, we ran two one-way ANOVAs. These analyses revealed no evidence for a significant effect of condition on overall TGD attitudes, $F(2, 162) = .13$, $p = .875$, $\eta^2 <.01$, or on scores for the gender and sex belief subscale, $F(2, 162) = .04$, $p = .964$, $\eta^2 <.01$. This provides no evidence to support our hypothesis for men. Next, we tested the effect of femininity threat on women's attitudes similarly. These analyses also revealed no evidence for a significant effect of condition on overall TGD attitudes, $F(2, 162) = 1.79$, $p = .170$, $\eta^2 = .02$, or on scores for the gender and sex belief subscale, $F(2, 162) = 2.77$, $p = .066$, $\eta^2 = .03$. This provides evidence to support our hypothesis for women. Table XYZ reports the means and standard deviations for both outcome variables by condition.

Table 6. 2
Mean (M) and Standard Deviation (SD) by Condition for Men and Women.

	TGD Attitudes		Gender and Sex Beliefs	
	M	*SD*	*M*	*SD*
Men				
Threat	155.04 [145.82, 164.24]	36.96	46.82 [42.96, 50.68]	14.54
Affirm	152.40 [143.18, 161.62]	29.09	46.16 [42.30, 50.02]	13.27
Control	155.60 [146.38, 164.82]	37.19	46.18 [42.32, 50.04]	15.59
Women				
Threat	169.60 [163.47, 175.73]	24.18	50.58 [47.20, 53.97]	13.04
Affirm	176.96 [170.84, 183.09]	22.08	55.56 [52.18, 58.95]	11.96
Control	169.95 [163.82, 176.07]	22.74	50.67 [47.29, 54.06]	13.09

Notes. 95% Confidence Interval is shown in square brackets.

6.3.3 Discussion

Here, we examined whether threatening men's and women's traditional gender identity would influence their attitudes towards TGD people and their endorsement of the traditional binary gender identity. In contrast to what was hypothesised, following a masculinity threat, cisgender men did not show significantly more negative attitudes toward TGD people and less positive gender and sex beliefs relative to cisgender men who did not receive this threat or who received affirming feedback. As anticipated, cisgender women showed no difference in their attitudes towards the TGD community or their gender and sex beliefs following a femininity threat relative to cisgender women who did not receive this threat or who received affirming feedback.

Our findings support the socially constructed nature of gender and gender-related attitudes as established in previous research. In contrast to the current UK-based findings, research in other countries has found masculinity threat to be associated with more negative attitudes towards TGD people (e.g., Ching et al., 2022). For example, Konopka et al. (2021) found that Polish men exposed to a masculinity threat experienced a greater negative emotional response and heightened trans negativity than those who received no threat cues. Previous research has established that perceptions of masculinity vary by country (Fiałkowska, 2019). DiMuccio et al. (2017) explain these differences in perceptions of masculinity when they found that men in the US viewed manhood as more precarious than Danish men, as the former group perceived needing to demonstrate manhood through the physical ability of the body rejecting femininity. In contrast, Danish men described manhood as a physical embodiment and valued the role of femininity within it. Men in the UK may be similar to Danish men in their perceptions of manhood. Hence, a threat to masculinity may not have been deemed problematic for a UK sample of men. However, for completeness, future research should explore cross-cultural perceptions of masculinity while accounting for additional variables such as political identity, that are also known to be influential (Worthen et al., 2017).

Similarly, attitudes towards the TGD community within the UK may overall be more favourable compared to other countries (the US, China and Poland) that have previously found negative associations between masculinity threat and trans negativity. For example, the cultural climate of Poland, which was ranked 44/49 by the ILGA-Europe in terms of human rights laws for LGBTQ+ people, is very different to the UK, which was ranked 14/49 by the ILGA (ILGA-Europe, 2022). Indeed, this pattern of findings was also supported by the self-reported TGD attitudes across all conditions shown in which our UK sample generally reported positive attitudes and beliefs on average. It may be that other established responses to masculinity threat (e.g., aggressive driving; Braly et al., 2018) may still occur for UK men. However, given that our sample of men reported relatively positive TGD attitudes and men in the UK generally support TGD issues (Morgan et al., 2020), trans negativity may not be an appropriate compensatory mechanism for UK men. Despite this finding amongst our sample, the UK can still be a hostile place for TGD people to reside, given the prevalence of high-profile public debates concerned with TGD lives that are initiated and maintained by certain people drawing on arguments that stem from transgender-exclusionary radical feminism. Therefore, future research may want to engage with participants who hold such views to understand predictors of negative attitudes more completely.

The participants' age could have also been responsible for the lack of identified effect of our masculinity threat cue on self-reported trans negativity. Previous research (Ching, 2022; Harrison & Michelson, 2019; Konopka et al., 2021) has recruited student samples with a mean age range much lower than what was reported in the current study (M_{age} = 41.8, SD_{age} = 13.6). During early adulthood, it has been argued that masculinity and femininity are highly valued and strongly associated with one's social identity, and a threat to gender has been shown to be negatively associated with attitudes towards gender and sexual minority populations (Konopka, et al., 2021). Hence, a gender identity threat cue may be more relevant to younger individuals. In the current sample, the mean age of participants was much greater than that of a typical student sample. It, therefore, may be an explanation for the lack of significant effect.

Finally, it could also be argued that our masculinity threat manipulation was ineffective. In contrast to what we hypothesised, we found a lack of effect of masculinity threat on reporting negative emotions. This finding is consistent with Konopka et al. (2019), who also found no change in self-reported affect following a masculinity threat cue. Yet, they demonstrated that masculinity threat did increase trans negativity. It may be that the lack of self-reported negative emotional response to a masculinity threat is a mechanism to protect masculinity and, as a result, an inability to express emotions effectively (K. M. Bennett, 2007). Indeed, the expression of emotions is intrinsically linked with a feminine identity, and men are shown to be less likely to report instances of emotional or psychological distress (Ridge et al., 2011). As masculinity threat cues are shown to cause an antifeminine bias and reduce engagement in feminine activities, men may be reluctant to express negative affect (Cheryan et al., 2015; O'Brien et al., 2005). Despite this, we did find significant differences in satisfaction scores, with men reporting themselves to be less satisfied when receiving a threatening score, consistent with previous research. Similarly, the gender identity threat cues used in the present study have been well-established to produce a response (e.g., Glick et al., 2007; Harrison & Michelson, 2019; Salvati et al., 2021). As such, we deem this an unlikely explanation for the lack of effect.

In summary, the findings of experiment four show that masculinity threat does not influence men's attitudes toward TGD people in a UK sample of men. This contrasts with findings from other sociocultural groups. This adds to the emerging existing literature investigating the effects of masculinity threat. This expands the findings we reported in Chapter 5, given that we did not find any significant effect of our masculinity threat prime on men's WHR and BMI preferences. Specifically, our findings collectively may suggest that UK men may respond differently to a masculinity threat than men from other sociocultural backgrounds. We consider this more in Chapter 8.

7. CHAPTER 7: THE EYES HAVE IT: EYE TRACKING MEN'S PREFERENCES UNDER SITUATIONAL THREATS

7.1 Introduction

In the previous chapter, we explored the influence of situational threat cues on men's body shape and size preferences using a self-report attractiveness paradigm. In experiment five, we evaluate the influence of priming for subtle situational threat cues on men's body shape and size preferences while using a broader range of outcome measures.

Previous research examining men's preferences has primarily relied on attractiveness rating paradigms (Dixson et al., 2011b). Similarly, previous eye-tracking research has used free viewing tasks, whereby participants view a body stimulus for a set amount of time and then provide an attractiveness rating (Wenzlaff et al., 2016). However, these free-viewing attractiveness-rating paradigms have limitations. For instance, it is possible that presenting a single stimulus on the screen may cause participants to fixate on the area of the stimulus, which is changing, irrespective of a preference toward that area. For instance, previous research has shown that people tend to focus on the aspect of a stimulus which changes (Reisenzein et al., 2019; Remington et al., 1992). Furthermore, participants may quickly become aware of the purpose of the task.

One way of overcoming these limitations and capturing additional information is to combine the eye-tracking free-viewing paradigm with a purposeful experimental task. This not only disguises the purpose of the task but also allows us to collect a broader array of measurements. This task measures attentional biases toward specific stimuli because attention is reasoned to be orientated towards relevant stimuli, meaning when a dot replaces that stimulus, reaction times are faster (MacLeod et al., 1986). Faster reaction times when the dot replaces the target stimulus (i.e., the stimulus which is supposed to be preferred in the visual field) relative to the neutral stimulus (i.e., the stimulus which is not supposed to be preferred) is an indicator of an attentional bias toward the target (Lu & Chang, 2012; MacLeod et al., 1986). However, while the dot-probe task is regularly used across various fields, it has limited reliability (Schmukle, 2005). Fortunately, the task's reliability improves when using alternative outcome measures (rather than reaction time), such as the first saccade's latency (Blechert et al., 2010; Skinner et al., 2018). We provide a more in-depth review of the dot-probe paradigm in Chapter 3.

Considering the above, this chapter explores men's preferences using a combined eye-tracking dot-probe paradigm. Like the original dot-probe paradigm, we intend to observe whether men express an attentional bias toward target stimuli (i.e., 0.7 WHR and average BMI) relative to neutral stimuli (i.e., 0.6 and 0.8 WHR; underweight and overweight BMI). However, instead of using reaction times, we will use the latency of the first saccade as the indicator of attentional bias. In addition, this paradigm also allows us to capture more traditional indicators of visual interest using regular free-viewing tasks (e.g., average dwell time). We provide more details on our exact outcome measures below. As we have several different outcome measures, we make specific hypotheses within our results section. However, we present the research questions for this chapter below. We define how we operationalised preferences in Section 7.2.4.

1. Do men primed with mortality, masculinity or pathogen threat cues show an attentional bias toward more attractive (i.e., target; see below) bodies relative to less attractive (i.e., neutral) bodies?
2. Do men primed with mortality, masculinity or pathogen threat cues show enhanced preferences toward the more attractive body shapes (i.e., 0.7 WHR) and sizes (i.e., average BMI)?
3. Do men primed with mortality, masculinity, or pathogen threat cues show different preferences toward specific areas of the body?

7.2 Methods

7.2.1 Design and Participants

We employed a lab-based experimental design using a combination of eye-tracking and self-report indices as outcome variables. We sampled 101 participants using Nottingham Trent University's participant recruitment system and other forms of advertisement (e.g., social media, message boards and personal connections). Of those participants, we could not calibrate the eye-tracker for nine participants. We removed six participants as they did not meet the study criteria or failed to follow the experimental instructions. Finally, we removed another six participants due to poor data quality across most trials (i.e., their fixations were persistently toward one corner of the screen).

The final sample comprised 80 participants aged between 18 and 55 (M_{age} = 26.58, SD_{age} = 8.40). We allocated 20 participants to each of the four conditions: pathogen threat (M_{age} = 26.30, SD_{age} = 8.62), mortality (M_{age} = 28.85, SD_{age}= 10.26), masculinity (M_{age} = 24.75, SD_{age} = 7.03), and control prime conditions (M_{age} = 26.40, SD_{age} = 7.44). Using a one-way ANOVA, we found no evidence of significant age differences between the four conditions, $F(3, 76) = .81$, $p = .493$. For their time, participants received research participant credits or either a £5 or £10 voucher, depending on the project stage[17]. Data collection for each condition occurred concurrently. Our sample size was comparable to other eye-tracking experiments (Blechert et al., 2010; Dagnino et al., 2012; Hall et al., 2011). The BPS Cognitive Section supported this experiment with funding of £500. We are very grateful for their support.

We registered this experiment on the OSF. However, we did not pre-register for this experiment, primarily because our predictions were not fully formed during data collection. Specifically, we were unsure what outcome measures we would produce from our data. As indicated on the OSF, the data for this experiment was accessed and analysed before registration. However, this experiment's hypotheses and analysis methods logically follow the previous chapters. For transparency, we still registered this experiment to ensure all the experimental materials were openly available for scrutiny. However, we refrain from referring to this as *pre*-registered work. All materials, raw data files, accompanying R scripts and analysis outputs are available on the OSF (https://tinyurl.com/LCC2023-EYES). We report a detailed description of our eye-tracking paradigm and the apparatus used.

[17] Due to greater available funding, we increased the payment to participants in our later recruitment.

7.2.2 Materials[18]

7.2.2.1 Priming Methods

We randomly assigned participants to one of the four conditions in this experiment in a double-blind fashion. Qualtrics handled this randomisation. Participants assigned to the pathogen, mortality and masculinity prime conditions received similar priming content as experiments one – three (appendix one - three). We adapted our priming methods to ensure that each situational threat cue was similar in length and complexity. For the mortality threat condition, participants completed 14 instead of 10 items. They also did not complete the distraction task. We believed that the set-up time for the eye-tracker would suffice as a distraction task. Participants did not receive 60 items from the BSRI for the masculinity threat prime; they received 30 items instead.

Participants in the control condition received different priming content relative to the previous three experiments. We did this primarily for pragmatic reasons, as creating a suitable control group to compare each situational threat cue primes (i.e., mortality, masculinity, and pathogen threat) would significantly reduce recruitment requirements. This was necessary given the monetary and time commitments imposed on this project. However, we deemed this new control task appropriate as it was neutral and did not actively prime for any situational threat cue. Administering a neutral task as a control task is common in priming research (Burke et al., 2010; Harrison & Michelson, 2019; Tulving & Hayman, 1995; Tybur et al., 2010). It was also of similar length and complexity to the three situational threat cue primes.

The participants received a short passage describing a modular phone in this control condition. A modular phone is a smartphone concept that allows people to upgrade individual components rather than the entire device[19]. We presented participants with a description of a modular phone. We asked them to rate how useful upgrading seven specific aspects of the phone would be from 1 (*not useful at all*) to 5 (*extremely useful*). The seven aspects included

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[18] The experimental paradigm for this experiment was published: Cahill, L., Cristino, F., Marriott, M., & Dunn, A. K. (2023). Developing an eye tracking dot-probe paradigm to measure men's body shape and size preferences. *The Cognitive Psychology Bulletin*, 8(1).

[19] More information about modular smartphones can be found here: https://en.wikipedia.org/wiki/Modular_smartphone

the phone's body, the battery, the display, the rear camera, the top module (e.g., speaker), the bottom module (e.g., charging port) and the back protective cover. We also presented an open-ended question asking participants to "*briefly explain whether you would purchase a modular phone and why".* We outline the control prime used in experiment five in appendix four.

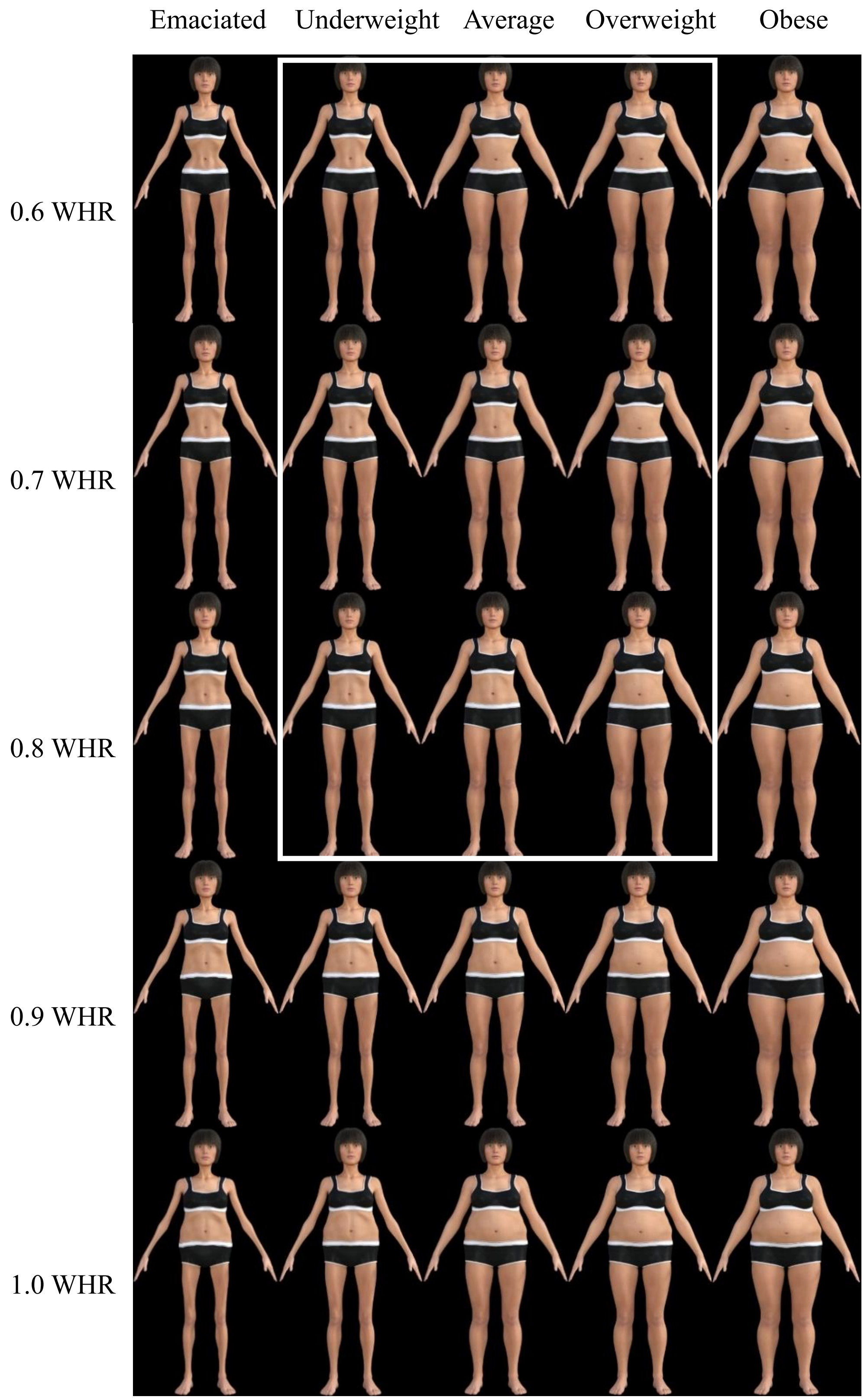
7.2.2.2 Stimuli

Experiments one - three used 25 stimuli varying across five WHR (0.6, 0.7, 0.8, 0.9, 1.0) and five BMI (emaciated, underweight, average, overweight and obese) categories. We used a reduced stimulus set for experiment five, consisting of nine stimuli across three WHR (0.6, 0.7, 0.8) and three BMI (underweight, average, overweight) categories. We decided to use a reduced stimulus set. Figure 7.1 displays the stimuli we used in experiment five, including the subset of stimuli used (within the white rectangle). Our reduced stimulus set comprised one BMI or WHR category above and below the most attractive. For instance, we selected bodies with a 0.6, 0.7 and 0.8 WHR paired with underweight, average and overweight BMI.

We selected this reduced stimulus set because research has shown that when unusual or atypical stimuli are presented alongside each other, they may capture a person's attention (referred to as *surprise;* Reisenzein et al., 2019). This effect is powerful when the change in a stimulus is abrupt and apparent (Remington et al., 1992). For instance, if one trial presented a body with an overweight BMI and the subsequent trial presented a body with an emaciated BMI, this sudden change may be surprising and capture attention. For this reason, we selected the 0.7| average stimulus and included the stimuli in one category surrounding this (e.g., 0.8| average and 0.7| Underweight).

We acknowledge that reducing our range of stimuli has limitations. Specifically, it reduces the range of body types that men are presented with and does not allow us to capture preferences toward all five WHR and five BMI categories. It also does not allow us to explicitly investigate the *avoid unfit* direction of preferences, as we did in experiments one - three. For this reason, we make no formal three-way hypotheses in our results (i.e., a three-way WHR x BMI x condition interaction). However, we deemed this an appropriate trade-off as using this subset provided several benefits for our current purposes. Doing so allowed us to address whether priming men with situational threat cues directly caused an attention bias toward more attractive WHRs (i.e., 0.7 WHR) and BMIs (i.e., average BMI). As we were only comparing two WHR and BMI categories at any time, we could address whether there was an attentional bias towards 0.7 WHR and average BMI relative to a lower or higher WHR and BMI. For instance, if participants report a persistent lower latency of the first saccade for 0.7 WHR bodies relative to 0.8 WHR bodies, this will indicate an attentional bias toward the more attractive WHR relative to a higher WHR. We could also observe whether priming men with situational threat cues modulated this bias. A reduced stimulus set also limited the burden placed on the participant. We aimed to keep our paradigm under 30 minutes to reduce visual drift and participant fatigue (Peitek et al., 2018). A longer experiment would also increase the risk of the prime effect becoming less effective. We aimed to minimise this to ensure our priming effect remained active for as long as possible.

Figure 7. 1
The 9 (3 BMI x 3 WHR) Body Stimuli used in Experiment 4.



Note. We used the stimuli contained within the white rectangle. The stimuli are not to scale.

7.2.2.3 Apparatus

We created our experimental paradigm using the SR Research Experiment Builder (version 2.3.38). We used the EyeLink 1000 (SR Research, Mississauga, Ontario, Canada) in tower mount configuration to collect our eye tracking data. We used this eye-tracking system rather than other systems as it is deemed the most precise and allows for flexible troubleshooting of calibration issues (Holmqvist & Zemblys, 2016). The EyeLink 1000 samples at a rate of 1000 Hz (1000 frames per second) and has a mean spatial accuracy of .57º, which has minimal degradation over time (Ehinger et al., 2019). The eye tracker measures eye movements via a non-intrusive infrared light, which tracks the pupil and the corneal reflection. Specifically, the EyeLink 1000 extracts saccades by computing a displacement of 0.1°, a velocity of 30°/s and an acceleration of 8000°/s (SR Research, Mississauga, Ontario, Canada). The EyeLink 1000 categorises anything which is not a saccade as a fixation. We used a nine-point calibration to ensure high spatial accuracy. A calibration dot was displayed in the centre and toward each of the edges of the screen. Participants fixated on the centre of the dot to perform the calibration. Following this, we validated this calibration. We sometimes ran multiple calibrations to select the most optimal. We used a drift check screen before each trial (see below for a description of the exact trial sequence) to assess whether this calibration degraded throughout the experiment. If the calibration did degrade, we reperformed the calibration and validation during the experiment.

The participants completed the experiment on a desktop computer with an Intel i7-6700 CPU at 3.40 GHz, 16GB of RAM and an Nvidia GT 720 GPU operating on Windows 7. They viewed the experiment on a BenQ 24" monitor (53.3cm x 30.5cm; 1280px x 1024px; 40.26° x 25.30°), with a refresh rate of 144 Hz and a 1ms response rate. Throughout the experiment, we ensured that the background colour remained the same for the calibration, drift check and trial screens (RGB: 0, 0, 0). This controlled for changes in luminosity, a crucial determinant of data quality. Participants sat approximately 65cm from the screen. The participants sat on a chair which could move vertically, but the table was always approximately 77.5cm from the floor.

A specially adapted Lenovo SK-8825 full-sized wired keyboard was used during the experiment to allow the participants to provide the attractiveness rating easily. As participants were required to use the space bar to navigate the information screen, we placed the keys used to provide the attractiveness rating as closely as possible. We used the Z – M keys, representing an attractiveness rating of 1 – 7, respectively. We coloured these keys using bright, luminous orange to distinguish them from the other keys. However, to minimise instances where participants moved their heads during the experiment, we ensured they familiarised themselves with the placement of the keys.

7.2.2.4 Eye Tracking Paradigm

We created our experimental paradigm in the SR Research Experiment Builder (version 2.3.38). We developed a combined eye-tracking dot-probe paradigm. This paradigm comprises a free viewing and dot-probe element, allowing us to collect information about attentional bias and visual interest toward overall bodies and specific bodily areas. We outlined the differences between the traditional and eye-tracking dot-probe paradigms in Chapter 3 (Figure 3.1), but we provide a brief overview here for clarity.

In the original dot-probe task (outlined in greater detail in Chapter 3), the participants view the stimuli presented on the screen before a probe (e.g., a dot) replaces one of the two stimuli (Lu & Chang, 2012). The participants respond to the dot using a key press. This reaction time reflects an attentional bias toward specific stimuli because attention is reasoned to be orientated towards relevant stimuli, meaning when a dot replaces that stimulus, reaction times are faster (MacLeod et al., 1986). In eye-tracking versions of this paradigm, the first saccade latency is used instead of reaction times to indicate attentional bias. Furthermore, rather than removing and replacing the stimulus with a probe, it is also possible to highlight the stimulus and then keep it on screen. This combines the dot-probe paradigm with a free-viewing task. This would allow for both the first saccade latency to be calculated (i.e., attentional bias) and data regarding where a participant looks at a stimulus to be captured (i.e., indicators of visual interest). At the same time, participants can rate the attractiveness of the stimuli. This addition also allows us to capture explicit attractiveness ratings. We provide more information on our eye-tracking paradigm here. Our paradigm resembled the approach employed by Blechert et al. (2010).

For our paradigm, participants received a total of 56 trials. Each trial presented two of the nine stimuli illustrated above. We included 48 experimental trials, whereby one of the two *targets*[20], WHR and BMI categories, was paired with one of the four *neutral* stimuli. A target stimulus referred to one that contained the most attractive WHR (i.e., 0.7 WHR) and BMI (average BMI), as rated in our previous experiments. Conversely, the neutral stimuli were either a higher (i.e., 0.8 WHR, overweight BMI) or lower (i.e., 1.0 WHR, underweight BMI) WHR or BMI relative to the target WHR and BMI. We also included an additional eight filler trials. These trials involved pairing two neutral stimuli to balance the number of presentations. This allowed us to collect information about visual interest and attractiveness ratings toward each body[21].

The structure of the trials matched that of a traditional dot-probe task. Each trial began with a central drift-check fixation cross. After a successful drift check, a second screen displayed the same central fixation cross in the centre, while two stimuli were shown on either side of the screen. Within each of the 48 experimental trials, a target stimulus was paired with a neutral stimulus. Both stimuli appeared on the screen's left or right side equally, the order of which was counterbalanced. We varied the time the stimuli remained unhighlighted uniformly between 1800 - 2200ms to prevent the participants from prematurely guessing and moving their eyes toward the highlighted stimulus. The participants were instructed not to move their eyes from the central fixation cross. We also varied (i.e., jittered) the vertical position of the two stimuli between each trial by a maximum of 2.56°. We did this uniformly to control whether the location of the first fixation was meaningful and purposeful rather than automatically occurring toward the same place, irrespective of the stimulus (DeWall & Maner,

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[20] We acknowledge that the word "target" has different definitions depending on the experimental paradigm. Our experiment defines a *target* as the WHR and BMI, rated as the most attractive in our previous experiments. In this way, we will hypothesise that men will show a preference (i.e., attentional bias) toward the target stimuli relative to a neutral stimulus. We define a neutral stimulus as a lower or higher WHR or BMI relative to the target stimulus.

[21] We did not include these filler trials in the attentional bias analysis as we were not interested in assessing whether there was a bias between two neutral stimuli. Instead, these trials were included when examining the attractiveness and fixation data (e.g., total dwell time, number of fixations) to ensure we had adequate trials and data for each stimulus.

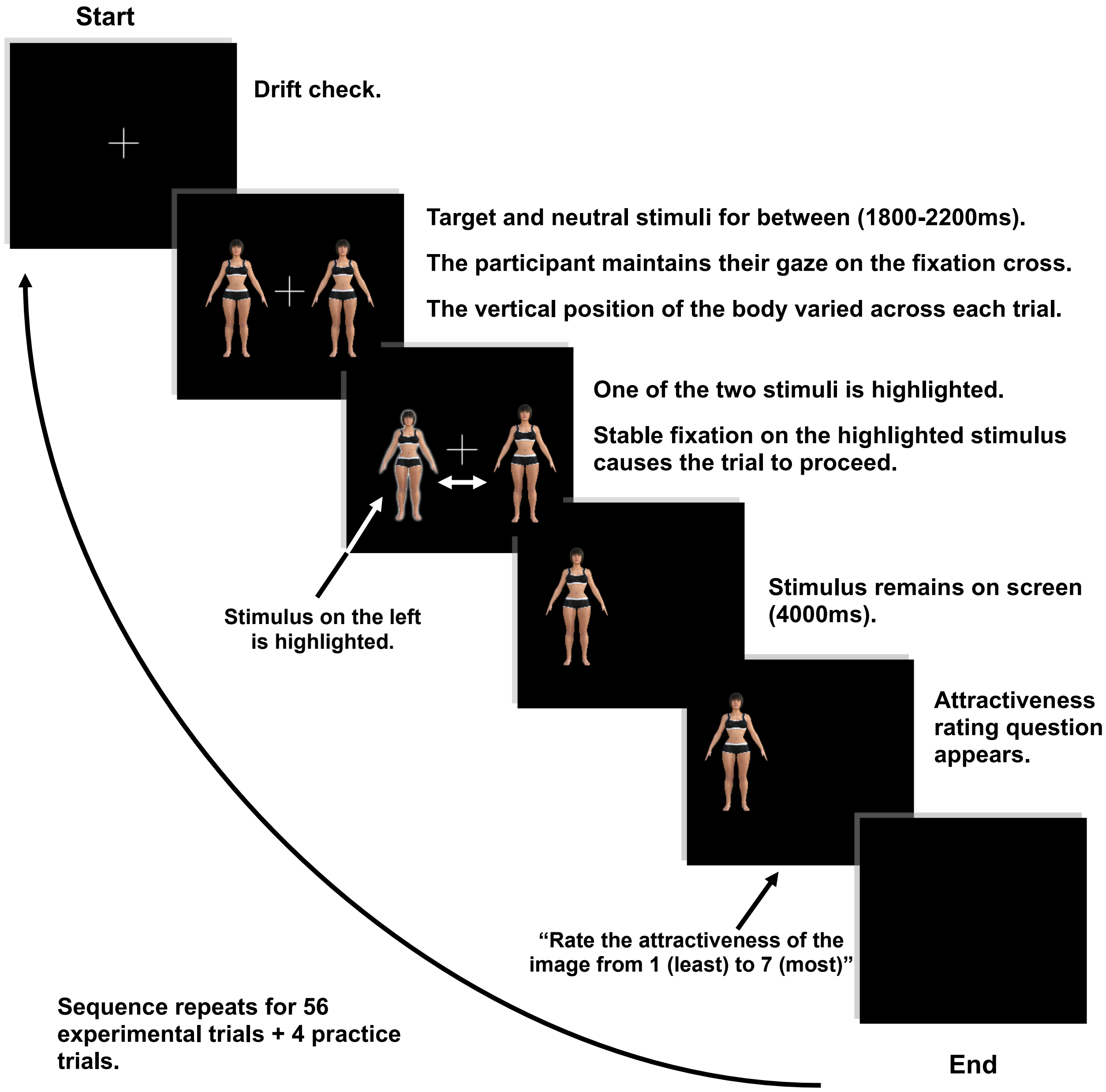
2008). The horizontal distance (8.65°va) from the central fixation cross to each stimulus was constant across all trials.

