Examining Perceived Pathogen Threat and Body Weight Preferences using Experimental Priming

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Declaration

Signed:

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Acknowledgments

I would like to thank the following people:

- Dr Andrew Dunn, my Director of Studies, for always believing in me. I would not be where I am today without Andrew and I will always be grateful to him
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This thesis is dedicated to my Grandfather, Gordon Weston (9th June 1922 – 21st November 2008) whose memory will always be in my heart.

Abstract

Background: It has been shown that individual levels of hunger affect preferences for body weight with hungry males preferring heavier female bodies than satiated males. This suggests that body weight preferences are not fixed and vary with ecological conditions. It is therefore possible that the way we perceive bodies could also be affected by other environmental factors such as disease and the potential existence of pathogens. Furthermore, research has indicated that individuals have a behavioural immune system that causes them to become more vigilant in pathogen heavy environments and implicitly change their behaviour accordingly. However, no research has examined if perceived pathogen threat will affect body weight judgments meaning this thesis will be the first to bring the two research areas together.

Aim: The main aim of the thesis was to examine the effects of using experimental pathogen primes on individuals' body weight preferences. The thesis also aimed to create and validate a new set of body stimuli that could be used due to problems with existing stimuli.

Methods: A sample of female participants was used. Experiment 1 was concerned with stimuli development and testing the reliability and validity of pictorial body stimuli that varied in BMI. A priming paradigm was used to activate concerns about pathogen threat. Experiment 2 examined the effects of visual pathogen primes on participants' body weight preferences. Experiment 3 further explored the effects of

pathogen priming on body weight preferences but with a verbal pathogen prime. Experiment 4 examined preferences for body weight after exposure to a threat prime intended to cause increased anxiety as opposed to pathogen levels. Experiment 5 investigated the effects of pathogen priming on muscularity preferences in male bodies.

Results: The main findings were that pathogen priming causes individuals to shift their body weight preferences towards the healthy weight BMI category with heavier bodies being found more attractive and healthy. This is owing to the fact that BMI preferences before priming were for low BMI's meaning a shift towards slightly heavier bodies was a shift towards a healthier body. This is thought to be because increased body weight signifies better health, pathogen resistance and access to resources. This effect appears to only be significant in female bodies compared to male bodies. In addition, this effect appears only to be present in judgments of others body weight, and does not affect own levels of body dissatisfaction. This effect seems to be specific to pathogen threat and not related to general threats.

Conclusion: In conclusion, using the newly validated stimuli, the results suggest that pathogen priming causes individuals to shift their body weight judgments. This suggests that the way we perceive bodies is not fixed and is sensitive to environmental pathogen prevalence.

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Chapter 1

Literature Review

1.1 Introduction

This literature review provides an overview of the research in the field of body perception and pathogen prevalence. It focuses mainly on the suggestion that body weight preferences may be affected by factors such as environmental pathogen prevalence. The review first explores the research conducted on bodies which looks at cues to the perceived attractiveness of bodies, cross cultural preferences for bodies and the relationship between resource availability and body weight preference. It then secondly looks at the psychological literature surrounding pathogen prevalence and implications of the behavioural immune system. The review will consider the notion that body weight preferences are not fixed but could vary with ecological conditions including the presence of real or perceived pathogens. This is a response that is consistent with the behavioural immune system, an evolved mechanism that causes individuals to become more vigilant in pathogen heavy environments and implicitly change their behaviour. The affects of environmental pathogen prevalence on body preferences, and the suggestion that individual preference for body weight may be affected by perceived or actual pathogen levels, is an important area of research that has yet to be properly examined. Therefore, the main aim of the thesis will be to further explore this.

1.2 Waist to Hip Ratio and Body Mass Index

The human body conveys a wide range of complex perceptually important information. One physical feature of the body that has been frequently used to explain attractiveness judgments is body shape, as measured by the waist to hip ratio (WHR) (e.g. Singh, 1993a). The WHR relates to the specific distribution of fat deposition on the lower body, as calculated by the ratio of waist circumference to hip circumference (Singh, 1993a). Male and female bodies are shaped differently due to sex hormones that play a crucial role in the accumulation, metabolism and distribution of adipose tissue (Norgan, 1997). For example, oestrogen is responsible for fat deposition in the gluteofemoral regions whereas testosterone causes fat to be stored in the trunk and abdomen. These hormones are crucial in causing the profound sex differences in fat distribution that emerge during puberty. Therefore, women tend to store fat in their buttocks and thighs resulting in a gynoid distribution. However, men will have more fat deposited in the stomach resulting in an android distribution. It is this sexually dimorphic distribution of body fat that causes the shape differences between male and female bodies and is typically quantified by measuring the WHR.

A large amount of research (e.g. Singh, 1993a, 1993b, 1994a, 1994b, 1994c, Singh, Dixon, Jessop Morgan, & Dixon, 2010; Singh & Luis, 1995; Singh & Young, 1995,) has focused on the significance of the role of female WHR in perceived attractiveness. Most notably Singh (1993a; 1993b) argued that a low WHR in females represents the optimum fat distribution for high fertility and good health and consequently this body shape should be considered attractive by all men. He also suggested that men have evolved to detect and use WHR as a direct assessment of a women's underlying fitness. Furthermore, Singh claimed that it is therefore possible to systematically change a women's attractiveness by manipulating her WHR. To test this theory Singh (1993a, 1993b) developed a set of 12 line drawings of female body shapes that varied in WHR. The body shapes were arranged in three different weight categories (underweight, normal and overweight) and within each category there were four body shapes varying in WHR from 0.7 to 1.0. In various experiments (Singh, 1993a; 1993b; 1994a; 1994b; 1994c, Singh & Luis, 1995; Singh & Young, 1995) a relationship between WHR and perceived attractiveness was demonstrated. It was shown that body shapes with a low WHR were found to be more attractive, healthier and were assigned greater reproductive value than body shapes with a high WHR. Additionally, similar to Caucasian men (mainly North American and European), a preference for a low WHR was demonstrated in African Americans (Singh, 1994a) and Indonesia males (Singh & Luis, 1995) suggesting that a low WHR is found consistently attractive across cultures. Singh suggested that a low WHR is a universal norm of female attractiveness, and therefore a preference for a low WHR in females is culturally invariant.

The line drawings that Singh used in his research (see Singh 1993a pp 298) have not only been criticised for lacking ecological validity (Tassinary & Hansen, 1998) but also for inadvertently altering body weight as they varied in WHR. Within each weight category the body weight of each of the figures is supposed to be held constant, while WHR is varied by narrowing the waist. However, as body shapes are varied by altering the width of the torso around the waist, this not only alters the WHR, but also the apparent body weight. This means that as the WHR's of the bodies get higher so does the apparent weight of the body. This makes it difficult to say if the changes in perceived attractiveness are changes in WHR or differences in body weight, or both.

More recently research has (Platek & Singh, 2010; Singh et al., 2010; Singh & Randal, 2007) looked at the relationship between WHR and attractiveness by using images of women prior and post having reconstructive surgery that had altered their prolific WHR.   This surgery had taken adipose tissue from the waist and stomach region and implanted it on to the buttock area resulting in a lower prolific WHR. It was claimed by Singh and Randal that these images, unlike for example Singh's line drawings, altered WHR independently of body weight, with some patients gaining weight post-surgery and some patients losing weight. It was found that post-operative images of females with lower WHRs were perceived to be more attractive than the pre-operative images with higher WHRs (Singh & Randal, 2007). To further examine the universality of the relationship between WHR and attractiveness Singh et al. (2010) examined the body preferences of individuals from three diverse cultures (Africa, Indonesia & New Zealand). It was shown that bodies with a low WHR were perceived as more attractive across all cultures (Singh et al., 2010). It was therefore concluded by Singh et al. (2010) that WHR is a crucial determinant of female physical attractiveness and this is consistent across all cultures.

An increasing amount of research (e.g. Holliday, Longe, Thai, Hancock, & Tovée, 2011; Tovée & Cornelissen, 2001; Tovée, Hancock, Mahmoodi, Singleton, &

Cornelissen, 2002; Tovée, Maisey, Emery, & Cornelissen, 1999) has now suggested that overall body fat, as indicated by the body mass index (BMI), is a more important physical feature of the body than shape. BMI is the body mass of an individual divided by the square of their height. This research has shown that when treated independently, BMI rather than WHR is the main predictor of female physical attractiveness in bodies. For example, Tovée et al. (1999) assessed BMI and WHR as two separated variables and found that BMI was the primary predictor of attractiveness accounting for over 70% of the variance. In comparison WHR accounted for only 2% of the variance. It is possible that body shape is an important cue to attractiveness but WHR does not seem to be the primary index.

Therefore, to address this Tovée et al. (2002) treated the torso of the body as a waveform and used two methods of waveform analysis to determine which components were the best predictors of attractiveness. It was found that the components related to body weight were good predictors, but those that appear to be linked to shape cues were not. This also suggests that BMI is a stronger predicator of perceived attractiveness than WHR. Tovée et al. (2002) also argue that WHR is limited in its ability to predict health. They point out that a female could be anorexic and suffering from amenorrhoea but could have a WHR the same value as a healthy fertile female, meaning that WHR does not have to vary with fertility. This suggests that WHR is an unreliable cue to the health of a body. Tovée et al suggest that BMI is a more useful cue to the overall health and fertility of an individual.

In addition to this Cornelissen, Hancock, Kiviniemi, George and Tovée (2009) found that when looking at eye movements of participants rating images for BMI, WHR and attractiveness the areas of the body fixated on when making BMI judgments were also fixated on when making attractiveness judgments. As the areas that were fixated on when making WHR judgments were not the same this suggests that BMI is used more in the assessment of attractiveness than WHR.

These results have also been demonstrated across cultures (Swami, Antonakopoulos, Tovée, & Furnham, 2006; Swami, Caprario, Tovée, & Furnham, 2006; Swami, Neto, Tovée, & Furnham, 2007). Using photographic images of females Swami, Antonakopoulos et al., (2006) examined the relative importance of BMI and WHR in two distinct countries (Britain and Greece). It was shown that in males from both countries BMI was the primary predictor of attractiveness for female bodies. Swami, Caprario et al.,(2006) also looked at the importance of BMI and WHR across Britain and Japan demonstrating that BMI was the main predictor of attractiveness in both countries compared to WHR.

It has been suggested (Holliday et al., 2011; Platek & Singh, 2010) that the perception of attractive bodies is associated with reward systems in the brain. This research has shown that changing BMI and WHR in bodies can activate areas of the brain reward system suggesting that body shape and size play an important role in attractiveness judgments. Specifically, it has been argued (Platek & Singh, 2010) that the optimal WHR activates regions of the male brain that are associated with reward processing. They demonstrated that viewing images of females with a low WHR activated men’s orbital frontal cortex (specifically the right para-anterior cingulate gyrus) whereas images of females with a higher WHR did not. It was also shown that viewing images that varied in BMI only activated low level visual areas (right lingual gyrus, left fusiform gyrus and right lateral occipital cortex) that are tuned to noticing variations in body configuration but not involved in the aesthetic evaluation of the body. Platek and Singh suggested that this is why a low WHR in females is found attractive by men across all cultures. However, the images used in this research have been criticised for not being standardised because they vary in both viewing angle and level of illumination (Holliday et al., 2011). This means that whilst the images did not vary physically in BMI the images could have given the appearance that the bodies were of different BMIs.

In addition, as research (Cornelissen et al., 2009; Tovée et al., 1999) has suggested it is the degree to which the stomach protrudes (stomach depth) that is used as a judgement to body weight, the fact that the images varied in stomach depth from before to after surgery could have lead people to perceive a difference in BMI between the images. Consequently, if the images used by Platek and Singh are giving the impression that they vary in body weight then the effects found could actually be related to perceived differences in BMI and not differences in WHR. Therefore, Holliday et al. (2011) tested the relative importance of WHR and BMI on brain activity by using computer generated body shapes that varied in BMI and WHR independently. The participants rated these body shaped for attractiveness during an fMRI scan. It was found that varying BMI activated higher visual areas (e.g., the extrastriate body area), the caudate nucleus and other parts of the brain reward system. Consequently, Holliday et al. claimed that BMI, not WHR as claimed by Platek and Singh (2010), modulates reward mechanisms in the brain and is therefore the primary signal to perceived attractiveness in bodies. Consequently, it appears that that the perception of a body's shape and size is associated with reward systems in the brain

From the research discussed it is apparent that both WHR and BMI are potential cues to the perceive attractiveness of bodies. It seems that BMI is potentially a more important cue to the attractiveness of bodies than WHR. However, this does not completely eliminate WHR as a cue to attractiveness and it is likely that WHR still plays an important role in the perception of bodies. Indeed, research (Johnson & Tassinary, 2005) has shown that WHR is particularly important when making sex judgments. Previous research (e.g., Cutting, Proffitt, & Kozowski, 1978) has suggested that bodily motion is used when making sex judgments. This has shown that observers can identify the sex of a walker using point light displays because of different motion patterns in the shoulders and hips. Bodily motion is sexually dimorphic, for example, it seems there are distinct differences between males and females motion patterns when walking owing to physical differences in skeletal structures of the body (e.g., the pelvis). A female walking pattern is characterised by a hip translation opposed to shoulder twist whereas the opposite is true for a male walking style (Barclay, Cutting & Kozowski, 1978). Therefore, it had been suggested that people would use motion when making judgments regarding sex. However, Johnson and Tassinary (2005) claimed that morphology, and how this might interact with motion, had been overlooked. To examine this further Johnson and Tassinary used body shape stimuli that varied in both morphology and motion.

These body shapes (walkers) varied in WHR and walking motion, in addition all observable sex characteristics were removed from the walkers making the sex of them ambiguous. It was demonstrated that when the sex of a walker was already specified participants' fixations on the waist and hips decreased to chance levels. However, when the sex of the walker was unspecified the participants spent more time fixating on the waist and hips than any other part of the body. Therefore, it would seem people look at the waist and hips when it was necessary for them to learn the sex of walker. The findings from Johnson and Tassinary (2005) show the importance of a body's morphology for making sex judgments. Morphology is, according to Johnson and Tassinary, more reliable than motion to determine sex. They suggested using the WHR to make sex judgments is a useful and efficient method due to the distinct difference in body shapes between males and females.

1.2.1 Male Body Shape

In comparison to the large amount of research on female body shape, less research has been conducted on male body shape. Research (e.g., Coy, Green, & Price, 2014; Maisey, Vale, Cornelissen, & Tovée, 1999; Swami, Smith et al., 2007; Swami & Tovée, 2005b; Swami & Tovée, 2008) which has examined male body shape has found that WHR, BMI and waist to chest ratio (WCR) are important cues in the perceived attractiveness of male bodies. Indeed, it has been suggested that muscularity, as indicated by the WCR ratio appears to be a better predictor of attractiveness than either BMI or WHR in male bodies (Maisey et al., 1999; Swami, Smith et al, 2007). Research has shown that men with a low WCR are perceived to be more attractive both by females (Coy et al., 2014; Maisey et al., 1999) and by gay males (Swami & Tovée, 2008). Both females and homosexual men appear to show a preference for males who have an "inverted triangle" shape (a narrow waist and a broad chest and shoulders) which is a shape consistent with upper body muscle and strength. This would suggest that shape is important in the perceived attractiveness of male bodies (Maisey et al., 1999; Swami & Tovée, 2008).