Following this, one of the two stimuli was highlighted by placing a white glowing outline around the edge of the stimulus. This approach differs from Blechert et al. (2010), who placed a coloured box around the stimulus their participants should look toward. We used a glowing outline rather than a box to prevent our participants from having to move their eyes toward the boundary of this box rather than the stimulus itself. Instead, presenting a glowing outline around the stimulus encouraged the participants to look toward the area of the body they most preferred. We placed an invisible rectangular box around the stimulus, which served as a trigger to record when our participants looked at the stimulus. This box included some of the blank space around it. When the eye-tracker identified a stable fixation within this box, the remaining elements of the display (fixation cross and unhighlighted stimulus) disappeared. The highlighting also disappeared at this point.

We instructed the participants to explore this body however they liked. The body remained on screen for 4000ms. After this, we asked participants to "*rate the attractiveness of the image from 1 (least) to 7 (most)*". Participants responded to this using the Z – M keys on the keyboard. After responding, the experiment advanced. The benefit of asking our participants to rate the attractiveness of the stimulus was that we also captured an attractiveness rating similar to experiments one - three but under lab conditions. It also encouraged our participants to observe the areas of the body they find relevant when forming an attractiveness judgement, allowing us to assess the visual interest properties which lead to this judgement.

We also created a separate practice experiment. This experiment consisted of four trials, using the stimuli we did not select for use within the thesis in Chapter 3. We used these practice trials to familiarise participants with the experimental paradigm before completing the priming task. This order minimised the delay between completing the priming task and the full experiment. Figure 7.2 depicts the experimental procedure.

Figure 7. 2
Procedure for the Eye Tracking Paradigm.



7.2.3 Procedure

The experiment took place in a windowless cubicle on NTU City Campus. The participants arrived and completed the informed consent and demographic questions using an online Qualtrics survey. At this point, the participants were randomly allocated into each condition using the Qualtrics randomisation algorithm. Once complete, the participant positioned themselves to be comfortable, with their chin securely on the chinrest and their head on the headrest. The experimenter adjusted the headrest as necessary to achieve a stable calibration. Following this, a calibration (and validation) task was carried out, in which the participants followed a moving dot around the screen. Once successfully calibrated, the participant completed the four practice trials. Having established that they had understood the task instructions, the participants returned to the Qualtrics survey and completed either the mortality, masculinity, pathogen, or control prime tasks. The priming tasks took approximately 5 minutes to complete. After completing the priming task, the participants were recalibrated and asked to complete the full experiment. If the calibration became poor during the experiment or the participant moved their head, the experimenter redid the calibration process. After completing all 56 trials in the sequence shown in Figure 7.2, the participants were debriefed, thanked, and compensated for their time. The experiment took approximately 30 minutes to complete.

7.2.4 Outcome Measures

Using our dot-probe paradigm, we examined whether men showed greater preferences within the early attentional system for target or neutral stimuli. We assigned all 0.7 WHR and average BMI bodies as targets and all remaining WHR and BMI stimuli as neutral. In this way, we could examine whether men showed faster first saccade latencies for more attractive (i.e., target) bodies overall and whether our situational threat cues would modulate this. We used this outcome measure to explore our first research question.

For the remainder of our analyses, we divided our outcome measures into overall stimulus and area of interest (AOI) outcome measures. Examining preferences at the level of the whole stimulus allowed us to explore men's WHR and BMI preferences and whether situational threat cues modulate these preferences. Previous research has shown that men view more attractive bodies for longer (Suschinsky et al., 2007). We broadly expected each situational threat cue to enhance men's visual interest (as indicated by our outcome measures) toward more attractive body shapes and sizes. We conceptualised preferences toward the overall stimulus using explicit *(1) attractiveness ratings, (2) fixation count, and (3) the first saccade latency.* We used these outcome measures to explore our second research question.

Additionally, examining preferences toward specific areas of interest allowed us to examine men's preferences toward specific bodily areas and whether situational threat cues modulate these preferences. Previous research has established that certain body areas (e.g., the waist) are important when determining health and fertility (Garza et al., 2016). Despite previous research showing that the breast and chest area receives more visual attention than other body areas, we did not predict our situational threat cues to influence men's preferences toward the breast AOI. This is because previous research has predominantly shown that breasts convey conflicting information concerning health and fertility (Dixson et al., 2011b; Furnham et al., 2006).

It is also likely that the increased visual interest in the breast AOI found in previous research is mainly due to several limitations with previous research, some of which we outlined in Chapter 3 and which we address in our experimental paradigm. First, previous research has often presented the stimuli in concurrent order and varied the breast size of the stimuli (e.g., Garza et al., 2016). This means that participants are likely to focus on the aspect of the stimulus that is changing (the breasts). Second, previous research has not varied the vertical position of the stimuli, meaning the participants may fixate first toward the centre of the stimulus. Third, to our knowledge, no previous research has normalised the fixation count depending on the size of their AOIs, and the breast AOI is often the largest. Logically, if an AOI is larger than other AOIs, it will likely receive more fixations by chance. Based on these reasons, we do not believe our situational threat cues will alter men's preferences toward breast AOI. Conversely, the waist and hip areas provide health and fertility information (Singh, 2006; Suschinsky et al., 2007). As such, we believe each situational cue will influence men's preferences toward the waist and hip area. Our hypotheses presented below follow logically from these lines of argument.

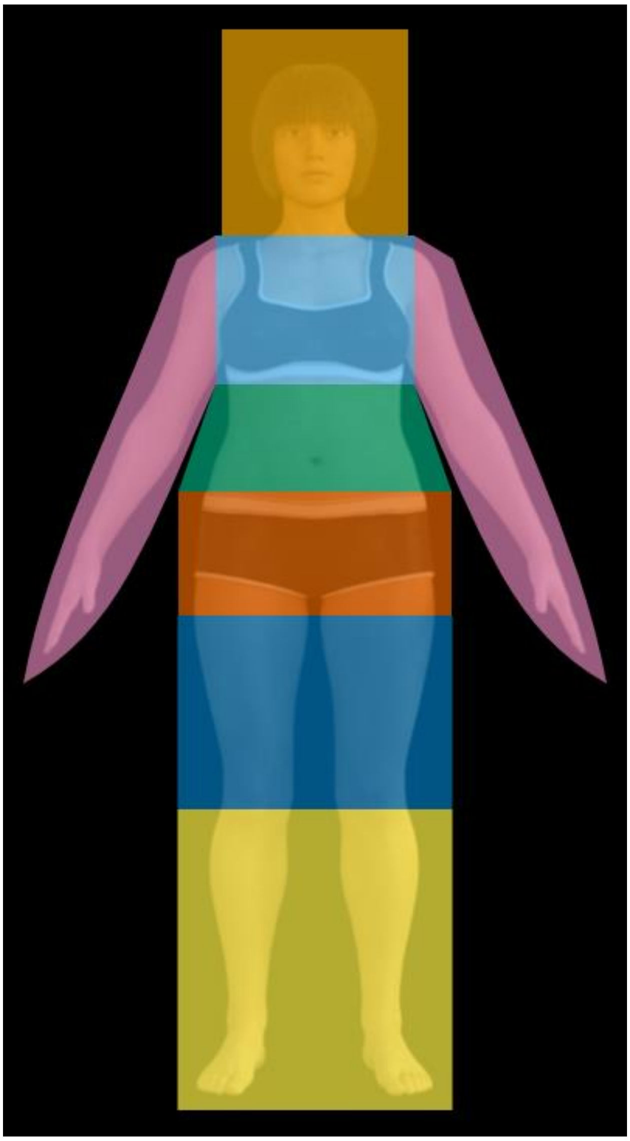
Given this, we expected that when we primed men with our situational threat cues, these areas may receive more visual attention and interest than others. Likewise, we conceptualised preferences toward specific areas of interest by examining the *(1) first fixation count (as a proportion), (2) the mean first saccade latency toward this location, (3) the fixation count, (4)* *the mean dwell time and (5) the number of revisits.* We used these outcome measures to explore our third and final research question.

7.2.5 Data Preparation

To allow us to investigate preferences for specific body areas, we used Affinity Photo Editor (version 2.0) to divide the body into seven areas of interest (AOI). Figure 7.3 illustrates each AOI. The AOIs were predetermined and similar to previous research (Dixson et al., 2011b; Garza et al., 2016). They included *(1)* the *head*, extending from above the hairline to below the larynx, *(2)* the *upper body and breast* (hereafter referred to as *breasts*)*,* extending from below the larynx to below the waistline of the upper body clothing (and to the boundary of the arms), *(3)* the *arms and hands* (hereafter referred to as *arms*), encompassing both the left and right arms, *(4)* the *waist*, consisting of the area directly below the upper body clothing to directly above the lower body clothing, *(5)* the *hips and groin* (hereafter referred to as *the hips*), extending from above the lower body clothing to the upper thigh, *(6)* the *thighs*, encompassing the upper thigh down toward the knee, and *(7)*, the *lower body* extending from below the knee to the feet.

We extended the AOI to encompass black space around each body part to capture any fixations at the boundary (e.g., the left side of the waist). Adding a boundary around an AOI reduces the risk of removing valid observations toward the edge of a stimulus (Orquin et al., 2016). We used the same size AOI for each body, independent of the WHR or BMI of that stimulus. We also calculated the size of each AOI (in pixels) based on the total size of all AOIs. We used this ratio to normalise our outcome measures (see below) to the size of the AOI. As such, the size of the AOIs was as follows: head (11.99%), upper body and breast (9.24%), arms and hands (18.12%), waist (8.31%), hips and groin (10.52%), thighs (16.40%) and lower legs (25.43%).

Figure 7. 3
An Example Stimulus Divided into the Seven AOIs.



Notes. The image details the seven AOIs (from top to bottom): head, upper body and breast, arms and hands, waist, hips and groin, thighs, and lower body. OKABE colour scheme.

7.2.5.1 Data Cleaning and Reduction

Before completing the preliminary and primary analyses, we prepared and cleaned the raw eye-tracking data to produce our outcome variables. Proprietary data files from the eye tracker (*edf* files) were converted to text files (*asc* files) using the SR Research EDF to ASC converter. EyeLink *edf* files contain samples and events. Samples reflect all measurements taken by the eye-tracker across the sampling period (e.g., 1000 Hz or 1000 samples per second). Files containing samples are large and cumbersome, which is why we only extracted events. Events refer to the parsed fixation, saccade, and blink events the eye tracker recorded.

Once converted, we imported these files into R, where we began to prepare the data. We extracted each participant's relevant information using the R *eyelinker* package (*version 0.2.1*; Barthelme, 2021). This package parses fixations and saccades into separate data frames. We used both data frames to calculate our outcome measures. We used both data frames because they each contained distinct information. For instance, the *saccade* data frame contained information about saccadic movements' start and endpoints. This information was useful when cleaning the first saccade latency information, which relied on the participant beginning the trial on the central fixation cross. The data cleaning R Markdown file with annotated comments is available on the OSF.

We began by cleaning the data and removing incomplete trials. These were trials where the experimenter aborted because of poor eye-tracking calibration. We excluded .13% of trials because of this. We also accounted for the jitter in the vertical position between the trials by correcting the y-position of the fixations or end of saccades. We calculated the extent to which the stimulus presented to the participant varied from the centre of the screen. Taking this jitter value, we deducted this from the vertical position of the fixation or end of the saccade. This process ensured that all fixations and endpoints of the saccades were normalised, taking the centre of the screen as a baseline.

We removed any fixations where the x and y coordinates were implausible (e.g., greater than the screen size). Because of this, we removed 6.04% of fixation observations. We assigned each fixation and the endpoint of a saccade to one of the seven AOIs. We removed any fixation (9.43%) and saccade (8.23%) observations which were not within one of the seven AOIs. We performed similar cleaning steps to Blechert et al. (2010) to ensure the accuracy of the first saccade's latency. We used the starting position of the saccade to remove observations where the participant was 2.0° from the central fixation cross at the start of the trial, either vertically or horizontally. We also removed any latencies less than 100ms, as these are involuntary and reflexive eye movements, which are uninfluenced by the properties of the stimulus (Knox et al., 2017; Şentürk et al., 2016). We removed 2.63% of trials because of these reasons.

Finally, we removed abnormally high observations before computing our first saccade latency outcome measure. We aimed to retain as many valid observations as possible per best practice (Baguley, 2012). We only removed a small number of observations which we believed to be extreme. As we computed a mean first saccade latency (see below) for each of our latency outcome measures, we did this to prevent extreme values from artificially inflating our mean values. Based on visual boxplot examinations of the data, we determined that most identified outliers were clustered (below 1500ms). We believed these represented valid (albeit slow) first saccade latencies. However, it became apparent that some observations for the first saccade latency were spuriously high (exceeding 1500ms). We believed that these observations reflected participants not engaging with the experiment. We removed all observations (.08%) which exceeded 1500ms[22]. Further outliers may be identified in our subsequent analysis as we computed a mean first saccade latency. We deal with these on a case-by-case basis.

7.2.5.2 Outcome Measure Creation

Dot-Probe Outcome Measure. We first examined whether men preferred more attractive bodies (i.e., target stimuli) relative to less attractive stimuli (i.e., neutral stimuli). For this, we used the first saccade latency. We assigned any bodies comprising 0.7 WHR or average BMI targets to create this outcome variable. We assigned all remaining bodies to contain a less attractive WHR (i.e., 0.6 or 0.8) or BMI (i.e., underweight or overweight) as neutral stimuli. We then calculated the mean first saccade latency for each participant grouped by the stimulus type (i.e., target or neutral).

Overall Stimulus Preferences. To calculate our overall stimulus outcome measures, we produced our outcome measures by grouping by WHR and BMI for each participant. We calculated a mean attractiveness rating for each participant grouped by WHR and BMI. This rating constitutes a similar outcome variable to the ordinal attractiveness ratings used in experiments one - three. For fixation count, we calculated the total number of fixations across

[22] For transparency, we found that there were no significant differences across any of our analyses that used the mean first saccade latency as the outcome measure when removing these observations relative to the analyses which included them. We removed those outliers for prudence to ensure that spurious outliers did not influence our estimations.

each stimulus and each trial across the viewing period (i.e., 4000ms). However, as certain stimuli were presented more often and some trials were removed for participants, we normalised this fixation count. We did this by dividing the total number of fixations by the number of times a stimulus was presented. This normalisation ensured a more frequent stimulus did not inflate the fixation count. Readers should interpret this outcome variable as the number of fixations per stimulus presentation per participant. A higher fixation count indicates greater interest in a stimulus (Mahanama et al., 2022; Scott et al., 2023).

Similar to previous research (e.g., Blechert et al., 2010), we used the first saccade latency to calculate an attentional bias. We calculated the mean latency of the first saccade for each participant grouped by WHR and BMI. This mean latency directly compared attentional biases across the three WHR and BMI categories. As mentioned above, using a subset of our stimuli also meant that we could directly compare whether men showed a preference for the target stimuli (i.e., 0.7 WHR and average BMI) relative to either a neutral stimulus exhibiting a higher (i.e., 0.8 and overweight) or lower (i.e., 0.6 and underweight) WHR or BMI. A lower (i.e., faster) mean saccade latency would indicate a preference for a specific body shape or size in the form of an attentional bias (Skinner et al., 2018).

Area of Interest Preferences. We captured a range of AOI-specific outcome measures which provide different information concerning men's preferences toward specific body areas. We calculated these outcome measures by grouping by AOI for each participant.

The first fixation count reflected how often a participant looked toward each AOI as their first fixation. That is, the first area a participant looked at once the stimulus was highlighted. A greater number of first fixations toward an area would indicate a preference for that area within early attention. To calculate the number of first fixations, we first removed any first fixations not within one of the seven AOIs (21% of observations). We then calculated the number of first fixations within each AOI for each participant expressed as a percentage of the total number of trials (56 trials).

We created the total number of fixations within each AOI for each participant. However, as the size of each AOI is different, we corrected this by normalising the total fixation count. We did this by dividing the total by the size of the AOI as a proportion. This normalisation ensured that the fixation count was not affected by the size of the AOI. This also ensured that we could directly compare the number of fixations per percentage area and examine each AOI's relative importance, irrespective of the size of the AOI. Readers should interpret this as being the percentage of fixations per percentage area.

We also calculated the mean dwell time. This represented the total duration of fixations within each AOI divided by the number of fixations within that AOI. We did not use the normalised fixation count but rather the raw fixation counts in each AOI.

The mean first saccade latency was calculated similarly to above, but we created a mean latency across the different AOIs per participant. Specifically, this outcome measure referred to the time between the stimuli becoming highlighted and the start of the saccade. A faster mean first saccade latency reflects an attentional bias toward a specific AOI (Skinner et al., 2018).

Finally, we calculated the number of revisits. This outcome measure represented the number of times an AOI was revisited (i.e., viewed more than once within a trial but not consecutively) for each participant. For instance, if a participant views the head, the waist and then the head, this is a revisit toward the head. As such, we calculated the total number of times a participant revisited each AOI. A higher revisit count reflected an increased preference toward a specific AOI relative to the other AOIs (Garza et al., 2016).

7.3 Results

The raw *asc* files, data cleaning and analysis R Markdown files are available on the OSF. Like Chapter 5, we use mixed effect modelling to analyse the eye-tracking data to examine our hypotheses (presented below). We modelled participants as random effects across each analysis. The specific fixed effect predictors varied across analyses. However, they included WHR (0.6, 0.7, 0.8), BMI (underweight, average, overweight), condition (mortality threat, masculinity threat, pathogen threat control prime) and AOI (head, breasts and upper body, waist, hips and groin, thighs, lower body, hands, and arms). We modelled participants as a random effect across each analysis. As our primary hypotheses (see below) involved exploring the influence of our situational threat cues, we include additional exploratory analyses assessing whether men's preferences toward the seven AOIs varied for each WHR and BMI category in appendix five. This chapter does not provide the main or interaction effects of WHR and BMI. These effects are given in more detail in appendix five. Whilst not directly related to our research questions, these analyses may interest the reader.

To allow us to make the same comparisons as Chapter 5, that is, comparing each situational threat cue prime condition with the control prime condition, we divided each datafile into 3: each comprising one of the three situational threat primes (e.g., mortality, masculinity, and pathogen threats)[23]. We did this as we were uninterested in any differences between the situational threat cues. Splitting the data files also reduced the chances of a Type 2 error, as any actual difference between the situational threat cue conditions and the control condition may be overshadowed when looking at the differences across all four conditions.

Unlike experiments one - three, we will only model the two-way interaction effects within these analyses. This was for both pragmatic and theoretical reasons. We aimed to simplify the interpretation of our findings pragmatically due to many potential contrasts and the high likelihood that mixed effect models will fail to converge when examining complex models. Theoretically, as we used a reduced stimulus set, we felt that examining any three-way interactions with WHR, BMI, and condition would provide limited insight into men's preferences.

We began by exploring men's preferences toward the overall stimuli. We next examined men's preferences toward specific areas of the body. We present our hypotheses before each analysis for clarity due to the various outcome measures that we used. These hypotheses allow us to explore the research questions proposed in Section 7.1.

[23] Each comparison comprised exploring one situational threat cue condition and the control condition (n = 40): mortality threat condition vs control condition, masculinity threat condition vs control condition and pathogen threat condition vs control condition.

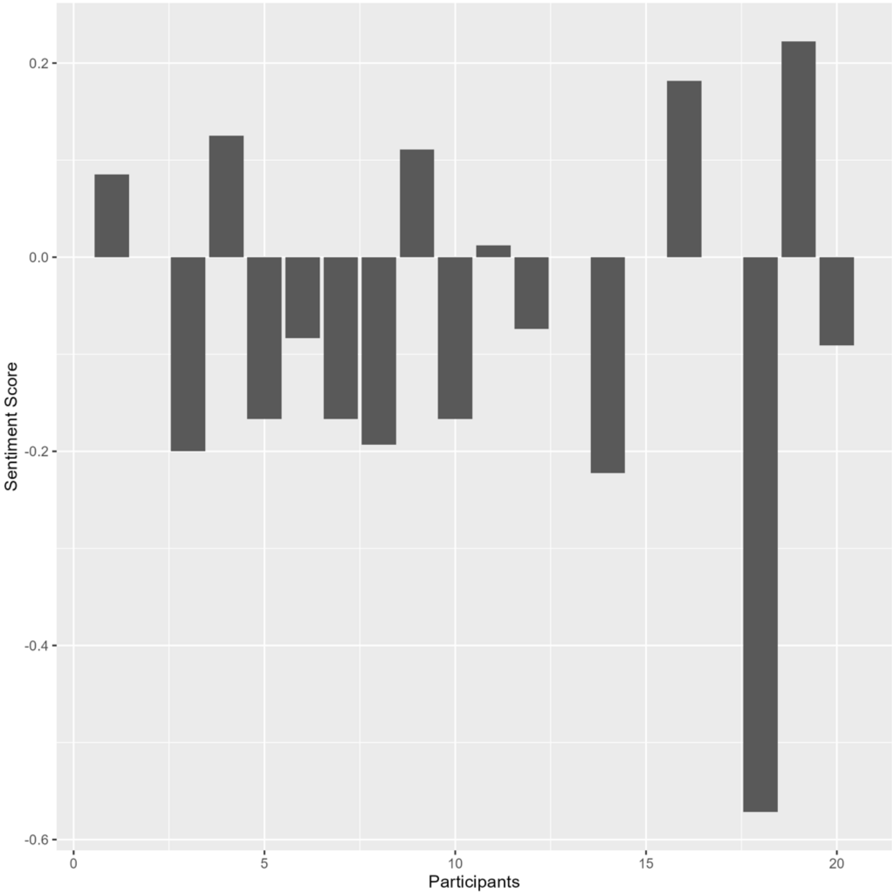
7.3.1 Preliminary Analyses

Before conducting the primary analyses, we completed the same relevance and appropriateness check for our mortality and pathogen manipulations that we did in experiments one and three.

7.3.1.1 Mortality Threat

We began by examining participant's responses to the Fear of Personal Death Questionnaire. Scores on this questionnaire can range between 14 and 70. The participants in our sample scored moderately, scoring closer to the lower end of the scale (M = 37.35, SD = 11.63). This is different to our findings for experiment one. We next examined the free-text responses and conducted a sentiment analysis. As expected, Figure 7.4 shows that most participants expressed a negative sentiment when considering death, and these negative sentiments appeared to be generally stronger. For example, participant eighteen (the most negative response) commented, "*anxiety, uncertainty and general fear of potentially painful death*".

Figure 7. 4
Free-Text Response Sentiment Score for the Mortality Condition Participants.



Notes. Sentiment scores range from -1 (negative) to +1 (positive). Each data point represents a participant. Sentiment scores of 0 are not missing data; they represent a participant who gives a neutral (i.e., 0) sentiment score.

7.3.1.2 Pathogen Threat

We examined the participant's responses to the Perceived Vulnerability to Disease Questionnaire. Scores on this questionnaire can range between 15 and 105. Our participants generally scored moderately on their belief that they are vulnerable to disease, with a mean score toward the scale's midpoint (M = 57.45, SD = 4.72). Using the same function used in experiment three (adapted to the responses of the current sample), we found that the majority of participants (n = 15) reported believing they had risk factors, compared with three who reported they felt they did not and two which we could not categorise.

7.3.2 Dot-Probe Task: Preferences Toward Target vs Neutral Stimuli

We first explored participants' overall preference toward attractive (i.e., target) relative to neutral stimuli (our first research question). We hypothesised a significant *two-way* *interaction between stimulus type and condition*, such that men in each prime condition (mortality, pathogen, and masculinity threat) relative to the control condition would display an attentional bias (i.e., faster or lower first saccade latencies) toward the target, relative to the neutral stimuli.

To explore our hypotheses, we used linear mixed-effect modelling using the *lmerTest* package (Kuznetsova et al., 2017). We used restricted maximum likelihood to fit our linear mixed effect model and explored any main or interaction effects using the type II Kenward-Roger approximation. This approach reduces the risk of Type 1 errors (S. G. Luke, 2017; Manor & Zucker, 2004). We defined stimulus type (i.e., target or neutral) and condition as our fixed effect predictors and participants as random effects.

Our outcome variable was first saccade latency (in milliseconds; *ms*). We examined the distribution of these mean latencies and the residuals from the fitted model and found a slight skewness, which is typical for reaction time measures. We identified four first saccade latency outliers in our data (between 550 and 750 ms). Per best practice, we determined these to be valid responses and retained them (Baguley, 2012). Despite the skewness we identified, we continued using a mixed effect model as they are robust to even severe normality violations (Schielzeth et al., 2020). Table 7.1 summarises the findings from our analysis.

Table 7. 1
Main and Two-Way Interactions for Stimulus Type and Condition with First Saccade Latency as the Outcome Measure.

	df	***F***	***p***
Stimulus Type	1	.06	.805
Stimulus Type x Condition $_{mortality/control}$	1	.40	.530
Stimulus Type x Condition $_{masculinity/control}$	1	1.45	.236
Stimulus Type x Condition $_{pathogen/control}$	1	<.01	.957

Note. We estimated the main effect for stimulus type from the overall sample (N = 80). We did not find any main effect for condition either overall (across the four conditions) or when split by condition ($p > .05$).

We found no evidence of any significant main or interaction effects. Participants did not look more quickly toward the target, M = 399ms, 95% CI [376ms, 421ms], relative to the neutral stimuli, M = 397ms, 95% CI [375ms, 420ms]. The first saccade latencies toward the target and neutral stimuli were similar across each condition. Table 7.2 shows the mean first saccade latencies toward target and neutral stimuli across each condition.

Table 7. 2
Estimated Marginal Means for Stimulus Type by Condition for the First Saccade Latency.

Condition	**Stimulus Type**	
	Target	Neutral
Mortality	401 [356, 447]	403 [358, 449]
Masculinity	385 [341, 430]	395 [351, 440]
Pathogen	394 [348, 439]	384 [339, 430]
Control	415 [371, 459]	406 [362, 451]

Note. Values represent the estimated marginal mean. Square brackets represent the 95% CI estimated from the mixed-effect model. The first saccade latency is shown to the nearest milliseconds.

7.3.3 Overall Stimulus: WHR and BMI Preferences

We next examined men's preferences toward different body shapes and sizes overall. Specifically, we explore attractiveness ratings, mean first saccade latency, and overall fixation count (normalised by the number of times a stimulus is presented). We present the two-way interaction effects between condition and WHR and condition and BMI.

7.3.3.1 Attractiveness Ratings

We first explored the attractiveness ratings given to each WHR and BMI. We present similar hypotheses as Chapter 5, but as we used a reduced range of stimuli, we did not make any predictions in the avoid unfit direction (see Chapter 5 for an exploration of this preference direction). We also do not make a three-way hypothesis. We hypothesised:

1. A significant *two-way interaction between WHR and condition*, such that men in each prime condition (mortality, pathogen, and masculinity threat) relative to the control condition would show significantly higher attractiveness ratings for 0.7 WHR relative to any other WHR.
2. A significant *two-way interaction between BMI and condition*, such that men in each prime condition (mortality, pathogen, and masculinity threat) relative to the control condition would show significantly higher attractiveness ratings for average BMI relative to any other BMI.

We used the same linear mixed-effect model defined in Section 7.3.1 to test our hypotheses. We examined the distribution of attractiveness ratings and the fitted model's residuals, which were normally distributed, and deemed a linear mixed-effect model to be appropriate. We defined WHR, BMI and condition as fixed effect predictors and participants as the random *effect*. Table 7.3 reports our interaction effects.

Table 7. 3
Two-Way Interaction Effects for WHR, BMI and Condition with Attractiveness Ratings as the Outcome Measure.

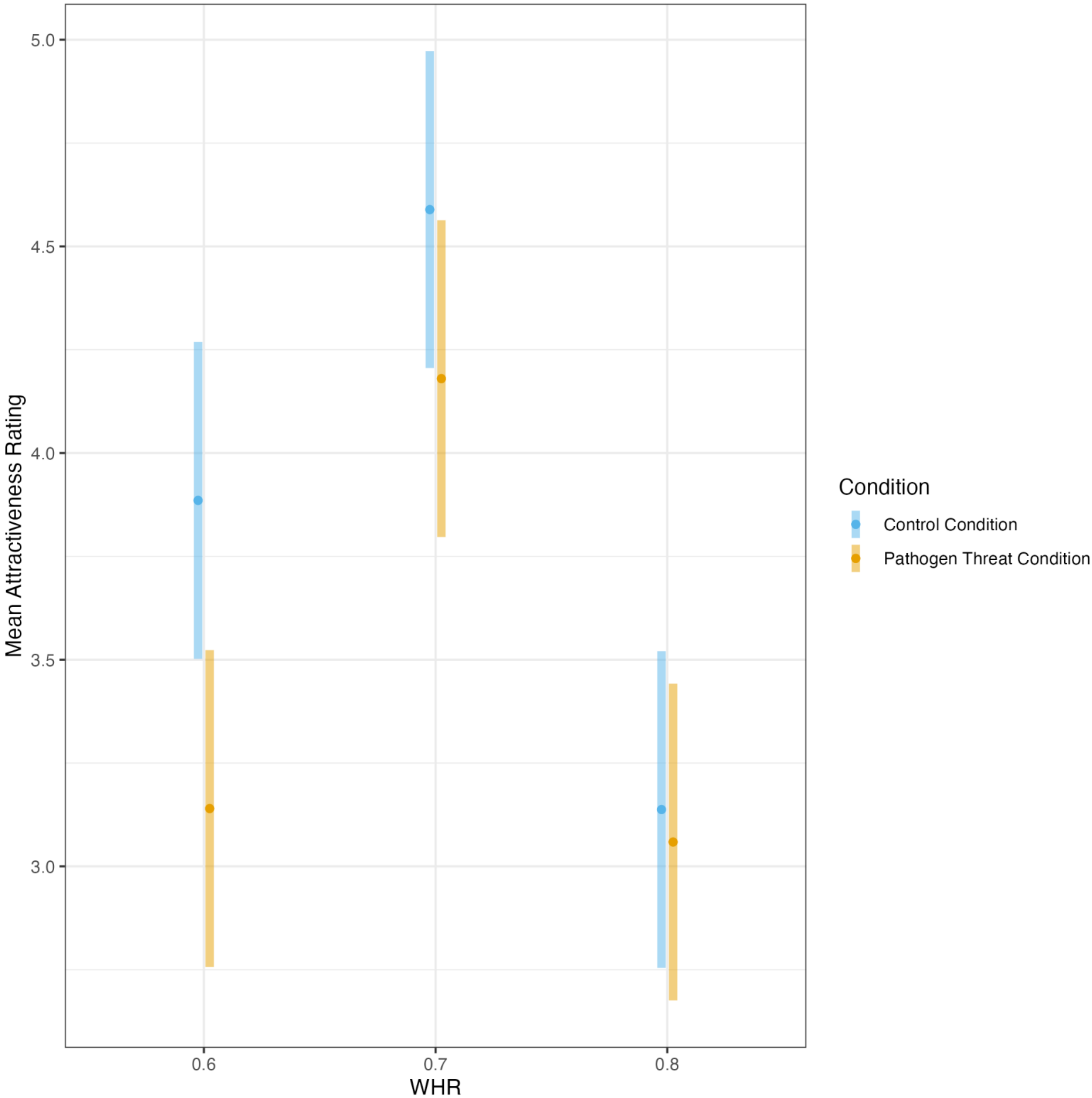
	df	*F*	*p*
WHR x Condition $_{\text{mortality}/\textit{control}}$	2	.40	.672
BMI x Condition $_{\text{mortality}/\textit{control}}$	2	.08	.925
WHR x Condition $_{\textit{masculinity/control}}$	2	<.01	.999
BMI x Condition $_{\textit{masculinity/control}}$	2	1.15	.319
WHR x Condition $_{\textit{pathogen/control}}$	**2**	**3.52**	**.031**
BMI x Condition $_{\textit{pathogen/control}}$	2	.28	.757

Note. **Bold** values indicate significant effects at $p < .05$.

Concerning our hypotheses, we found no evidence to support any two-way interaction between BMI and condition across each of the three situational primes. Likewise, we found no evidence for a significant two-way interaction between WHR and condition for mortality and masculinity situational threat cues. However, we found a significant two-way interaction between WHR and condition for pathogen threat. Holm-corrected pairwise comparisons revealed differences between the pathogen threat and control condition for 0.6 WHR, $t(72.9) = 2.74$, $p = .008$.

Men in the control condition showed significantly greater preferences for 0.6 WHR, $M = 3.89$, 95% CI [3.50, 4.27], relative to men in the pathogen threat condition, $M = 3.14$, 95% CI [2.76, 3.52]. There were no differences between either condition when examining 0.7 or 0.8 WHR. However, as shown in Figure 7.5, men in the pathogen threat condition gave consistently lower ratings for each body type than the control condition. Table 7.4 presents the estimated marginal means for each WHR and BMI category across each condition.

Figure 7. 5
Mean WHR Attractiveness Ratings for the Pathogen Threat and Control Conditions.



Note. The error bars reflect the 95% CI, which is estimated from the mixed-effect model. Attractiveness ratings can range from 1 to 7.

7.3.3.2 Attentional Bias: First Saccade Latency

We next examined whether the participants evidenced an attentional bias (via our dot-probe task) toward the different WHRs or BMIs. This extends the analysis we conducted in Section 7.3.1 by exploring men's preferences toward specific body shapes and sizes using the dot-probe paradigm rather than toward more attractive stimuli overall. We hypothesised:

1. A significant *two-way interaction between WHR and condition*, such that men in each prime condition (mortality, pathogen, and masculinity threat) relative to the control condition would display an attentional bias (i.e., faster or lower first saccade latencies) toward the target 0.7 WHR relative to a neutral stimulus showing either a higher (i.e., 0.8 WHR) or lower (i.e., 0.6 WHR) body shape.
2. A significant *two-way interaction between BMI and condition*, such that men in each prime condition (mortality, pathogen, and masculinity threat) relative to the control condition would display an attentional bias (i.e., faster or lower first saccade latencies) toward the target average BMI relative to a neutral stimulus showing either a higher (i.e., overweight BMI) or lower (i.e., Underweight BMI) body size.

We used the same linear mixed-effect model defined above to test our hypotheses. Our outcome variable was first saccade latency (in milliseconds; *ms*). We examined the distribution of these mean latencies and the residuals from the fitted model and found a slight skewness, which is typical for reaction time measures. We identified several outliers and determined most of these to be valid responses. One outlier was substantially higher than the remaining first saccade latencies. We ran our analysis with and without this observation removed and found no differences between both models. For simplicity and per best practice, we opted to retain this outlier and proceed with the analysis as planned.

Despite the skewness we identified, we continued with using a mixed effect model as they are robust to even severe normality violations (Schielzeth et al., 2020). We summarise the output of this analysis in Table 8.4. As shown, we found no evidence for any two-way interaction effects; the first saccade latency for different body shapes and sizes did not vary depending on whether men received priming content. Table 7.6 presents the estimated marginal means for each WHR and BMI category across each condition.

Table 7. 4
Two-Way Interaction Effects for WHR, BMI and Condition with First Saccade Latency as the Outcome Measure.

	df	*F*	*p*
WHR x Condition $_{mortality/control}$	2	.18	.837
BMI x Condition $_{mortality/control}$	2	1.43	.241
WHR x Condition $_{masculinity/control}$	2	.54	.589
BMI x Condition $_{masculinity/control}$	2	.50	.607
WHR x Condition $_{pathogen/control}$	2	.40	.671
BMI x Condition $_{pathogen/control}$	2	1.88	.155

7.3.3.3 Overall Visual Interest: Fixation Count

Next, we examined the participant's overall fixation count toward each WHR and BMI. Fixation count reflects a participant's overall visual interest in a particular WHR or BMI. We hypothesised:

1. A significant *two-way interaction between WHR and condition*, such that men in each prime condition (mortality, pathogen, and masculinity threat) relative to the control condition would display a higher fixation count toward 0.7 WHR relative to a higher (i.e., 0.8 WHR) or lower (i.e., 0.6 WHR) body shape.
2. A significant *two-way interaction between BMI and condition*, such that men in each prime condition (mortality, pathogen, and masculinity threat) relative to the control condition would display a higher fixation count toward average BMI relative to a higher (i.e., overweight BMI) or lower (i.e., Underweight BMI) body shape.

We used the same linear mixed effect model above to test our hypotheses. We modelled the normalised number of fixations as our outcome variable. By normalising, we applied the correction outlined in Section 7.2.5.2 to normalise each fixation depending on how often the stimulus was presented. This ensured the fixation count was not inflated by how often a stimulus was presented. Initially, the fixation count was a frequency (i.e., integer values). This normalisation made the values non-integer, meaning we had to model this normalised fixation count as continuous. Readers should interpret the fixation count as the number of fixations per stimulus presentation. To ensure the appropriateness of our analyses, we first checked the distribution of the fixation count and the fitted model's residuals. These were normally distributed, and we deemed a linear mixed-effect model appropriate. Table 7.5 summarises our two-way interaction effects. Table 7.6 presents the estimated marginal means for each WHR and BMI category across each condition.

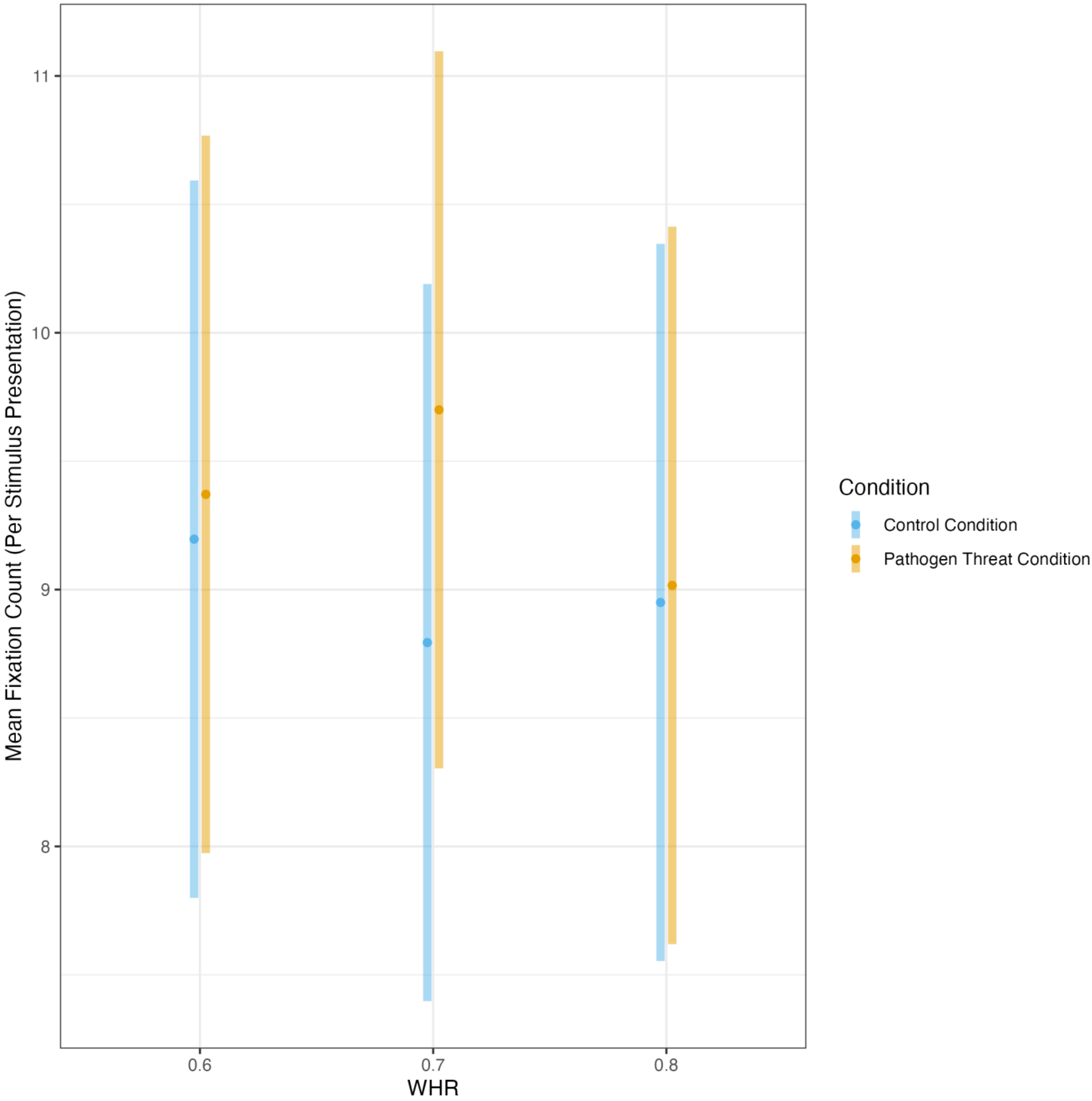
Table 7. 5
Two-Way Interaction Effects for WHR, BMI and Condition with Fixation Count as the Outcome Measure.

	df	*F*	*p*
WHR x Condition $_{mortality/control}$	2	1.67	.191
BMI x Condition $_{mortality/control}$	2	.20	.817
WHR x Condition $_{masculinity/control}$	2	1.35	.26
BMI x Condition $_{masculinity/control}$	2	2.11	.12
WHR x Condition $_{pathogen/control}$	**2**	**3.59**	**.029**
BMI x Condition $_{pathogen/control}$	2	1.63	.198

Note. **Bold** values indicate significant effects at $p < .05$. The fixation count is normalised.

Concerning our hypotheses, we found no evidence to support any two-way interaction between BMI and condition across each of the three situational primes. Likewise, we found no evidence for a significant two-way interaction between WHR and condition for mortality and masculinity situational threat cues. However, we found a significant two-way interaction between WHR and condition for pathogen threat. Despite this, we found no differences in WHR preferences between men in the control and pathogen threat conditions after correcting for familywise error rates. Figure 7.6 illustrates the WHR by condition interaction.

Figure 7. 6
Mean WHR Fixation Count for the Pathogen Threat and Control Conditions.



Note. The error bars reflect the 95% CI, which is estimated from the mixed-effect model. The mean values reflect those from the normalised fixation count.

Table 7. 6

Estimated Marginal Means for each WHR and BMI Category by Condition for Each Outcome Measure.

Outcome Measure	Condition	WHR			BMI		
		0.6	0.7	0.8	Underweight	Average	Overweight
Attractiveness Ratings	Mortality	3.76 [3.41, 4.12]	4.67 [4.32, 5.03]	3.02 [2.66, 3.37]	3.29 [2.93, 3.64]	4.43 [4.08, 4.79]	3.74 [3.38, 4.09]
	Masculinity	3.60 [3.24, 3.95]	4.30 [3.94. 4.65]	2.84 [2.48, 3.20]	2.89 [2.53, 3.24]	4.22 [3.87, 4.58]	3.62 [3.26, 3.97]
	Pathogen	3.14 [2.78, 3.50]	4.18 [3.82, 4.54]	3.06 [2.70, 3.41]	2.88 [2.53, 3.24]	4.12 [3.76, 4.47]	3.38 [3.02, 3.73]
	Control	3.89 [3.53, 4.24]	4.59 [4.23, 4.94]	3.14 [2.78, 3.49]	3.40 [3.04, 3.75]	4.45 [4.10, 4.81]	3.76 [3.40, 4.12]
First Saccade Latency	Mortality	410 [363, 457]	404 [357, 450]	399 [352, 446]	397 [350, 444]	414 [367, 460]	402 [355, 449]
	Masculinity	397 [351, 442]	385 [340, 430]	394 [349, 440]	388 [343, 434]	391 [346, 437]	396 [351, 442]
	Pathogen	377 [330, 423]	391 [344, 437]	396 [349, 443]	403 [356, 450]	382 [335, 429]	378 [331, 425]
	Control	410 [364, 455]	415 [370, 461]	409 [364, 455]	409 [363, 454]	401 [355, 446]	425 [379, 470]
Fixation Count (Normalised)	Mortality	9.59 [8.29, 10.89]	8.75 [7.45, 10.05]	8.66 [7.36, 9.96]	9.13 [7.83, 10.4]	8.76 [7.46, 10.10]	9.11 [7.81, 10.40]
	Masculinity	8.71 [7.41, 10.01]	8.84 [7.54, 10.14]	8.95 [7.65, 10.25]	8.81 [7.51, 10.1]	8.97 [7.67, 10.30]	8.72 [7.42, 10.00]
	Pathogen	9.37 [8.07, 10.67]	9.70 [8.40, 11.00]	9.02 [7.72, 10.32]	9.51 [8.21, 10.8]	9.43 [8.13, 10.70]	9.15 [7.85, 10.40]
	Control	9.20 [7.90, 10.50]	8.79 [7.49, 10.09]	8.95 [7.65, 10.25]	9.24 [7.94, 10.5]	8.70 [7.40, 10.00]	9.00 [7.70, 10.30]

Notes. Values represent the estimated marginal mean. Square brackets represent the 95% CI, which is estimated from the mixed-effect model. The fixation count is normalised per the number of times the stimulus was presented. The first saccade latency is to the nearest milliseconds. Attractiveness ratings ranged from 1 – 7.

7.3.4 Preferences Toward Each AOI

We next examined preferences toward specific areas of the body. As highlighted in Chapter 2, the waist and hip regions of the body provide ample information concerning health and fertility (Garza et al., 2016). Previous research using eye-tracking methods has also shown that when evaluating the attractiveness of an individual, men fixate more on the waist-to-hip areas (P. L. Cornelissen, Toveé, et al., 2009). Suschinsky et al. (2007) refer to these areas as reproductively relevant regions. Research has shown that other upper body areas, such as the breasts, also receive greater visual attention (Dixson et al., 2011b). However, as the breasts provide limited information regarding reproductive value and quality, it is unlikely that our situational threat cues would increase preference toward the breast area (Furnham et al., 2006). As such, our hypotheses presented below follow logically from previous research. When reporting the main effect for AOI, we used the full sample ($N = 80$).

7.3.4.1 Initial Interest: First Fixation Count and Saccade Latency

We first addressed early attentional processing and interest indicators: the number of first fixations within each AOI expressed as a proportion and the first saccade latency toward those AOIs.

First Fixations. We begin by addressing the location of the first fixation. We hypothesised a significant *two-way interaction between AOI and condition*, such that men in each prime condition (mortality, pathogen, and masculinity threat) relative to the control condition would display a higher proportion (%) of first fixations toward the waist and hip areas relative to each other AOI. However, we predict no differences between the waist and hip AOI, as both likely provide similar information.

Before examining our hypotheses, we checked to ensure that the number of first fixations was a meaningful outcome measure. Specifically, we ensured that participants were not simply viewing the same location between each trial. As we varied the vertical location of the stimuli between each trial (i.e., jittered the stimuli), we explored whether the vertical location of the first fixation correlated with this jitter value. If no correlation existed, this would imply that the location was not purposeful (i.e., participants fixated directly toward the left or right of the screen, independent of where the body was). If a correlation were present, this would imply that participants purposefully adjusted their first fixation location depending on which area of the body men preferred. We found a significant correlation, r = -.20, p <.001, and proceeded with the planned analysis.

As outlined above, we used the first fixation count to create a proportion. That is, we calculated the number of first fixations within each AOI for each participant expressed as a percentage of the total number of trials (56 trials). We refer to this outcome variable as the *proportion of first fixations* for brevity.

We aimed to use a linear mixed-effect model, as we did above. We checked the distribution of the proportion of first fixations and the fitted residuals from the linear mixed effect model and found extreme normality violations. We also identified that the model was singular, meaning adding participants as a random effect did not account for any variance. For this reason, we decided to proceed with a linear model, not including the random effect of the participant.

To address the severe non-normality of our outcome variable and fitted residuals, we first log-transformed our outcome variable, which is an effective solution to skewed residuals. We then used the *MASS* package's *rlm* function, which computes linear models with an M estimator. An M estimator assigns weights to each data point. Data points contributing to the non-normality of the residuals are assigned lower weights, helping mitigate those values' impact on the model. This makes the model's estimations robust to the normality deviations (Maronna et al., 2006; Ripley et al., 2023). Together, we deemed this an appropriate solution to our non-normality. We back-transformed the outcome variable to produce Figure 7.7.

We also found that the *lower legs* and *head* received minimal first fixations and could not be estimated within the model. The first fixations were low on these two AOIs (collectively 14 out of 3354). We excluded the few observations with the lower legs or head as the first fixation location. Table 7.7 summarises the two-way interaction effects of this model.

Table 7. 7
Two-Way Interaction Effects for AOI and Condition with Proportion of First Fixations as the Outcome Measure.

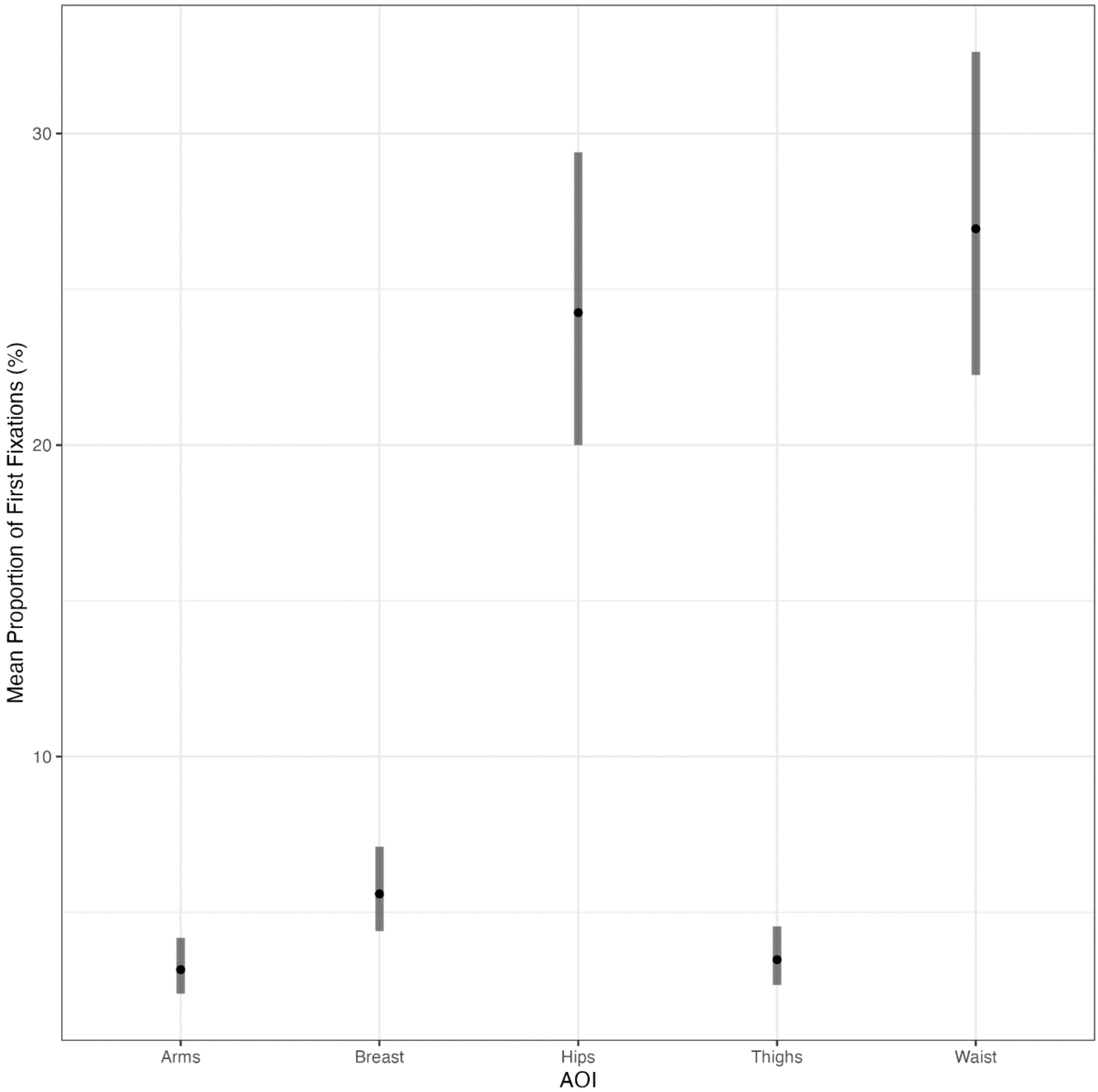
	df	F_{robust}	*p*
AOI	**4**	**82.54**	**<.001**
AOI x Condition $_{mortality/control}$	4	.62	.650
AOI x Condition $_{masculinity/control}$	4	.23	.918
AOI x Condition $_{pathogen/control}$	4	1.21	.311

Note. **Bold** values indicate significant effects at $p < .05$.

We found evidence for a significant main effect of AOI, suggesting that the proportion of first fixations varies across the seven AOIs. Figure 7.7 summarises the main effect of AOI. The waist and hips received a higher proportion of first fixations. Holm-corrected pairwise comparisons revealed that all contrasts differ significantly, except for the arms and thighs and the waist and hips (both comparisons at $p = .894$). Concerning our hypothesis, we found no significant interaction between AOI and each of the three situational threat cues. We provide descriptive statistics for the proportion of first fixations for each AOI by condition in Table 7.12.

Figure 7. 7

Mean Proportion of First Fixations for each AOI.



Note. The error bars reflect the 95% CI estimated from the mixed-effect model. This analysis did not include the head and lower leg AOIs due to a low frequency of first fixations. The mean proportion of first fixations reflects the number of first fixations within each AOI for each participant expressed as a percentage of the total number of trials (56 trials).

First Saccade Latency. We next examined the latency of the first saccade toward each AOI. We hypothesised a significant *two-way interaction between AOI and condition*, such that men in each prime condition (mortality, pathogen, and masculinity threat) relative to the control condition would display an attentional bias (i.e., faster or lower first saccade latencies) toward the waist and hip areas relative to each other AOI. However, we predict no differences between the waist and hip AOI, as both likely provide similar information.

We used a linear mixed effect model to model our data, defining AOI and condition as the fixed effect and participants as the random effect predictor. The outcome variable was the first saccade latency (in milliseconds; *ms*). We excluded the few observations where the endpoint of this first saccade landed on the lower legs or head for the same reasons as above. We examined the distribution of these mean latencies and the residuals from the fitted model and found a slight skewness, which is typical for reaction time measures. We identified several outliers in our data. However, these outliers were clustered and reasonable (less than 900ms). We decided to retain these outliers. Despite the skewness we identified, we continued with using a mixed effect model as they are robust to even severe normality violations (Schielzeth et al., 2020). Table 7.8 summarises our findings. We found no evidence for any main or interaction effects; the latency of the first saccade does not vary due to what area of the body is attended to and is uninfluenced by situational threat cues. We provide descriptive statistics for the first saccade latency for each AOI by condition in Table 7.12.

Table 7. 8
Two-Way Interaction Effects for AOI and Condition with the First Saccade Latency as the Outcome Measure.

	df	*F*	*p*
AOI	4	1.80	.131
AOI x Condition $_{mortality/control}$	4	.48	.750
AOI x Condition $_{masculinity/control}$	4	1.86	.124
AOI x Condition $_{pathogen/control}$	4	1.09	.366

7.3.4.2 Overall Interest: Fixation Count, Dwell Time and Number of Revisits

Fixation Count. We hypothesised a significant *two-way interaction between AOI and condition*, such that men in each prime condition (mortality, pathogen, and masculinity threat) relative to the control condition would display a higher overall fixation count toward the waist and hip areas relative to each other AOI. However, we predict no differences between the waist and hip AOI, as both likely provide similar information.

As outlined above, we normalised the fixation count by dividing each fixation count by the size of each AOI (as a proportion). The fixation count was changed from a count to a continuous outcome variable. Readers should interpret the fixation count as the number of fixations per percentage of the area of interest. In other words, this allows us to quantify how many fixations occur within each AOI normalised by size. This allows us to compare fixation counts across different AOIs of varying sizes.

Examining the distribution of fixation counts and the residuals from the fitted model revealed significant deviations from normality and high skewness. We intended to fit a mixed effect model with a robust estimator using the *robustlmm* package, but the *rlmer* object this produces has limited support with other R functions. While we could have fitted this model using the *rlm* function as we did with the proportion of first fixations, this model was not singular, and participants accounted for some of the random variances within the model. Furthermore, despite the normality violations, we found that a linear mixed-effect model was significantly better fitting than a robust linear model without participants as a random effect[24]. To rectify the non-normality of our residuals, we log-transformed our outcome variable. This improved the distribution of our residuals. The values presented in Figure 7.8 were back-transformed. Given this, we deemed a linear mixed-effect model to be appropriate. Table 7.9 shows the findings from this analysis.

Table 7. 9
Two-Way Interaction Effects for AOI and Condition with Fixation Count as the Outcome Measure.

	df	*F*	*p*
AOI	**6**	**390.50**	**<.001**
AOI x Condition $_{\text{mortality}/\textit{control}}$	6	.77	.597
AOI x Condition $_{\textit{masculinity/control}}$	6	.27	.953
AOI x Condition $_{\textit{pathogen/control}}$	6	1.49	.183

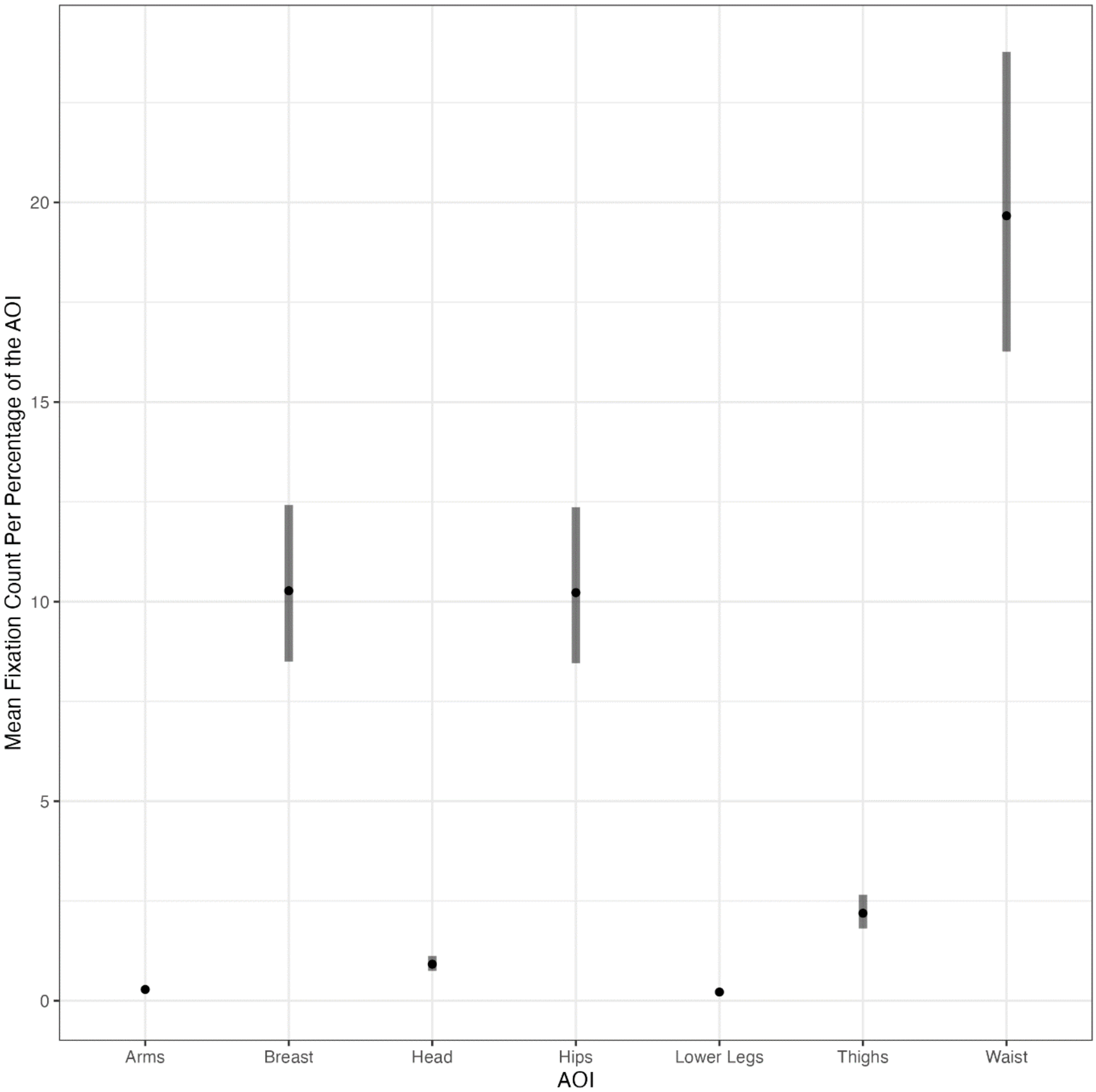
Note. **Bold** values indicate significant effects at $p < .05$. The fixation count is normalised.

There was evidence for a significant main effect of AOI, suggesting that the number of fixations varies across the seven AOIs. As shown in Figure 7.8, holm-corrected pairwise comparisons reveal that the waist area received significantly higher fixations than the other AOIs. There were no significant differences between the breast and hip AOI (p = .971). The remaining AOIs received fewer fixations overall (the mean is just above zero, and the 95% CI

[24] To determine model fit we used the Akaike Information Criteria (AIC). The linear mixed effect model was significantly better fitting (χ^2 = 22.84, p = <.001; *AIC*: 3317.9) relative to the robust linear model (*AIC*: 3338.6).

is narrow). Concerning our hypothesis, we found no significant interaction between AOI and each of the three situational threat cues. We provide descriptive statistics for the fixation count for each AOI by condition in Table 7.12.

Figure 7. 8
Mean Normalised Fixation Count for each AOI.



Notes. The error bars reflect the 95% CI estimated from the mixed-effect model. The mean values reflect those from the normalised fixation count, which reflects the number of fixations per percentage of each AOI.

Dwell Time. We next examined mean dwell times. A higher mean dwell time indicates that participants spent longer looking at each AOI and indicates visual interest. We hypothesised a significant *two-way interaction between AOI and condition*, such that men in each prime condition (mortality, pathogen, and masculinity threat) relative to the control condition would display a higher mean dwell time toward the waist and hip areas relative to each other AOI. However, we predict no differences between the waist and hip AOI, as both likely provide similar information.