However, research (Fan, Dai, Liu, & Wu, 2005; Maisey et al*.,* 1999; Swami & Tovée, 2005b) has suggested this is in combination with leanness, suggesting that although muscularity is important, a male body still has to be lean to be considered attractive. Fan et al. (2005) claimed that the volume height index (VHI) is the strongest visual cue to the perceived attractiveness of male bodies compared to other body ratios. The VHI is an alternative to BMI and is calculated by an individual's body volume being divided by the square of their height. Fan et al. (2005)'s research showed that VHI explained 73% of the variance in attractiveness ratings compared to the 18 other body ratios which were considered. VHI and BMI should have a strong linear relationship (Fan, Liu, Wu & Dai, 2004) and VHI is more indicative of weight than shape. Therefore, these results would suggest that body weight is important to the perceived attractiveness of male bodies.

In male bodies it is possible that both body weight and muscularity play important roles in the perceived attractiveness. This is different to female bodies where it would seem that body weight is a much more important cue than body shape.

1.2.2 Other Body Cues

Various other possible physical characteristic may be important when perceiving bodies. One such characteristic is the leg to body ratio (LBR). Fashion models are on average 11 cms taller than typical women (Tovée, Mason, Emery, McCluskey, & Cohen-Tovée, 1997) and this is largely because they have longer legs. Despite this, there has been little research examining the affects of leg length on the perceived attractiveness of bodies. One attempt by Swami, Einon and Furnham (2006) used line drawings of figures that varied in LBR. This found that female figures with a higher LBR were rated as more attractive than figures with lower LBRs. However, this effect was not found with male figures suggesting the LBR plays a more important role in judgments of female body attractiveness than in male body attractiveness.

LBR is a sexually dimorphic characteristic with females typically having higher LBRs than males therefore it is possible that higher LBRs are associated with femininity. Furthermore, LBR may also be a signal of youthfulness, which is more valued in women than men. A preference for a higher LBR in females could also be the result of sociocultural influences such as Western media, which portrays females with longer legs as being more attractive. This is supported by research that showed that participants in rural Malaysia, where there is less exposure to Western media, preferred a lower LBR in females than British participants (Swami, Einon, & Furnham, 2007). In addition, leg shape could also be of some importance, for example, the muscularity of the leg may be more important in males than in females. However, it is possible that in real life settings other factors, such as clothing, posture and whether a person is sitting or standing, will make differences in LBR hard to judge meaning it may have limited use in attractiveness judgments (Swami, Einon, & Furnham, 2006).

Another physical characteristic of female bodies is breast size, however less research has focused on this despite the sexual importance of breasts in most human cultures (Koff & Bevenage, 1998). Research that has examined breast size as an indicator of attractiveness has not yielded consistent results. For example, Furnham and Swami (2007) found that line drawings of bodies with smaller breasts were found to be more attractive than bodies with larger breasts. This contradicts research that has suggested that large breasts are perceived as most attractive (Furnham, Dias, & McClelland, 1998). Furnham et al. (1998) found that the attractiveness of breast size varied according to the shape and size of the body, meaning that large breasts were only found attractive when the body shapes remained thin. This might suggest that breast size is a less important characteristic of physical attractiveness than body weight or shape (Furnham, Swami, & Shah, 2006). However, some research (Cornelissen et al., 2009; Dixon, Grimshaw, Linklater, & Dixon, 2011) has shown that when making attractiveness judgments about female bodies, both females and males spend more time looking at the breasts and upper body compared to other body areas. Although it is possible that they are using breast size as an indicator of body fat, breast size does not appear to be a very useful index for attractiveness judgments because there is great variability in breast size.

Another salient female body feature is buttock size. However, buttock size also appears to be a relatively unimportant predictor of attractiveness in female bodies (Furnham & Swami, 2007). Though there are cultural differences in the valuation of buttock size with some ethnic groups placing more of an emphasis on buttock size (Marlowe, Apicella, & Reed, 2005). For example, it is possible that steatopygia (a high degree of fat deposition in the gluteal areas, especially prevalent in females but does occur to a lesser degree in males) is an important feature in attractiveness judgments of female bodies among cultures and ethnic groups in which it is prominent, most notably the Khoikhor in South Africa. It is also possible that buttock size has remained a poor predictor of attractiveness in female bodies because the stimuli used in experiments generally fails to represent the buttocks. For example, Marlowe et al. (2005) argued that using images of women in front view do not show the size of the buttocks. Using very basic line drawings of females in profile view, they found that men from the Hadza tribe preferred drawings of women with more protruding buttocks compared to American men. This suggests that this characteristic is found more attractive in cultures where it is more prevalent.

1.2.3. Summary

There are many factors which affect how people make judgments about bodies and what type of body shape is perceive to be attractive or healthy. Although as outlined above various cues are involved in the perception of bodies, it appears that BMI and WHR appear to be the most crucial cues to the perceived attractiveness of female bodies. When comparing WHR and BMI it has been demonstrated however that BMI is a more important cue then WHR: when making attractiveness judgments looking at BMI and WHR independently research (Holliday et al*.,* 2011; Tovée & Cornelissen, 2001; Tovée et al*.,* 1999, 2002) has shown that BMI is a much better predictor of attractiveness in bodies. This has been found across cultures (Swami, Antonakopoulos et al., 2006; Swami, Caprario et al., 2006; Swami, Neto et al., 2007) suggesting that BMI is consistently found to be the most important cue when perceiving female bodies. In comparison less research has been conducted with male bodies, however this research does suggest that WCR and BMI are both important cues to the perceived attractiveness of male bodies (Maisey et al*.,* 1999; Swami, Smith et al., 2007; Swami & Tovée, 2005b, 2008). Although it appears that BMI is the primary cue to the perceived attractiveness of bodies, preferences for what is an ideal body weight, as indicated by BMI, appear to differ across cultures. The next section will outline some of the cross cultural effects found in preferences for body weight.

1.3 Cross Cultural Effects in Body Preferences

Preferences for female and male body shape and weight are known to vary cross culturally (e.g., Marlowe et al., 2005; Marlowe & Wetsman, 2001; Swami, Henderson, Custance, & Tovée, 2011; Swami & Tovée, 2007b, 2007c; Tovée, Swami, Furnham, & Mangalparsad, 2006). For example, Marlowe and Wetsman (2001) looked at the body shape preferences of the Hadza, using the line drawings developed by Singh (1993a). The Hadza are an indigenous ethnic group living in Tanzania, they are not closely genetically related to any other people (Tishkoff et al., 2007). The Hadza are hunter-gatherers and are one of the few societies in the world who still live by hunter gathering making them invaluable to researchers (Marlowe, 2010). Many Hadza still have virtually the same lifestyle as their ancestors had in the early 20th century (Marlowe, 2010). Marlowe and Wetsman (2001) found that males from the Hadza tribe preferred a higher WHR in female body shapes compared to American men. It was suggested that this is a result of a preference for higher levels of body fat in women as the figures with high WHR were also the fattest. Other research (Marlowe et al., 2005) has demonstrated that men's preferences for WHR vary between cultures with Hadza men preferring females with a lower prolific WHR, and therefore more protruding buttocks, than American men do.

To further explore cross cultural preferences in body weight Tovée et al. (2006) examined female and male preference for female bodies varying in BMI across two different cultures (United Kingdom Caucasian and South African Zulu). They found a significant difference between the two groups with the Zulu group finding larger female bodies more attractive than UK Caucasians. They also found significant differences between the preferences of South African Zulus and Zulus who had recently moved to the UK. In addition to this, it was also shown that British men of African origin had the same body weight preferences as White UK Caucasian men. Together this suggests that the differences found between the two cultures are not fully due to genetic or ethnic differences but that preferences for body weight might vary according to different environment pressures and conditions (Tovée et al., 2006).

Other research has demonstrated a preference for heavier bodies in certain cultures. Swami et al., (2011) examined the body weight preferences of men from three distinct cultures; Bali, Lombok and London. Bali and Lombok are two islands in Indonesia that differ mainly in their SES and exposure to Western media. Lombok is economically depressed where as Bali is more developed and affluent. It was found that men from Lombok perceived larger females to be more attractive than men from Britain or Bali. In addition to this it has been demonstrated that Finnish Sami males (the indigenous people of northern Scandinavia) prefer heavier female bodies than Finnish and British males (Swami & Tovée, 2007b). Therefore, it would seem that differences in body weight preferences could be linked to the socio economic status of the individual as in societies where there is a lack of resources heavier bodies are preferred. This is also suggested by Swami and Tovée (2005a) who examined male and female preferences for female body weight preferences across five different levels of socio-economic development from Britain and Malaysia. It was found that participants living in Britain and Kuala Lumpa preferred thinner bodies than participants living in Kota Kinabalu (a less developed city) who in turn preferred thinner bodies than participants living in rural villages. Suggesting that in lower SES settings heavier bodies are preferred.

Some research has demonstrated that regardless of the culture or national setting individuals in low socio economic status (SES) groups show a preference for a heavier female body. For example, Swami and Tovée (2007a) found that the perceived attractiveness of female bodies varied significantly between Thai participants living in Bangkok (an affluent, industrialised environment), Thai participants now living in Britain and Thai participants in resource-poor, hill tribes in Northern Thailand. Specifically, the participants living in hill tribes preferred larger female bodies compared to Thai participants living in Britain or Bangkok.

In addition to this, Swami and Tovée (2013) have also demonstrated that male preference for female breast size varies according to SES. Swami and Tovée (2013) used males from three different levels of socio economic development in Malaysia. It was found that males from low SES areas preferred female bodies with larger breasts compared to those in medium SES areas who in turn preferred larger breasts than males living in high SES settings. As mentioned in the previous section breast size is not always a reliable cue to attractiveness in bodies. However, breast size may act as an indicator of calorific storage and fat reserves in non-lactating females (Gallup, 1982). These findings also suggest that men in lower SES settings prefer heavier female bodies.

Research with male bodies has also shown cross cultural differences in female preferences. Using female participants from Britain, Kuala Lumpa and rural Malaysia, Swami and Tovée (2005b) showed that the WCR was a more important cue for females in Britain and Kula Lumpa whereas for females in rural Malaysia BMI was the most important cue for physical attractiveness. In general, female's in Britain and Kuala Lumpa were more reliant on body shape and preferred a relatively slim male body with an inverted triangle shape. Whereas the Malaysian participants were more reliant on body weight and chose a heavier male body with a less defined shape. This is consistent with the idea that body weight is a more important cue in rural areas where there are a lack of resources.

Together these findings suggest that preferences for body weight are changeable and can be altered with exposure to different environmental conditions. The differences in preferences for bodies that are found across cultures could be partly due to the different valuation put on thinness in different cultures. As certain cultures have a much greater emphasis on being thin a preference for a thinner body could be due to this. For example, in Western society being thin is usually associated with happiness, success and social acceptability. Whereas being overweight is linked to laziness and lack of willpower (Grogan, 2008). Conversely in non- Western cultures thinness is associated with malnutrition and poverty while being overweight signifies wealth and health (Grogan, 2008). It is also likely that exposure to Western media will have an affect on body preferences as this often portrays thin females as being more attractive. The ideal female body in Western society, as depicted by fashion models, has become thinner over time. For example, when looking at Miss America contestants and Playboy centrefolds research has shown that these women became increasingly thinner over a 20 year period between 1959 and 1978, while conversely American women in general became heavier (Garner, Garfinkel, Schwartz, & Thompson, 1980). In Western society there is a prejudice and discrimination against overweight individuals (Crandall, 1994) and this is reinforced through the media (Grogan, 2008). Therefore, preferences for thin female bodies in some cultures could be due to a greater exposure to Western media as individuals in less developed areas may have less access to this.

Media influence could also be influential in preferences for male bodies. It is apparent that attractive male bodies are often depicted as being muscular in the media. For example, it has been shown that Playgirl centrefolds became increasingly muscular between the years 1973 and 1997 becoming especially muscular in the 1990s (Leit, Pope, & Grey, 2001). It is not just Playgirl centrefolds that have become more muscular, male action figure toys have also become increasingly more muscular over time. (Pope, Olivardia, Gruber, & Borowiecki, 1999) Pope et al. (1999) found that the measurements of the waist, chest and biceps of male action figures have increased over a 30 year period. Therefore, it is possible in cultures that have more Western media exposure to a more muscular male body has become more attractive through repeated exposure to media and toys that depict muscular men as being more attractive.

A variety of factors influence attractiveness judgment and body preferences. Although some of these factors may be the result of exposure to media it is likely that resource availability and current environmental conditions play a crucial role in shaping preferences for body weight. While thin females are often considered attractive in certain cultures in other cultures body fat is seen as an attractive quality. In these settings body fat is considered an indicator of wealth and prosperity, only individuals with access to resources would be able to gain body weight consequently making this an attractive quality. It is apparent that an individual's preference for body weight can alter depending on their current environment, with body preferences changing as individuals move between different environments (Tovée et al., 2006). This results in cross cultural differences in body weight preferences being consistently found, with individuals in settings where there are a lack of resources showing a preference for a heavier female body.

1.4 Resource Availability and Body Preferences

Until recently the relationship between environmental context and body weight preferences lacked an obvious psychological mechanism as it seemed unlikely that individuals consciously showed a preference for heavier women because of their lack of resources. Nelson and Morrison (2005) therefore proposed an implicit psychological mechanism that would account for this. It was suggested that the individual physiological state associated with a lack of resources provides implicit cues about collective resources and this in turn then structures personal preference**.** For example, individual levels of hunger may lead the individual to believe that their community has a lack of resources causing them to find attractive those with greater body weight, as body weight is a useful indication of food access.

To test their theory Nelson and Morrison (2005) manipulated levels of hunger and financial satisfaction to examine if this would affect preferences for bodies. They asked males and females going in and out of a canteen to state their ideal partner weight and also how hungry they were. It was found that men who felt hungry showed a preference for heavier female partners compared to men who were feeling satiated. In addition to this, it was demonstrated that males with higher levels of financial dissatisfaction preferred heavier female body weight.

Interestingly neither of these effects were found in females' preferences for male body weight.

To examine this further Swami and Tovée (2006) conducted a similar experiment with males using photographs of female bodies varying in weight. Photographic stimuli were used as it is able to show more precisely the changes in body weight preferences. It also enables the results to be comparable to other research that has used photographic stimuli. Swami and Tovée asked males going in and out of a canteen to rate the images for how attractive they thought they were. It was found that men who were hungry perceived heavier female bodies to be more attractive than males who were satiated. Therefore, it seems that individual levels of hunger act to implicitly suggest a lack of resources leading males to find attractive female bodies with increased body weight as they perceive these females to have access to food and resources.