We used the same linear mixed-effect model used above to test our hypotheses. The mean dwell time (in milliseconds) was the outcome variable. Before testing our model, we viewed the distribution of mean dwell times and the residuals from the fitted model. We noted them to be approximately normally distributed despite a slight skewness. This skewness was caused by several outliers reflecting high mean dwell times (i.e., > 600ms). However, we retained these valid observations (Baguley, 2012). Despite the slight violations to the normality assumption, we deemed our modelling approach appropriate as linear mixed effect models are robust to even extreme normality violations (Schielzeth et al., 2020). Table 7.10 shows the two-way interaction effects.

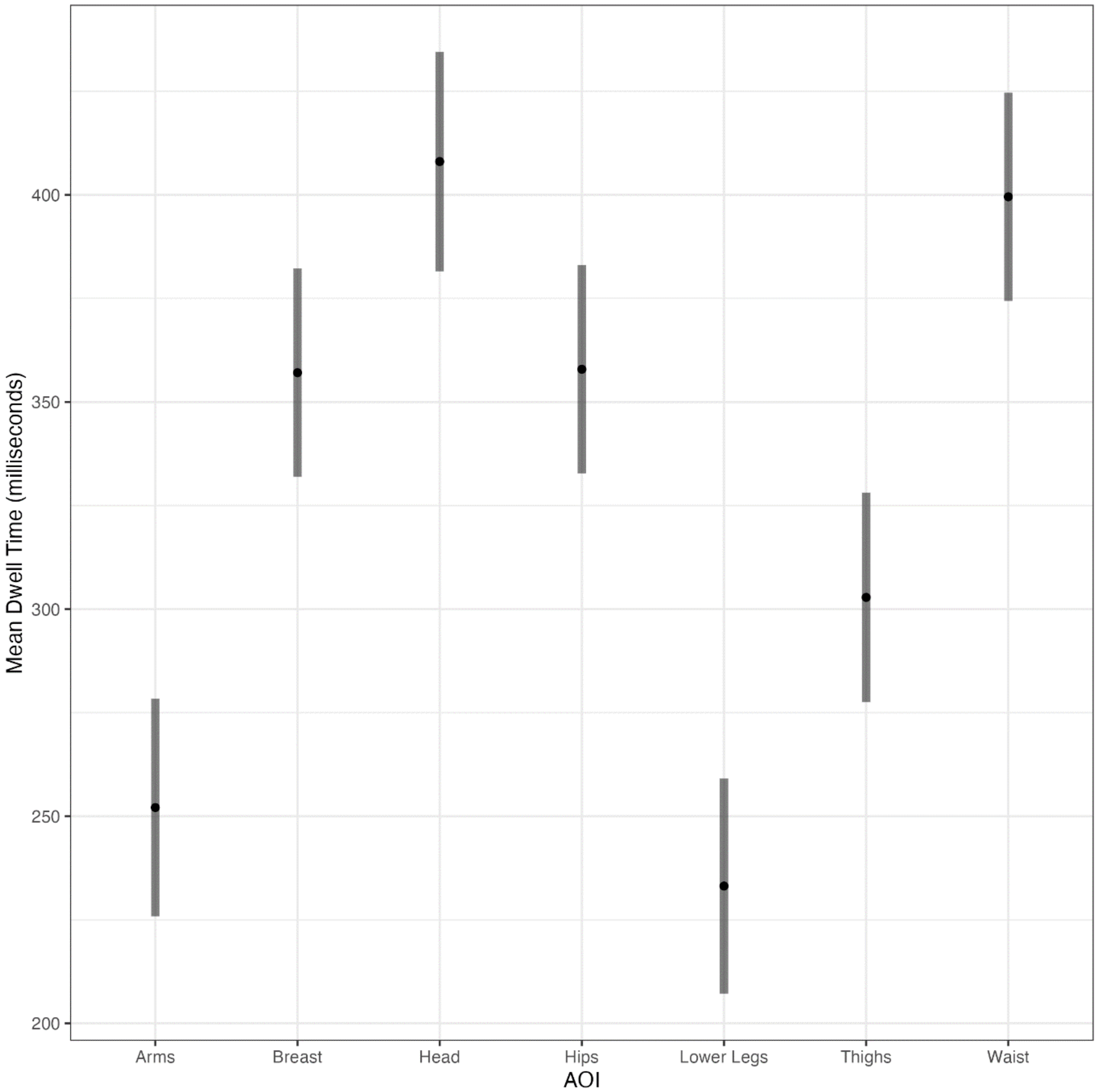
Table 7. 10
Two-Way Interaction Effects for AOI and Condition with Dwell Time as the Outcome Measure.

	df	*F*	*p*
AOI	**6**	**36.33**	**<.001**
AOI x Condition $_{mortality/control}$	6	.76	.601
AOI x Condition $_{masculinity/control}$	6	.59	.741
AOI x Condition $_{pathogen/control}$	6	.47	.830

Note. **Bold** values indicate significant effects at $p < .05$.

There was evidence for a significant main effect of AOI, suggesting that the mean dwell time varies across the seven AOIs. As shown in Figure 7.9, participants dwelled the longest on the head, followed by the waist, hips and groin and then the breast and upper body. Holm-corrected pairwise comparisons revealed that all comparisons were significant (p <.05) except the comparison between the arms and lower legs (p = .746), breast and hips (p = .999), and the head and waist (p = .999). This presents interesting deviations from the findings shown with fixation count. We consider this pattern in the discussion. Concerning our hypotheses, we found no significant interaction between AOI and condition for either mortality, masculinity or pathogen priming. We provide descriptive statistics for the dwell time for each AOI by condition in Table 7.12.

Figure 7. 9
Mean Dwell Time (in milliseconds) for each AOI.



Note. The error bars reflect the 95% CI estimated from the mixed-effect model.

Number of Revisits. We hypothesised a significant *two-way interaction between AOI and condition*, such that men in each prime condition (mortality, pathogen, and masculinity threat) relative to the control condition would revisit the waist and hip areas more relative to each other AOI. However, we predict no differences between the waist and hip AOI, as both likely provide similar information.

Our outcome variable represented the frequency for each AOI per participant summed across all trials. We initially planned on using a generalised mixed-effect model based on a Poisson distribution using the *lme4* package. However, visual inspection of the data suggested an over-dispersed pattern. To test this, we fit a generalised linear model based on a Poisson distribution and used the overdispersion test from the *AER* package (Kleiber & Zeileis, 2022). This test indicated the outcome variable to be significantly over-dispersed (p <.001)[25]. Over-dispersed data can substantially increase the risk of type one errors, so we used a negative binomial regression using the *MASS* package (Ripley et al., 2023). We used a mixed effect negative binomial regression, modelling AOI and condition as the fixed effect predictors and participant as the random effect. We summarise the main and interaction effects using a likelihood ratio Chi-Square Test. Table 7.11 summarises the two-way interaction effects.

Table 7. 11
Two-Way Interaction Effects for WHR, BMI and Condition with Revisit Count as the Outcome Measure.

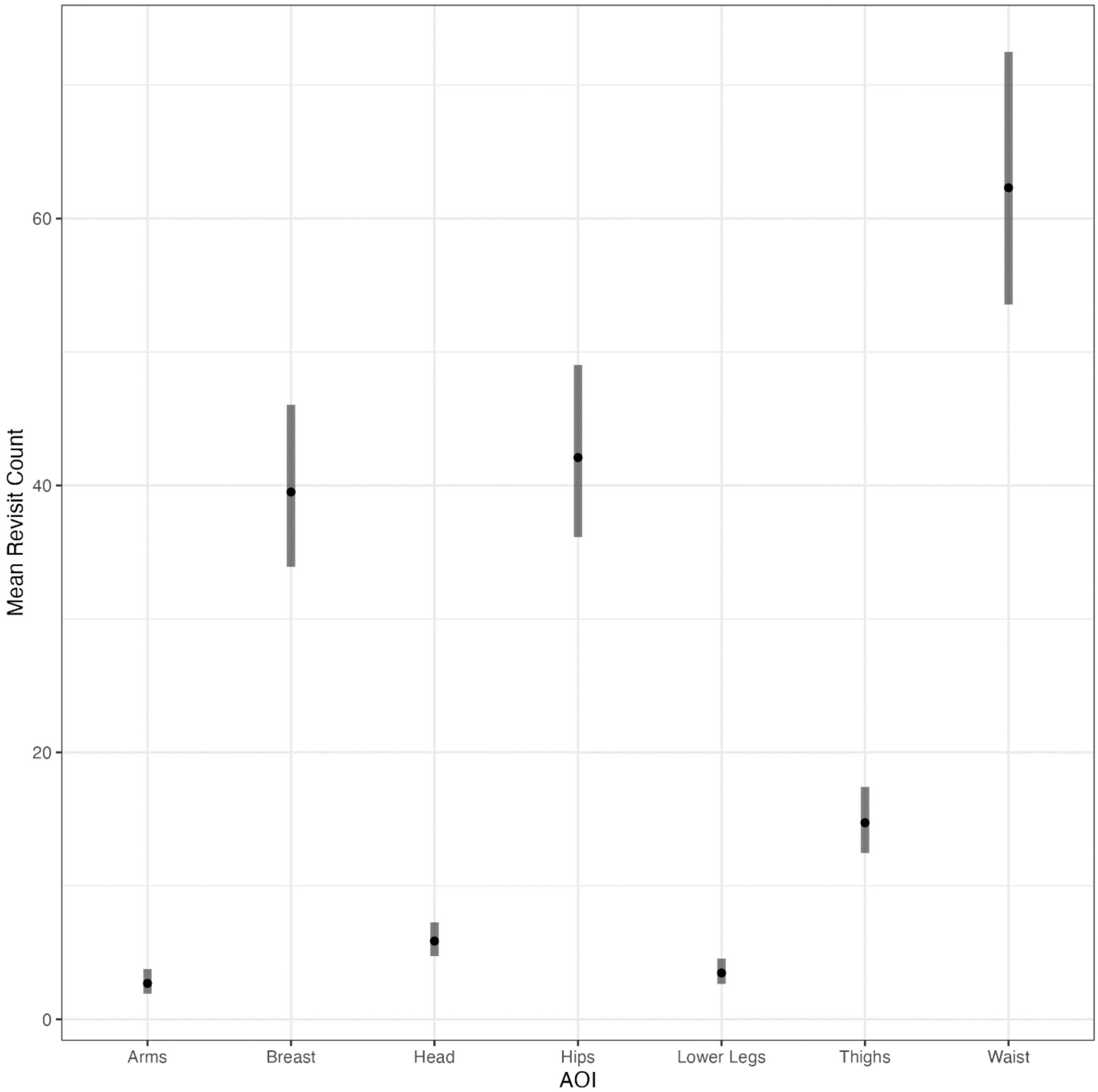
	df	χ^2	*p*
AOI	**6**	**724.81**	**<.001**
AOI x Condition $_{mortality/control}$	6	10.94	.090
AOI x Condition $_{masculinity/control}$	6	3.0	.809
AOI x Condition $_{pathogen/control}$	**6**	**12.89**	**.045**

Note. **Bold** values indicate significant effects at $p < .05$.

There was evidence for a significant main effect of AOI, suggesting that the revisit count varied across the seven AOIs. As shown in Figure 7.10, Holm-corrected pairwise comparisons reveal that the waist area received significantly higher revisits than each other AOI. There were no significant differences between the breast and hip AOI (p = .567). The remaining AOIs received a similar number of fixations.

[25] A Poisson distribution assumes a dispersion of 1. Our data indicated a dispersion of 11.88.

Figure 7. 10
Mean Revisit Count for each AOI.



Note. The error bars reflect the 95% CI estimated from the mixed-effect model.

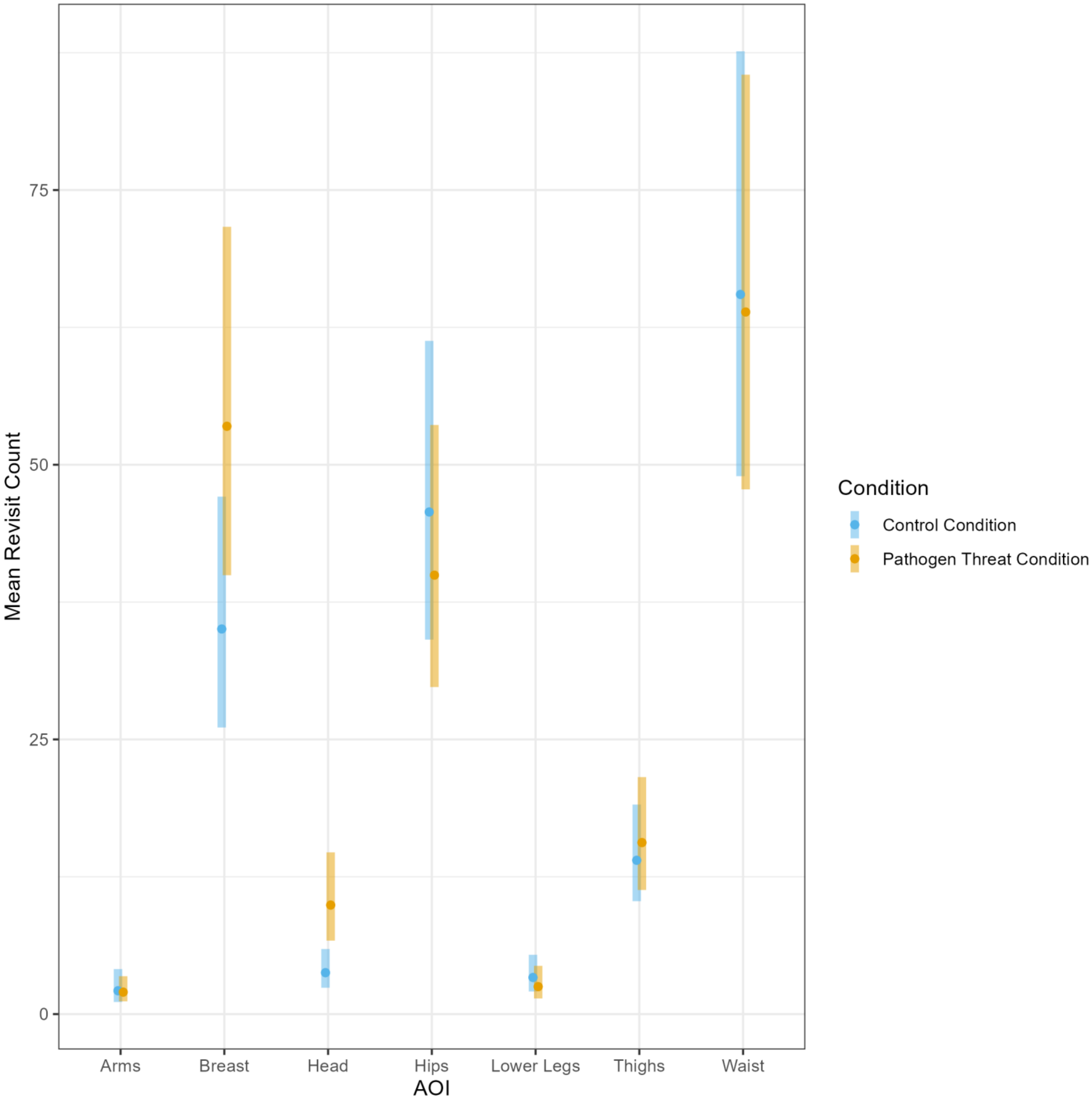
Concerning our hypothesis, we found no significant interaction between AOI and mortality or masculinity threat. We did find a significant interaction effect between AOI and pathogen threat. As shown in Figure 7.11 and evidenced by Holm-corrected pairwise tests, men in the pathogen threat condition revisited the breast AOI significantly more, $M = 53.50$, 95% CI [39.95, 71.65], relative to the control condition, $M = 35.05$, 95% CI [26.09, 46.09], $p = .046$. Similarly, men in the pathogen threat condition revisited the head AOI significantly more, $M = 9.92$, 95% CI [6.69, 14.72], relative to the control condition, $M = 3.77$, 95% CI [2.40, 5.92], p

= .002. We provide descriptive statistics for the revisit count for each AOI by condition in Table 7.12.

We note, however, that while there was no evidence of a significant interaction effect between mortality threat and AOI (p = .090), an interesting trend was shown when examining the estimated marginal means (Table 7.12). Participants in the mortality threat condition appeared to revisit the head more often than the participants in the control condition. Given that the 95% CIs do not overlap, there is reason to believe this difference is significant. There appeared to be no other apparent differences between the mortality threat and control conditions when observing any other AOI.

Figure 7. 11

Mean Revisit Count for each AOI for the Pathogen and Control Conditions.



Note. The error bars reflect the 95% CI estimated from the mixed-effect model.

Table 7. 12

Estimated Marginal Means for Each Area of Interest by Condition.

Outcome Measure	Condition	Area of Interest						
		Head	Breast and Chest	Waist	Hips and Groin	Thighs	Lower Legs	Arms
Proportion of First Fixations (%)	Mortality	-	6.58 [4.1, 10.54]	23.44 [16.03, 34.28]	19.77 [13.39, 29.2]	3.84 [2.3, 6.42]	-	2.88 [1.76, 4.71]
	Masculinity	-	6.06 [3.71, 9.9]	32.26 [22.06, 47.18]	29.15 [19.74, 43.06]	4.65 [2.72, 7.96]	-	2.82 [1.54, 5.14]
	Pathogen	-	4.92 [3.26, 7.42]	27.9 [18.89, 41.21]	24.02 [16.42, 35.13]	3.24 [1.94, 5.41]	-	5.48 [3.11, 9.65]
	Control	-	4.99 [2.92, 8.54]	24.98 [17.08, 36.53]	24.98 [17.08, 36.54]	2.54 [1.44, 4.48]	-	2.25 [1.28, 3.97]
First Saccade Latency	Mortality	-	425 [348, 501]	407 [350, 465]	405 [347, 464]	408 [335, 481]	-	422 [342, 501]
	Masculinity	-	455 [382, 527]	400 [344, 456]	379 [322, 436]	331 [266, 397]	-	378 [280, 475]
	Pathogen	-	393 [328, 459]	413 [355, 472]	369 [312, 427]	352 [285, 420]	-	385 [305, 465]
	Control	-	454 [378, 530]	422 [366, 478]	391 [335, 447]	459 [391, 526]	-	390 [311, 470]
Fixation Count	Mortality	1.08 [.72, 1.63]	8.30 [5.68, 12.14]	19.65 [13.45, 28.73]	10.36 [7.09, 15.15]	2.15 [1.47, 3.15]	.18 [.12, .27]	.24 [.16, .36]
	Masculinity	.83 [.57, 1.21]	9.92 [6.79, 14.50]	19.90 [13.62, 29.08]	10.49 [7.18, 15.34]	1.99 [1.35, 2.94]	.26 [.18, .38]	.31 [.21, .47]
	Pathogen	1.12 [.75, 1.67]	13.97 [9.56, 20.42]	19.58 [13.40, 28.62]	9.78 [6.69, 14.29]	2.35 [1.61, 3.44]	.19 [.13, .28]	.37 [.25, .54]
	Control	.71 [.47, 1.08]	9.67 [6.62, 14.13]	19.52 [13.36, 28.53]	10.28 [7.04, 15.03]	2.30 [1.57, 3.36]	.27 [.18, .39]	.24 [.16, .36]
Dwell Time	Mortality	398 [344, 452]	342 [292, 392]	383 [333, 434]	343 [292, 393]	291 [240, 341]	211 [158, 263]	282 [230, 335]
	Masculinity	390 [339, 440]	364 [314, 415]	406 [356, 457]	372 [322, 422]	315 [264, 367]	217 [166, 269]	272 [218, 326]
	Pathogen	446 [393, 498]	359 [308, 409]	387 [337, 437]	365 [315, 415]	308 [258, 358]	259 [207, 312]	227 [176, 279]
	Control	399 [344, 454]	364 [313, 414]	421 [371, 472]	352 [302, 402]	297 [247, 347]	246 [194, 297]	227 [174, 280]
Revisit Count	Mortality	6.31 [4.11, 9.68]	35.55 [26.16, 48.31]	61.80 [45.65, 83.67]	42.80 [31.54, 58.07]	16.11 [11.53, 22.51]	4.11 [2.38, 7.11]	9.80 [5.08, 18.92]
	Masculinity	5.00 [3.31, 7.55]	36.55 [26.90, 49.66]	58.25 [43.01, 78.88]	40.15 [29.58, 54.51]	13.35 [9.43, 18.91]	4.22 [2.45, 7.29]	1.25 [.57, 2.72]
	Pathogen	9.92 [6.6, 14.92]	53.50 [39.49, 72.49]	63.90 [47.21, 86.49]	39.95 [29.43, 54.24]	15.61 [11.17, 21.82]	2.50 [1.41, 4.44]	2.00 [1.15, 3.48]
	Control	3.77 [2.37, 5.99]	35.05 [25.79, 47.64]	65.50 [48.40, 88.65]	45.70 [33.70, 61.98]	14.00 [10.17, 19.28]	3.33 [2.03, 5.46]	2.12 [1.09, 4.15]

Note. Values represent the estimated marginal mean. Square brackets represent the 95% CI estimated from the mixed-effect model. We back-transformed the proportion of first fixations and fixation count from the log-odds scale. The fixation count was normalised per the size of the AOI as a proportion. The first saccade latency and dwell time are to the nearest milliseconds. Due to the limited number of first fixations, the head and lower legs are not shown for the proportion of first fixations or the first saccade latency outcome measures.

7.5 Discussion

In this chapter, we explored three research questions to examine the influence of mortality, masculinity or pathogen threat cues on men's preferences. We conceptualised *preferences* in different ways. First, we examined whether men primed with these cues should show an attentional bias toward more attractive bodies (i.e., targets) overall. Second and third, we explored whether men primed with each of these cues showed different preferences across a range of measures toward the more attractive body shapes (i.e., 0.7 WHR) and sizes (i.e., average BMI) and toward specific body areas as defined by our seven AOIs, respectively. We used a combined eye-tracking dot-probe paradigm to examine these research questions. This paradigm allowed us to capture a range of outcome measures, including covert and overt attentional preference indicators. To summarise our findings, we group this section into our three research questions presented in Section 7.1.

7.5.1 Dot-Probe Paradigm

We begin by discussing the findings relating to our first research question: Do men primed with mortality, masculinity or pathogen threat cues show an attentional bias toward more attractive (i.e., target) bodies relative to less attractive (i.e., neutral) bodies? We explored this using the dot-probe paradigm and participants' first saccade latencies. We collapsed participants' latencies across all target stimuli (i.e., 0.7 WHR and average BMI bodies) and neutral stimuli (i.e., 0.6 and 0.8 WHR and underweight and overweight BMI).

We found no evidence for any significant main effect of stimulus type or interaction effect between stimulus type and each of our three situational threat cues. While we did not make any formal main effect hypothesis, we find the lack of main effect particularly surprising, given that more attractive stimuli are attended to faster than less attractive stimuli (Cloud et al., 2023) and are biased within the attentional system (Lu & Chang, 2012). A preference for attractive stimuli within the attentional system is advantageous as it would facilitate the effective identification of high-quality partners (Maner et al., 2007). However, we did not find this within our analyses. Men did not show an attentional preference toward more attractive bodies overall. We also found that priming men with our three situational cues did not increase attentional preference toward more attractive stimuli. Again, this is surprising given that situationally relevant stimuli should be biased within the attentional system (Maner et al., 2007).

We can interpret these findings in one of two ways. While there may be no bias in the early attentional system for attractive bodies, which are uninfluenced by whether men are exposed to specific situational threat cues, that should make identifying attractive qualities situationally relevant. We view this explanation as unlikely as research has shown that evolutionarily relevant information, specifically information which is relevant to the selection of an optimal mate, is attended to more quickly (Maner et al., 2007, 2008, 2009). Alternatively, the dot-probe paradigm has been criticised for having poor reliability (Schmukle, 2005). While using the first saccade latency as the outcome measure improves reliability, some still question whether it is a valid measure of attentional bias (Thigpen et al., 2018). As such, the most likely explanation is the poor reliability of the dot-probe paradigm. We explore this finding in greater detail in Chapter 8.

7.5.2 Overall Body Size and Shape Preferences

We next summarise the findings relating to our second research question: Do men primed with mortality, masculinity or pathogen threat cues show enhanced preferences toward the more attractive body shapes (i.e., 0.7 WHR) and sizes (i.e., average BMI)? For this, we examined men's preferences toward the overall stimulus at the level of WHR and BMI. We used explicit attractiveness ratings, fixation count and first saccade latency as preference indicators. Attractiveness ratings represented a similar (albeit non-ordinal) outcome measure to those we used in experiments one - three. Fixation count represented the total number of fixation events recorded across the viewing period (i.e., 4000ms) and a participant's overall visual interest (Mahanama et al., 2022). Recall that we normalised the fixation count such that it was not inflated by some stimuli being presented more often than others. The first saccade latency indicated attentional bias; lower first saccade latencies indicated an attentional bias toward a specific stimulus overall (Skinner et al., 2018).

We hypothesised that men in the three situational threat cue conditions would show enhanced preferences (i.e., higher attractiveness ratings) toward 0.7 WHR and average BMI. Consistent with experiments one and two, we found no influence of either mortality or masculinity threat on men's WHR or BMI preferences. Men in neither condition showed differential preferences relative to the control condition. Inconsistent with our findings from experiment three, we did find a significant WHR by condition interaction for pathogen threat; men in the pathogen threat condition showed significantly lower preferences toward 0.6 WHR. This is a potentially interesting finding, given that pathogen threat was likely to have an effect because of the importance of avoiding pathogens (Ainsworth & Maner, 2014b; Tooby & Cosmides, 1990a). This finding potentially highlights how very low WHRs may signal reduced health or the presence of illness. Furthermore, given that our findings from this in-person experiment were inconsistent with the findings from our online experiment (experiment three), this may suggest potential differences between online and lab-based experimental testing, despite previous research suggesting comparable findings (Peyton et al., 2021). We explore this finding in greater detail in Chapter 8.

We also hypothesised that men in the three situational threat cue conditions would display an attentional bias toward the more attractive body shapes and sizes (i.e., 0.7 WHR and average BMI). However, we found no significant main or interaction effects for WHR, BMI or condition. This suggests that, like for more attractive bodies (i.e., targets), overall, men did not show a preference within the attentional system for more attractive body shapes and sizes. We could interpret this as suggesting that there may be no bias in the early attentional system for specific WHRs or BMIs when men are exposed to specific situational threat cues. However, as we discussed above, we find this finding unlikely given that evolutionarily and situationally relevant stimuli are biased within the early attentional system (Lu & Chang, 2012; Maner et al., 2007). The poor reliability of the dot-probe task more likely explains our results. We consider this in greater detail in Chapter 8.

Finally, we examined fixation count. We hypothesised that men in the three situational threat cue conditions would display a greater fixation count toward the more attractive body shapes and sizes (i.e., 0.7 WHR and average BMI). A greater fixation count serves as an indicator of greater overt visual interest in a particular stimulus (Mahanama et al., 2022; Trabulsi et al., 2021). However, we found no evidence of any significant interaction effects. Our findings provide little evidence to support that men primed with mortality, masculinity or pathogen threat cues would show greater preference (in the form of fixations) toward 0.7 WHR or average BMI. However, it could be argued that this was to be expected. Most research has shown that variations in WHR and BMI may serve as broad first-pass filters (Singh, 1993a; Tovée et al., 2007)[26]. That is, people may only need to look toward bodies once or twice to determine the quality of a potential partner. It may be that situational threat cues influence men's viewing behaviour toward specific areas of the body rather than toward the body overall. We discuss our findings in relation to this possibility in the next section.

7.5.3 Area of Interest Preferences

Finally, we addressed our third research question: Do men primed with mortality, masculinity, or pathogen threat cues show different preferences toward specific areas of the body? For this, we examined men's preferences toward each of the seven AOIs: the head, the upper body and breasts, the arms and hands, the waist, the hips and groin, the thighs, and the lower body.

We grouped our outcome measures into early and overall indicators of preference. Early visual interest indicators included the proportion of first fixations count and saccade latency. The proportion of first fixations, or how many times a participant viewed each AOI as their first fixation expressed as a proportion of the total number of trials, represented a participant's initial interest in each AOI. The first saccade latency reflected how quickly participants completed their first saccade and indicated an attentional bias toward specific AOIs; lower first saccade latencies indicated an attentional bias toward a specific stimulus.

We captured a participant's overall visual interest using fixation count, dwell time and the number of revisits. Fixation count represented the total number of fixation events recorded

[26] While Singh (1993) explicitly referred to WHR as a broad first-pass filter, BMI (to our knowledge) has not been referred to using this exact terminology. However, both WHR and BMI are argued to perform the same function when men look to judge the attractiveness of a prospective partner.

across the viewing period (i.e., 4000ms) and represented a participant's overall visual interest toward each AOI. To correct for some AOIs being larger than others, we normalised the fixation count. The fixation count, therefore, represents the number of fixations per percentage of the area of interest. The mean dwell time similarly represented an indicator of overall visual interest, defined by how long each participant spent viewing each AOI on average. The number of revisits accounted for which AOI participants were most interested and how often they returned to view each AOI.

Based on previous research, we broadly hypothesised that men primed with each situational threat cue would show greater preference (across each outcome measure) for the waist and hip areas of interest. The waist and hip areas are important when evaluating the potential of a prospective partner, termed the reproductively relevant areas (Suschinsky et al., 2007). We believed that men in each prime condition would show greater preferences. While research has shown that other upper body areas, such as the breasts, also receive greater visual attention (Dixson et al., 2011b), we did not believe our situational threat cues would influence men's preferences toward the breast area of interest. This is because breasts are theorised to provide limited information regarding reproductive value and quality (Furnham et al., 2006).

Examining our early preference indicators, we hypothesised that men in each prime condition would show a preference within the early attentional system for the waist and hip areas, regarding a higher proportion of first fixations and a faster first saccade latency. We found no support for these hypotheses. However, for the proportion of first fixations, we did find a significant main effect of AOI. When examining the proportion of first fixations, men displayed a significantly greater proportion of first fixations toward the waist AOI overall, followed by the hip AOI. This supports previous research showing that men direct greater visual interest and attention toward those areas (Garza et al., 2016). Importantly, we found this finding while varying the vertical height of the stimuli between trials. This means that participants were not simply directing their gaze toward the centre of the stimuli. Rather, their first fixations were purposefully directed toward the waist and hip areas relative to any other body area.

We found no evidence of any main or interaction effects for the first saccade latency. This would suggest that our participants showed no attentional bias toward specific AOIs either independently or when primed with each of our situational threat cues. The same arguments we presented above could be used to explain this finding. It may be that men do not display an attentional bias toward the waist or hip AOI. However, given the importance of those areas (and the persistent finding across our results that those AOIs are preferred), we find this unlikely. The poor validity of the dot-probe task more likely explains our results. We consider this in greater detail in Chapter 8.

Examining the indicators of overall visual interest reveals interesting findings. We hypothesised, based on previous research highlighting the importance of the waist and hip areas, that men in the three situational threat cue conditions would display more *(1)* overall fixations, *(2)* a higher mean dwell time and *(3)* a greater number of revisits toward the waist and hip AOIs. While we found no support for these hypotheses, we did find that pathogen threat interacted with AOI for revisit count in unexpected ways. We also found a significant main effect for AOI across each outcome measure.

For fixation count, we found that the waist AOI received the highest number of fixations, followed by the breast and hip AOI, which received a similar fixation count. These findings again highlight the importance of the waist AOI and how men prefer this. It also highlights how the hip and breast AOIs are also important. This suggests that when men view bodies overall, they cluster their fixations toward the upper body (i.e., chest, waist and hips). Despite little evidence to support the role of breast size or shape in evaluating mate quality, they still receive generally high visual interest (Dixson et al., 2011a; Furnham et al., 2006). These findings suggest that the waist area of interest receives the greatest amount of overt visual interest across the viewing period. Importantly, we found this after normalising the number of fixations for the size of each AOI. This suggests that the preference for the waist AOI was not caused by the relative size of this AOI. However, we note that the waist AOI was small relative to other AOIs, which makes this finding more compelling.

A similar pattern can be seen for each AOI except for the head when examining dwell time. Participants dwelled longest on the head (albeit with a similar dwell time to the waist AOI). This finding is unsurprising, given that the face has been shown to capture a person's attention (Langton et al., 2008; Theeuwes & Van der Stigchel, 2006). Participants likely dwelled for longer on the head due to the various individual features (e.g., the eyes) present on the face. However, it is interesting that participants dwelled on the waist to a similar extent as the head. Similarly, participants also dwelled more on the hips and breast area. This again highlights the importance of the waist relative to other areas of the body and suggests that the upper body areas tend to receive greater visual interest. However, we found that priming men with each of the three situational threat cues did not alter the fixation count or mean dwell time toward any of the AOIs.

Finally, we examined the number of revisits, which indicates which areas of the body participants were most interested in and returned to most frequently. We similarly found a main effect for AOI. Men revisited the waists the most, followed by the hips and breast areas; these findings were consistent with those found for overall fixation count. Again, this highlights the importance of the waist area when evaluating the attractiveness of a potential partner. Despite a significant interaction between AOI and condition for men primed with pathogen threat cues, we did not find any support for our hypotheses. Men in the pathogen threat condition revisited the head and breast areas significantly more than men in the control condition.

Previous research has shown that specific variations in facial features (e.g., adiposity, masculinity or femininity) communicate information concerning an individual's current or past pathogen resistance (de Jager et al., 2018; Pereira et al., 2020). The increase in revisits toward the breast area is less conclusive. While we argued that the breast area of the body provides little information about a partner's health status, some research has argued otherwise (Zelazniewicz & Pawlowski, 2011a). To our knowledge, no previous research has directly implicated the breasts in providing information concerning pathogen avoidance. It is also possible that this increase in revisits was simply an artefact, and we note that the confidence intervals between the control and pathogen threat condition overlapped. While we interpret this in our discussion, we remain tentative about our claims. Men fixating on the head or waist may traverse to the other area by passing through the breast AOI, increasing the revisit count. We discuss this finding in greater detail in Chapter 8.

7.5.4 Conclusion

In summary, our findings provide limited support for the influence of mortality and masculinity on men's preferences toward attractive bodies overall, toward attractive body shapes and sizes specifically, or towards the areas of the body which are important when evaluating a partner's potential (i.e., the waist and hips). We found evidence that priming men with pathogen threat influenced their attractive ratings for different body shapes (i.e., lower preferences for 0.6 WHR) and greater visual interest (in the form of a higher number of revisits) toward the head and breast area of the body. These findings expand on those in Chapter 5. We must note that we deployed a novel combined eye-tracking dot-probe paradigm in this experiment, allowing us to capture overt and covert preference indicators. We present a more detailed discussion of our findings in the next Chapter.

8. CHAPTER 8: SUMMARY AND GENERAL DISCUSSION

This chapter provides a summary and discussion of our findings. We also address the limitations of each experiment and propose new directions for future research concerning examining men's WHR and BMI preferences. We begin by providing a brief overview of the aim of this thesis.

8.1 Brief Synopsis of this Thesis

In this thesis, we presented six empirical studies. Our first two studies (study 1a and 1b) involved creating new computerised stimuli varying in WHR and BMI for use in this thesis and beyond. We also conducted four experiments to explore the influence of our three situational threat cues (i.e., mortality, masculinity and pathogen threat cues) on men's body shape (i.e., WHR) and size (i.e., BMI) preferences. We also conducted one additional experiment to further explore the effect of masculinity threat on UK men by exploring this situational threat cue vis-à-vis an established compensatory response in other cultures: negative attitudes toward trans and gender-diverse people. Previous research examining men's WHR and BMI preferences has attempted to establish the existence of stable WHR and BMI preferences. These stable preferences are said to occur for the body shapes and sizes that signal evolutionarily advantageous outcomes (or at least are perceived to signal), such as optimal health and fertility (Dixson et al., 2011; Furnham et al., 2006; Holliday et al., 2011; Lassek & Gaulin, 2018; Platek & Singh, 2010; Singh, 1993; Sugiyama, 2015). However, given that contemporary men experience different environments from their ancestral past, the importance of certain signals and men's WHR and BMI preferences may be contingent on external cues. That is, men's preferences toward certain body shapes or sizes are influenced by external cues (e.g., pathogens) that may make certain cues more important than others and shift men's WHR and BMI preferences (Al-Shawaf et al., 2019; Dixson, 2022; Goetz et al., 2019; Lewis & Buss, 2022).

A small but informative body of research has shown that preferences for specific traits vary due to specific cues (e.g., regarding mortality risk). However, as argued in Chapter 2, this research has primarily examined the influence of relatively persistent and long-term contexts (e.g., societal resource access) on men's preferences. Comparatively, research has paid limited attention to the influence of immediate situational threat cues imposed at the individual level (Ainsworth & Maner, 2014a; Maner et al., 2007). For instance, whether immediate cues regarding pathogen risk influence men's body shape and size preferences. Examining these situational threat cues was the overall aim of this thesis.

This thesis examined three situational threat cues: mortality, masculinity, and pathogen threat. We focused on these three situational threat cues because they represent immediate psychological and environmental threats likely to influence men's preferences. Previous research offers a compelling case for why each of these situational threat cues should influence men's preferences (see Chapter 2). We also focused on these situational cues because they represent situational encounters that men may be exposed to daily. For instance, men routinely experience subtle messages concerning mortality, pathogen risk, and how they stand regarding other men concerning their adherence to masculine norms. As such, if these situational threat cues influenced men's body shape and size preferences, we believed this would have both applied (e.g., for body image interventions) and theoretical implications.

Based on previous research, we broadly expected that each situational threat cue would alter which WHR and BMI category men preferred. Specifically, we anticipated that these cues would shift men's preferences toward the most (and, by extension, away from the least) attractive WHRs (0.7 WHR) and BMI (average BMI) relative to the preferences held by men in the general population[27]. We also expected that these cues would alter the areas of the body that men view as important. Specifically, we believed these cues would alter (i.e., increase) the visual interest and attentional preference men may direct toward the areas of the body deemed reproductively relevant, such as the waist and hips (Suschinsky et al., 2007).

[27] For clarity, we found in Chapter 4 (study 1a) that a large sample rated 0.7 WHR and average BMI (and their combination; 0.7| average) as, on average, the most attractive, healthy, and fertile; we defined the most attractive body shape and size in our subsequent chapters based on these findings. Conversely, our sample rated 1.0 WHR and emaciated BMI (and their combination; 1.0| emaciated) as the least attractive, healthy and fertile; we defined the least attractive body shape and size in Chapter 5 based on these findings.

We explored men's preferences within this thesis using a variety of measures, including self-report attractiveness rating paradigms (Chapter 5; experiments one – three) and various visual interest (via eye-tracking) and attentional preference indicators (Chapter 7; experiment five). We provide more information on how we conceptualised preferences in the relevant chapters and comment on this in greater detail in the following section.

We also conducted an additional experiment that was independent from the rest of this thesis to further explore the effect of masculinity threat. As masculinity threat is an emerging field of research, we wanted to explore whether threatening UK men's (and women's) masculinity (and femininity) influenced their attitudes toward trans and gender diverse people. To achieve this, we present an additional exploration of this situational threat cue in Chapter 6. We discuss this in more detail below.

8.2 Summary of Findings and Main Conclusions

Here, we summarise the main findings from each of our seven empirical studies and how these findings relate to the aim of this thesis. We then synthesise these findings to draw overall conclusions. In the subsequent sections, we discuss and interpret our findings regarding the broader research literature.

8.2.1 Studies 1a and 1b

In studies 1a and 1b (Chapter 4), we developed 3D-modelled female body stimuli that varied in WHR and BMI and were validated online. We did this for two reasons: *(1)* to create a set of stimuli from which to choose a subset for use in this thesis and *(2)* so that the full set could then be made available on the OSF for other researchers to use.

We also validated the stimuli we created. To validate our stimuli, our participants rated how realistic, attractive, healthy and fertile each stimulus was. These measurements allowed us to see which stimuli were more realistic and validate our stimuli by observing whether they received similar attractiveness, health and fertility ratings as other well-used stimulus sets (e.g., line-drawn stimuli). Our findings support the validity of both the clothed and unclothed stimuli;

the clothed and unclothed stimuli were rated moderately realistic, but ratings varied across each stimulus.

We also found that our stimuli were rated similarly regarding attractiveness, health and fertility to other well-used stimuli sets. Specifically, our participants rated 0.7 WHR and average BMI (and their combination) as the most and 1.0 WHR and emaciated BMI (and their combination) as the least attractiveness, health and fertility. We used these ratings to inform our operationalisation of the most and least attractive in Chapters 5 and 7. Our findings from this chapter have several implications, which we comment on in greater detail in Section 8.6.1.

8.2.2 Experiments 1-3

In experiments one - three (Chapter 5), we used an online attractiveness rating paradigm whereby participants were presented with stimuli varying in WHR and BMI and asked to rate the attractiveness of each stimulus. This self-report attractiveness paradigm is commonly used to examine preferences toward various features, including faces, voices and bodies, with the attractiveness rating serving as a proxy for examining an individual's preferences (A. J. Lee et al., 2015; Roberts & Little, 2008). Within these experiments, we also aimed to address a limitation with previous research examining men's WHR and BMI preferences. Previous research has relied on measuring preferences towards a particular WHR and BMI in terms of which is most attractive. By contrast, very little research has examined how preferences may shift away from specific WHRs and BMIs in terms of which is the least attractive. We refer to these directions as the *approach fit* and *avoid unfit* direction of preferences, respectively (Park et al., 2012).

We hypothesised that men in each of the situational threat cue conditions (i.e., mortality, pathogen, and masculinity threat) would display enhanced preferences (i.e., higher attractiveness ratings) toward 0.7 WHR and average BMI and diminished preferences (i.e., lower attractiveness ratings) toward 1.0 WHR and emaciated BMI. We conceptualised these WHRs and BMIs as the most and least attractive based on the findings from study 1a (Chapter 4). We hypothesised both two and three interactions between WHR, BMI and condition.

Contra to our predictions, we found no evidence to suggest that our mortality, pathogen or masculinity threat cues influenced our participants' WHRs and BMI preferences. Notwithstanding the above, we did find a significant difference between the mortality threat and control condition (experiment one) in the avoid unfit direction for BMI (i.e., our participants in the mortality threat condition reported lower attractiveness ratings for *emaciated and underweight* BMI than participants in the control condition). However, upon closer inspection of the data, we found an overlap in the confidence intervals for the attractiveness ratings provided by men in the control relative to the mortality threat condition for emaciated and underweight BMI. This overlap undermines any strong claims we might make about this in terms of priming, and instead, we attribute the apparent finding to noise in the data.

Given this weak finding for mortality threat, we can conclude that we found limited support for the influence of our three situational threat cues on men's body shape or size preferences when using attractiveness ratings as the outcome measure. However, as noted in Chapters 3 and 5, attractiveness rating paradigms have several limitations, which we aimed to resolve in Chapter 7.

8.2.3 Experiment 4

We further explored our masculinity threat prime in experiment four using a different outcome measure (Chapter 6). Specifically, we used an outcome measure with an established relationship with masculinity threat in other cultures. We explored whether threatening men's (and women's) masculinity (and femininity) threat affects their attitudes toward trans and gender diverse (TGD) people. Despite research showing that a masculinity threat prime causes men to report lower attitudes toward TGD people in other cultures (e.g., Poland), experiment four did not show that this was the case for UK men. This finding offers interesting insights into whether masculinity threat affects UK men, and what outcomes this threat may produce. We also found that threatening women's femininity did not influence their TGD attitudes. This finding was consistent with the limited research showing threatening women's femininity does not cause any compensatory behaviours. We interpret our findings below, and how this adds to the wider research literature.

8.2.4 Experiment 5

In experiment five (Chapter 7), we addressed some additional limitations with the existing research and our methods. Specifically, we were concerned that explicit self-report paradigms (as used in experiments one – three), though useful and convenient, are subject to response biases, and attractiveness ratings toward static stimuli may not translate into actual preferences and behavioural intentions (Baumeister et al., 2007). While research has begun using alternative preference measures, such as indicators of visual interest using eye-tracking, this research also has limitations. Specifically, they often focus on measuring men's overt attention and have limitations with their experimental design. A detailed summary of these limitations can be found in Section 3.1.3.

In Chapter 7, we aimed to address some of these issues using a novel combined eye-tracking dot-probe paradigm approach created purposefully for this experiment (Cahill et al., 2023). This novel paradigm allowed us to collect a broader array of measurements relative to previous research, including *(1)* indicators of overt visual attention (e.g., fixation counts), *(2)* an indicator of attentional bias in covert attention (i.e., the first saccade latency), and *(3)* an explicit self-report attractiveness rating. This novel bespoke eye-tracking paradigm allowed us to fully explore men's preferences for overall stimuli (e.g., visual interest in bodies with a 0.7 WHR relative to other bodies) and specific body areas (e.g., the waist area relative to other areas of the body).

We examined three broad research questions in Chapter 7. Specifically, we explored whether men primed with mortality, masculinity or pathogen threat show *(1)* an attentional bias toward more attractive (i.e., target; see below) bodies relative to less attractive (i.e., neutral) bodies, *(2)* enhanced preferences toward attractive body shapes (i.e., 0.7 WHR) and sizes (i.e., Average BMI) and *(3)* different preferences toward specific areas of the body. We conceptualised preferences in this experiment using a variety of outcome measures. Due to the many outcome measures and hypotheses relating to our second and third research questions, we summarise these in Tables 8.1 and 8.2, respectively.

8.2.4.1 Research Question 1: Preferences for 0.7 WHR and Average BMI Overall

We begin by summarising our findings regarding our first research question. We hypothesised that a significant *two-way interaction between stimulus type and condition*, such that men in each prime condition (mortality, pathogen, and masculinity threat) relative to the control condition would display an attentional bias (i.e., faster [or lower] first saccade latencies) toward the target, relative to the neutral stimuli. We defined all bodies that contained an attractive WHR or BMI as targets and all remaining stimuli as neutral. A faster first saccade latency would indicate that the person had already directed their covert attention toward that stimulus, facilitating faster first saccade latencies (i.e., attentional bias). We explored this using the dot-probe element of our eye-tracking paradigm.

Contrary to our hypotheses, we found no evidence for a main effect for stimulus type or interaction effect between stimulus type and condition; men appeared to show no attentional bias toward more attractive stimulus overall, and this was not modulated when men were primed with each situational threat cue. This finding could be interpreted as men showing no preference within the early attentional system (i.e., an attentional bias) toward more attractive stimuli. This finding is inconsistent with previous research (e.g., Lu & Chang, 2012). Furthermore, given that we found no significant interaction effect for any analyses that relied on the first saccade latency and the dot-probe paradigm (see below), the more likely explanation is this paradigm's poor reliability and general inconsistencies. We commented on the limitations of this paradigm in Chapter 7 but discussed the limitations of this paradigm in greater detail in Section 8.4.

8.2.4.2 Research Question 2: Preferences for Attractive Body Shapes and Sizes

We next summarise our second research question. This research question expands on our first research question by examining men's preferences toward more attractive WHRs and BMIs specifically rather than toward more attractive bodies overall. We aimed to explore the influence of each of our three situational cues on men's body shape and size preferences. We outline the WHR by condition and BMI by condition hypotheses for each outcome measure in Table 8.1. We broadly predicted that men in the mortality, masculinity, or pathogen threat condition would prefer the more attractive WHR (0.7 WHR) and BMI (Average) relative to the control condition. By preferences, we refer to each outcome measure presented in Table 8.1.

In summary, we found no evidence to support each hypothesis in Table 8.1, despite significant interaction effects between pathogen threat and WHR for attractiveness ratings and fixation count. Men in each priming condition relative to the control condition showed no greater preferences (i.e., higher attractiveness ratings, overall fixation counts, and faster [or lower] first saccade latencies) toward 0.7 WHR or average BMI.

However, we did find evidence that pathogen threat influenced men's preferences when we examined their attractiveness ratings (albeit not in the expected direction). Men in the pathogen threat condition rated 0.6 WHR as significantly less attractive than men in the control condition. This finding is interesting, and we explore this in greater detail below. This finding may suggest some support for pathogen threat decreasing preferences toward the most thin-looking bodies regarding WHR. Whilst we found a significant interaction effect between pathogen threat and WHR for fixation count, after correcting for familywise error rates (and upon visual inspection), there was no evidence for any significant differences in fixation counts given toward each WHR for the pathogen threat relative to the control condition. For this reason, we opted not to interpret this finding.

Table 8. 1
Summary of the Overall Visual Interest and Attentional Hypotheses.

Outcome Measure	Hypothesised Interaction Effects	
	WHR by Condition	**BMI by Condition**
Attractiveness Ratings	Men in the *mortality, pathogen, and masculinity threat* conditions relative to the control condition would show **higher attractiveness ratings for 0.7 WHR than any other WHR.**	Men in the *mortality, pathogen, and masculinity threat* conditions relative to the control condition would show **higher attractiveness ratings for average BMI than any other BMI.**
First Saccade Latency	Men in the *mortality, pathogen, and masculinity threat* conditions relative to the control condition would display attentional bias (**i.e., faster first saccade latencies) toward 0.7 WHR relative to either a higher (i.e., 0.8 WHR) or lower (i.e., 0.6 WHR) body shape.**	Men in the *mortality, pathogen, and masculinity threat* conditions relative to the control condition would display an attentional bias **(i.e., faster first saccade latencies) toward average BMI relative to either a higher (i.e., overweight BMI) or lower (i.e., underweight BMI) body size.**
Fixation Count	Men in the *mortality, pathogen, and masculinity threat* conditions relative to the control condition would show a **higher fixation count for 0.7 WHR than any other WHR.**	Men in the *mortality, pathogen, and masculinity threat* conditions relative to the control condition would show a **higher fixation count for average BMI than any other BMI.**

Notes. We defined preferences toward a specific WHR or BMI as men showing higher attractiveness ratings, fixation counts, and faster (or lower) first saccade latencies. We found no evidence to support any of the hypotheses listed here.

8.2.4.3 Research Question 3: Preferences for Specific Body Areas

Finally, we summarise our third research question. This research question expands on our first and second questions by exploring men's preferences toward specific areas of the body. We explored the influence of each of our three situational cues on men's preferences toward specific areas of the body. We defined seven areas of interest (AOIs) in Chapter 7, including the *(1)* head, *(2)* breasts, *(3)* arms, *(4)* waist, *(5)* hips, *(6)* thighs and *(7)* the lower legs. We outline the AOI by condition hypotheses for each outcome measure in Table 8.2.

Based on previous research illustrating the importance of the waist and hip area of the body when determining the quality of a potential partner (Suschinsky et al., 2007), we broadly predicted that when primed with mortality, masculinity or pathogen threat, men would show greater preference toward the waist and hip AOI. We define how we operationalised preferences in Table 8.2. We did not expect a difference *between* the waist and hip AOI. While previous research has shown that men direct more visual attention toward the breasts, we did not expect our situational threat cues to influence preferences toward the breasts. Our reasoning was based on research suggesting that breasts provide limited information regarding the potential quality of a partner (Furnham et al., 2006; Garza et al., 2016).

We categorised men's preferences into initial and overall interest indicators. We explored men's early interest by examining first fixations (i.e., where they first look) and their first saccade latency when making this fixation. Both are indicators of early preference toward a stimulus. Comparatively, we explored men's overall preference by examining their visual interest across the viewing period (i.e., 4000ms). We measured overall preference by using overall fixation count, mean dwell time and revisit count. These overall preference measures reflect an individual's interest in a particular stimulus (Mahanama et al., 2022).

In summary, we found no evidence to support each hypothesis in Table 8.2, despite a significant interaction effect between pathogen threat and AOI for revisit count. Men in each priming condition relative to the control condition showed no greater preferences for the waist and hip AOIs than other AOIs. Specifically, we found no evidence that men showed a greater preference toward the waist and hip AOI when primed with each situational threat cue when examining our initial and overall preference indicators. We found a significant pathogen threat by AOI interaction for revisit count. Interestingly, participants were more likely to revisit the head and breast area when primed with pathogen threat relative to the control condition. We interpret each of these findings in the subsequent sections.

While we did not make any formal hypotheses concerning the main effect of AOI, we suggested throughout Chapter 7 that men would show greater overt and covert interest in the waist and hip areas of the body relative to any other AOIs. This trend was generally supported in our data (but only for overt preferences) and extends the current research base. We discuss this finding in greater detail in Section 8.5.

Table 8. 2
Summary of the Area of Interest (AOI) Visual Interest and Attentional Hypotheses.

	Outcome Measure	Hypothesised AOI by Condition Interaction Effect
Initial Interest	Proportion of First Fixations	Men in the *mortality, pathogen, and masculinity threat* conditions relative to the control condition would display a **higher proportion of first fixations toward the waist and hip areas relative to each other AOI.**
	First Saccade Latency	Men in the *mortality, pathogen, and masculinity threat* conditions relative to the control condition would display a **lower (i.e., faster) first saccade latency toward the waist and hip areas relative to each other AOI.**
Overall Interest	Fixation Count	Men in the *mortality, pathogen, and masculinity threat* conditions relative to the control condition would display a **higher overall fixation count toward the waist and hip areas relative to each other AOI.**
	Dwell Time	Men in the *mortality, pathogen, and masculinity threat* conditions relative to the control condition would display a **higher mean dwell time toward the waist and hip areas relative to each other AOI.**
	Revisit Count	Men in the *mortality, pathogen, and masculinity threat* conditions relative to the control condition would have **a higher revisit count toward the waist and hip areas relative to each other AOI.**

Notes. We defined preferences toward a specific area of interest as men showing a higher proportion of first fixations, a higher overall fixation and revisit count, higher dwell times and a faster (or lower) first saccade latency toward a specific area of interest relative to other areas of interest. We found no evidence to support any of the hypotheses listed here.

8.2.5 Main Conclusions

Based on the review of our findings above, we can draw several conclusions from this thesis. We will interpret our findings in greater detail in the following sections. Generally, it is clear from Chapters 5 and 7 that we identified limited support for the influence of each of our situational threat cues on men's body shape and size preferences in the manner we predicted or concerning their preferences toward specific areas of the body. While we did find some evidence for an effect of pathogen threat in Chapter 7 (which we discuss below), generally, each of our situational threat cues did not increase the importance (as measured above) of attractive qualities and thereby did not shift men's preferences (across a range of indicators) toward more attractive bodies. This finding contrasts the range of compelling evidence on which we based our initial hypotheses. We outline this evidence and interpret our findings concerning this evidence in the next section. Equally, each situational threat cue did not shift men's preferences toward the most important areas of the body when evaluating a potential partner's quality (e.g., the waist). However, we did find some evidence for the influence of pathogen threat concerning preferences toward specific areas of the body.

It is important to note that (for reasons we outline in Section 8.7.3) we did not include manipulation checks within this research, and it is difficult to determine conclusively whether our priming methods were effective in instilling a sense of mortality, masculinity or pathogen threat in our participants. However, as we used mortality, masculinity and pathogen threat primes, which have been shown to result in a priming effect robustly, we believe that our situational threat primes were appropriate. Despite this, we comment on this potential limitation in greater detail in Section 8.7.3, especially regarding the relevance and appropriateness checks we completed. Based on our findings, we can draw four main conclusions:

1. Our current situational threat cues (i.e., our mortality, masculinity, and pathogen threat cues) had limited influence on men's body shape (i.e., WHR) and size (i.e., BMI) preferences or men's preferences toward specific areas of the body.

2. Pathogen threat appeared to influence men's preferences somewhat. However, this finding was inconsistent across the different self-report and overt and covert attention measures.
3. Our findings provide limited support for an expanded context-dependent model of mate selection that would include the influence of situational threat cues, at least when examining the situational threat cue primes that we used within this thesis.
4. Our findings add some interesting insights into the emerging field of masculinity threat research. Overall, our findings collectively question whether masculinity threat has the same effect on UK men compared to men from other countries and sociocultural backgrounds.

8.3 The Influence of Situational Threat Cues on Men's WHR and BMI Preferences

Considering our main conclusions, we will discuss and interpret our findings regarding our situational threat cues. We provide a synthesised discussion of how our findings relate to and have implications for the broader context-dependent model in Section 8.6.2. We begin each section by providing a brief overview of previous research and our rationale (outlined in greater detail in Chapter 2). We then present potential interpretations for our findings. As pathogen threat was the only situational threat cue that influenced men's preferences for specific body shape (via attractiveness ratings) and areas of the body (via revisit count), we begin by evaluating this situational threat cue.

8.3.1 Pathogen Threat

We explored the influence of pathogen threat on men's WHR and BMI preferences. Pathogen threat refers to the state of belief that a person is at imminent risk of disease or communicable sickness (Schaller, 2011). The influence of pathogen threat on human behaviour is theorised to be influenced by the behavioural immune system (Tybur et al., 2009). Unlike the resource-intensive and costly physiological immune response, the behavioural immune system is believed to be a prophylactic system which allows people to actively avoid encountering potential pathogenic stimuli, such as sick people (Brüne & Wilson, 2020). The behavioural immune system is also hypothesised to influence human mating and coupling behaviours by encouraging people to avoid others who might increase their risk of disease or pathogens and encourage coupling behaviours with those deemed healthy (A. J. Lee et al., 2015; Little et al., 2011). This preference for healthier partners has several benefits, considering the intimate nature of romantic and sexual interactions (Bressan, 2021; Sugiyama, 2015).

No research has directly examined the influence of pathogen threat priming on men's WHR and BMI preferences or their preferences for specific body areas. We predicted that men after exposure to a pathogen threat cue would show greater preferences toward the WHR (i.e., 0.7) and BMI (i.e., average), which are the body shapes and sizes perceived to be most attractive. We also predicted that men would show greater preference for the waist and hip areas of the body, as both areas provide information relevant when determining a partner's mate quality (Suschinsky et al., 2007).

As outlined above, our experiments showed no evidence to suggest that priming men with pathogen threats influenced their preferences toward the *most attractive* body shapes and sizes (as generally perceived by men). We found this across various outcome measures, including self-report attractiveness ratings, overt visual interest indicators (e.g., fixation measures) and covert attentional bias measures (i.e., first saccade latency). Our findings suggest that men primed with pathogen threats do not show an increased preference toward more attractive body shapes and sizes. This finding contrasts with the extensive research showing that men, primed with pathogen threat or when measuring environmental pathogen threat, show a greater preference for attractive qualities (e.g., faces) that individuals often interpret to indicate health and fertility (A. Jones & Jaeger, 2019; Zheng, 2019). We find this surprising given that, unlike faces, women's bodies can vary across their lifetime and may be greater indicators of immediate health status (Tybur et al., 2022). We also find this unexpected as our diverse sample in Chapter 4 rated 0.7 WHR and average BMI as the most attractive, healthy and fertile body shapes and sizes.

Our findings also contrast and extend the limited previous research that has explored men's WHR and BMI preferences when influenced by pathogen threat. Lee et al. (2015) found that higher pathogen sensitivity was associated with significantly greater preferences toward lower WHR and lower BMI (albeit this was not significant). However, they measured pathogen sensitivity (rather than threat) and used a limited array of WHR and BMI categories. This limited array likely explained why they did not find a significant effect of pathogen sensitivity on men's BMI preferences. Our findings may suggest that priming men with situational cues relating to pathogen threat is not the same as actively experiencing (pathogen presence) or believing you are at risk of pathogens (sensitivity). This may present one explanation for our differing findings.

Indeed, we used an intentionally subtle pathogen prime cue, which relied on participants considering their own risk of pathogens. While this has been used in previous research (see Watkins et al., 2012), most research employing pathogen-threat primes relies on alternative, more extreme primes. For instance, some researchers have used visual pathogen threat primes, such as human faeces, which we could argue are more likely to activate the behavioural immune system and the behaviours associated with this (Culpepper et al., 2018). We opted not to use this priming approach because it did not reflect the actual pathogen threat primes men are likely to experience. Recall that we used priming methods to reflect the type of pathogen threats men may experience regularly. This difference in our priming approach may explain why men in experiments three and four did not show a greater preference for more attractive qualities.

Despite not finding that pathogen threat influenced men's body shape or size preferences in the manner we expected or that would support previous research, men in the pathogen threat condition showed lower preferences toward 0.6 WHR via attractiveness ratings. Despite using similar paradigms, this finding was found in our in-person experiment (experiment five) but not in our online experiment (experiment three). This finding is particularly interesting. While our sample in Chapter 4 rated 0.7 WHR as the most attractive, healthy, and fertile, 0.6 WHR was also rated relatively high. One interpretation of this finding is that men show lower preferences toward the body shapes they perceive to be healthy and fertile when primed with pathogen threat, contrary to our initial predictions. However, it is unclear why the participants in the pathogen threat condition also did not rate 0.8 WHR as less attractive, given that our sample in Chapter 4 rated 0.6 and 0.8 WHR similarly on each of the three measures. Furthermore, if our findings conclude that pathogen threat decreased men's preferences toward more attractive traits, then this questions why men did not show reduced preferences toward 0.7 WHR.

There are several explanations for our findings. One potential explanation could be that we used an online experiment in experiment three and an in-person experiment in experiment five. We present a more nuanced explanation of what the discrepancy between our in-person and online experiments means for online experimentation in Section 8.7.2. Another explanation could be due to differences in our experimental paradigm between experiments three and five. Participants in experiment five did not view the same array of stimuli as the participants in experiment three. Specifically, as we used a reduced stimulus set to administer our eye-tracking paradigm effectively, participants were not exposed to the most unattractive body shape (i.e., 1.0 WHR). The paradigm also caused participants to view the same stimuli several times, whereas, in experiment three, they viewed the stimuli only once. This may have resulted in participants making their attractiveness ratings for each body based on the relative attractiveness of the other bodies to which they may have been exposed. Exposure to bodies of varying sizes has been shown to influence subsequent preferences (Boothroyd et al., 2012). Given that the most unattractive WHR was not included, this may have resulted in participants viewing 0.6 WHR as the most unattractive relative to the other bodies shown (especially given that 0.7 and 0.8 WHR were rated as more attractive in Chapter 4). We acknowledge that this explanation is entirely speculative, and we cannot provide a concrete explanation for the lack of similar findings within the broader research literature.