In line with these findings more recent research (Swami & Tovée, 2013) has shown that men's preferences for female breast size are also affected by individual level of hunger. As mentioned previously breast size could possibly be used as an indicator of fat reserves with larger breasts signalling increased food availability. Swami and Tovée used five female bodies varying in breast size only. The results demonstrated that hungry men prefer significantly larger female breasts then satiated men. Therefore, it seems that, in line with the findings from Swami and Tovée (2006), males are selecting females who they perceive to be heavier when hungry. It appears that implicit cues regarding resource availability influence judgements of female body weight. This effect seems to be specific to bodies as Swami, Poulogianni and Furnham (2006) found that resource scarcity (as indicated by hunger at least) did not influence people's preferences for the size of non-human objects such as bottles. This suggests that the effects found are not just because of a preference for larger things in general but specific to body weight. It is still not clear however if this effect is present in females' preferences for female or male body weight.

Research (Fisher & Rosenthal, 2006) with the swordtail fish, *Xiphophorus birchmanni*, has demonstrated that the effects shown by Swami and Tovée may also be evident in non-human animals. Female mate choice was found to alter as function of food availability. It was shown that female swordtail fish who had been experimentally food deprived preferred the chemical cues of well fed male swordtail fish compared to the cues of male swordfish who were under nourished. This effect was not as strong in female swordtail fish that had not been food deprived, suggesting that when female swordtail fish have limited access to food resources they will attend to cues indicating male resource access more (than when they have adequate food access). This behavioural response to changes in environmental conditions indicates it is possible that a relationship between female preference and environmental resource access will be present in other non-human animals. It is most likely then that human females' body preferences are also sensitive to changes in environmental conditions.

1.4.1. Environmental Security Hypothesis

Pettijohn, Sacco and Yerkes (2009) also demonstrated the affects of hunger on individual preference. They showed that hungry males had a preference for females who were heavier, taller and older. Pettijohn et al. (2009) claimed that these are all characteristics that are associated with maturity. This effect was not found in females, however it was demonstrated that hungry females showed a greater preference for mature personality traits in males compared to satiated females. Pettijohn et al. (2009) proposed the Environmental Security Hypothesis (ESH; Pettijohn & Tesser, 1999, 2005) to explain their findings. Pettijohn and Tesser suggest that individuals' construct their personal preferences based on how secure or insecure they feel in their current surroundings. Therefore, if environmental conditions are threatening individuals will show a preference for more mature characteristics, this is mainly because maturity is associated with the ability to deal with potential dangers, risks and a harsher environment. Pettijohn et al. (2009) claim that feelings of hunger are used as cues which implicitly suggest a need for nutrition and a less secure environment and this leads individuals to show preferences for mature characteristics.

Evidence in support of this hypothesis comes from a series of studies (Pettijohn & Jungeberg, 2004; Pettijohn & Sacco, 2009; Pettijohn & Tesser, 1999, 2003, 2005) examining this hypothesis. For example, Pettijohn and Tesser, (1999) found that in times of social and economic depression in the United States of America (USA) preferences for American actress with mature facial features were greater. Though this effect was not demonstrated with popular American actors (Pettijohn & Tesser, 2003). Pettijohn and Jungeberg (2004) also examined facial and body characteristics of Playboy Playmates of the Year, from 1960 to 2000, and identified that in difficult social and economic times in the USA, Playmates of the Year tended to be older, heavier and taller. These characteristics are associated with maturity and suggest that more mature Playboy models were preferred under greater social and economic threat.

In addition to this Pettijohn and Sacco (2009) also looked at Number 1 songs in the USA from 1955 to 2003 and found that when social and economic times are less threatening female performers with larger eyes and male performers with larger eyes and smaller chins were preferred. These are more neotenous facial features therefore suggesting that preferences can alter depending on the social and economic state of a country, with individuals showing a preference for more youthful faces when in a more secure environment and a preference for maturity when under threat. Pettijohn and Tesser (2005) have also demonstrated experimentally that both males and females show a preference for female faces with smaller eyes when manipulated to experience environmental threat (Pettijohn & Tesser, 2005). In their experiment, the participants were manipulated to show heightened levels of anxiety and given faces with either increased or decreased eye size to choose from. The participants in the threat condition showed a greater preference for faces with small eyes. This was thought to be due to smaller eyes being associated with maturity and large eyes with youth. Providing further support for the ESH, Swami and Tovée (2012) showed that males who were experimentally manipulated to experience psychological stress preferred heavier female bodies than controls. This is possibly because, as suggested by Pettijohn et al. (2009), heavier bodies are associated with maturity and therefore when under psychological stress males show a preference for these characteristics as they signal greater security and a better ability to manage environmental danger.

Following from the idea that physiological, economic and social threat can alter individual preference. There is evidence to suggest that considering the threat of mortality and death can alter behaviours. Awareness of death in a species with a strong desire for life is a paradox, this creates the potential for an ever present fear of death that must be continually repressed to make successfully living in the world possible (Becker, 1973). Using Becker's work, Greenberg, Pyszczynski and Solomon (1986) put forward the Terror Management Theory (TMT). TMT suggests that individuals are unconsciously motivated to preserve their cultural views, self-esteem and close relationships to protect from the anxiety caused by the fact that death is inevitable. Experimentally priming individuals with the idea of death has been the most popular way to research the theory (Burke, Martens, & Faucher, 2010). Mortality salience has been manipulated in a variety of primes including questionnaires and a slideshow with death themes. For example, Rosenblatt, Greenberg, Solomon, Pyszczynski and Lyon (1989) primed court judges with the Mortality Attitudes Personality Survey (Rosenblatt et al., 1989). The judges were then asked to set a hypothetical bond for a defendant who was a prostitute. It was shown that judges who were primed set a significantly higher bond than judges who had not been primed. In another experiment using university students as participants, it was demonstrated that not only did participants who had been primed set a higher bond for an alleged prostitute they also gave a higher reward for a hypothetical woman who helped the police apprehend a criminal. Rosenblatt et al. (1989) suggest that when people are primed to think about their mortality they consistently give harsher treatment of a moral transgressor or greater rewards to people who uphold moral values. Making death salient to participants increases their need for protection from the anxiety that arouses from this. As a result, this leads to more negative reactions to those who undermine society and more positive reactions to those who uphold it. TMT suggests that the beliefs and values that make up an individual's cultural worldview protect the individual from the anxiety caused by the awareness of mortality. Those who deviate from society and cultural norms are viewed negatively because this behaviour threatens the values that maintain an individual’s cultural worldview and sense of security.

Other research supporting this has shown that priming mortality can result in a preference for those who conform to stereotype behaviour (Greenberg et al., 1990; Schimel et al., 1999). These types of priming effects have been shown to be robust across a wide variety of primes and behaviours (Burke, Martens, & Faucher, 2010). The effects are unique to death and do not occur as a response to other adverse topics (Greenberg & Kosloff, 2008). It has been suggested that individuals can enter into either proximal defence mechanisms to distract themselves from the problem or distal defence mechanisms that promote behaviour that has no logical connection to death but enables the individual to see themselves as having made a valuable contribution to society. (Darrell & Pyszczynski, 2016). Therefore, it seems that the threat of one’s own mortality and being primed to consider this can cause changes in behaviours suggesting that environmental security can pay a crucial role in shaping our behaviours and preferences.

The ESH predicts that individuals will change their preferences in line with their current environmental context. Research (Pettijohn et al., 2009; Pettijohn & Jungeberg, 2004; Pettijohn & Sacco, 2009; Pettijohn & Tesser, 1999, 2005; Swami & Tovée, 2012) has demonstrated that physiological, economic, social and psychological stress can alter attractiveness preferences. Specifically, for bodies it has been has shown that the affects of resource deprivation will alter preferences for body weight (Nelson & Morrison, 2005; Swami & Tovée 2006, 2013). This research suggests that attractiveness preferences, and in particular body weight preferences, are labile and can be affected by many types of environmental conditions.

1.5 Environmental Pathogen Prevalence and Body Preferences

The ESH suggests that individuals construct their preferences based on how secure they feel in the current environment. It is possible that if body preferences are affected by resource availability other environmental pressures could affect preferences for bodies. One such pressure is the level of environmental pathogens and disease. An increased level of pathogens and disease would lead to individuals feeling less secure in their environment possibly therefore resulting in a change in preferences for body weight.

In faces it is thought that as well as cues such as the sexual dimorphism of the face (Rhodes, Chan, Zebrowitz, & Simmons, 2003; Thornhill & Gangestad, 2006), the texture and tone of the skin (Fink, Grammer, & Matts, 2006; Stephen, Smith, Stirrat, & Perrett, 2009) and structural symmetry (Gangestad & Thornhill, 2003), people also use facial adiposity (Coetzee, Perrett, & Stephen, 2009) as a cue to the underlying health of the individual. Facial adiposity has been found to be correlated with poor health (Reither, Hauser, & Swallen, 2009) and higher levels of facial adiposity are correlated with cardiovascular health and respiratory infections (Coetzee et al., 2009). It has been demonstrated by Coetzee et al. (2009) that participants use facial adiposity when making judgements of health, therefore it is possible that a good visual cue to the health of a body is its weight. Indeed, research (Swami, Miller, Furnham, Penke and Tovée, 2008) has shown that people use body weight, as indicated by BMI, when judging the health of a body suggesting that it is used as a cue to the health of an individual.

Body weight provides an indication of health as it is associated with actual health measures. Being out of the healthy BMI weight range has many negative health implications, for example decreased immunity and higher death rates are linked to being underweight (Flegal, Graubard, Williamson, & Gail, 2005; Ritz & Gardner, 2006) whilst cardiovascular disease and diabetes are prevalent in obese individuals (Mokdad, Ford, Bowman, Dietz, Vinicor, Bales, & Marks 2003; Wilson, D'Agostino, Sullivan, Parise, & Kannel, 2002). Bodyweight is particularly important to female fertility as females need between 17% and 22% body fat for menstruation (Frisch, 1987; Frisch & McArthur, 1974). Therefore, low body weights see the occurrence of amenorrhea and consequently reduced fertility. Brownell, Steen and Wilmore (1987) suggested that it might be regional fat loss, rather than total fat loss, that causes amenorrhea with a loss of fat from the hips, thighs and buttocks being more significant as these provide much of the energy for pregnancy and lactation. Being underweight in pregnancy causes increased risk of foetal growth restriction (Doherty, Magann, Francis, Morrison, & Newnham, 2006) and many other adverse pregnancy outcomes (Neggers & Goldenberg, 2003). Although this suggests body fat is beneficial for successful pregnancy outcome, obesity also brings health risks in pregnancy for example, there is an increased risk of early miscarriage in obese females (Lashen, Fear, & Sturdee, 2014). In addition, Watkins, Rasmussen, Honein, Botto and Moore (2003) showed that obese females are at greater risk of having an infant with birth defects such as spina bifida. Therefore, being in a healthy weight range is not only important for fertility but also for successful pregnancy outcomes.

It seems that as body weight is linked to actual health people will use it as a visual cue to the health of an individual. Therefore, it is possible that body weight is a health cue that individuals may use under conditions of increased environmental pathogen prevalence. There is some research on pathogen prevalence and cues of health and this will be discussed in the next section.

1.5.1 Environmental Pathogen Prevalence and Face Preferences

Research (Little, Apicella, & Marlowe, 2007) has started to explore the relationship between preferences for health cues in faces and environmental pathogens. It has found that preferences for facial symmetry are greater in the Hadza than in UK participants (Little et al*.,* 2007). As symmetry is thought to be an indices of underlying health (Gangestad & Thornhill, 2003) it is possible that preferences for higher levels of facial symmetry would be preferred in environments where there is greater pathogen prevalence. Owing to their lifestyle and environment the Hadza are at a much greater threat of disease than UK individuals are. As mentioned in Section 1.3, the Hadza are often hunter-gatherers (living in the outdoors) in areas where pathogens are more prevalent. They also have limited access to medicines and healthcare. Therefore, it would seem that in environments where there is increased pathogen threat facial symmetry becomes more salient and is a more important cue.

In line with Little et al.'s findings other research (DeBruine, Jones, Crawford, Welling, & Little, 2010) has also shown cross cultural differences in face preferences. This highlighted a negative correlation between a country's health status (derived from eight World Health Organisation statistics for mortality rates, life expectancies and the impact of communicable disease) and women's preferences for masculinity in male faces. This showed that the average masculinity preference increased as national health decreased. In these countries, with lower health status, there is a higher mortality rate and greater incidence of disease again suggesting that a greater threat of pathogens causes a preference for cues of good health in faces.

Research (DeBruine, Jones, Tybur, Lieberman, & Griskevicius, 2010; Fisher, Fincher, Hahn, DeBruine, & Jones, 2013; Jones, Feinberg, Watkins, Fincher, Little, & DeBruine, 2013; Jones, Fincher, Welling, Little, Feinberg, Watkins, Al-Dujaili, & DeBruine, 2013) has examined the relationship between measures of pathogen disgust and face preferences. For example, DeBruine, Jones, Tybur, Lieberman and

Griskevicius (2010) found that females who scored highly on measures of pathogen disgust, using the Three Domains of Disgust scale (TDD; Tybur, Lieberman, & Griskevicius, 2009), showed greater preferences for masculinity in male faces. However, preferences were not correlated with moral or sexual disgust suggesting that this relationship is related specifically to pathogen disgust and not disgust in general. In addition to this, Jones, Fincher, Welling, Little, Feinberg, Watkins, Al-Dujaili and DeBruine (2013) found that men's scores on the pathogen subsection of the TDD scale were positively correlated with preferences for femininity in female faces. Suggesting feminine faces are perceived as being more attractive by men who score highly on measures of pathogen disgust. This suggests a relationship between individual level of pathogen disgust and facial characteristics that indicate good health. This relationship also appears to be independent of the affects of moral and sexual disgust as these measures were found by to be negatively correlated with femininity preferences, indicating that the relationship found is not due to men's general disgust sensitivity but is specifically linked to pathogen disgust. Furthermore, Fisher et al. (2013) have also demonstrated a correlation between pathogen disgust and facial adiposity, with thinner faces being preferred by men who scored highly on measures of pathogen disgust, which they suggest, is related to faces with higher facial adiposity being perceived as being unhealthy.

The above studies have only examined the correlation between pathogens and face preferences and accordingly some research (Lee & Zietsch, 2011; Little, DeBruine, & Jones, 2011; Watkins, DeBruine, Little, Feinberg, & Jones, 2012) has begun to experimentally explore this relationship. Little et al. (2011) found that exposing people to visual primes of pathogen contagion can affect female preferences for masculinity in male faces and male preferences for femininity in female faces. Specifically, Little et al. (2011) found that after being shown images that were meant to invoke pathogen disgust (e.g. a white cloth stained with bodily fluids) men preferred more feminine and more symmetrical female faces, whilst women preferred more masculine and more symmetrical male faces. Also using a pathogen prime Lee and Zietsch (2011) found that females who were primed using a questionnaire, to activate concerns about pathogen vulnerability, demonstrated stronger preferences for masculine characterises in mates compared to females who had been primed for resource scarcity by completing a questionnaire about financial worries. In addition to this, Watkins et al. (2012) demonstrated that females who were primed to experience concerns about pathogen threat found masculine male faces significantly more attractive than feminine versions of the same face. Therefore, it would appear that experimentally priming individuals to experience a pathogen threat can alter their face preferences.