Another potential and more nuanced explanation is due to differences in our sample. We explored whether our sample in experiments three and five viewed themselves as susceptible to pathogens and disease and reported their risk factors. While our participants in experiment three largely stated that they did not have any risk factors, most of our participants in experiment five did report some risk factors for pathogens and disease. As such, it could be argued that our sample in experiment five was more likely to be affected by our pathogen threat prime, given they viewed themselves as having these risk factors. However, it is important to note that both samples reported similar scores on the Perceived Vulnerability to Disease Questionnaire and that this explanation is speculative. We discuss this further below and make suggestions for future research.

In addition to exploring men's preferences for different body shapes and sizes overall, we also found that pathogen threat did not influence men's preferences toward the body areas that are important when making mating decisions (i.e., waist and hip area) when exploring our initial interest indicators or our overall interest indicators. This finding is particularly surprising as the waist and hip areas provide ample health and fertility information (P. L. Cornelissen, Toveé, et al., 2009; Garza et al., 2016; Suschinsky et al., 2007). While we did not find that pathogen threat influenced men's preferences toward body areas in the way we predicted, we did find a significant interaction between pathogen threat and men's preferences toward the head and breasts for revisit count. Specifically, men in the pathogen threat condition showed significantly higher preferences (in the form of the number of revisits) relative to the control condition. The revisit count is a particularly important outcome measure, indicating where participants are more likely to direct their visual interest. Arguably, other indicators (e.g., fixation count) may reflect participants simply scanning the stimulus, whereas revisit count is a direct measure of what aspect of the stimuli participants decided to return to view (Garza et al., 2016; Mahanama et al., 2022).

This finding (while unexpected) is novel. It expands previous research, which has so far focused on men's preferences toward overall features (e.g., the face) rather than the relative importance of specific body areas. We show that men primed with pathogen threats may look more often toward the head than toward other areas. This finding is thought-provoking, given that we have suggested so far that most research has explored the influence of pathogen threat on men's facial preferences (e.g., Ainsworth & Maner, 2019). As we argued in Chapter 2, men perceive certain facial features as more attractive, likely because they believe they are healthier. As such, it may be that our participants were more likely to look toward the face to determine the person's health status following a pathogen threat prime. However, we note that this explanation is speculative.

A potential reason for this is that while we did not purposefully alter the features of our stimuli's face, given that our stimuli were computer generated, the face was symmetrical. The face also had no visible blemishes or markings. Previous research has shown that men prefer women's faces when they are symmetrical and have very few markings based on the belief that they may indicate pathogen presence (Ainsworth & Maner, 2019; A. J. Lee et al., 2013; Symons, 1995). As such, men primed with pathogen threat may have been more likely to revisit (i.e., direct their visual interest selectively) toward the head as this may convey (or at least is believed to convey) information concerning pathogen presence and resistance. Again, this explanation is speculative.

We also showed that men were more likely to look toward the breast area of interest when primed with pathogen threat. We argued in Chapter 7 that we did not believe our situational threat cues would influence men's preferences toward the breast area, given that the breasts provide limited information concerning the quality of a potential partner (Furnham et al., 2006). However, research has shown that the breasts receive greater visual attention than other body areas, such as the lower body (Dixson et al., 2011b). It is possible that our initial thinking was incorrect. For instance, Zelazniewicz and Pawlowski (2011b) argue that the breasts provide some information that may be relevant to determining the health status of a partner. Specific breast variations influence attractiveness ratings, such as shape, size and areolar pigmentation (Dixson et al., 2011b, 2011a; Lynn, 2009).

Similar to the head, while we did not intentionally alter the breasts of our stimuli, as they are computer generated, they also have breasts that are equally shaped, sized, and youthful in appearance (i.e., limited breast ptosis). Some evidence has implicated these qualities as indicators of developmental stability and health, and men often rate breasts that contain these features as more attractive (Groyecka et al., 2017; Tovée et al., 2000; Zelazniewicz & Pawlowski, 2011b). It could be possible that men primed with pathogen threat were more likely to look at the breast area of interest on our stimuli because they indicate some potential benefit. This may suggest that priming for pathogen threat causes men to look more toward the breast area to determine the potential health of a prospective partner.

In summary, we found no support for our predictions that pathogen threat would increase men's preferences (across a range of measures) toward more attractive body shapes and sizes, either overall or when examining specific WHR and BMI preferences. We also found no evidence that pathogen threat altered men's preferences toward specific body areas relevant when making mating decisions (e.g., the waist). However, most interestingly, we did find that pathogen threat altered men's preferences toward the head and breast area of the body as indicated by revisit count. These findings may highlight that the head and breast AOI offer information concerning a prospective partner's pathogen resistance. While research has investigated men's facial preferences following pathogen threat, this is the first study to show the importance of the head relative to other areas of the body and the importance of the breasts when men are primed with pathogen-related concerns.

8.3.2 Mortality Threat

In experiment one and five, we examined whether mortality threat, defined as a state of threat that occurs when individuals consider their demise, influenced men's WHR and BMI preferences (Vaughn et al., 2010). Existing research has shown that when primed for mortality threat, men report greater preferences for more attractive qualities in potential partners (Plusnin et al., 2018; Silveira et al., 2014; Śmieja et al., 2006) and report that the body is of greater importance relative to other bodily features, such as the face, when evaluating a potential partner (Zhao et al., 2019). However, no research until this point has directly examined whether priming men with mortality threat cues would influence their preferences toward specific bodily features, such as different WHRs or BMIs. Similarly, no research has explored men's preferences toward specific areas of the body. As outlined above, our experiments found no evidence to suggest that priming men with mortality threats influenced their body shape and size preferences. We also found that mortality threat did not influence men's preferences toward specific body areas. We found this lack of effect across a range of measures. We present an interpretation of these findings below.

Previous research has shown that both men and women experience changes in their mating motivations when exposed to a mortality threat cue (Plusnin et al., 2018). However, for men, these changes are stronger and manifest differently. Birnbaum et al. (2011) showed that men report greater interest in romantic and sexual interactions with individuals described to be attractive using vignettes. Under times of threat from mortality (or pathogens), men shift their reproductive motivations toward identifying traits signalling health and fertility as these traits become situationally relevant (Little et al., 2011). Favouring sexual interactions with attractive individuals may represent an evolved and adaptive process following mortality threat, as it would increase the chances of successful reproduction in the short term (Plusnin et al., 2018).

This shift also enhances men's preferences for attractive features that signal greater health and fertility (Zhao et al., 2019). For instance, Silveira et al. (2014) showed that when primed for mortality threat, men, but not women, showed greater preferences for meeting women with attractive faces relative to when not primed for mortality threat. Our findings also do not support the limited research showing that mortality threat increases men's importance on the body relative to the face (Zhao et al., 2019). When examining preferences toward body shapes and sizes specifically, rather than bodies (relative to other physical features), we found that mortality threat did not shift men's preferences.

Our findings offer interesting insights into existing research, implying that, unlike faces, mortality threat does not shift men's preferences toward more attractive WHRs or BMIs. This finding is surprising, given that our sample in Chapter 4 rated 0.7 WHR and average BMI as the most attractive, healthy and fertile, a conclusion echoed across previous research (e.g., Swami et al., 2008). It is also particularly compelling that we found no differences across our self-report, overt (e.g., fixation count) and covert (e.g., first fixation count) preference indicators.

We also found that mortality threat did not alter men's preferences toward specific areas of the body. Our study is the first to examine men's preferences toward specific areas of the body (rather than features overall) when primed with mortality threat. Given the theorised shifts in men's mating motivations caused by mortality threat, we anticipated that men would prefer the waist and hip area of interest relative to other areas because these areas provide significant information about prospective partner *quality* (Garza et al., 2016; Suschinsky et al., 2007).

However, we found no differences in visual or attentional preference toward these body areas. These findings are particularly interesting and expand previous research, which has thus far observed preferences toward overall features (e.g., attractive faces; Silveira et al., 2014). Here, we show that mortality threat neither increases overall preferences toward attractive WHRs and BMIs nor toward areas of the body that are important when judging bodily attractiveness.

There are several potential explanations for our findings. It could be reasoned that while men primed with mortality threat experience a change in their mating motivation, this does not manifest in preferences toward specific body shapes or sizes or toward areas of the body deemed reproductively relevant (e.g., the waist). Instead, it may be advantageous for men to show greater preference for sexual contact with many women, regardless of the attractiveness of their WHR or BMI. Some research supports this, showing that when men experience changes in their mating motivations, the standards they seek in potential partners decrease (see Plusnin et al., 2018, for a review). For instance, Hirschberger et al. (2002) showed that mortality threat caused participants to compromise their standards for potential partners. One explanation for this reduction in standards is that mortality threat increases the desire to form close relationships at the expense of partner quality (Cox et al., 2008; Frischlich et al., 2015). Close relationships in this context would serve a similar purpose as reproduction, providing a sense of worldview and comfort. This may explain why men showed no greater overall preferences for more attractive WHRs or BMIs or preferences toward the areas of the body relevant when judging the attractiveness of a potential partner. It may be that the shift caused by mortality threat may manifest in preferences toward traits which provide long-term benefits, such as interpersonal warmth (Devenport et al., 2023). Future research should explore this possibility.

A preference for attractive partners following mortality threat may be contingent on whether the person endorses an unrestricted mating strategy and seeks short-term partners (Plusnin et al., 2018). Kosloff et al. (2010) showed that when people desire short-term partners, they seek out highly attractive partners when primed with mortality threat. In contrast, people preferred qualities indicating similarities (e.g., shared interests and outlooks on life) when desiring a long-term partner rather than attractiveness. This preference for similarities is because they may be more advantageous in acquiring and keeping long-term partners (i.e., forming close relationships). Thus, a participant's sociosexual orientation may influence how they respond to a mortality threat cue and whether this response manifests in changes to mating motivations. However, as we did not measure sociosexual orientation in our experiments, we could not explore the potential moderating effect of this individual difference variable. Other individual differences may also explain our findings. For instance, some research has demonstrated that high self-esteem protects against mortality threat (Hirschberger et al., 2002). However, as we did not measure or control for self-esteem within our analyses, it is unclear whether this explains our findings. It could be that a specific combination of individual differences is required for the mortality threat to influence an individual and shift their WHR and BMI preferences.

It is important to note that while our findings examined men’s preferences toward specific WHRs and BMIs using attractiveness ratings and eye-tracking measures, previous research has used alternative measures. Our different outcome measures may be an alternative explanation for our differing findings. For instance, Silveria et al. (2014) showed that men reported being more in favour of meeting a woman with an attractive face when primed with a mortality threat. However, they found no difference in attractiveness ratings given to each face. It is important to note that this latter finding is unsurprising, given that the authors only included faces rated as highly attractive in their pilot study, leaving little room for a mortality threat manipulation to influence attractiveness ratings.

Similarly, Zhao et al. (2019) did not capture the attractiveness of respective features but asked participants to rate the importance of the face relative to the body. The differences in our findings may be due to the different measures we used relative to previous research to conceptualise preferences. However, we found that mortality threat did not influence men’s WHR or BMI preferences across various outcome measures, including self-reported attractiveness and visual and attentional indicators. We reason that the comparative findings across our different outcome measures suggest this explanation to be unlikely. Instead, our findings suggest that, unlike previous research examining other features (e.g., faces), men's

WHR and BMI preferences are likely not influenced by mortality threat, or this effect may require a specific combination of individual differences.

It is important to also comment on the specifics of our sample. Our relevance and appropriateness checks in experiment one and five generally showed that our sample reported relatively high fear of personal death. That said, our sample in experiment five generally scored lower on the Fear of Personal Death Scale than our participants in experiment one. The lack of a significant effect of our mortality threat cue is even more surprising given that our sample in both experiments appeared to fear death. This suggests that our sample not being receptive to our prime is unlikely to fully explain our null findings. That said, an alternative mortality threat prime with a similarly susceptible sample might have a different effect.

Based on the findings from our experiments, we found no evidence that subtle mortality threats influence men's body shape or size preferences. Our findings offer interesting insights into existing research, which has demonstrated that when primed for mortality threat, men report greater preferences for more attractive qualities in potential partners (Plusnin et al., 2018; Silveira et al., 2014; Śmieja et al., 2006), and report that the body is of greater importance when relative to other bodily features, such as the face (Zhao et al., 2019). However, our sample showed no greater preference for attractive WHRs or BMIs or toward specific body areas across various measures. Our findings help to explore further the potential outcomes of mortality threat and further our understanding of what situational threat cues influence men's body shape and size preferences.

8.3.3 Masculinity Threat

Given the emerging field of masculinity threat research, we aimed to explore this situational threat cue further. We wanted to explain our findings further by evaluating whether masculinity threat affects UK men's attitudes toward TGD people, a response to masculinity threat that has been robustly identified in other sociocultural contexts. We begin by exploring our findings relating to men's body shape and size preferences (experiments two and five) and then present our findings concerning men's attitudes toward TGD people (experiment four). We then synthesise these different research findings.

Similar to mortality threat, our experiments examined whether situational threat cues relating to gender identity threat (i.e., masculinity threat) influenced men's WHR and BMI preferences. Previous research has established that the extent to which men are encouraged to adhere to traditional masculine gender norms can influence preferences toward different body shapes and sizes (Kosakowska-Berezecka & Besta, 2018). However, research up until this point had focused on examining persistent environmental factors (i.e., cultural and societal gender norm adherence), with no research examining variation in gender norm adherence at the individual level (e.g., Swami, Antonakopoulos, et al., 2006). Thus, we examined whether priming men with a subtle masculinity threat cue would influence their WHR and BMI preferences. As mentioned above, our self-report and eye-tracking experiments found no evidence that priming men with masculinity threat influenced their WHR or BMI preferences.

Research has demonstrated that men primed with masculinity threat experience similar shifts toward adopting traditional gender roles and norms and behave in traditionally *masculine* ways to a more extreme (or *toxic*) degree (Willer et al., 2013). These behaviours include various responses, such as driving more aggressively, displaying increased toughness and more negative behaviours toward women, such as sexual harassment (Alonso, 2018; Braly et al., 2018; Fowler & Geers, 2017; O'Connor et al., 2017). No research to date has addressed the influence of masculinity threat on men's WHR and BMI preferences. Despite this, considering masculinity threat has been robustly shown to increase adherence to masculine gender norms, and this adherence to masculine norms is associated with the above shift in WHR and BMI preferences, there is strong reason to believe that situational threat cues that trigger masculinity threat should alter men's mating motivations and their preferences (Hunt et al., 2016; Swami, Antonakopoulos, et al., 2006; Willer et al., 2013). We reasoned that priming men with masculinity threat cues would influence their body shape and size preferences in the same manner as when traditional gender norms are adhered to more on a sociocultural level.

However, we did not find that priming men with subtle masculinity threat cues influenced their WHR or BMI preferences across our experiments. Our findings expand on existing research focusing on the influence of sociocultural differences in gender norm adherence. When a society or culture strongly promotes a traditional view of gender (i.e., men and women adopt certain roles and gender is binary) and men experience pressure to conform to these norms, they display altered WHR and BMI preferences (Furnham & Greaves, 1994). In societies and cultures where traditional gender norms are adhered to more strictly (e.g., Greece, Japan, Portugal), men express a greater preference for a traditionally feminine body shape (i.e., 0.7 WHR) and body size (i.e., average BMI; Furnham & Nordling, 1998; Kosakowska-Berezecka & Besta, 2018; Swami, Antonakopoulos, et al., 2006). Our findings suggest that while persistent differences in gender norm adherence at the societal level influence men's body shape and size preferences, subtle threats to masculinity threat, which should promote more traditional gender role engagement at the individual level, do not. As no research has explored masculinity threat's influence on WHR and BMI preferences, we interpret our findings concerning broader masculinity threat research. Potential explanations, however speculative, should be explored in future research.

One explanation for our findings is that masculinity threat may not alter men's WHR and BMI preferences specifically but may increase objectification. As discussed in Chapter 2, previous research has illustrated that men who adhere to traditional gender norms are likelier to engage in objectifying behaviour, reducing a person's body to a sexual object (Dahl et al., 2015; Moradi & Huang, 2008). Objectification occurs toward all women but more frequently toward women who possess an attractive body type by ideal societal standards (Bareket et al., 2019; Bareket & Shnabel, 2020; Gervais et al., 2013). As objectification is one of the most prominent methods of endorsing a patriarchal power system (Fredrickson & Roberts, 1997), men experiencing threatened masculinity may turn to objectification to reaffirm their identity. We reasoned that this would shift men's preferences toward more attractive WHRs and BMIs and the areas of the body that are important when evaluating a woman's attractiveness. However, masculinity threat may only alter men's objectifying behaviours.

A recent study by Vescio et al. (2023) showed that men primed with masculinity threat were more likely to recall instances where they sexually objectified women. However, little research has explored whether priming men with masculinity threat directly influences objectification. As such, a potential explanation for our findings is that masculinity threat may not alter preferences toward *specific* body shapes or sizes but may increase sexually objectifying behaviours as a more convenient method of reaffirming masculinity. However, this explanation is speculative, given the significant lack of research in this area. Future research using appropriate methodologies is required to test the effect of masculinity threat on men's objectifying behaviours (e.g., by using a Body Inversion Paradigm; Bernard et al., 2021)[28].

Before introducing the explanation that we believe to be most likely, we will first interpret our findings from experiment four. Our findings from experiment four showed that threatening UK men's masculinity did not affect their overall attitudes toward TGD people. This contrasts findings from other countries, where a robust effect of masculinity threat has been shown (e.g., Poland, Konopka et al., 2019). It could be that a masculinity threat is less impactful for UK men (an explanation we believe is most likely considering the findings from experiments two, four and five).

It could also be that responding negatively to TGD people is not a compensatory mechanism to masculinity threat that UK men might use. This explanation is logical, given that perceptions of masculinity do vary by country (Fiałkowska, 2019). Considering the specifics of the UK, the increase in public TGD narratives in the UK mainstream media (e.g., "Heartstopper" featuring "Ellie", a trans character, Sam Smith, a British-made singer and songwriter who recently came out as nonbinary) and previously shown positive impacts of parasocial contact (e.g., Massey et al., 2021), future research may wish to control for the effects of previous intergroup contact, especially when this contact has been positive. However, at the same time, the increase in the negative public narrative around TGD lives in the UK also needs to be acknowledged. TGD people have been the centre of several recent high-profile public

[28] We note that measuring objectification does not require a person to express a preference toward a body type. For instance, the typical Body Inversion Paradigm measures the degree to which bodies are interpreted as objects (Zogmaister et al., 2020). When bodies and faces are inverted, they become more difficult to process, whereas objects are easier to process once inverted. Research using this method shows that when men are more likely to objectify women inverting a body stimulus does not impair performance as they interpreted the stimulus as an object (Bernard et al., 2021).

debates concerned with the gender binary with significant debate occurring on social media platforms such as Twitter and in certain factions of the mainstream UK media. As such, UK men might not turn to trans negativity following a masculinity threat. However, we find this explanation less likely given that trans and gender diverse people are generally subject to greater prejudice and negativity within the UK at present.

Another potential explanation is whether threatening UK men's masculinity is relevant. We believe this to be the most likely explanation. As we argued above, the extent to which a country or culture promotes traditional gender norms influences men's preferences (Kosakowska-Berezecka & Besta, 2018). We sampled our participants from the United Kingdom (UK), which ranks highly concerning gender equality. The UK ranks 15th globally and 6th in Europe for gender equality when rated across various facets, such as educational attainment and political involvement (European Institute for Gender Equality, 2020[29]; World Economic Forum, 2023). While men in the UK believe other men view masculinity as important, they do not perceive masculinity as valued by society (Iacoviello et al., 2022). Similarly, both women (74%) and men (69%) reported largely rejecting traditional gender roles in the 2018 British Social Attitudes Report (Phillips et al., 2018).

Comparatively, most other research employing masculinity threats (albeit examining different outcomes) has done so in countries where gender remains highly differentiated, such as Italy, which ranks 79th for gender equality globally (Salvati et al., 2021; World Economic Forum, 2023). For instance, Cerbara et al. (2022) found that adherence to traditional gender norms in Italy was 60% regardless of age. Given that in the UK, gender equality is high, traditional gender roles are challenged and disestablished, and men view masculinity as not valued, our sample may not have responded to threats to their masculinity in the way we

[29] While a more recent version of the European Gender Equality Index was published in 2022, the UK was not included due to *Brexit*. The last reporting year that the UK was included was 2020.

predicted (if at all). As such, conducting this research with UK men may also be an explanation for our findings from experiments two, four and five.

Similarly, individual differences, such as personality factors, could moderate the effect of masculinity threat. For instance, Ching (2022) found that the effect of masculinity threat on attitudes toward the trans and gender-diverse community was moderated by whether men viewed their self-worth as contingent on their masculine identity. Likewise, Parent and Cooper (2020) showed that greater conformity to masculine norms moderated the effect of masculinity threat on viewing hypermasculine advertisements as positive. However, as we did not measure these constructs within our sample, masculinity threat may occur more strongly (or only) in men who view masculinity as an essential aspect of their identity.

Based on our experiments' findings, we found no evidence that subtle threats to masculinity influence men’s body shape or size preferences. We acknowledged in Chapter 2 that the evidence associating masculinity threat to changes in men’s body shape and size preferences was less conclusive, and very little direct research existed. We reasoned that the effect of masculinity threat would be weaker than mortality or pathogen threat. Despite this, we found that masculinity threat did not alter men’s WHR or BMI preferences across a range of explicit or implicit measures.

Our findings expand current research focused on persistent differences in sociocultural gender norms. Our findings also help to elucidate the potential consequences of masculinity threat and what situational threat cues may influence men’s body shape and size preferences. We also found that masculinity threat did not alter men’s attitudes toward TGD people. More generally, our findings add to the recent increase in research examining the effects of masculinity threat. Taken together, our findings suggest that, in a UK context, the effect of masculinity threat may be less significant than in cultures where masculinity is more important. An alternative argument is that while the masculinity threat may have been effective, changes in preferences for different body shapes and sizes and attitudes toward TGD people may not be a compensatory mechanism endorsed by UK men. That said, in experiment two we did find that men reported lower attractiveness ratings for women's bodies overall. Future research is needed to understand these processes further and evaluate potential moderating variables.

8.4 Dot-Probe Paradigm (Attentional Bias)

One of the core aspects of our experimental paradigm for experiment five was including a combined dot-probe eye-tracking element. While we risk repeating some of the above information, it is important to reflect on the findings of the dot-probe element of our paradigm. The purpose of the dot-probe paradigm in our experiment (not mentioning the methodological benefits we outlined in Chapters 3 and 7) was to allow us to capture whether men displayed an attentional bias toward attractive bodies overall, toward a specific WHR or BMI and specific areas of the body when primed with each of our situational threat cues.

As we outlined above, we found no evidence to suggest that men primed with mortality, masculinity or pathogen threat cues show any attentional bias toward *(1)* more attractive bodies overall, *(2)* more attractive WHRs and BMIs, *(3)* areas of the body important when making coupling or mating decisions. While we made no formal hypotheses concerning these effects, we also found no evidence that men showed any attentional bias toward more attractive stimuli overall or areas of the body important when making decisions when averaged across priming conditions.

We failed to find significant findings across our analyses that relied on the first saccade latency as the outcome measure. This was despite our belief that each situational threat cue would cause situationally relevant stimuli (e.g., attractive stimuli) to be attended to covertly and, thus, responded to more quickly. One interpretation of these findings is that men may not have an attentional bias toward more attractive WHR and BMIs when exposed to specific situational threat cues. Similarly, these findings suggest that men showed no attentional bias toward specific body areas (e.g., waist) independently or while primed with each situational threat cue. However, we view this interpretation as unlikely as research has shown that evolutionarily relevant information, specifically information concerned with selecting an optimal mate, is attended to more quickly (Lu & Chang, 2012; Maner et al., 2007, 2008, 2009). For example, previous research has shown that lower WHRs capture a person's attention

(Cloud et al., 2023). What is especially unexpected is that there was no main effect of AOI or main effect of stimulus type (when examining overall attractive vs. less attractive stimuli). Across each of our outcome measures, we showed that men preferred the waist AOI relative to other areas. We expected the waist AOI to be attended to more quickly, but this was not the case.

A more likely explanation is that our findings support the growing body of research questioning the reliability of the dot-probe paradigm (Thigpen et al., 2018). Chapter 3 outlined that the dot-probe paradigm has been criticised for having poor reliability, which may explain the inconsistencies in findings when this paradigm is used (Schmukle, 2005). However, previous research has adapted the dot-probe paradigm (in the same manner as we did in experiment five) to use first saccade latency as the outcome measure rather than reaction times, which improves reliability (Blechert et al., 2010; Skinner et al., 2018). We reasoned that these changes would improve the reliability of our dot-probe paradigm. However, the findings from experiment five suggest otherwise.

Thus, we suggest that readers interpret our findings that use the first saccade latency as the outcome measure with caution. We strongly believe that our findings (or lack thereof) do not indicate an absence of attentional bias but are owing to limitations with the dot-probe paradigm. Researchers aiming to use this paradigm in future need to be aware of these limitations.

8.5 Preferences Toward Specific Body Areas

We also felt it was important to comment on another interesting finding from this thesis, but one that we did not make any formal hypotheses about or were not directly related to the central research aim of this thesis. In experiment five, we reported the Areas of Interest (AOIs) that men preferred when evaluating women's bodies for attractiveness. We specifically examined a range of outcome measures outlined in Section 8.2. The findings from experiment five indicate that men generally preferred the waist, hips, and breast AOI (in this order). In each case, men preferred the waist more, whereas the hips and breasts received similar interest (except for average dwell time, which we discussed in Chapter 7).

Our findings are consistent with and expand existing research that has demonstrated that the waist and hip areas of the body are important when evaluating the *quality* of a prospective partner (Dixson et al., 2011b). Suschinsky et al. (2007) refer to these areas as reproductively relevant regions as they provide information about the health and fertility of a potential partner. The waist area is often considered the most important, serving as a broad first-pass filter for determining mate quality (Singh & Singh, 2011; Suschinsky et al., 2007). Our findings support the importance and preference toward the waist; the waist received more overall fixations and revisits than other areas. The number of times a participant revisited the waist speaks highly to the importance and preference toward this AOI. A higher number of revisits implies that participants felt this area was important and preferred returning to view this area relative to any other area of the body (Garza et al., 2016).

We also found that men spent longer looking at the waist area relative to other areas of the body. While this was not different from how long participants looked at the face, this finding is particularly important. Most research has shown that the face receives higher dwell times (Langton et al., 2008; Theeuwes & Van der Stigchel, 2006). A simple explanation for this is that the face is more visually complex than other areas of the body and, therefore, takes longer to process. Given that the waist has very few complex features relative to the face (e.g., the face has the eyes and the nose), it is interesting that the waist received a similar mean dwell time. This finding again highlights the relative importance of the waist area.

Our findings explicitly support the importance of the waist and hip area as a broad *first-*pass filter. Singh (1993) suggests that men evaluate a woman's WHR (i.e., observe the waist and hip areas more often) first to determine the quality of a mate before individuals move on to look at other areas of the body. We found support for this, with our sample showing a significantly higher proportion of first fixations toward the waist area than any other AOI, followed by the hips. This finding supports the view that men fixate first on the waist before proceeding to other areas of the body. Importantly, we found this finding while varying the vertical height of the stimuli between trials. This means that participants were not simply directing their gaze toward the centre of the stimuli. Rather, participants purposefully directed their first fixations to the waist and hip areas relative to any other body area[30].

However, our findings contrast those of previous research, showing that the chest and breast AOI received the highest number of fixations, irrespective of breast size. These researchers have claimed that this indicates that the breast area of the body is important when making mating decisions (Dixson et al., 2011b; Garza et al., 2016). However, we did not find that in our analyses. It should be noted that while our research indicates that men generally prefer the waist and hip area over the breasts when men were exposed to pathogen threat, the significance of the breast area in terms of how often men revisited it did increase. As mentioned, the waist area received the largest amount of overt visual interest, followed by the hips and breasts. The latter two areas received comparable visual interest. Our findings likely differ due to the strengths of our experimental design and data analysis. Specifically, we varied the vertical position of the stimuli across trials, whereas previous research did not. This may suggest that the preference toward the chest and breast area in previous studies was due to men immediately fixating on the centre of the stimuli, a commonly reported artefact in eye-tracking research (DeWall & Maner, 2008). Furthermore, we normalised the size of our AOIs. To our knowledge, no previous research evidencing a preference toward the breasts performed these standardisations (e.g., Dixson et al., 2011b; Garza et al., 2016). The relative size of the chest and breast area, combined with participants likely looking toward this area first if the vertical position of the stimuli is not varied, offers a potential explanation for our findings.

8.6 Implications

In this thesis, we identified several interesting findings that we have explored above. Here, we discuss the implications drawn from our findings. We specifically focus on the practical implications concerning the creation of our stimuli and the potential benefits this may have for future research. We also comment on the theoretical implications of this thesis's findings on the context-dependent model of mate selection.

[30] In appendix five, we include supplemental analyses unrelated to this thesis's primary aim. However, they may be of interest to the reader. We present the main and interaction effects for WHR and BMI and the two and three-way interactions between WHR, BMI and AOI for each of our eye-tracking outcome measures.

8.6.1 Stimuli

One of the implications of this thesis is that we successfully created a set of 3D body stimuli that vary in WHR and BMI. In Chapters 3 and 4, we discussed several limitations of existing stimulus sets (very few of which are openly available for use). Our goal in generating new stimuli was to rectify some limitations by creating full-bodied and colourised stimuli varying across a wide range of WHR and BMI categories and making the resulting stimuli open source on the OSF. We found that participants viewed our stimuli as moderately realistic and rated them similarly in terms of attractiveness, health, and fertility relative to other previously used stimulus types (e.g., line-drawn stimuli). Our stimuli present a promising new direction for WHR and BMI research. Specifically, our stimuli are fully open source and available on the OSF, and researchers can make alterations to them using the same software (Daz^{3D}) we used to create them. Our stimuli offer greater flexibility to future researchers and aid in resolving some of the initial hurdles with 3D stimuli creation (e.g., computational resources). Our stimuli also help to address some of these limitations and represent a wide range of WHR and BMI categories. However, it is important to acknowledge that our sample rated our stimuli moderately realistic. For this reason, in Section 8.8, we comment on how future research may create more realistic stimuli.

8.6.2 A Context-Dependent Model: Is There a Place for Situational Cues?

As mentioned, the primary aim of this thesis was to explore the influence of mortality, masculinity and pathogen situational threat cues on men's body shape and size preferences. In Chapter 2, we outlined how previous research has largely explored men's WHR and BMI preferences as stable rather than acknowledging the influence of contextual factors (Maner et al., 2007). Research that has acknowledged those factors has focused on the influence of persistent environmental contexts (e.g., socioeconomic status) rather than the influence of immediate situational cues at the level of the individual. As explained by Maner (2007), current "*evolutionary theories of mating, however, have tended to rely on motives presumed to be chronically active and have left relatively unexplored effects of situational activated motivational states*" (p. 389). Our central aim within this thesis was to explore these situational threat cues and whether they influence men's body shape and size preferences and their preferences toward specific areas of the body.

While we did find some interesting findings concerning pathogen threat, especially when examining preferences toward specific areas of the body, we generally found limited support across our experiments that our mortality, masculinity and pathogen threat cues influence men's preferences. These findings, in turn, mean this thesis provides limited support for an expanded context-dependent model that includes the role of situational threat cues at the level of the individual.

One interpretation of our findings is that persistent and long-term environmental or social factors may influence men's preferences more than immediate situational threat cues. Previous research has shown that persistent mortality, masculinity and pathogen threat cues in the environment influence men's body shape and size preferences (Mo et al., 2014; Saxton et al., 2020; Swami, Antonakopoulos, et al., 2006). Similarly, Boothroyd and colleagues (2020) suggested that the preference for slim, curvaceous women may be caused by persistent exposure to societal appearance ideals (e.g., the thin ideal) rather than the frequency of exposure. This may support the idea that relatively long-term and persistent environmental or social cues primarily influence men's preferences rather than frequent situational threat cues at the individual level.

An alternative perspective is to adopt an interactionist approach. A potential direction for future research is to examine the interaction between wider contextual factors and situational threat cues imposed at the level of the individual. It could be argued that for specific threats to have an effect, they may need to be experienced on a relatively persistent basis. For instance, whether pathogen threat primes influence men's preferences toward specific features in a context (e.g., at a country level) where pathogen threat is high. However, this does not explain the findings from our exploratory analyses in Chapter 5. Interestingly, we conducted two exploratory analyses in experiment one and three, where we removed participants who either did not report being fearful of death, or who did not view themselves as being at risk of diseases or pathogens. We found that when only focusing on those participants who reported fear of death and pathogens, there were no differences in our findings. However, we note that removing these participants may have led to issues with our statistical power in those exploratory analyses. Despite this, these findings do point to an interesting direction for future research, which should address the interaction between of *(1)* wider, more persistent environmental threats *(2)* perceived individual risk and *(3)* immediate situational threat cues.

Despite our findings providing limited support for the influence of immediate situational threat cues on men's body shape and size preferences, this conclusion comes with caveats. It is important to note that we examine just three potential situational threat cues in this thesis (see Section 8.8 for a commentary), and other situational threat cues may have a greater influence. Our findings are also limited to the three specific situational threat primes we used in this thesis. Future research employing alternative mortality, masculinity or pathogen threat primes may find differing results.

8.7 Strengths and Limitations

It is important to comment on some of the strengths and limitations of this thesis. We acknowledge that our experiments have some limitations, but in most cases, these limitations were based on active decisions due to necessary compromises. We reflect on these here. We also comment on some of the strengths of each of our experiments.

8.7.1 A Thesis Under Quarantine: COVID-19

Firstly, it is important to consider the looming threat of COVID-19. As discussed in Chapter 3, the current research occurred in a specific context: the COVID-19 pandemic. As we have argued throughout this thesis that context and situational cues are important when examining men's WHR and BMI preferences, it is impossible to ignore that the context surrounding the COVID-19 pandemic may have influenced our findings. Given the pervasive nature of COVID-19 throughout this thesis (to a lesser extent in year three), our participants may have become desensitised to information concerning mortality and pathogen threat. This potential effect of COVID-19 is an unavoidable limitation. However, as we outlined in Chapter 3, we maintain that the potential influence of COVID-19 on the effectiveness of our priming methods should be minimal.

A strength of our design, which we believe mitigated these potential negative influences, is the effectiveness of our priming approaches and the subtle nature of our primes. We intentionally used subtle mortality and pathogen threat primes intended to cause participants to consider pathogen and mortality threat information relevant to them. Our priming methods included questionnaires to make participants consider their pathogen and mortality risks. If COVID-19 were a relevant pathogen or mortality concern, priming for pathogen and mortality threat would facilitate greater access to those thoughts relative to those held by the comparison (i.e., control) condition. In this way, if participants were concerned about COVID-19, it may have enhanced the effectiveness of our primes. However, as the influence of COVID-19 has decreased in the UK in recent months, future research may wish to replicate our findings under less trying circumstances while considering some of the suggestions we make in this (and the subsequent) section.

8.7.2 Online Experiments

We also acknowledge a potential limitation with conducting experiments one – four online. Our decision to conduct online experiments was based on legal constraints caused by COVID-19 and on the assumption that they would produce similar findings to lab-based experiments. Previous research supported this reasoning, showing that both methods yield consistent findings (Peyton et al., 2021). However, our eye-tracking experiment showed a significant interaction between WHR and pathogen threat regarding attractiveness ratings, which we did not observe in our online experiment. These discordant findings could suggest limitations to using online experimental designs or due to the methodological or sample characteristic differences that we outlined in Section 8.3.1. One explanation is that the nature of online, which provides limited control over the online experimental procedure, could have influenced our findings, resulting in the observed differences. Alternatively, this could simply be a rogue finding.

Given the significant strengths of online experimental designs (e.g., access to participants), we are reluctant to suggest that online experimentation is unreliable, especially considering the previous research has extensively shown that online experiments are valid and provide similar findings to in-person testing (Klein et al., 2018; Peyton et al., 2021; Saxton et al., 2020). Given that we cannot provide a conclusive explanation for our findings, it may be prudent for future research to ensure online experimental paradigms are robust and reliable, especially as they become more frequently deployed (Gagné & Franzen, 2023).

8.7.3. Effectiveness of Our Situational Threat Cue Primes

A final potential limitation is the effectiveness of our priming methods. As outlined in Chapter 3, there remains controversy concerning priming methodologies and whether they produce robust and reliable effects (Chivers, 2019). We used mortality, masculinity and pathogen threat primes within this thesis, which have been used frequently to produce priming effects. However, it is difficult to determine conclusively whether each situational threat cue did not influence men's body shape or size preferences or whether the primes were not effective.

Previous research has employed manipulation checks to assess whether their priming methods were effective. For instance, the Positive and Negative Affect Scale (PANAS) has been used to assess mortality threat, reasoning that mortality threat would increase negative affect (e.g., Zhao et al., 2019). However, other than in experiment three and five, we opted not to include manipulation checks as it is difficult to determine whether the content of a manipulation check is appropriate. Before employing a manipulation check, it is necessary to establish whether it is a valid benchmark for whether a priming effect is present. A particular prime must reliably influence the manipulation check construct to be valid (Ejelöv & Luke, 2020). For instance, research must show that mortality threat robustly increases negative affect for the PANAS to be an appropriate manipulation check. However, previous research has not always found this to be the case (Zhao et al., 2019). Another potential issue with administering manipulation checks is that it involves the participants considering information directly after the prime may alter the priming effect (Hauser et al., 2018). For this reason, researchers recommend against using manipulation checks in experimental research, and we adhered to these recommendations (Fayant et al., 2017; Hauser et al., 2018).

Despite this decision, we acknowledge that it is difficult to determine conclusively whether our findings were due to a lack of effect of each situational cue or a lack of effect of the situational threat cue prime on participants. One direction for future priming research is to develop and validate specific types of priming material. This focus on encouraging research to validate and test the reliability of priming material would provide more robust methods and help resolve some of the controversies surrounding priming more generally. Despite this, as we used robust priming methods in this thesis (see Section 3.2.2 for a review), we believe these were appropriate.

As mentioned in section 8.6.2 above, future research should also actively explore the *relevance and appropriateness* of their situational threat primes by exploring whether their participants generally feel the situational priming material is relevant. Methodologically, it is important to administer any questions to test this before the priming material itself; the priming material may, otherwise, influence the participant's responses to measure. We suggest that future research consider implementing similar checks that we included here to assess the relevance and appropriateness of their situational threat primes both generally and at the participant's level.

A potential direction for future research is to collect baseline data for all participants on the priming variables. As mentioned above, future research should examine the interaction between various aspects of perceived risk, both at an environmental and individual level. By administering measures of each construct to all participants, it would be possible to determine the moderating effect of certain variables (e.g., perceived vulnerability to disease and endorsement of traditional gender norms). We could not examine these moderating variables in this thesis as only those in the threat conditions completed the measures. We also did not use a measure of gender role adherence that would be appropriate for this task. We suggest that future research explore this direction by examining whether certain variables moderate the effect of our situational threat cue primes (i.e., by increasing or decreasing the effect).

A final consideration is whether masculinity threat research should be explored further in sociocultural settings where gender role adherence is low and men are not strictly encouraged to adopt these practices. As we found in experiments two, four and five (especially four), there is evidence to suggest that UK men might not respond to masculinity threats in ways that men from other cultures do. More research exploring the cross-cultural consequences and effectiveness of masculinity threat primes is needed.

8.7.4 Open Research

A significant strength of this research is our adherence to the core principles of Open Research (Lindsay et al., 2016; Vicente-Saez & Martinez-Fuentes, 2018). Across each of our six empirical studies, we registered our study aims, methods and hypotheses. We also made our methods, anonymised data and reproducible analysis R scripts available for scrutiny. We were also transparent concerning any changes or amendments we made throughout our research process, which were clearly outlined on the OSF. We believe these approaches should be more widely adopted as they increase the confidence and robustness of psychological research. We implore future researchers (and those beginning their PhD journey) to consider implementing Open Research principles into their work.

8.8 Recommended Directions for Future Research

Whilst this thesis aimed to resolve some of the limitations of previous research, several exciting directions remain for future study. This section is not exhaustive, but we recommend five directions for future focus. These recommendations may resolve broader limitations with research examining body shape and size preferences.

First, despite our attempt to create a new set of computerised body stimuli, as noted above, participants rated these as only moderately realistic. Future research could benefit from adding to and creating more realistic stimulus sets. Researchers could take advantage of 3D modelling individuals using 3D body scanners, which are becoming a more common tool in research settings to create realistic body stimuli (Daanen & Ter Haar, 2013; Groves et al., 2023). For instance, Maalin et al. (2021) obtained 3D body scans from 397 individuals, allowing for the creation of 3D models that varied accurately in body shape and size. While 3D body scanners offer a method of creating accurate body stimuli, this process would be time-consuming to identify and sample a range of different body types. This approach to creating stimuli would also rely on an institution having a functioning 3D body scanner and the researcher knowing its operation. Despite the practical limitations of 3D body scanning, the approach may provide a way to create more realistic stimuli varying in WHR and BMI.

Second, as emphasised throughout this thesis, very few studies have explored the influence of situational threat cues on men's body shape (i.e., WHR) and size (i.e., BMI) preferences. We aimed to explore the influence of three situational threat cues, but as we highlighted in Chapter 2, this was not an exhaustive list. While we did not find evidence that the three situational threat cues we employed in this thesis influenced men's WHR or BMI preferences, other situational cues may. For instance, previous research has demonstrated that people prefer larger objects and bodies when hungry (Cazzato et al., 2022; Saxton et al., 2020). However, other research has shown no hunger influence on men's body size preferences (Boothroyd et al., 2020; Jucker et al., 2017). However, to our knowledge, no research has explicitly primed men with either of these situational threat cues. As such, future research could explore alternative situational threat cues, such as hunger or socioeconomic status. For instance, it may be possible to prime men with cues of socioeconomic threat by highlighting the rising cost of living in the United Kingdom[31]. This cue would be similar to the three situational threat cues we employed currently, representing a subtle, potentially everyday occurrence. As such, while this thesis contributes to the research literature by exploring the influence of three situational threat cues, more work is needed to fully explore the full breadth of potential cues that may influence men's preferences.

Third, in addition to exploring alternative situational threat cue primes, future research may benefit from exploring alternative features that may indicate beneficial qualities (other than WHR and BMI). For instance, research has shown that leg length, or leg-to-body ratio (LBR), is associated with attractiveness in both men and women; longer legs are rated more attractive (Kiire, 2016; Swami, Einon, et al., 2006). This preference may be due to the perceived health benefits of longer legs, which are associated with greater insulin production,

[31] When writing this thesis, the Cost-of-Living Crisis significantly burdens UK households. The Bank of England reports the current inflation rate to be 7.9% (August 2023). Using information about the rising cost of living could serve as a suitable and topical socioeconomic threat prime in the current context.

heart health, and developmental stability (Swami, Einon, et al., 2006; Versluys et al., 2018). Most research examining men's preferences has focused on WHR or BMI. However, examining alternative bodily cues (e.g., LBR) may provide a more complete picture of what specific bodily variations men find attractive and how these preferences may vary due to specific situational threat cues.

Fourth, while we focused on men in this thesis, future research should explore women's preferences toward different features. Research examining women's preferences is comparatively less plentiful than research examining men. Specific indicators, such as shoulder-to-hip ratio (SHR), are important for women when determining a potential partner's attractiveness (Braun & Bryan, 2006; Pazhoohi et al., 2012). However, little research has examined how women's preferences may vary due to situational cues. One study has examined women's pathogen disgust sensitivity and preferences for SHR. Lee et al. (2015) found that higher pathogen disgust sensitivity predicted preferences for larger SHR. However, no research has examined how women's preferences toward SHR may vary following situational threat cue priming. As such, this presents an interesting direction for future research[32].

Finally, we restricted our sample to only White participants, and our stimuli were White/Caucasian. While this is a limitation of this thesis in that it limits the generalisability of our findings, this was necessary as body shape and size preferences do vary based on ethnicity and most research in the past has used White stimuli (Sorokowski et al., 2014; Wetsman & Marlowe, 1999). Despite this, limited research has explored men's or women's preferences toward physical characteristics in non-White populations or while using non-White stimulus sets (for an exception, see Garza et al., 2016). Similarly, as highlighted in Chapter 3, most research examining men's WHR or BMI preferences has done so with WEIRD populations. We recommend that future research explore men's and women's preferences for physical features while using a more diverse range of stimuli and a more diverse sample of participants.

[32] We comment on SHR to illustrate a potential indicator that future research may wish to explore when examining women's preferences. However, this is just one of several potential indicators, such as chest to waist ratio (Coy et al., 2014).

8.9 Conclusions

In this thesis, we explored three immediate situational threat cues and examined whether they influenced men's WHR, BMI preferences and their preferences toward specific areas of the body. Despite our predictions that each of these situational threat cues would enhance men's preferences toward the most attractive WHRs and BMIs, we found no evidence for this. This thesis was novel in that it is the first work to actively explore men's body shape, size and specific area preferences under situational threat cues. We also did so while using bespoke stimuli and methodologies. These findings offer important insights into existing WHR and BMI research. Future research may wish to expand on our findings using the above suggestions. Our research also adds to the emerging field of masculinity threat research and specifically considers the potential effect of masculinity threat on UK men populations.

9. CHAPTER 9: REFERENCES

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10. CHAPTER 10: APPENDICES

10.1 Appendix 1: Mortality Threat and Control Primes Used in Experiment 1.

The priming items were taken from the Fear of Personal Death (Florian & Kravetz, 1983) and prior research (Grabe et al., 2005). The control items were inspired by Davis et al. (2016).

10.1.1 Mortality Threat Prime:

Participants placed *"Death Frightens me because…"* directly before each statement in Table 10.1. Participants responded on a rating scale ranging from 1 (*untrue)* to 5 (*true).* We also presented participants with a free-text box asking them to "*Briefly explain what feelings the thought of your death arouses*".

Table 10. 1
Items from the Fear of Personal Death Scale Used to Prime for Mortality Threat.

Death frightens me because:
I am uncertain of what to expect.
Life will go on without me.
I will be forgotten.
My absence will not be felt.
I will miss future events.
My relatives will not overcome sorrow.
Events will take place without me.
I will experience a loss of life's pleasures.
Of causing sorrow to relatives and friends.
My loss will not hurt close ones.
I will not realise my life goals.
My ability to think will cease.
There will be a loss and destruction of the self.
I will be buried deep in Earth.

10.1.2 Control Prime:

Participants placed *"my leisure activities excite me because"* directly before each statement in Table 10.2. Participants responded on a rating scale ranging from 1 (*untrue)* to 5 (*true).* We also presented participants with a free-text box asking them to "*Briefly explain what feelings typically occur during your leisure activities*".

Table 10. 2
Items Used for Control Prime in Experiment 1.

My leisure activities excite me because:
I enjoy their uncertainty.
I get to experience life to its fullest.
I make new memories.
My presence is felt by others.
I look forward to future events.
I get to spend time with relatives.
I get to take part in events and activities.
I get to experience life's pleasures.
I get to experience happiness with friends and relatives.
My participation makes others happy.
They allow me to further my life goals.
They cause me to think and are challenging.
They make me feel whole as a person.
I get to spend time with nature.

10.2 Appendix 2: Masculinity Threat, Affirm, and Control Primes Used in Experiment 2 and 5.

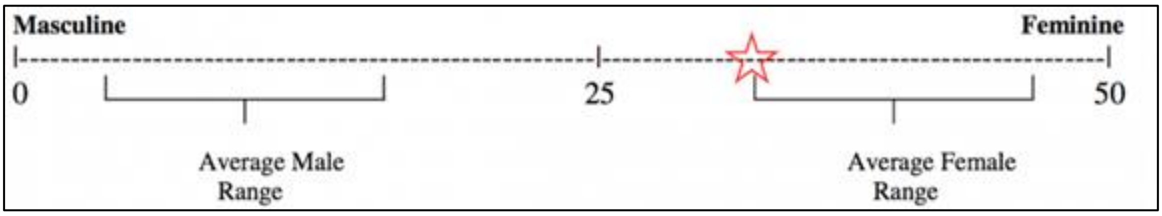
We used the priming material created by Harrison and Michelson (2019) with their permission. We used the Big Five Inventory 10 to create our control prime items(BFI-10; Rammstedt & John, 2007).

10.2.1 Masculinity Primes (Threat and Affirm)

Participants in the masculinity threat and affirm conditions completed the 60-item Bem Sex Role Inventory (BSRI; Bem, 1974). The BSRI measures how well individuals adhere to traditional gender norms by having participants rate how well typically masculine (e.g., "*acts as a leader*"), typically feminine (e.g., "*affectionate*"), and typically neutral (e.g., "*adaptable*") statements describe them on a 7-point rating scale ranging from 1 (*never*) or 7 (*always or almost always true*).

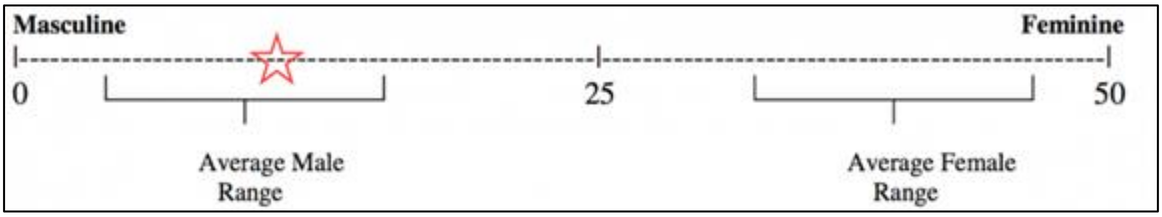
Masculinity Threat Prime. Participants in the masculinity threat condition received feedback that their score was within the feminine range of responses ("*Your Score is: 32. Based on your responses, your score is within the Feminine range of responses*"). The visual indicator shown in Figure 10.1 accompanied this feedback.

Figure 10. 1
The Visual Feedback Provided to the Masculinity Threat Condition.



Masculinity Affirm Prime. Participants in the masculinity affirm condition received feedback that their score was within the masculine range of responses ("*Your Score is: 13. Based on your responses, your score is within the Masculine range of responses*"). The visual indicator shown in Figure 10.2 accompanied this feedback.

Figure 10. 2
The Visual Feedback Provided to the Masculinity Affirm Condition.



10.2.2 Control Prime

Those in the control group received feedback on how they scored on each Big Five personality construct (Extraversion, Agreeableness, Conscientiousness, Emotional Stability, Intellect). Figure 10.3 illustrates the feedback provided to participants.

Figure 10. 3
The Visual Feedback Provided to the Control Condition.

Extraversion (your level of sociability and enthusiasm): **38% (moderate)**
Agreeableness (your level of friendliness and kindness): **29% (moderate)**
Conscientiousness (your level of organization and work ethic): **42% (moderate- above average)**
Emotional Stability (your level of calmness and tranquility): **40% (moderate)**
Intellect (your level of creativity and curiosity): **50% (moderate-above average)**

10.2.3 General Procedure

To increase the sense of realism and to encourage the participants to think that an actual score was being calculated based on their responses, we presented participants with a screen that stated, "*Please wait… We are analysing your responses. This may take up to 30 seconds. Please do not refresh this page or close your browser. This page will advance automatically*". The screen would not advance until at least 20 seconds had passed. After this screen, participants received feedback and the respective visual indicator above.

10.3 Appendix 3: Pathogen Threat and Control Primes Used in Experiment 3.

10.3.1 Pathogen Threat Prime

In the pathogen prime condition, participants received and completed the Perceived Vulnerability to Disease Questionnaire (PVD; Duncan et al., 2009) shown in Table 10.3. Participants responded on a 7-point rating scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). Participants also completed an open-ended question asking them to "*Briefly explain whether you have any risk factors (e.g., your environment, hobbies) which make you susceptible to getting sick".*

Table 10. 3
Items from the PVD Used to Prime for Pathogen Threat.

PVD Items
In general, I am very susceptible to colds, flu and other infectious diseases.
I am unlikely to catch a cold, flu or other illness, even if it is 'going around'.
If an illness is 'going around', I will get it.
My immune system protects me from most illnesses that other people get.
I am more likely than the people around me to catch an infectious disease.
My past experiences make me believe I am not likely to get sick even when my friends are sick.
I have a history of susceptibility to infectious disease.
I prefer to wash my hands pretty soon after shaking someone's hand.
I avoid using public telephones because of the risk that I may catch something from the previous user.
I do not like to write with a pencil someone else has obviously chewed on.
I dislike wearing used clothes because you do not know what the last person who wore it was like.
I am comfortable sharing a water bottle with a friend.
It really bothers me when people sneeze without covering their mouths.
It does not make me anxious to be around sick people.
My hands do not feel dirty after touching money.

10.3.2 Control Prime

In the control prime condition, participants received and completed an adapted version of the PVD shown in Table 10.4. We matched each question for complexity and length to ensure they were comparable. Participants responded on a 7-point rating scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). Participants also completed an open-ended question asking them to "*Briefly explain whether you have any personal qualities (e.g., hobbies, interests) which make you distinct from others.".*

Table 10. 4
Items from the Adapted-PVD Used as the Control Prime for Experiment 3

Adapted-PVD Items
In general, I am very susceptible to falling over and embarrassing myself.
I am unlikely to lose my cool, even in situations where it 'is common'.
If I walk past a restaurant, I am very likely to go in.
My willpower protects me from giving in to peer pressure that others would give in to.
I am more likely than the people around me to attend a party.
My past experiences make me believe I am not likely to fall for a malicious email which has convinced my friends in the past.
I have a history of susceptibility to making poor decisions.
I prefer to wash my hair after walking in the rain.
I avoid using public stores and do my shopping online.
I do not like to walk across an open space that someone has obviously spilt water on.
I dislike wearing dress shoes because I find them to be uncomfortable.
I am comfortable walking publicly with a friend.
It really bothers me when people use poor grammar while texting.
It does not make me anxious to watch a football game.
My hands do not feel shaky after playing video games.

10.4 Appendix 4: Control Prime Used in Experiment 5.

For experiment five, we used the same mortality, masculinity, and pathogen threat primes experiments one – three. We used a different control prime matched for length and complexity as the situational threat primes. We provided and asked participants to read the extract below. We used Wikipedia to create this extract (https://en.wikipedia.org/wiki/Modular_smartphone).

"*Modular phones are touchscreen-based smartphones designed to be easily repaired by the user. They initially came into production in 2015. Modular phones are designed to have a lower environmental impact than comparable mass-market phones (e.g., iPhones), with an expected lifespan of 5 years. The modular design allows components to be replaced individually. The phone components are designed to be replaceable, with the end user only needing to use a screwdriver to replace components of the phone. In addition, it is possible to replace individual components within each module. Typically, you can replace seven removable parts: the main chassis (i.e., the body of the phone), the battery, the display assembly, the rear camera module, the top module (selfie camera, headphones, speaker, sensors), the bottom module (loudspeaker, vibration, microphone and charging port), and the back protective cover. This means that your phone can be updated to suit your needs without having to purchase a new phone*."

Participants were then asked to consider "*the seven removal parts mentioned above, how useful would it be to be able to easily change them?*". Participants rated how useful it would be to change (1) the main chassis, (2) the battery, (3) the display, (4) the rear camera, (5) the top module, (6) the bottom module, (7) the back protective cover on a rating scale ranging from 1 (*not useful at all*) to 5 (*extremely useful*). Participants also completed an open-ended question asking them to "*Briefly explain whether you would purchase a modular phone and why*".

10.5 Appendix 5: Additional Analyses from Experiment 5.

In this appendix, we provide additional analyses from experiment five. Examining the interactions between each WHR, BMI, and AOI was not the focus of this thesis. Due to the large number of comparisons, we included this as an appendix. We believe that these analyses may be of interest to the reader.

We used the same outcome measures as experiment five, dividing our outcome measures into overall stimulus and area of interest (AOI) outcome measures. Examining preferences at the level of the whole stimulus allowed us to explore men's WHR and BMI preferences. Additionally, examining preferences toward specific areas of interest allowed us to examine men's preferences toward specific bodily areas, and these varied due to the body shape or size of that body. For clarity, we repeat the outcome measures we used. We conceptualised preferences toward the overall stimulus using explicit (1) *attractiveness ratings,* (2) *fixation count, and* (3) *the first saccade latency.* Likewise, we conceptualised preferences toward specific AOIs by examining the (1) *proportion of first fixations,* (2) *the mean first saccade latency toward this location,* (3) *the fixation count,* (4) *mean dwell time and* (5) *the number of revisits.*

We begin by evaluating the main and interaction effects for WHR and BMI for our whole stimulus outcome measures. We then examine the two- and three-way interaction effects for WHR, BMI and AOI. Given the large number of comparisons, we present any significant findings visually.

10.5.1 Results and Discussion

We performed the same data cleaning and reduction steps as experiment five. To calculate our overall stimuli preference outcome measures (i.e., attractiveness ratings, the first saccade latency, and overall fixation count), we grouped by WHR and BMI across participants. We grouped by WHR, BMI and AOI across participants to calculate our areas of interest outcome measures. We averaged each of our outcome measures across each prime. As such, all effects reported in this section are for the total sample size ($N = 80$). The raw *.asc* files, data cleaning and analysis R Markdown files are available on the OSF (https://tinyurl.com/LCC2023-EYES). Like Chapter 7, we use mixed effect modelling to analyse our data where possible (see below). We present the results of each analysis here, but interpreting the analyses in full is outside the scope of this thesis.

10.5.1.1 Overall Stimulus: WHR and BMI Preferences

Attractiveness Ratings. We began by exploring self-reported attractiveness ratings. We used linear mixed effect modelling with restricted maximum likelihood. We explored any main or interaction effects using the type II Kenward-Roger approximation. This approach reduces the risk of Type 1 errors (S. G. Luke, 2017; Manor & Zucker, 2004). We examined the distribution of attractiveness ratings and the fitted model's residuals, which were normally distributed, and deemed a linear mixed-effect model to be appropriate. We defined WHR and BMI as fixed effect predictors and participants as the random effect. Table 10.5 illustrates the main and interaction effects of WHR and BMI on attractiveness ratings.

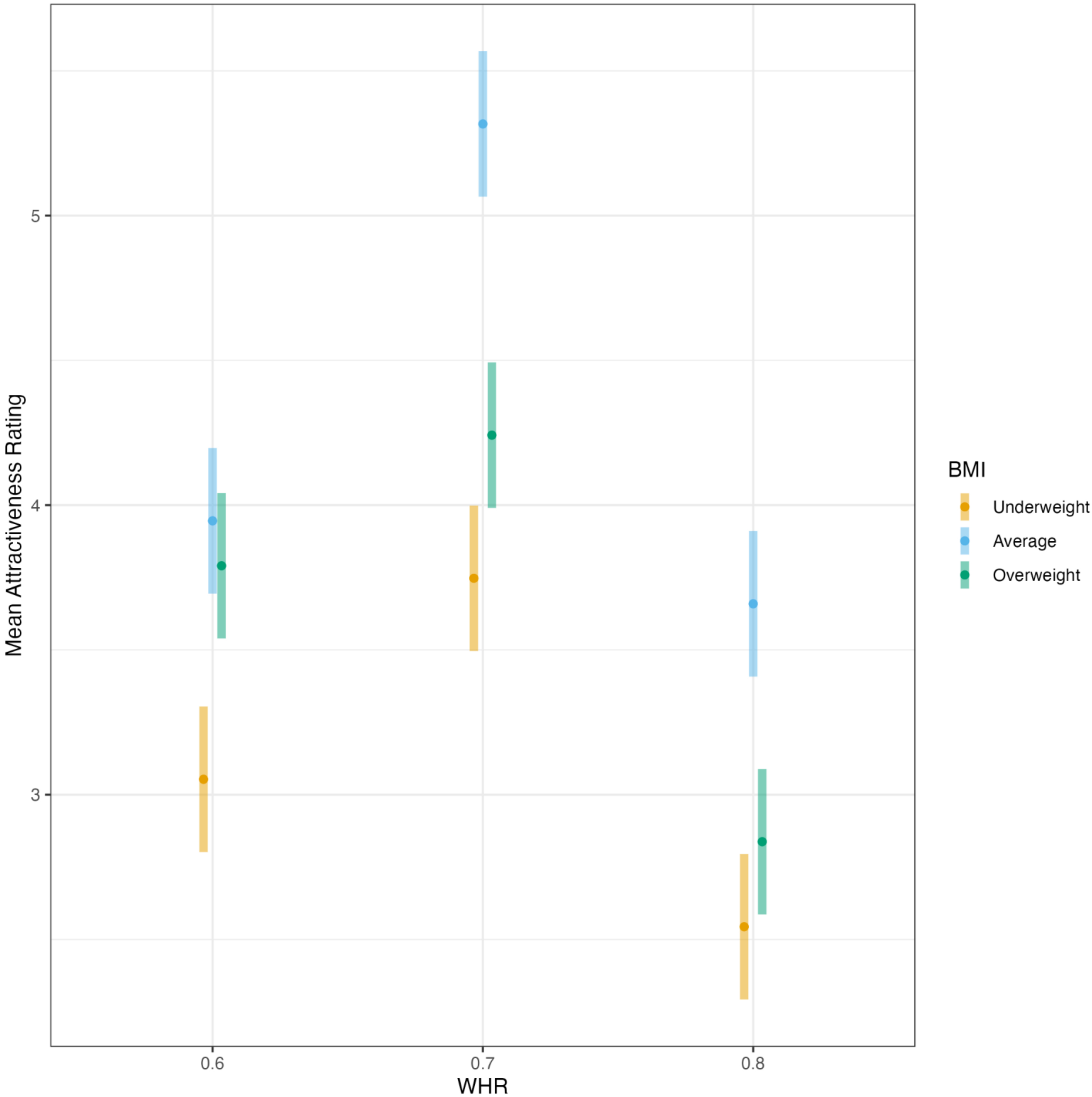
Table 10. 5
Main Effects and Two-Way Interaction for WHR and BMI with Attractiveness Ratings as the Outcome Measure.

	df	*F*	*p*
WHR	2	123.62	<.001
BMI	2	86.65	<.001
WHR x BMI	4	5.30	<.001

Notes. All effects are significant at $p < .05$.