Taken together the research discussed suggests that pathogen prevalence can affect face preferences with individuals placing more value on cues which indicate good health when they feel more at threat from pathogens. The findings regarding face preferences and pathogen prevalence are consistent with the ESH and the notion that individuals will change their preferences in line with the current state of perceived environmental threat.

Variability in attractiveness and health preferences in response to a current environmental threat may have been particularly important in the past as disease and illness would have posed a major threat and the capacity to change attractiveness preferences in line with the state of the current environment would have helped maximise reproductive fitness. The next section will look in more detail at the evolution of a behavioural immune system which is intended to aid individuals with the detection of pathogen presence.

1.6 The Behavioural Immune System

Infectious disease poses a major threat to an individual's physical and reproductive health. Consequently, many organisms, including humans, have evolved a physiological immune response that detects and destroys pathogens that enter the body. Since it can be costly to produce this type of immune response it has been proposed that humans have evolved a set of cognitive and affective mechanisms (behaviours) intended to reduce pathogen contact. This is known as the behavioural immune system (Schaller, 2011; Schaller & Duncan, 2007; Schaller & Park, 2011). The behavioural immune system allows individuals to detect potential cues of disease in others and engage in behaviours that prevent contracting pathogens from these individuals. This can then act as a first line of defence against pathogens by preventing them coming in contact with our bodies.

It is argued that the behavioural immune system has evolved to be sensitive to cues that suggest pathogens may be present. These cues include morphological and behavioural cues that suggest infection or disease and when detected these cues can trigger behavioural and cognitive responses. However, since these cues may generalise they might not always suggest actual infection or disease and consequently this can result in signal detection problems (Schaller & Park, 2011). False positive errors can occur when healthy people are perceived as being sick and false negative errors occur when sick individuals are perceived to be healthy. The health costs associated with perceiving sick people as being healthy are far greater than those associated with perceiving healthy people as being sick. Therefore, the behaviour immune system has evolved to minimise the likelihood of false negative errors and has a tendency to make false positive errors (Kurzban & Leary, 2001). This tendency to make false positive errors has resulted in the behavioural immune system being very sensitive to cues that signify the potential presence of infectious illness in others. Similar to the biological immune system, which can attack organic matter that is completely harmless or even beneficial in the case of organ transplants, the behavioural immune system may also respond in an over inclusive way to cues that signal the presence of pathogens. This means that the behavioural immune system is prone to false positive errors and consequently the threat of disease may be implicitly perceived from an overly inclusive set of stimuli.

In addition to signal detection problems there are also cost/benefit problems associated with the behavioural immune system. Although there are benefits from the detection and avoidance of things which are perceived to pose a threat of infection there are also costs as well. When individuals are not at great risk to infection the benefits of behavioural avoidance may be outweighed by the costs of it. However, in situations when individuals are particularly vulnerable to infection the costs may be outweighed by the benefits of behavioural avoidance. The behavioural immune system has functional flexibility (Schaller & Park, 2011) meaning in situations where individuals are, or perceive themselves to be under greater threat of pathogens and disease they are especially attentive to cues that indicate pathogen presence. This functional flexibility can result in a range of behavioural, cognitive and emotional responses.

There is an increasing amount of evidence (Ackerman, Becker, Mortensen, Sasaki, Neuberg, & Kenrick, 2009; Faulkner, Schaller, Park, & Duncan, 2004; Lund & Boggero, 2014; Navarrete & Fessler, 2006; Park, Faulkner & Schaller, 2003; Park, Schaller, & Crandall, 2007) that suggests that due to signal detection problems the behavioural immune system has implications for prejudice and discriminatory behaviour. For example, individuals who are in fact healthy can be perceived to be infected because of morphological abnormalities such as physical disabilities or disfigurements. Park et al. (2003) found that individuals who scored highly on measures of perceived vulnerability to disease (measured using the Perceived Vulnerability to Disease Scale; PVD; Duncan, Schaller, & Park, 2009) were less likely to report having friends or acquaintances with disabilities, suggesting a link between concerns about contracting diseases and an avoidance of individuals with disabilities. In addition to this, Park et al. (2003) looked at reaction times to assess the extent to which images of individuals either with disabilities or without disabilities were implicitly linked to semantic information regarding disease. It was found that disabled individuals were more likely to be associated with disease than non-disabled individuals were. Ackerman et al. (2009) also found that disfigured faces were more likely to hold the attention of participants who had been primed with visual images relating to pathogen contagion.

If the behavioural immune system is sensitive to morphological deviations and abnormalities, then it is likely that it will be sensitive to signals of extreme obesity or malnourishment. To date there has been little research examining aversive reactions to extremely thin people, however some research (Park et al., 2007) has examined the behavioural immune system and negative attitudes towards obesity. Images of obese people often arouse disgust (Harvey, Troop, Treasure, & Murphy, 2002) which suggests that dislike of obese people could be linked to the behavioural immune system. Park et al. (2007) looked to see if anti fat attitudes (measured by a questionnaire measuring antipathy toward obese people) were correlated with individual differences in perceived vulnerability to disease (measured by the PVD scale). They found a positive correlation between perceived vulnerability to disease and dislike of fat people, this effect was found to be much stronger when individuals had viewed images of obese people before completing the antipathy measure. In addition to this, Park et al. (2007) conducted an experiment where they made pathogen concern salient by using a slide show of images relating to germs and diseases. Following this the participants were given an implicit association task to assess the extent to which disease and unpleasantness concepts were associated with images of obese people. It was found that the manipulation increased the extent to which obese people were implicitly linked with disease but did not affect the association between obesity and unpleasantness. This suggests that not only is concern about disease linked with a dislike of overweight people but that also the visual perception of individuals who deviate from morphological norms will activate the behavioural immune system.

Dramatically underweight individuals may be perceived as being contagious as parasite infections can result in substantial weight loss, however research has yet to examine if the same effect would be found with severely underweight individuals. Obesity has no logical link with infection and therefore the findings of Park et al. highlight the non-rational functioning of the behavioural immune system and how, as obesity was unlikely to be present in the past, it has evolved to respond to a wide range of cues including any kind of morphological deviation from the norm.

There is also research (Faulkner, Schaller, Park, & Duncan, 2004; Navarrete & Fessler, 2006) to suggest that the behavioural immune system contributes to xenophobia and ethnocentrism. Faulkner et al. (2004) demonstrated in a Canadian sample of participants that higher concerns about perceived vulnerability to disease (measured using the PVD scale) were correlated with anti-immigration attitudes (xenophobia) but only when the immigrants were from a subjectively foreign location (e.g., African countries). Perceived vulnerability to disease did not predict negative attitudes from a subjectively familiar location (e.g., Eastern Europe). Furthermore, Faulkner et al. (2004) showed, in an experiment that made concerns about pathogen threat salient by showing a series of images relating to the transmission of germs and bacteria, that participants exhibited far stronger xenophobic attitudes as compared to participants who had viewed images not relating to the transmission of germs. For example, when being asked to allocate government funds to either subjectively familiar immigrants (e.g., Scottish immigrants) or unfamiliar immigrants (e.g., Nigerian immigrants) it was found that the participants who had been in the pathogen salient condition were more likely to allocate funds to familiar rather than unfamiliar immigrants. However, the participants who had viewed images not related to pathogen threat allocated similar amounts of funds to familiar and unfamiliar immigrants. Similarly, Makhanova, Miller and Manor (2015) found that white participants who scored highly on the germ avoidance subsection of the PVD (Duncan et al., 2009) showed a bias towards categorising black target faces (which may have been, among white participants, implicitly associated with foreign locations) as members of a novel out group. In addition, when the participants with low germ avoidance scores were primed by reading a news article about illness it was shown that they were also more likely to categorise black targets as members of the novel out-group.

Contact with individuals from foreign populations may result in an increased risk of contracting a disease for which the current population has no acquired immunity. In addition, foreigners may be unaware of, and therefore may violate, local customs relating to food preparation and person hygiene that prevent the transmission of disease. African countries may be associated more greatly with infectious illness due to diseases such as AIDS and Ebola having much higher prevalence there. This is possibly why the effects found in Faulkner et al. (2004) were only present when immigrants were from these types of foreign locations. Hence, the behavioural immune system may respond to cues that suggest an individual is foreign to the population because to do so will lead to reduced infection.

Research by Navarrete and Fessler (2006) supports the findings. They have shown in American participants that increased perceived vulnerability to disease (measured using the PVD) is related to greater positive attitudes towards one's own cultural group, in this case America (measured using the American Ethnocentrism Scale; Neuliep, & McCroskey, 1997). In addition to this, they have also demonstrated that sensitivity to disgust is related to xenophobia. Specifically, it was found that scores on the Disgust Scale (Haidt, McCauley, & Rozin, 1994) predicted a participants' preference for a culturally familiar target (an American author) over a foreign target (a foreign author). Moreover, following exposure to the Disgust Scale the participants showed an increased preference for the American target over the foreign one compared to controls. This suggests that the scale had acted as a pathogen prevalence prime, making concerns about pathogen threat more salient.

In line with this research has shown that women in the first trimester of pregnancy exhibit heightened ethnocentric and xenophobic attitudes (Navarrete, Fessler, & Eng, 2007). The first trimester of pregnancy is accompanied by increased vulnerability to disease due to immunosuppression, which is necessary for tolerance of the foetus. Therefore, this suggests that a weakened immune system can lead to prejudice and discriminatory attitudes. In addition to this, it has been found that females in the first trimester of pregnancy experience greater disgust sensitivity than females in the second or third trimesters. Despite there being a relationship between disgust and nausea, results showed that individual levels of nausea and stage of pregnancy both contributed separately to levels of disgust sensitivity. This suggests that the elevated levels of disgust seen in the first trimester are not just due to increased nausea at this stage but are possibly a result of an increased vulnerability to disease

Research (Lund & Boggero, 2014) has also demonstrated that the behavioural immune system may play a part in stigmatism and prejudice towards mental illness. Lund and Boggero demonstrated that participants implicitly associated mental illness with disease and sickness over danger. It was also shown that this effect was increased when participants were presented with a news article, about the H1N1 influenza virus, intended to prime concerns about pathogen threat in participants. Therefore, a behavioural immune response may play a role in prejudice attitudes to those suffering from mental illness. Other research (Murray & Schaller, 2012) has shown that when individuals are, or perceive themselves to be, more vulnerable to pathogen infection, they are more likely themselves to conform to majority opinion and to more strongly encourage conformist behaviour in others. Historically conformance to local customs particularly those related to food preparation and personal hygiene were an important way of limiting the spread of infection and conformist behaviour would have been beneficial in pathogen risky environments. This suggests the behaviour immune system does not only play a role in discriminatory behaviours but also conformist behaviours and attitudes.

Interestingly research (Schaller, Miller, Gervais, Yager, & Chen, 2010) has suggested that the behavioural immune system may affect the biological immune system. It would appear even the visual presence (images depicting people displaying symptoms of illness e.g., coughing, sneezing) of pathogens and disease can trigger a physical immune response. Schaller et al. (2010) demonstrated that presenting the visual images of people coughing and sneezing had physiological effects in their participants. It was found that the participants who were shown these images had higher levels of the pro-inflammatory cytokine interleukin-6 (IL-6) compared to controls. As IL -6 is a cytokine secreted by the white blood cells as part of the immune system response to pathogen presence in the blood stream, an increased level suggests a more aggressive immune following pathogen priming. This response did not occur in individuals who were shown images relating to threat to induce stress meaning that the response was specific to cues of disease and not related to possible stress caused by viewing the disease images.

The research outlined above suggests that the behavioural immune system has implications for a range of behavioural responses to people who may be completely healthy. Signal detection problems mean the behavioural immune system responds to a general set of stimuli and a variety of different cues can be misinterpreted as a sign of illness or pathogen presence. As discussed this could result in prejudice and discriminatory attitudes. The behavioural immune system may have implications, not just at an individual level, but also across society and this will be considered in the next section.

1.6.1 Cross Cultural Effects of the Behavioural Immune System

There are several cross cultural effects of the behavioural immune system, for example when looking at worldwide personality Schaller and Murray (2008) found that in environments with higher pathogen prevalence there were lower reported levels of the personality traits extraversion and openness to experience. High levels of these personality traits imply greater impulsivity and a tendency to take risks and deviate from norms. This could result in an increased exposure to pathogens especially in environments with increased pathogen threat. Therefore, these traits would not be advantageous in environments with high levels of pathogen prevalence. Indeed, research has shown that individuals who report higher levels of concern about disease also report lowers of extraversion (Duncan, Schaller, & Park, 2009). Consequently, personality styles may vary as a response to the current environmental conditions meaning in environments where pathogen prevalence is high individuals adopt a more cautious and careful disposition. In environments where there is a greater threat of disease, the society norms are more likely to be characterised by behaviours that reduce the risk of infection.

Supporting this is research (Fincher, Thornhill, Murray, & Schaller, 2008; Thornhill, Fincher, & Aran, 2009) that has shown that higher levels of pathogen prevalence are related to higher levels of collectivism in cultures also suggesting that pathogen prevalence is related to changes in behaviours. Furthermore, research (Murray, Schaller, & Suedfeld, 2013) has shown that the pathogen prevalence of a society is related to the government style in that society, with authoritarian governments being linked to higher levels of pathogen prevalence. Additionally, White, Kenrick and Neuberg (2013) also demonstrated that when looking at the 2010 USA congressional elections, in districts with higher pathogen prevalence physically attractive candidates were more likely to be elected, which was suggested to be due to physical attractiveness being used as a cue to the health of an individual. Also, the use of culinary spices is greater in environments where there is greater threat of disease (Sherman & Billing, 1999). This is possibly because spices are natural antibiotics and their use in food may be a useful defence against pathogen infection. Consequently, making them more beneficial in conditions where there is greater threat of disease and infection.

It is possible however, that increased use of spices in these environments could be related to them being more readily available due to the climate in these settings. In addition, differences in personality characterises could be partially a result of a difference in cultural traditions. Further problems with cross cultural methods are discussed in more detail in Chapter 2, nevertheless it would seem the affects of the behavioural immune system could be seen not only at an individual level but also possibly throughout society. Another important cross cultural effect of the behavioural immune system are potential differences in mate choices brought about by the increased detection of health cues in pathogen heavy and risky environments.

1.6.2 Behavioural Immune System and Mate Choice

Infectious disease is often acquired from individuals of the same species. Infections can be spread from bodily fluids or contact with food or water that has been contaminated by these infected fluids. We should try to reduce contact with individuals who present with cues that signify infection and this is particularly important in potential mates, as this type of relationship involves repeated interactions and has implications for future offspring fitness.

Preferring healthy individuals as mates has reproductive benefits. It has been suggested (Tybur & Gangestad, 2011) that there are both direct and indirect benefits that occur from mating with healthy individuals. Direct benefits include reduction of the chance of contamination and infection. In addition, disease free individuals are likely to be better able to care for potential offspring, and infected individuals may transmit the infection to offspring either in utero or while caring for offspring. Indirect benefits from mating with a healthy individual include a likelihood that they will pass good genes on to their offspring. Therefore, in environments where disease is particularly prevalent the benefits of avoidance of infectious disease and therefore the preference for non-infected mates should be greater. To select a mate that is free from disease or illness involves being able to detect cues that indicate this and therefore it is possible that the behavioural immune system plays an important role in mate choice and influences what we find attractive when we are feeling vulnerable to disease.

Accordingly, Gangestad and Buss (1993) have shown that in countries where there is increased pathogen prevalence, physical attractiveness is valued more in a mate than in environments with lower pathogen prevalence. This is thought to be because of the potential relationship between physical attractiveness and health, with good physical appearance being one possible indicator of health. As previously mentioned (see Chapter 1 Section 1.5.1), DeBruine, Jones, Crawford, Welling and Little (2010) demonstrated that women from countries with poor national health, and therefore probable increased threat of disease, show a greater preference for masculinity in male faces. Sexual dimorphism, in this case increased signals of masculinity, is a trait thought to be associated with better health suggesting that females at greater risk of disease are attracted to male's they perceive to be healthy.

1.6.3 Disgust

One key component of the behavioural immune system is the emotion disgust. Disgust is a varied emotion which is brought about by a variety of acts, substances and behaviours. Although disgust may have ancient evolutionary roots in a basic distaste response to spoiled foodstuffs (Rozin, Haidt, & McCauley, 2008), it is widely believed to be an emotion that has evolved to motivate behavioural solutions to many different adaptive problems (Tybur et al., 2009).

An increasing amount of research has demonstrated disgust to be a key component in disease avoidance mechanisms (Oaten, Stevenson, & Case, 2009). For example, research (Curtis, Aunger, & Rabie, 2004) has shown that objects which pose a potential disease threat are reported as being significantly more disgusting than control images which have no disease relevance. Schaller (2014) suggests that disgust almost always accompanies reactive responses, such as a direct avoidance of infected substances, to sensory cues that indicate an immediate risk of infection e.g., the smell of faeces. There are also proactive responses, such as prejudice towards individuals with disabilities, brought about by cues that may indicate a potential threat of disease e.g., physical disfigurements. However, it is not always clear if disgust always accompanies these type of proactive responses. Schaller says that although disgust may not be present in the immediate context of a behavioural immune system response, such as an increase in conformist behaviour or a prejudice attitude, disgust may still have played an important causal role in producing this type of behavioural immune response. Energy resources are consumed every time emotions are aroused, therefore it is unlikely that disgust would have evolved unless it is linked with unique disease-avoidant benefits that outweighed its costs. Schaller (2014) argues that one of the most important benefits of disgust is its affect on memory and the long term casual implications that result from this. The arousal of disgust at one moment in time may have consequences for proactive disease avoidance behaviour in the future. For example, disgust may elicit memories that then facilitate behavioural avoidant strategies. On a grander scale, disgust might be associated with individuals who are subjectively different to oneself. These feelings of disgust might generalise and indirectly facilitate prejudicial attitudes towards those like the associated individual. Therefore, Schaller (2014) suggests that although the role of disgust may not be as immediately clear in the role of proactive behavioural avoidance it does in fact indirectly play an important role through its affects on memory and attitude formation.

Disgust can come in different forms, Tybur et al. (2009) has proposed that disgust can be broken down into three different domains; moral disgust, sexual disgust and pathogen disgust. Pathogen disgust in particular is directly related to a behavioural immune system response. At the most basic level it is thought pathogen disgust evolved directly because of its disease prevention functions and its ability to aid pathogen avoidance (Fessler & Navarrete, 2003; Rozin & Fallon, 1987; Tybur et al., 2009; Tybur, Lieberman, Kurzban, & DeScioli, 2013). Tybur et al. (2013) argue that pathogen disgust serves as an initial line of defence against pathogen infection. Many things that elicit pathogen disgust are also likely to pose a risk of infectious disease e.g. bodily fluids such as vomit, feces, mucus, spoiled foods and micro-organisms such as fleas, lice and other bugs. Therefore, by motivating avoidance of these things disgust acts to protects us against disease and infection. Consistent with signal detection problems of the behavioural immune system, people experience disgust in response to an overly inclusive set of stimuli, experiencing disgust by not only things that pose a real threat of infection (e.g. dog faeces) but also by things that pose no risk at all but have a resemblance to real risks (e.g. chocolate shaped like dog feces) (Rozin, Millman, & Nemeroff, 1986). Thus disgust easily generalises to many objects. Schaller (2014) suggested that disgust is fundamental to the behavioural immune system, Lieberman and Patrick (2014) have also claimed that there is no difference between the behavioural immune system and the behavioural avoidance motivated by pathogen disgust described by Tybur et al. (2009, 2013).

As previously mentioned (see Chapter 1 Section 1.5.1), individual levels of pathogen disgust have been shown to be related to preferences for sexual dimorphism in faces. It has been shown (DeBruine, Jones. Tybur, Lieberman & Griskevicius, 2010; Jones, Feinberg, Watkins, Fincher, Little & DeBruine, 2013; Jones, Fincher, Welling, Little, Feinberg, Watkins & DeBruine, 2013) that people who rate higher on measures of pathogen disgust show greater preference for masculinity/femininity in opposite sex faces. Therefore, it seems that individuals who exhibit greater pathogen disgust show a preference for healthier faces.

Tybur et al. (2009, 2013) argue that sexual disgust evolved to assist individuals with avoiding reproductively costly sexual behaviours. This therefore aids with the production of healthy offspring. For example, although an individual's close family members may possess attractive qualities, family members are not good mating partners due to the increased chance of producing less healthy offspring. Moral disgust relates to antisocial activities e.g. lying and cheating. From an evolutionary perspective, avoiding contact with individuals who inflict social costs on an individual or their social group would have been beneficial (Tybur et al., 2009; 2013). Whereas pathogen disgust motivates behavioural avoidance of individuals who pose an infection risk and sexual disgust motivates avoidance of individuals in a specific sexual context, moral disgust motivates avoidance of social relationships with individuals who engage in adverse social behaviours. Consequently, according to Tybur et al. (2009) each type of disgust addresses a unique set of adaptive problems.

1.6.4 Summary

It would appear that humans have evolved a behavioural immune system to enable them to be able to detect the threat of disease via sensory cues that signify pathogen infection (Schaller & Duncan, 2007). However, as a result of signal detection problems the system responds to an overly inclusive set of stimuli and a variety of different cues can be misinterpreted as signs of infection (Kurzban & Leary, 2001). This is thought to have possibly contributed to prejudice behaviours against those with disabilities, with individuals wrongly interpreting physical disability as a cue of pathogen infection (e.g., Park et al*.,* 2003). It is even thought to have contributed to xenophobia with individuals being concerned about pathogen infection from those from foreign populations (e.g., Faulkner et al*.,* 2004).

Owing to the functional flexibility of the behavioural immune system (Schaller & Park, 2011) individuals become more vigilant to cues of infection when in environments where individuals are, or they perceive themselves to be, under increased vulnerability to pathogens. This appears to cause variations in preferences and behaviours across populations due to differences in pathogen prevalence in the local environment (e.g., Gangestad & Buss, 1993; Little et al*.,* 2007; Schaller & Muller, 2008; Sherman & Billing, 1999).

The behavioural immune system therefore has implications for cross cultural variations in behaviour. It is feasible that cross cultural differences in certain behaviours and preferences may, in part, be because of long standing differences in environmental pathogen load. For example, the cross cultural differences found in preferences for body weight could be due partly to different levels of pathogen prevalence in these cultures, which then become sexually selected owing to increased survival and mating success especially in remote populations.

As mentioned in Chapter 1 Section 1.5, body weight is potentially an important cue to the perceived health of an individual. Research has shown that individuals use BMI when making health judgments regarding female bodies (Swami, Miller, Furnham, Penke & Tovée, 2008) When looking at faces it has also been found that the adiposity of the face is an important cue to the perceived health of it (Coetzee et al., 2009). Body weight is associated with actual health measures, for example being underweight is linked with decreased immunity (Ritz & Gardner, 2006) and increased mortality (Flegal et al., 2005). In certain environments there are persistent problems with infectious diseases such as diarrhoea, tuberculosis, AIDS and Ebola. One symptom that is consistently linked with these deadly diseases is weight loss. Obese and overweight individuals are also at risk of many health problems including cardiovascular disease and diabetes (Mokdad et al., 2003; Wilson et al., 2002). Therefore, it would seem that being out of the optimal weight range is linked with poor health making body weight a good visual cue to health. Indeed, in British participants both underweight and overweight female bodies are judged as less attractive than normal weight bodies and this is possibly because they are perceived as being less healthy (Tovée et al., 2006). In South African Zulu participants overweight bodies are rated as attractive as normal weight bodies and this could be because in their culture excess body weight is not seen as sign of poor health (Tovée et al., 2006). Consequently, as body weight is potentially a good cue to better health it is possible that individual preference for body weight might vary, within the typical healthy range, in environments where people feel increased vulnerability to disease and illness.

1.7 Health and Attractiveness in Bodies

The relationship between health and attractiveness judgments regarding bodies is complex and apparently contradictory. As discussed body weight appears to be a good indicator of potential health and it is likely that bodies that are perceived to be healthy would also be perceived as being attractive. In mate choice (see section

1.6.2), selecting healthy individuals who are free from infectious disease has both direct and indirect benefits on survival and reproductively; direct benefits are the reduced risk of contamination and possible better access to resources if the individual is able to maintain good health. Indirect benefits include healthy genes that can be passed on to offspring. Accordingly, perceived health is an important cue in attractiveness judgments because of its benefits. Indeed, research with faces has shown that faces with higher levels of symmetry and sexual dimorphism (both associated with good genes and pathogen resistance) are rated as being more attractive (Gangestad & Thornhill, 2003; Rhodes, Chan, Zebrowitz, & Simmons, 2003; Thornhill & Gangestad, 2006; Wells, Baguley, Sergeant, & Dunn, 2009). However, when looking at research with bodies (Coetzee, Re, Perrett, Tiddeman, & Xiao, 2011; Stephen & Perera, 2014; Tovée, Furnham, & Swami, 2007) it has been suggested that participants tend to differ in their judgments of what they perceive to be an attractive and healthy body weight: in general, what is found to be a healthy body weight is usually heavier than what is found to be an attractive body weight. For example, Tovée et al. (2007) found, that when judging female bodily attractiveness, the healthiest BMI was not always perceived as the most attractive BMI. Although the differences between the two were often small, it was found that a lower BMI was preferred when judging bodies for attractiveness than when judging bodies for health. Using a Malaysian sample Stephen and Perera (2014) also demonstrated that males and females preferred a lower BMI when rating for attractiveness than when rating for health. In addition, Coetzee et al. (2011) found that females preferred lower levels of facial adiposity when judging faces for attractiveness compared to when judging faces for health. However, this was not apparent in males who preferred similar levels of facial adiposity when judging faces for attractiveness and health. It has also been suggested (Stephen & Perera, 2014; Swami & Hull, 2009) that a halo effect may be moderating the relationship between attractiveness and health in bodies such that BMI's for heath are being pulled towards the optimal BMI for attractiveness and are therefore being perceived as lower than they otherwise would be. It is possible then that the halo effect is masking people's true perceptions of a healthy BMI, which means the discrepancy between health and attractiveness may be even larger than it first appears.

It is likely a range of cultural factors (for example media influence and pressure from family and peers) also contributes to this difference between the perception of attractiveness and health in bodies. The influence from the Western media, that places high value on thinness and that promotes the belief that being thin is necessary to be attractive, is likely to cause some of the discrepancy between an attractive and healthy body weight. Indeed, Myers and Crowther (2007) have shown that the media play a crucial factor in the internalisation of a thin ideal. The ideal weight that is presented by the media may often not conform to health ideals, for example runway models have been criticised by health officials for having BMI's lower than what is considered healthy, with the average runway's model's BMI being below the World Health Organisation's threshold (<16) for medically dangerous thinness (Record & Austin, 2016). Research has also demonstrated that Miss America contestants and Playboy centrefolds have become increasingly thinner over a 20 year period (Garner et al., 1980). Concomitantly Stephen and Perera (2014) report that the preferred BMI in their sample fell in to the underweight BMI category (< 18.5) and it is possible that the media have helped create the view of what is perceived to be an attractive body weight. As some research has shown that the discrepancy between a healthy and attractive female weight is not present in males (Coetzee et al., 2011), this could suggest that the relationship is being moderated by levels of body dissatisfaction and pressure felt by females.

It would appear that while the relationship between health and attractiveness in bodies appears to be affected somewhat by media influence, there is still a strong link between the two. The fact that individuals choose a heavier body when rating for health compared to attractiveness suggest that individuals are aware that a higher body weight is necessary for good health but are affected by media portrayal of the thin ideal and possible peer and family influences when rating for attractiveness.

It is crucial for mate success that individuals have the ability to efficiently evaluate the attractiveness and health of potential mates as the wrong choice can have negative effects on reproductive success. It can be demanding to make very detailed judgments of attractiveness and it can limit options and is potentially unnecessary. Therefore, to simplify the process it is more affective to assign individuals into discrete categories such as attractive and unattractive, healthy and unhealthy. Categorical perception was first suggested for speech perception (Harnad, 1987) and has been used for many other types of perception such as facial expressions (Etcoff & Magee, 1992), facial identity (Levine & Beale, 2000) and race (Levine & Angelone, 2002). It has only recently been proposed for body perception as it has previously been assumed (e.g. Fan et al., 2004; Swami, Caprario et al., 2006; Swami, Neto at al., 2007) that body ratings for attractiveness would be made along a continuum from attractive to unattractive. However, research (Tovée, Edmonds, & Vuong, 2012) has suggested that this is not the case and bodies are in fact put into categories when being perceived.

Tovée et al. (2012) found that when judging female bodies for attractiveness and health, bodies were categorised into attractive and unattractive and healthy and unhealthy categories. One of the main elements of categorical perception is that individuals will be very sensitive to changes across a category boundary, for example between attractive and unattractive. However, individuals will be less sensitive to the same amount of change in bodies if they are within the same perceptual category, for example two bodies that are both in the attractive category. When measuring the sensitivity of discrimination between pairs of bodies, Tovée et al. (2012) found significantly better discrimination for pairs that were in different categories than for body pairs that were in the same category. This does not mean that individuals are unable to differentiate between bodies in the same category but rather they cluster the bodies into categories for ease of processing (Tovée et al., 2012). Categorical perception allows, given an individual's limited neural processing resources, improvement in across category sensitivity by reducing the sensitivity within categories. Tovée et al. (2012) suggested that by enhancing the perception of physical differences across categories the perceptual system can make rapid decisions about important visual information regarding the human body. Instead of being equally sensitive to the physical changes in bodies across a whole range of body sizes and shapes, individuals have increased sensitivity at the point at which a body changes from attractive to unattractive, as this is arguably the most important part of the range.