We found evidence for a significant main effect for WHR and BMI and an interaction effect between the two. Per best practice, we do not examine the main effects when a higher-order interaction effect is present (Baguley, 2012). As such, we examined the interaction effect shown in Figure 10.4. Participants rated 0.7| average as the most attractive. Conversely, participants rated 0.8| underweight as the least attractive. However, we note that the 95% CI partially overlaps with the attractiveness ratings given for 0.8| overweight. These findings are like those identified in Chapter 4. Table 10.8 presents the estimated marginal means for each WHR and BMI category.

Figure 10. 4
Mean Attractiveness Rating for the WHR x BMI Interaction.



Notes. The error bars reflect the 95% CI estimated from the mixed-effect model.

First Saccade Latency. We next explored our indicator of attentional bias by examining the first saccade latency. We used the same linear mixed-effect model defined above to test our hypotheses. Our outcome variable was first saccade latency (in milliseconds; *ms*). We used the same linear mixed-effect model defined above to test our hypotheses. Our outcome variable was the first saccade latency (in milliseconds; *ms*). We examined the distribution of these mean latencies and the residuals from the fitted model and found a slight skewness, which is typical for reaction time measures. We identified several outliers and determined most of these to be valid responses. One outlier was substantially higher than the remaining first saccade latencies. We ran our analysis with and without this observation and found no differences between both models. For simplicity, we opted to retain this outlier and proceed with the analysis as planned.

Despite the skewness we identified, we continued using a mixed effect model as they are robust to even severe normality violations (Schielzeth et al., 2020). Table 10.6 illustrates the results of this analysis. When examining the first saccade latency, we found no evidence of any significant main or two-way interaction effects for WHR and BMI. Table 10.8 presents the estimated marginal means for each WHR and BMI category.

Table 10. 6
Main Effects and Two-Way Interaction for WHR and BMI with First Saccade Latency as the Outcome Measure.

	df	***F***	***p***
WHR	2	.19	.981
BMI	2	.13	.885
WHR x BMI	4	1.72	.143

Fixation Count. Finally, we explored indicators of overall interest toward each WHR and BMI by exploring the total fixation count across the viewing period (i.e., 4000ms). We used the same linear mixed effect model above to test our hypotheses. We modelled the normalised number of fixations as our outcome variable. We outlined this normalisation process in Chapter 7. We normalised each fixation depending on how often the stimulus was presented. Initially, the fixation count was a frequency (i.e., integer values). This normalisation made the values non-integer, meaning we had to model this normalised fixation count as continuous. Readers should interpret the fixation count as the number of fixations per presentation (i.e., the mean number of fixations made for each stimulus presentation). To ensure the appropriateness of our analyses, we first checked the distribution of the fixation count and the fitted model's residuals. These were relatively normally distributed, and we deemed a linear mixed-effect model appropriate. Table 10.7 illustrates the findings of this analysis.

Table 10. 7
Main Effects and Two-Way Interaction for WHR and BMI with Fixation Count as the Outcome Measure.

	df	*F*	*p*
WHR	**2**	**3.24**	**.040**
BMI	2	1.53	.217
WHR x BMI	4	1.38	.239

Notes. **Bold** values indicate significant effects at $p < .05$.

We found a significant main effect for WHR but not for BMI or the interaction between WHR and BMI. Holm-corrected pairwise comparisons revealed a significant difference between 0.6 WHR and 0.8 WHR, t(626) = 1.56, $p = .035$. Bodies with a 0.6 WHR received more fixations, $M = 9.22$, 95% CI: 8.58, 9.86, relative to bodies with a 0.8 WHR, $M = 8.89$, 95% CI: 8.25, 9.53. However, there were no differences between either body shape or 0.7 WHR, $M = 9.02$, 95% CI: 8.38, 9.66. Table 10.8 presents the estimated marginal means for each WHR and BMI category.

Table 10. 8
Estimated Marginal Means for each WHR and BMI Category for Each Outcome Measure.

`	**WHR**			**BMI**		
	0.6	0.7	0.8	Underweight	Average	Overweight
Attractiveness Ratings	3.60 [3.42, 3.78]	4.44 [4.26, 4.61]	3.01 [2.83, 3.19]	3.11 [2.94, 3.29]	4.31 [4.13, 4.49]	3.62 [3.44, 3.80]
First Saccade Latency	398 [375, 421]	399 [376, 422]	400 [376, 423]	399 [376, 422]	397 [374, 420]	400 [377, 423]
Fixation Count (Normalised)	9.22 [8.58, 9.86]	9.02 [8.38, 9.66]	8.89 [8.25, 9.53]	9.18 [8.54, 9.81]	8.97 [8.33, 9.60]	8.99 [8.36, 9.63]

Notes. Values represent the estimated marginal mean. Square brackets represent the 95% CI, which is estimated from the mixed-effect model. The fixation count is normalised per the number of times the stimulus was presented. The first saccade latency is to the nearest milliseconds. Attractiveness ratings ranged from 1 – 7.

10.5.1.2 Preferences Toward Each AOI

We next examined preferences toward specific areas of the body. However, unlike Chapter 7, we examine preferences toward each AOI across each WHR and BMI. As such, we focus only on the interactions between WHR, BMI and AOI (two- and three-way interactions). However, we present the other main and interaction effects for transparency.

Initial Interest

First Fixation Count. We begin by addressing the location of the first fixation expressed as a proportion. As outlined in Chapter 7 (Section 7.2.5.2), we used the first fixation count to create a proportion. That is, we calculated the number of first fixations within each AOI for each participant expressed as a percentage of the total number of trials (56 trials). We refer to this outcome variable as the *proportion of first fixations* for brevity.

We aimed to use a linear mixed-effect model, as we did above. We checked the distribution of the proportion of first fixations and the fitted residuals from the linear mixed effect model and found these to be normally distributed. However, as our outcome variable was non-linear, we log-transformed the proportion of first fixations. This model continued to be normally distributed. We back-transformed the data to create Figure 10.5. We also found that the *lower legs* and *head* received minimal first fixations and could not be estimated within the model. We excluded the few observations with the lower legs or head as the first fixation location. Table 10.9 summarises the two-way interaction effects of this model.

Table 10. 9
Main Effects and Two- and Three-Way Interactions for WHR, BMI and AOI with First Fixation Frequency as the Outcome Measure.

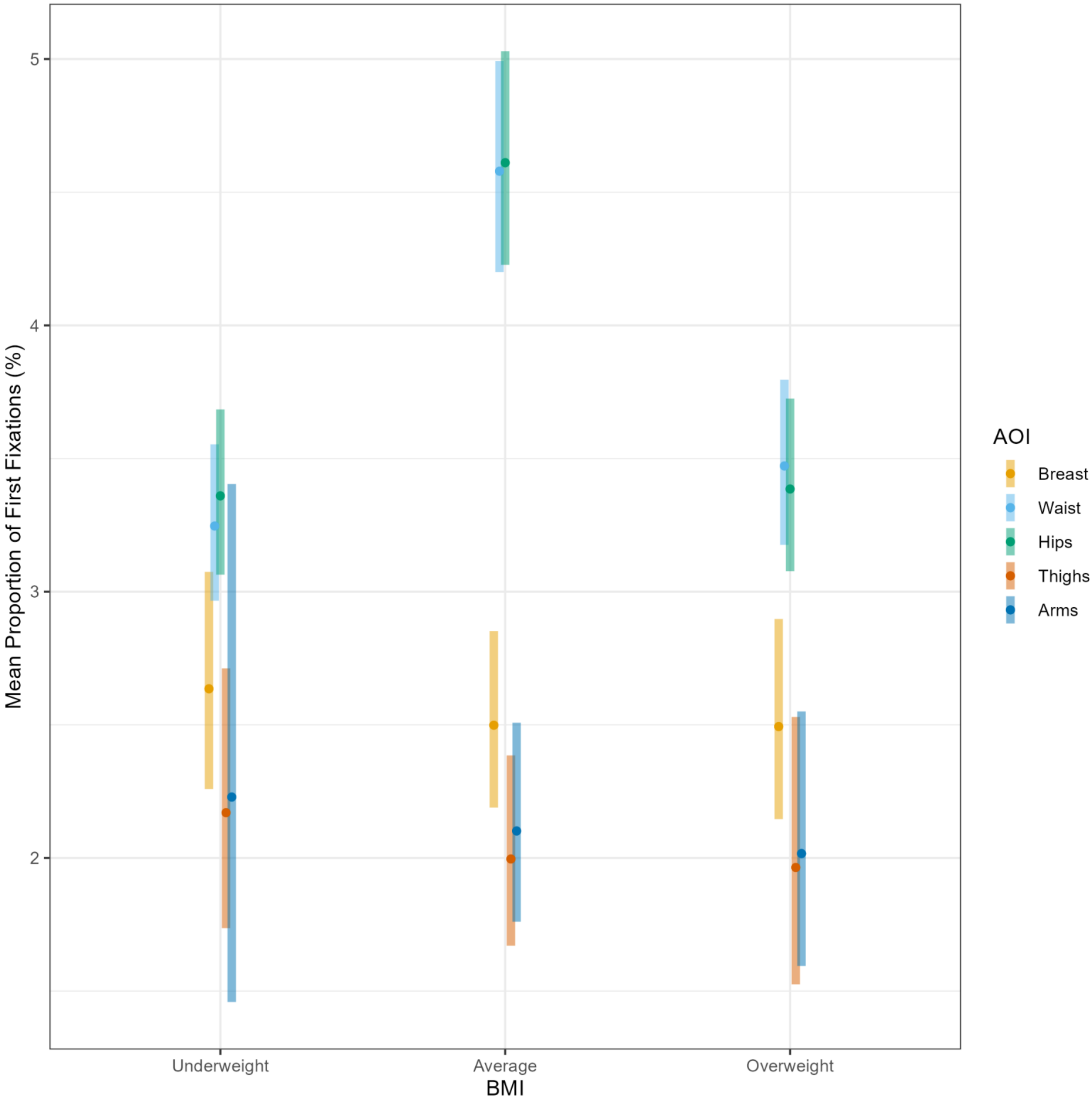
	df	*F*	*p*
AOI	**4**	**65.76**	**<.001**
WHR	**2**	**24.26**	**<.001**
BMI	**2**	**28.12**	**<.001**
WHR x BMI	**4**	**11.90**	**<.001**
AOI x WHR	8	1.65	.106
AOI x BMI	**8**	**3.02**	**.002**
AOI x WHR x BMI	16	.943	.518

Notes. **Bold** values indicate significant effects at $p < .05$.

We found a significant interaction effect between AOI and BMI. Figure 10.5 illustrates this interaction. As shown, when the body comprised an attractive average BMI, participants had a higher proportion of first fixations toward the waist and hip area of interest. The proportion of first fixations toward the waist and hip area was similar when examining average BMI. The participants also showed a higher proportion of first fixations toward the waist and hip area for overweight BMI relative to the other AOIs when looking at overweight BMI. However, when compared with underweight BMI, this difference was not significant.

Figure 10. 5

Mean Proportion of First Fixations for the AOI x BMI Interaction.

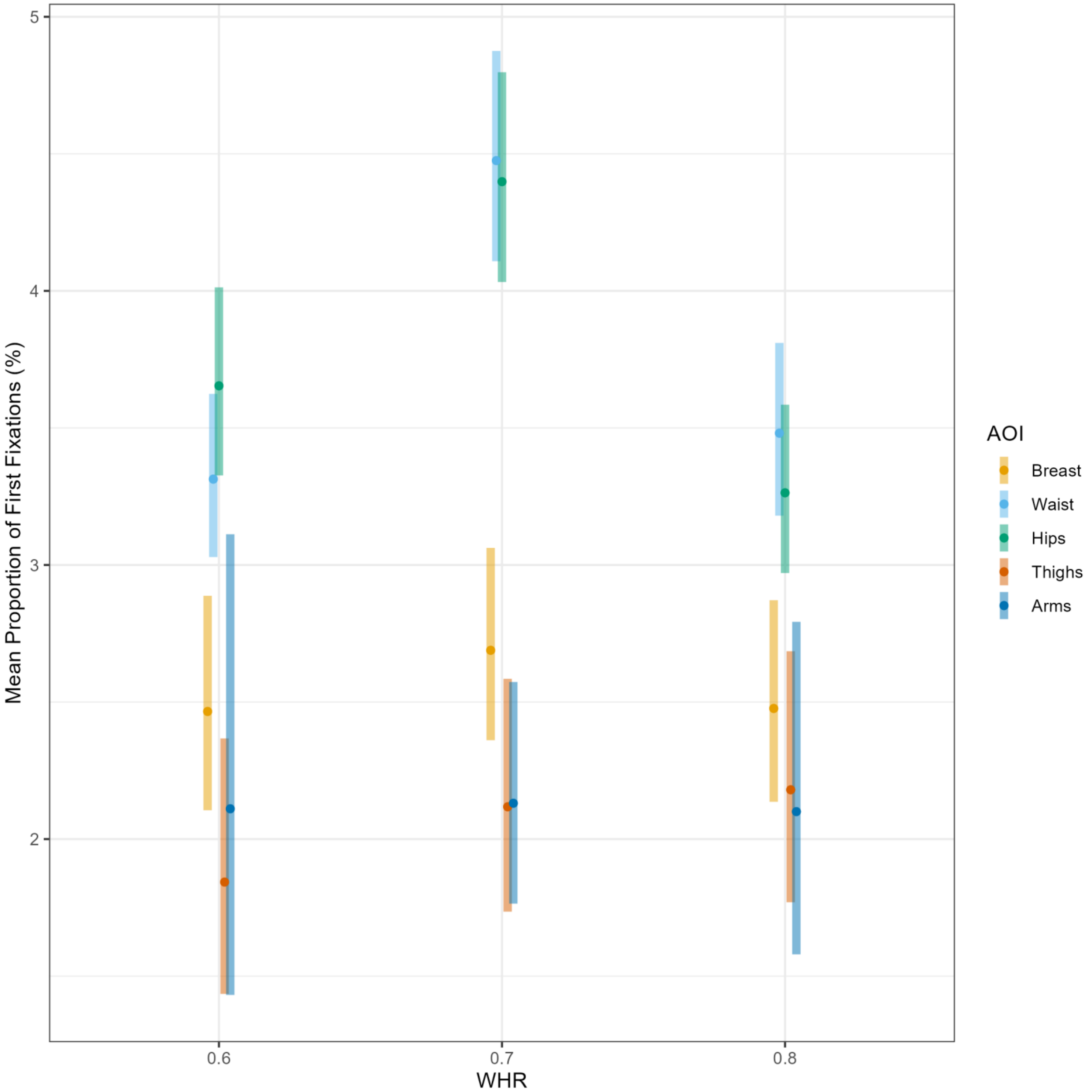


Notes. The error bars reflect the 95% CI estimated from the mixed-effect model. The frequency of the first fixation is normalised. This analysis did not include the head and lower leg AOIs due to a low frequency of first fixations. The mean proportion of first fixations reflects the number of first fixations within each AOI for each participant expressed as a percentage of the total number of trials (56 trials).

While we did not find a significant AOI by WHR interaction, visual inspection of the estimated marginal means revealed an interesting pattern, which we comment on here. As shown in Figure 10.6, participants showed a higher proportion of first fixations toward the waist and hip area of interest when viewing an attractive WHR (i.e., 0.7 WHR). This finding complements the AOI by BMI interaction.

Figure 10. 6

Mean Proportion of First Fixations for the AOI x WHR Interaction.



Notes. The error bars reflect the 95% CI estimated from the mixed-effect model. The frequency of the first fixation is normalised. This analysis did not include the head and lower leg AOIs due to a low frequency of first fixations. The mean proportion of first fixations reflects the number of first fixations within each AOI for each participant expressed as a percentage of the total number of trials (56 trials). This finding was not significant.

First Saccade Latency. We next examined first saccade latency, an indicator of attentional bias toward specific AOIs. We used the same linear mixed-effect model defined above to test our hypotheses. Our outcome variable was first saccade latency (in milliseconds; *ms*). We examined the distribution of these mean latencies and the residuals from the fitted model and found a significant skewness, which is typical for reaction time measures. The distribution of residuals was also heavily skewed, and we identified several outliers. Two of these outliers were relatively large. We ran our analysis with and without this observation removed and found no limited differences between both models. Per best practice, we opted to retain this outlier and proceed with the analysis as planned.

Despite the identified normality violations, we proceeded with our linear mixed-effect models as planned, as they are robust to even severe normality violations, and our violations were minor (Schielzeth et al., 2020). For the same reasons as above, we excluded the limited number of observations directed toward the head and the lower legs in this analysis. However, after running our initial model, we noticed that the 95% CIs derived from the mixed effect model were very wide for the arm AOI relative to the other AOIs. We believe this is due to the small number of first fixations toward the arms relative to the other AOIs. For prudence, we tested a model with and without the inclusion of the arm AOI and found limited differences. As such, we proceeded with including the arm AOI. However, we suggest that readers interpret the point estimate for the first saccade latency toward the arm with caution, given the wide confidence intervals. Table 10.10 displays the findings from this analysis.

Table 10. 10
Main Effects, Two- and Three-Way Interactions for WHR, BMI and AOI with First Saccade Latency as the Outcome Measure.

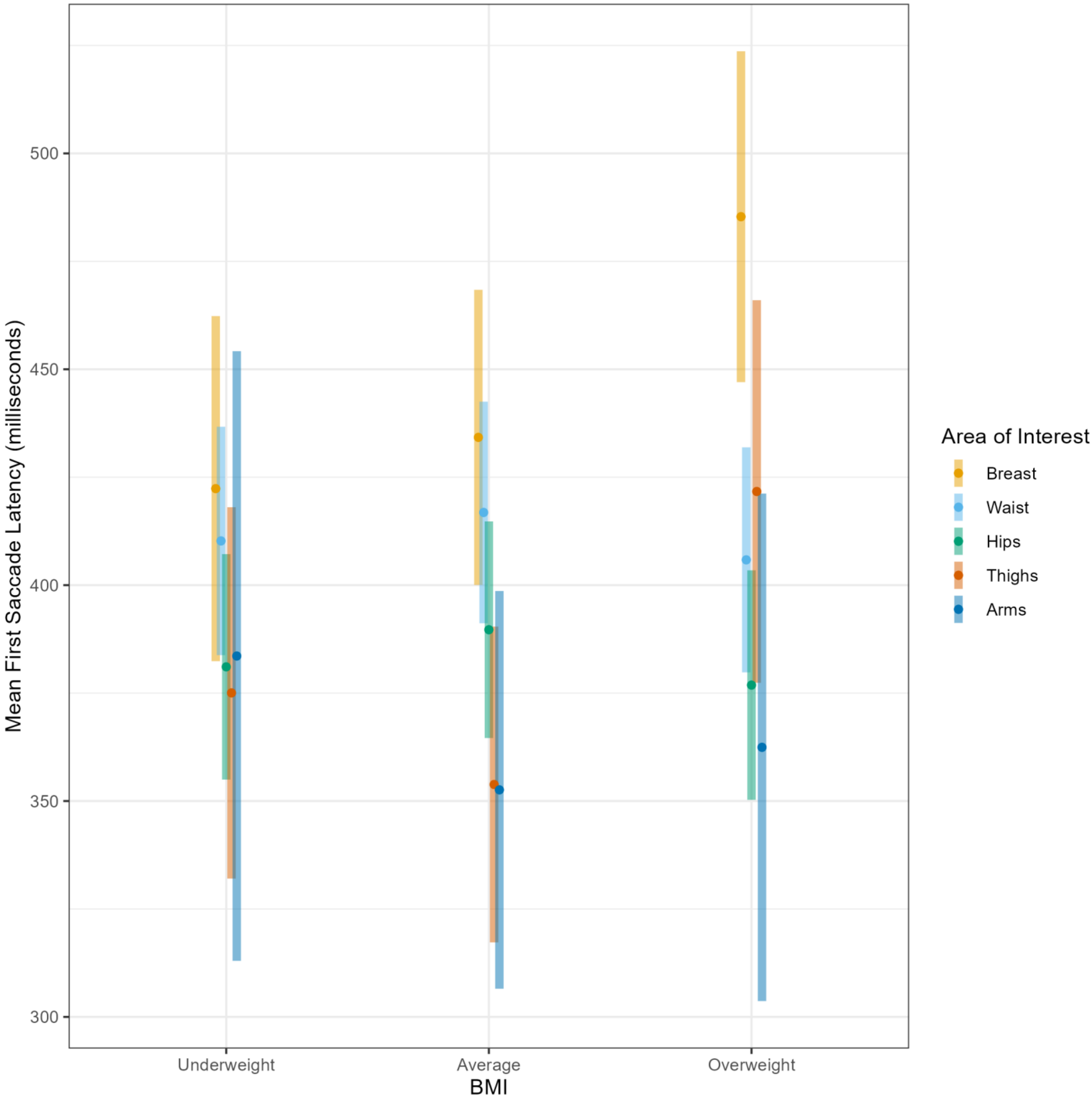
	df	*F*	*p*
AOI	**4**	**11.49**	**<.001**
WHR	2	.60	.547
BMI	2	.54	.581
WHR x BMI	4	1.00	.405
AOI x WHR	8	.66	.724
AOI x BMI	**8**	**2.01**	**.042**
AOI x WHR x BMI	16	1.33	.173

Notes. **Bold** values indicate significant effects at $p < .05$.

As shown in Table 10.10, we found no evidence of any significant two-way interaction effect between AOI and WHR or a significant WHR by BMI by AOIA interaction. However, we did find evidence for a significant BMI by AOI interaction. Figure 10.7 illustrates the interaction effect. We note that the arm AOI exhibits wide CIs, which we have explained above. However, it appears that participants responded more slowly to the breast AOI when the body consisted of an overweight BMI. This is an interesting finding and is the first analysis throughout this thesis that noted any effect when using the first saccade latency as the outcome measure. We note, however, that this effect was weak, and given that we found no other effect when examining the participant's first saccade latency, we suggest readers interpret this with caution.

Figure 10. 7

Mean First Saccade Latency for the AOI x BMI Interaction.



Notes. The error bars reflect the 95% CI estimated from the mixed-effect model.

Fixation Count. We next examined fixation count, which indicates a participant's overall preference toward each AOI. As outlined in Chapter 7, we normalised the fixation count by dividing each fixation count by the size of each AOI (as a proportion). The fixation count was changed from a count to a continuous outcome variable. The fixations should be interpreted as the number of fixations per percentage of the area of interest. In other words, this allows us to quantify how many fixations occur within each AOI normalised by size. This allows us to compare fixation counts across different AOIs of varying sizes. As such, we proceeded with a linear mixed-effect model. We defined the normalised frequency as the outcome measure, AOI, BMI and WHR as our fixed effect predictors and participants as our random effect.

After fitting our model, we noticed that the arms and lower legs AOI received a small number of overall fixations and were close to zero. Due to this, the model became unstable and could not accurately estimate the confidence intervals for both AOIs. For this reason, we opted to exclude the fixations toward the arms and lower legs from this analysis. For transparency, we identified the same effects (shown in Table 10.11) when comparing the analyses with and without the arm AOI. We assessed the residuals of our model and found those to be normally distributed, so we continued with our analysis as planned. Table 10.11 shows the findings from this analysis.

Table 10. 11
Main Effects, Two- and Three-Way Interactions for WHR, BMI and AOI with Fixation Count as the Outcome Measure.

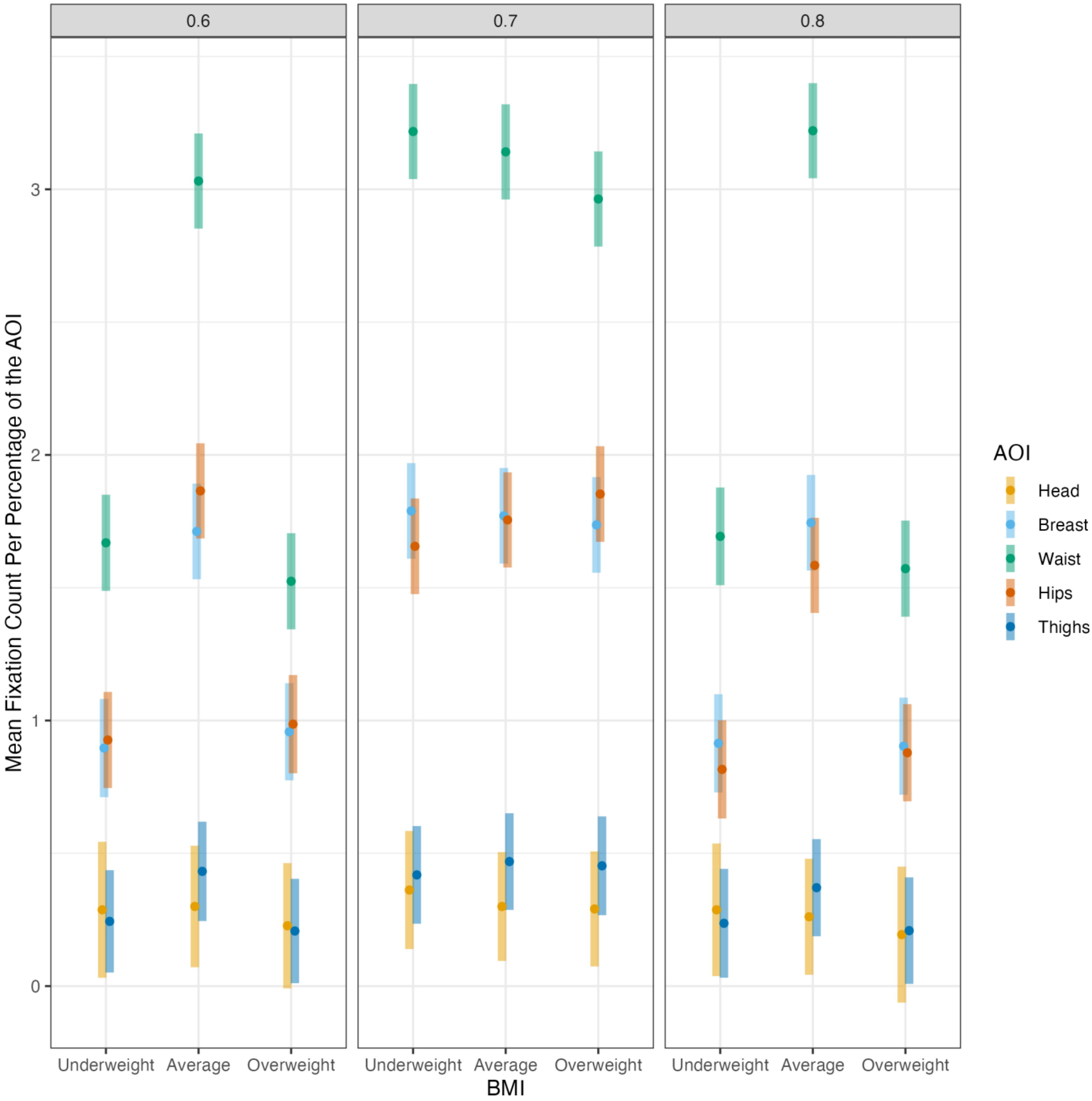
	df	***F***	***p***
AOI	4	941.91	<.001
WHR	2	176.30	<.001
BMI	2	164.16	<.001
WHR x BMI	4	38.61	<.001
AOI x WHR	8	17.54	<.001
AOI x BMI	8	20.38	<.001
AOI x WHR x BMI	16	5.12	<.001

Notes. All effects are significant at $p < .05$.

As shown, we found evidence for significant two and three-way interactions between AOI, WHR and BMI. As we identified a higher-order effect, we present this three-way interaction only, per best practice (Baguley, 2012). As shown in Figure 10.8, the participants were more likely to fixate on the waist area of interest, but only when the body contained an attractive WHR or BMI. For instance, when the body consisted of a 0.7 WHR, the participants looked toward the waist the most often, regardless of the BMI. Similarly, the participants also looked toward the waist of bodies that consisted of an average BMI, regardless of WHR.

Figure 10. 8

Overall Fixation Count for the AOI x BMI x WHR Interaction.



Notes. The error bars reflect the 95% CI estimated from the mixed-effect model. Each facet represents a WHR category. The mean values reflect those from the normalised fixation count, which reflects the number of fixations per percentage of each AOI. Each vertical panel reflects a WHR.

Dwell Time. We next examined mean dwell time (in ms). Before testing our model, we viewed the distribution of mean dwell times and the residuals from the fitted model. We noted them to be approximately normally distributed despite a slight skewness. This skewness was caused by several outliers reflecting high mean dwell times (i.e., > 600ms). However, we retained these valid observations (Baguley, 2012). Taken together, we deemed our modelling approach appropriate. Table 10.12 illustrates the findings from this analysis. As shown, we found no evidence for any significant two or three-way interactions between AOI, WHR and BMI.

Table 10. 12
Main Effects, Two- and Three-Way Interactions for WHR, BMI and AOI with Dwell Time as the Outcome Measure.

	df	*F*	*p*
AOI	**6**	**93.42**	**<.001**
WHR	2	.53	.591
BMI	2	.33	.718
WHR x BMI	4	.55	.698
AOI x WHR	12	.40	.963
AOI x BMI	12	1.60	.085
AOI x WHR x BMI	24	.62	.922

Notes. **Bold** values indicate significant effects at $p < .05$.

Number of Revisits. We conclude by examining the overall number of revisits. This outcome variable represents a frequency. As outlined in Chapter 7, we fit a generalised mixed-effect model using a Poisson distribution. In Chapter 7, we identified that this model was significantly over-dispersed, and we fit a negative binomial mixed effect model instead. We assessed whether this model was also over-dispersed using the *AER* package. We found that the dispersion was lower than we identified in Chapter 7 but was still significantly higher than 1 ($p < .001$). We decided to use a negative binomial mixed-effect model. Table 10.13 illustrates the findings of our analysis. As shown, we found no evidence for any differences in the number of revisits for each AOI across each WHR, BMI or their combination.

Table 10. 13
Main Effects, Two- and Three-Way Interactions for WHR, BMI and AOI with Revisit Count as the Outcome Measure.

	df	*χ2*	*p*
AOI	**6**	**1228.99**	**<.001**
WHR	**2**	**152.67**	**<.001**
BMI	**2**	**171.89**	**<.001**
WHR x BMI	**4**	**76.51**	**<.001**
AOI x WHR	12	14.86	.249
AOI x BMI	12	12.84	.381
AOI x WHR x BMI	24	22.26	.564

Notes. **Bold** values indicate significant effects at $p < .05$.