As discussed in Section 1.3 there are cross cultural differences in what constitutes an attractive body. Therefore, it is likely that category boundaries will vary across cultures, with the point at which a body goes from attractive to unattractive or healthy to unhealthy, being different in different settings.

1.8 Rationale and Aims

It can be argued that while cues such as BMI and WHR are crucial in making judgments about bodies the roles played by these cues are sensitive to environmental and ecological conditions. Research has demonstrated cross cultural effects in preferences for bodies (e.g., Tovée et al*.,* 2006) and has shown variations in body preferences across different SES groups (e.g., Swami & Tovée, 2007a, 2007b). This has highlighted a preference for heavier female bodies in environments where there are a lack of resources. In addition to this, it has been demonstrated that these effects can occur at an individual level with males who feel hungry showing an increased preference for heavier female bodies (Nelson & Morrison, 2005; Pettijohn et al*.,* 2009; Swami & Tovée, 2006).

As previously outlined (see Section 1.6) the behavioural immune system has implications for a broad range of psychological responses, including avoidant behaviours, and prejudice behaviour and attitudes. If individuals' preferences for bodies are affected by environmental factors such as resource availability, body preferences could also be affected by other important environmental factors like disease level and potential existence of pathogens. Consequently, it is possible that the behavioural immune system also has implications for the way we perceive bodies. As described in the literature review, research (e.g., DeBruine, Jones. Tybur, Lieberman & Griskevicius, 2010; Jones, Fincher, Welling, Little, Feinberg, Watkins & DeBruine, 2013) with faces has demonstrated a relationship between face preferences and individual levels of pathogen disgust. In addition to this research (Lee & Zietsch, 2011; Little et al*.,* 2011; Watkins et al*.,* 2012) has begun to show effects of experimentally manipulating individuals to experience concerns about pathogen threat and a change in face preferences.

However, although research has started to examine pathogen prevalence and face preferences this has never before been explored looking at body preferences. There is no research that currently brings together the literature on body preferences and the research on pathogen prevalence and the behavioural immune system. Consequently, this thesis will be the first to do this. Therefore, the main aim of this thesis is to experimentally examine the effects of perceived pathogen levels on body weight preferences.

Research on body preferences has relied heavily on line drawn or photographic stimuli. An alternative to these types of stimuli is the use of computer generated stimuli. Therefore, the thesis also aims to develop and validate a new set of computer generated body stimuli that can be used to measure body preferences and body dissatisfaction.

A large amount of the research on bodies has focused exclusively on female bodies, in this thesis preferences for both female and male bodies will be examined asking participants to make both same sex and opposite sex ratings. Perceived pathogen levels should affect preferences for male bodies as well as female bodies since body weight should be a cue to better health in both male and female bodies. Male and female bodies with a healthy weight have direct benefits of being pathogen free and reduced risk of contagion. However, some of the research (Nelson & Morrison, 2005) on body preferences and resource scarcity has found effects only in male's preferences for female bodies. It is not fully understood why this effect would not be present in female preferences for male bodies as the effect has been demonstrated in females in non-human animals (Fisher & Rosenthal, 2006). The research looking at pathogen prevalence and faces has demonstrated an effect in female's preferences for male faces. Therefore, it is possible that preferences for male bodies could be affected by pathogen prevalence in the same way as female bodies.

Chapter 2

Methodology

2.1 Introduction

This thesis is primarily concerned with measuring the effect of perceived pathogen levels on body weight preferences. This chapter outlines the methods that have been commonly used to assess pathogen prevalence and levels, particularly priming methods and how they can be used to cue concerns about pathogen threat.

Research examining pathogen prevalence and the behavioural immune system has used a variety of methods to test and examine hypotheses, however the three main methods used have been cross cultural correlations, individual differences and experimental priming (Tybur, Frankenhuis, & Pollet, 2014). These will now be discussed in more detail in the following sections.

2.2. Cross cultural methods

These methods test the extent to which levels of pathogen prevalence in certain cultures or populations covary with levels of certain behaviours (e.g., personality types or face preferences) in these populations. General indices of health have been used as a measure of pathogen stress in a population (e.g., DeBruine, Jones, Crawford, Welling & Little, 2010; White et al., 2013). Other research (e.g., Schaller

& Murray, 2008) has used measures such as Low's (1990) method of identifying the prevalence of nine different kinds of diseases and parasites (leishmania, schistosoma, trypanosoma, malaria, filaria, leprosy, dengue, typhus, and tuberculosis) around the world. This was estimated using old medical atlases and epidemiological maps, assigning a numerical score for each parasite based on its prevalence in a population. These prevalence scores were then totalled together for all nine parasite groups to create a final score for a population. Research using these methods has correlated measures of pathogen prevalence with various variables e.g., personality (Schaller & Murray, 2008), government style (Murray et al., 2013), the use of culinary spices (Sherman & Billing, 1999), and preferences for sexual dimorphism in faces (DeBruine, Jones, Crawford, Welling, & Little, 2010).

A problem with using these type of methods is the suggestion that using group level data to make inferences about individual level relationships is problematic (Tybur et al., 2014). For example, countries with higher levels of chocolate consumption have more Nobel Prize winners but there has been no evidence to suggest that individuals who consume more chocolate are more likely to win a Nobel Prize (Maurage, Heeren, & Pesenti, 2013). Another problem is the way in which pathogen prevalence is measured in cross cultural studies. These types of measures combine several types of pathogens which might be differentially confounded with other variables such as ethnicity, age, and educational levels. For example, Thornhill and Fincher (2011) calculated a pathogen stress index for each USA state using Centres for Disease Control estimates of morbidity and mortality caused by communicable disease. However, this index mainly measures sexually transmitted infections rather than other diseases (Hackman & Hruschka, 2013). This can be problematic when looking at the findings from Thornhill and Fincher (2011), which suggest that across the USA rates of certain types of homicide were higher in states with greater rates of communicable diseases, Hackman and Hruschka (2013) and Hruschka and Hackman (2014) have suggested that the correlations between pathogen stress and homicides were in fact an artefact of aggregating data across ethnic groups that have extremely different levels of sexually transmitted infections and homicides. The findings simply reflect the fact that certain states in the USA have higher numbers of particular ethnic groups meaning higher numbers of sexually transmitted infections and higher numbers of homicides. This variability in ethnic groups across populations has led to the findings rather than a causal effect of pathogen prevalence on homicide incidence.

Cross cultural studies have provided a good amount of evidence for the behavioural immune system and suggest that variation in some behaviours found in across cultures may be a result of different levels of pathogen prevalence. Findings from cross cultural and population studies should be treated with some caution due to the reasons with measurement of pathogen prevalence and confounding variables, however they do provide support for the behavioural immune system hypothesis.

2.3 Individual differences in concerns about pathogen threat and vulnerability

The method of using individual differences in concerns about pathogen threat or vulnerability refers to using scores on measures of individual levels of pathogen disgust or levels of perceived vulnerability to disease and examining how they covary with other measures, such as personality, attitudes and behaviours. Tybur et al. (2014) suggest that the three most common measures used to asses individual differences in concerns about pathogen threat are the Perceived Vulnerability to Disease (PVD) scale (Duncan et al., 2009), the Three Domains of Disgust (TDD) scale (Tybur et al., 2009) and the Disgust Scale (Haidt et al., 1994).

The PVD is composed of two factors. These are germ aversion and perceived infectability (Duncan et al., 2009). The germ aversion component relates to being concerned about contamination of germs and includes items such as, 'It *really bothers me when people sneeze without covering their mouths'*, and *'I do not like to write with a pencil someone else has obviously chewed on'*. Whereas perceived infectability relates to frequency of illnesses and has items such as, *'In general, I am very susceptible to colds, flu and other infectious diseases'*, and *'I am more likely than the people around me to catch an infectious disease'*. The PVD scale is used to assess individual differences in perceived vulnerability to infectious disease and has been used to examine the relationship between levels of this and discriminatory attitudes (e.g., Makhanova et al., 2014; Park et al., 2003, 2007).

The TDDS (Tybur et al., 2009) has 3 factors each measuring a different domain of disgust (pathogen, sexual and moral disgust). Participants rate how disgusting they find each item on a sale of 1 -7. Items from the pathogen domain include, *'Standing next to someone on the bus who has strong body odour'*, and *'Touching a dead body'*. The pathogen domain is the most appropriate for research regarding concerns about pathogen threats and the behavioural immune system. It has been used to examine the relationship between pathogen disgust and various traits such as preference for masculinity in male faces and femininity in female faces (e.g., DeBruine, Jones, Tybur, Lieberman & Griskevicius, 2010; Jones, Fincher, Welling, Little, Feinberg, Watkins & DeBruine, 2013)

The Disgust Scale (Haidt et al., 1994) comprises items intended to measure disgust. Items include, *'You take a sip of soda, and then realize that you drank from the glass that an acquaintance of yours had been drinking from'*, and *'You are about to drink a glass of milk when you smell that it is spoiled'*. It has been used in research which shows that people who score highly on this are more likely to have xenophobic attitudes (Navarrete & Fessler, 2006).

One criticism of using the Disgust Scale is that some of the items on the scale do not have a direct relationship to pathogen avoidance e.g., 'You see someone put ketchup on vanilla ice cream, then eat it'. Therefore, the appropriateness for its use in research concerning the behavioural immune system is not always clear (Tybur et al., 2104). However, it is still a valid tool for assessing disgust and therefore has been useful for examining the relationship between disgust and certain attitudes, for example xenophobic attitudes, which still provides some support for the behavioural immune system.

Another criticism is that although the scales are measuring different things they have been used interchangeably. The scales are only moderately correlated with each other (Tybur et al., 2014). Therefore, Tybur et al. (2014) suggested that researchers need to better explain the differences in the constructs measured by these scales to select the most suitable one for testing a particular hypothesis. These scales have still provided valuable evidence for the behavioural immune system, in general research using these scales seems to suggest that individuals scoring highly on perceived vulnerability to disease and levels of pathogen disgust can show different preferences and attitudes compared to those who score lower, suggesting that individual levels of concern about pathogen threat can have similar effects to those seen across cultures and populations.

2.4 Experimental priming

Previous research (e.g., Ackerman et al., 2009; Lee & Zietsch., 2011; Little et al., 2011; Makhanova et al., 2014; Schaller et al., 2010; Tybur et al., 2011; Watkins et al., 2012) that has experimentally explored perceived pathogen levels and concerns about pathogen threat has used a priming paradigm. This has involved presenting participants with a variety of different pathogen related primes (visual, olfactory, tactile and written information), looking at this effect on face preferences, behaviours and physiological responses. For example, Watkins et al. (2012) presented participants with the PVD scale (Duncan et al., 2009) to complete in the priming phase, so as to prime concerns about pathogen threat. Immediately after the prime they were presented with a two alternative forced choice test in order to see if the prime had affected their face preferences, compared with participants who had been primed with a questionnaire to activate concerns about resource scarcity. Similar to this Makhanova et al. (2014) primed participants by giving them a news article about the threat of a flu pandemic to read before presenting them with faces to categorise into groups. This was to determine if, compared to controls primed with a news article about weather, the pathogen prime caused a bias towards categorising faces implicitly associated with disease in an out group. In another example Little et al. (2011) used visual images of items thought to provoke concerns about pathogen threat. In this experiment participants had their face preference measured before being primed with a slideshow of visual images, participants then had their face preferences measured again after priming to establish if the prime had affected their preferences. Using a different priming modality Tybur et al. (2011) used olfactory primes that smelt of faeces in order to prime concerns about pathogen threat in their experiment. It was shown that priming increased intentions to practice safe sex.

Whilst a variety of different primes have been used including visual, olfactory, tactile and written information, the mechanisms underlying the behavioural immune system may not process all types of pathogens cues in the same way. It is unclear if and how different types of pathogen primes affect participant responses. For instance, an olfactory prime or a tactile prime that triggers the senses with a sensory cue may have a different effect to a written prime such as completing a questionnaire. A tactile prime involving touching something wet and viscous would lead to a pull away response where a written prime may not have this type of response. Primes may also have different effects on attention and memory, some research (Ackerman et al., 2009) has shown that attention to disfigured faces increases following a visual pathogen prime. A different kind of prime may lead to different results, for example an olfactory prime may cause attention to different things such as the source of the odour and or draw attention to different characteristics compared to a visual prime. Even within the same modality different types of prime may have different effects. The effects of the prime may also depend on the individual as some people may be more sensitive to pathogen cues than others.

By using a priming paradigm researchers have been able to experimentally manipulate participants' concerns about pathogen threat and vulnerability. Although priming has been used successfully in this context, there have been some criticisms directed at priming methods in general. In particular, there have been criticisms of social priming centred mainly around the suggestion that these type of priming effects can be unreliable and not always replicable (see Molden, 2014).

The term priming originally referred to how processing a stimulus makes a person more receptive to that same stimulus a period of time after (Bruner, 1957). Exposure to a stimulus can also affect the processing of subsequent stimuli that are related to the original stimulus. For example, in semantic priming, after reading the word dog, people may become faster at reading a semantically related word (e.g., cat) than without priming or priming with an unrelated prime (e.g., lamp). This is thought to be because the prime stimulus would activate its corresponding internal representation (node) in memory and such an activation would spread to other related nodes, thus facilitating the processing of related targets (Collins & Loftus, 1975). Repetition priming refers to a change in behavioural response to a stimulus following re-exposure (Oshner, Chiu, & Schacter, 1994). There is a lot of evidence for this kind of repetition and semantic priming (e.g., Ortells, Vellido, Daza, & Noguera, 2006; Tulving & Schacter, 1990). In contrast to this type of priming there is also behavioural priming sometimes referred to as social priming. Social priming occurs when the incidental processing of a cue changes behaviour (Ferguson & Mann, 2014). For example, Bargh, Chen and Burrows (1996) showed that participants primed with concepts related to the elderly (e.g., grey, wrinkle, lonely) walked more slowly down a hallway when leaving the experiment compared to those primed with words unrelated to old age. A type of social priming that has been found to be robust and reliable is evaluative priming (see Ferguson & Mann, 2014). Evaluative priming typically occurs when the evaluation of a stimulus unintentionally influences subsequent processing, such as the evaluation of another stimulus (Ferguson & Mann, 2014).

Fazio, Sanbonmatsu, Powell, and Kardes (1986) were the first to demonstrate an evaluative priming effect. Fazio et al.'s (1986) priming paradigm was adapted from the type of semantic priming originally used in memory research. For example, as mentioned, in these tasks participants are found to respond faster to a target word (e.g., dog) when primed with a semantically related word (e.g., cat) compared to being primed with an incongruent word (e.g., chair). In Fazio et al.'s evaluative priming task participants are presented with a priming word followed by a target word which they had to categorise as quickly as possible as either positive or negative. It was found that participants were faster at categorising target words (e.g., repulsive) when they were primed with an evaluatively congruent word (e.g., spider) compared to an incongruent prime (e.g., party). This shows that exposure to a stimulus then unintentionally interferes with the evaluative processing of the target stimuli. There has been an increasing amount of research using this evaluative priming paradigm and it has been used to research a wide range of phenomena including anorexia, attachment, depression, prejudice and stereotypes. (Herring et al., 2013).

Given the robustness of the priming used in cognitive psychology Ferguson and Mann (2014) concluded that evaluative priming is not only a similar process but also an extremely reliable phenomenon. Ferguson and Mann concluded that evaluative priming offers very good evidence for the general phenomenon of priming, and in particular of social priming. They suggest that there is no immediate difference between the priming used in cognitive psychology and the evaluative priming used in social psychology.

2.5 Current methods

As this thesis aims to explore the affects of perceived levels of pathogens and threat on body weight preferences in an experimental setting it was decided to use a priming paradigm to activate concerns about pathogen threat. As pathogen primes have been found to be effective in several studies (Lee & Zietsch, 2011; Little et al., 2011; Schaller et al., 2010; Tybur et al., 2011; Watkins et al., 2012) it seems it is a robust and effective method which overcomes some of the problems found in cross cultural and individual differences research. Using an experimental design rather than these type of correlational methods will allow a causal relationship to be tested. As different primes using different modalities may have different effects, the thesis will use both visual and verbal pathogen primes to explore this further.

Chapter 3

Stimuli Development

3.1 Experiment 1

The primary aim of experiment 1 was to develop and validate a set of computer generated body stimuli that could then be used in all subsequent experiments. As these experiments would be examining preferences for body weight, the stimuli needed to vary in body weight. In experiment 1a a set of female and male body stimuli that varied in body weight was validated. In experiment 1b the stimuli were used to create and validate a pictorial scale that could be used to measure body dissatisfaction.

3.2 Experiment 1a: Stimuli development and validation

3.2.1 Introduction

There has been extensive use of figure rating scales (e.g., Gardner, Jappe, & Gardner, 2009; Stunkard, Sorensen, & Schulsinger, 1983; Thompson & Gray, 1995) to represent different body weights when researching body preferences and dissatisfaction. This as a research tool has proved useful in enabling researchers to keep the properties of stimuli consistent while changing waist to hip ratios, body mass and size. However, there are various problems with using this type of stimuli.

For example, line-drawn figures have been said to lack realism and ecological validity and can therefore often appear unrealistic (Tassinary & Hansen, 1998). Thompson and Gray (1995) noted that previous line drawn scales have figures with disproportionate arms and legs, differential thickness between right and left arms, or a lack of separation between the arms and bodies in obese drawings. This has led to further criticism of research into physical attraction (e.g., Singh, 1993a, 1993b; Swami, Furnham, & Joshi, 2008) that has previously relied on line-drawn stimuli (Bateson, Cornelissen & Tovée, 2007; Gardner, Friedman, & Jackson, 1998). Often line-drawn figures (e.g., Singh, 1993a, 1993b) that vary in WHR are modified by altering the width of the torso, but this also changes apparent BMI, meaning it is not possible to say whether attractiveness ratings are made on the basis of WHR, BMI or both. In addition, these figures are usually drawn by a professional artist (e.g., Thompson & Gray, 1995). Therefore, the increase in body weight between figures is by the amount the artist subjectively considers to be an increase in body weight, rather than an accurate measurement, resulting in inconsistent size differences between successive figures (Gardner et al., 1998).

To address some of the previous problems with the measurement of figural stimuli Gardner et al. (2009) developed a line-drawn figure rating scale where the bodies were based on real body dimensions. However, although these bodies can be said to change in size, the way real bodies do, using line-drawn stimuli still lacks realism (Tassinary & Hansen, 1998). Therefore, to address these issues with line-drawn stimuli Swami, Salem, Furnham and Tovée (2008a) developed The Photographic Figure Rating Scale (PFRS). This scale comprises 10 photographic images of real women varying in BMI from underweight to obese and has been used to assess body dissatisfaction.

Although the PFRS offers improvement on line-drawn scales by using images of real bodies this can cause problems when maintaining consistency. For example, it has been noted (Swami, Salem, Furnham & Tovée, 2008a) that the bodies used in the PFRS vary in leg length. This is problematic since leg-to-body ratio (LBR) has been shown to affect attractiveness preferences in female bodies (Swami, Einon & Furnham, 2006) and therefore when being used in the measurement of body dissatisfaction some bodies may appear more attractive not because of their size but because of a more appealing LBR. In addition, the bodies used in the PFRS had their faces obscured in order to maintain consistency across images and it could be argued that this also reduces the ecological validity of the images as bodies in real life are rarely seen without faces. Problematically there is also currently no male version of the PFRS thus making comparable research with male body stimuli impossible.

Therefore, as there are various problems with the stimuli currently used in this area it was decided to create stimuli instead of using a current available body scale. The aim of this experiment was to develop a set of new pictorial stimuli, with both a female and a male version, using computer generated bodies. Using computer generated bodies improves on the drawn stimuli used in previous figure rating scales (e.g., Thompson & Gray, 1995; Stunkard et al., 1983). Computer generated images are more realistic and life-like whilst also being able to accurately control size and shape differences between successive bodies. Using computer generated stimuli allows variation in body proportions, such as LBR, to be controlled for which as seen in the PFRS cannot be controlled for when using photographic images. It also gives greater control over variation in physical characteristics like skin and facial features (identity). Therefore, as skin and facial features can be controlled for there is no need to obscure faces in the current stimuli and presenting a body with the face will likely increase the ecological validity of the stimuli.

Similar to previous research (e.g., Swami, Salem, Furnham & Tovée, 2008a; Thompson & Gray, 1995) the stimuli was initially tested for validity by assessing the extent to which the participants could successfully distinguish the size differences between the bodies. It was expected that for the scale to be valid the participants would be able to do this successfully. This was done in a 2 alternative forced choice (2AFC) task in which the participants had to state which they thought the thinnest body was out of pair of bodies. If the participants are able to correctly identify the thinnest body then it will be evident that the bodies vary in body weight in a way that is detectable by the participants.

3.2.2 Method

3.2.2.1 Participants

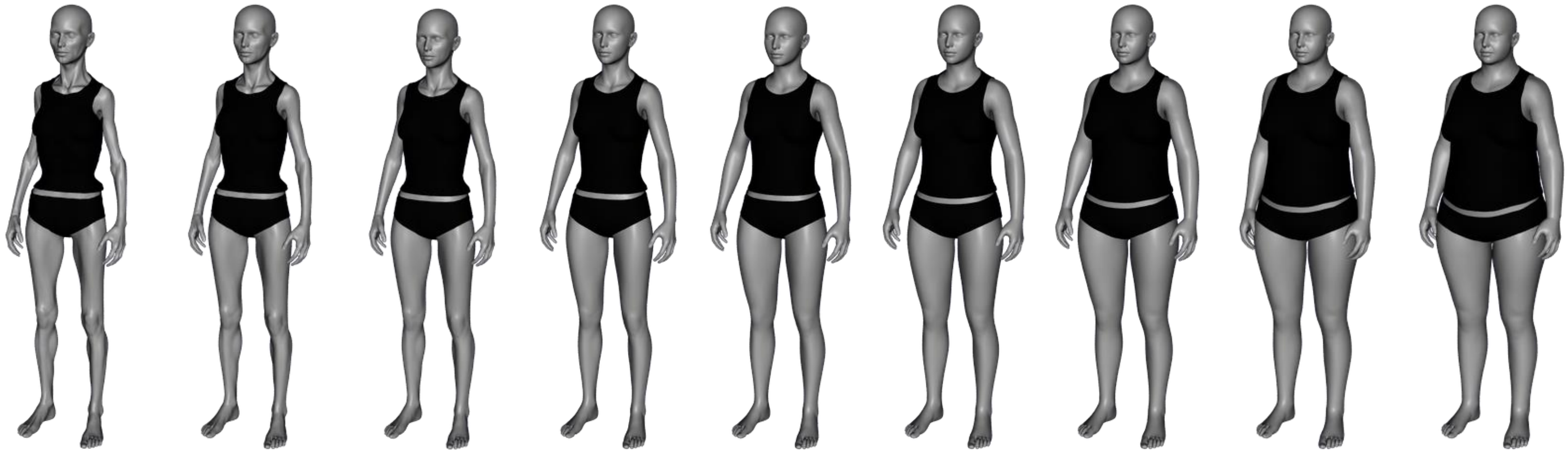
The sample consisted of 205 participants (female = 142, male = 63) who were students or staff from Nottingham Trent University.

The participants who were psychology students were given research credits in exchange for taking part in the experiment as part of the Psychology Division's research credit scheme.

3.2.2.2 Materials

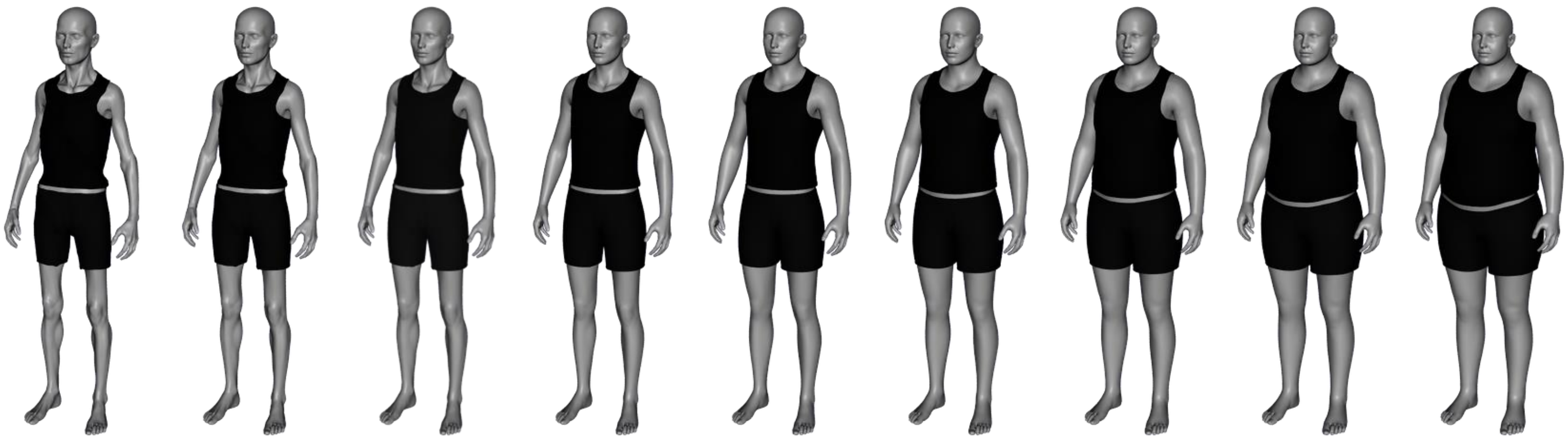
Body Stimuli: The scale was developed by creating a body with a BMI in the healthy weight category using DAZ Studio 4.0 software (www.daz3d.com). Using this software the body (Body 5 in Figures 1 and 2) was systematically altered to create 4 bodies which were successively thinner than the original body and 4 bodies which were fatter than the original body. This means 9 bodies were created in total which range from extremely thin to obese. This was done for both the female (see Figure 1) and male bodies (see Figure 2) creating two versions of the stimuli.

Figure 1: Female body stimuli



Body 1 Body 2 Body 3 Body 4 Body 5 Body 6 Body 7 Body 8 Body 9

Figure 2: Male body stimuli



Body 1 Body 2 Body 3 Body 4 Body 5 Body 6 Body 7 Body 8 Body 9

Following Crossley, Cornelissen and Tovée (2012) the bodies, without clothing, were exported out of DAZ studio into 3ds Max (www.autodesk.com). So as to measure the height of the body in real world measurements (cms). In addition to this 3ds Max calculated the volume of the body. Once volume is known the weight of the body can be estimated by multiplying the density of either the average young female body (1.04 g/cm³) or the average young male body (1.06 g/cm³). This then enabled the BMI of each body to be calculated by dividing the weight (kg) by the height (m) squared. (See Table 1 and 2 for measurements, weights and BMIs). The BMIs of the 9 bodies in both the female and male scale ranged from underweight to obese.

<u>Table 1: BMI's, Weights and Measurements of Female Bodies</u>

Body	*Height (cm)*	*Volume (cm³)*	*Density (g/cm³)*	*Weight (kg)*	*Height (meters)*	*Body Mass Index*
1	172.62	39433.94	1.04	41.01	1.73	13.8
2	172.62	43104.1	1.04	44.83	1.73	15
3	172.62	47421.31	1.04	49.32	1.73	16.6
4	172.61	52287.9	1.04	54.38	1.73	18.3
5	172.61	57364.37	1.04	59.66	1.73	20
6	172.62	66488.58	1.04	69.15	1.73	23.2
7	172.63	76290.74	1.04	79.34	1.73	26.6
8	172.64	86402.47	1.04	89.86	1.73	30.1
9	172.653	98237.68	1.04	102.17	1.73	34.3

Table 2: BMI's, Weights and Measurements of Male Bodies

Body	*Height (cm)*	*Volume (cm^3)*	*Density (g/cm^3)*	*Weight (kg)*	*Height (meters)*	*Body Mass Index*
1	172.62	40862.48	1.06	43.31	1.73	14.5
2	172.62	44786.76	1.06	47.47	1.73	15.9
3	172.62	49155.39	1.06	52.1	1.73	17.5
4	172.61	53826.42	1.06	57.06	1.73	19.1
5	172.61	58956.77	1.06	62.49	1.73	20
6	172.62	68373.29	1.06	72.48	1.73	24.3
7	172.63	78023.91	1.06	82.71	1.73	27.8
8	172.64	88868.72	1.06	94.2	1.73	31.6
9	172.65	101008.7	1.06	107.07	1.73	35.9

BMI is a useful indicator of body weight and it has been successfully used as a measure of body weight in various studies (e.g., Swami et al., 2011; Swami & Tovée, 2006, 2007a Tovée et al., 2006). BMI has been found to be related to attractiveness (Tovée et al., 1999; Swami, Antonakopoulos et al., 2006; Swami &Tovée, 2005a, 2005b) and health (Flegal et al., 2005; Mokdad., et al 2003; Ritz & Gardner 2006). There are some criticisms of BMI mainly that it is dependent on height and weight and does not take into account different levels of adiposity based on age, physical activity levels and sex. Therefore it is likely that because of this in some cases BMI either over or under estimates adiposity (World Health Organisation, 2000). However BMI is the most commonly used measure of body weight and it was chosen to use it here to distinguish body weight levels between the stimuli created. BMI classification categories as defined by the World Health Organisation are listed in Table 3 below.

Table 3: BMI Weight Categories

BMI range	*Weight category*
Below 18.5	Underweight
18.5 – 24.9	Healthy weight/Normal weight
25.0 -29.9	Overweight/Pre obesity
30-34.9	Obesity class 1

All of the bodies were depicted wearing black shorts and a T shirt, so the size and shape of the body is clearly visible and were depicted at an angle to enable more visual information about the 3D shape of the body. This gives a more realistic portrayal of the human body shape that would not be achieved by using simple front view bodies. Some researchers (Gardner et al., 2009) have recommended omitting facial and body features in pictorial stimuli that reflect Caucasian ethnicity. However, since removing or obscuring the facial features would reduce the ecological validity of the images, the bodies are instead presented in grey scale and without hair to minimise the effects of race or ethnicity but to maintain a life like look.

Two alternative forced choice (2AFC) task: Following Swami, Salem, Furnham and Tovée (2008a) and Thompson and Gray's (1995) validation of the PFRS and the CDFRS, the stimuli was tested for validity by assessing the extent to which the participants could successfully identify the body weight differences between the bodies. In Swami, Salem, Furnham and Tovée (2008a) and Thompson and Gray

(1995) the participants were asked to order the images from thinnest to heaviest and the percentage of correctly positioned bodies was used to establish this. In the current research the participants were given a task in which the participants were presented with pairs of bodies. The participants had to decide which body they thought was the thinnest body out of the pair. All possible pair combinations, with each body being presented on both the left and right, were presented. The percentage of combinations where the participants correctly identified the thinnest body was used to assess the ability of the participants to distinguish the body weight differences between all bodies and therefore validity of the stimuli.

3.2.2.3 Procedure

The participants were given the2AFC task in which they were presented with pairs of bodies using SuperLab 4.5 (www.superlab.com), on a 44.3 x 25.4 cm colour monitor. A total of 81 body combinations in total were presented to each participant in a random order. The participants had to decide which body they thought was the thinnest body out of each pair. This task was run twice for each participant, once with female bodies and once with male bodies, and this was counterbalanced.

3.2.3 Results

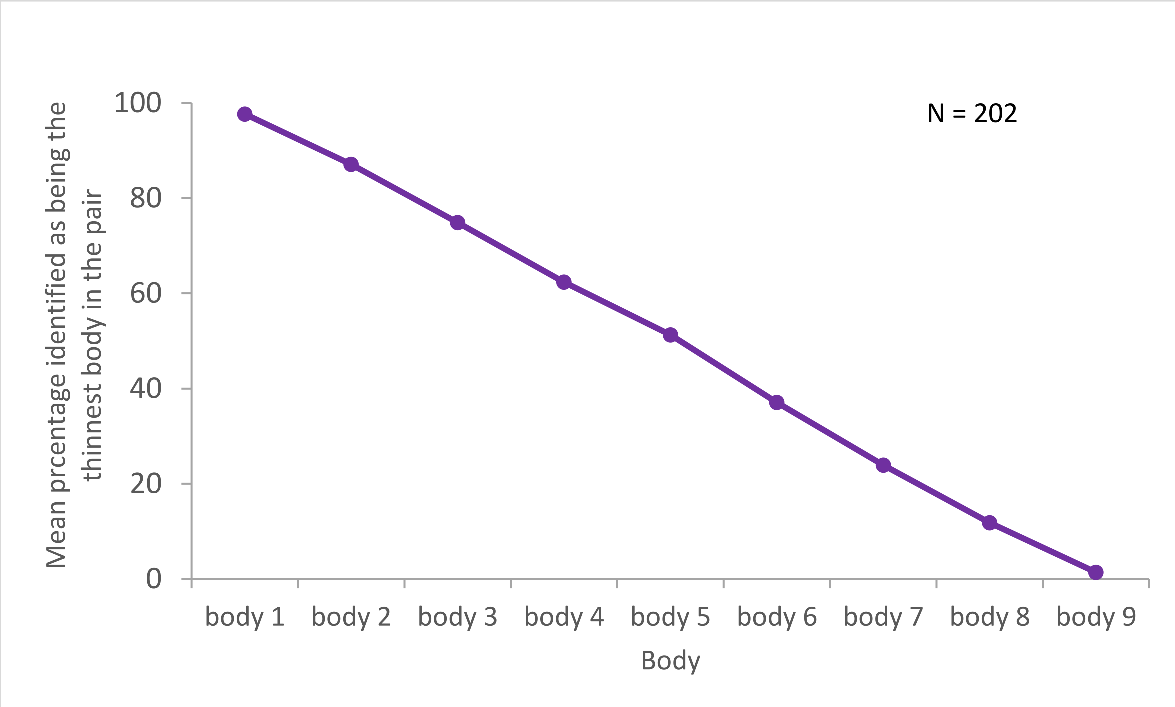
Three of the participants only completed the task for male bodies due to time constraints.

Female bodies

The data were analysed to see if the participants had correctly identified the thinnest body out of each body pair. The same body pairings were removed from the analysis meaning 72 pair combinations for each participant were analysed. For the purpose of this experiment bodies were numbered 1-9 in ascending order of BMI.

The results showed that when paired, the participants, on average, were able to correctly identify the thinnest body 97.59 % (*SD* 2.74) of the time. This suggests that the differences in body weight between the 9 bodies are clearly identifiable. Figure 3 shows the mean percentage each body was selected as being the thinnest body, in the 2AFC task pair, out of the total amount of times each body was presented. From looking at Figure 3 it is clear that body 1 was selected as the thinnest 97.69% of the time it was presented in a pair whereas body 9 was only selected as the thinnest 1.4% of the time it was presented in a pair.

Figure 3: Mean percentage each female body was identified as thinnest in the 2AFC task

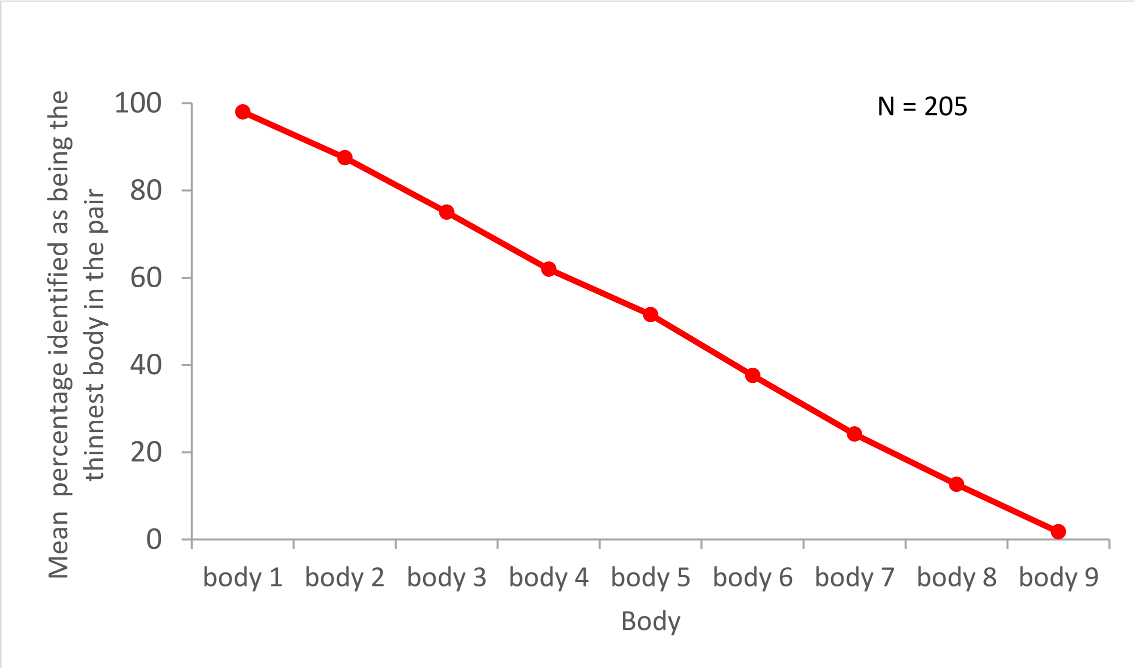


Male bodies

For male bodies the data was analysed in the same way to see if the participants had correctly identified the thinnest body out of each body pair. The same body pairings were removed from the analysis meaning 72 pair combinations for each participant were analysed.

The results showed that when paired, on average, the participants were able to correctly identify the thinnest body 97.19 % (*SD* 6.67) of the time. This suggests that the subtle differences in body weight and therefore BMI are easily detected. Figure 4 illustrates the findings.

Figure 4: Mean percentage each male body was identified as thinnest in the 2AFC task



3.2.4 Discussion

The results suggest that participants can easily detect the subtle differences in body weight between the nine bodies developed. This appears to be true for both the male and female bodies. The current stimuli offers improvement on scales which have used line-drawn stimuli (e.g., Stunkard et al., 1983; Thompson & Gray, 2005) by offering greater realism and providing more life-like figures. However, in using computer generated figures it also avoids the problems associated with using images of real people (e.g., PFRS) such as biases in judgements associated with certain racial groups, by controlling skin tone. It also controls for unwanted variation in body part ratios, inherent in real human beings both across and within the sexes.

The bodies can be used in paper print or visual format to create a scale that can be used to measure preference for body weight. As the body weight differences between all 9 bodies were easily detectable it was concluded that the stimuli created are suitable for use in research concerning body weight preferences.

3.3 Experiment 1b: Scale development

3.3.1 Introduction

The aim of experiment 1b was to validate a pictorial scale that could be used in the measurement of body dissatisfaction. Grogan (2008) defines body dissatisfaction as 'a person's negative thoughts about his or her own body' (p4). This includes judgements about size and shape, muscle tone and generally involves a discrepancy between one's own body type and an ideal body type. Although there are several techniques for measuring a discrepancy between an individual's own body weight and their ideal body weight, figure rating scales are most commonly used (e.g., Gardner et al., 2009; Stunkard et al., 1983; Thompson & Gray, 1995). This type of scale typically consists of line-draw or figural stimuli which vary from extreme thinnest to obese. Participants are usually asked to choose a figure they think (a) best represents their perceived actual body shape and (b) best represents their ideal body shape. Body dissatisfaction is then measured as the discrepancy between their perceived actual and ideal body shape.

There has also been an extensive use of line drawings in research on body dissatisfaction and this has received similar criticisms to those previously mentioned in Section 3.2.1. The PFRS (Swami, Salem, Furnham & Tovée*,* 2008a) has also been used in the measurement of body dissatisfaction and has been shown to have good validity and reliability when being used to assess body image (Swami, Salem, Furnham, & Tovée 2008a). However, the use of photographic images presents problems as mentioned in Section 3.2.1.

Accordingly, the aim here was to examine the validity and test re-test reliability of a new pictorial measure of body dissatisfaction. Since the scale was being developed to measure body dissatisfaction, the female participants completed the female body version and the male participants completed the male version as body dissatisfaction is typically measured using same gender stimuli. In line with previous research (Swami, Salem, Furnham, & Tovée, 2008a) construct validity was assessed by examining the correlation between the new scale and a measure of positive body image. It was hypothesised that these variables would be negatively correlated. In addition, the correlation between the participants perceived actual body size ratings and their BMI was also used to assess construct validity. It was predicted that there would be a positive correlation between the participants' BMI and their perceived actual body. Finally, test re-test reliability was examined by the correlation of body dissatisfaction scores from a first and second testing and this was expected to be positively correlated to show reliability.

3.3.2 Method

3.3.2.1 Participants

The participants were 190 (females = 130, males = 60) students or staff from Nottingham Trent University.

The participants who were psychology students were given research credits in exchange for taking part in the experiment.

3.3.2.2 Materials

Body stimuli: The body stimuli were the same as detailed in experiment 1a. For this part of the experiment the bodies were presented in paper format on a scale in ascending order of BMI. This scale can be used to measure body dissatisfaction by numbering the bodies from 1 to 9 (in ascending order of size), each body is scored as one body unit. The participants are asked to choose the body they would most like to look like (ideal) and the body they thought was closest to their perceived actual body shape (actual). The discrepancy between the participants' chosen perceived actual and ideal body was the participant's body dissatisfaction score. For example, if a participant chose body number 5 as their actual body and body number 2 as their ideal body their body dissatisfaction score would be 3. A higher score means a greater discrepancy between ideal and actual body chosen meaning greater dissatisfaction. This difference score does not reflect the direction of the body dissatisfaction and participants may have chosen an ideal body that was thinner or fatter than their chosen actual body. The highest body dissatisfaction score a participant could receive would be 8 if they selected body 1 and body 9. If a participant has no body dissatisfaction i.e. they selected the same number body for both their perceived ideal and actual body, they would have a score of 0.

Body Appreciation Scale (BAS; Avalos, Tylka, & Wood-Barcalow, 2005): The BAS comprises 13 items which are intended to measure body appreciation. Items are statements which the participants are asked to choose a response (never, seldom, sometimes, often, always) to. Some example items from the BAS include '*I feel that my body has at least some good qualities*' and '*My self-worth is independent of my body shape or weight*'. Items are scored on a 5 point scale (1 = never, 2 = seldom, 3 = sometimes, 4 = often 5 = always) and are averaged to obtain an overall body appreciation score. A higher score indicates higher body appreciation. The BAS has been shown to have good internal consistency (Cronbach's Alpha .94). Construct validity was demonstrated by a positive correlation with a greater tendency to evaluate one's appearance favourably (r = .68) and negative correlations with body preoccupation (r = -.79) and eating disorder symptomatology (r = -.6). In addition, test re-test reliability was found to be good (r = .9) over a 3 week period (Avalos et al., 2005).

Test re-test reliability: Test re-test reliability over a 5 week period was examined by the correlation of body dissatisfaction scores from the initial testing and then again after 5 weeks. There is no evidence to establish that one particular time period is best for reliability testing in pictorial body dissatisfaction measurement scales. Previous studies have used 1 week (Thompson & Gray 1995) and 3 weeks (Swami, Salem, Furnham & Tovée, 2008a), the current research chose 5 weeks as it seemed a suitable amount of time.

Demographics: The participants were also asked their self-reported height and weight which was used to calculate each participant's BMI. Previous research has suggested that self- report measures of weight and height are highly correlated with participants' actual weight and height (Spencer, Appleby, Davey, & Key, 2001).

3.3.2.3 Procedure

The participants were presented with the bodies as a scale on paper, with images going from left to right, from thinnest to fattest so as to measure their perceived body dissatisfaction. Bodies were numbered from 1 to 9 (in ascending order of size) and each body is scored as one body unit. The participants were asked to choose the body they would most like to look like (ideal) and the body they thought was closest to their perceived actual body shape (actual). This was a categorical judgment and participants could only choose one body each time. The female participants were presented with the female version of the scale and the male participants were administered the male. The participant's body appreciation was measured using the BAS. The participants were also asked their self-reported height and weight.

Five weeks after the initial test, the participants were invited to use the new rating scale to measure their body image again. Of the original female participants 64 completed the rating scale again (49.23% of the original sample) and of the male participants 20 (33.33% of the original sample) completed the scale for a second time.

3.3.3 Results

3.3.3.1 Female Version

Descriptive statistics: The descriptive statistics for the female sample are presented in Table 4.

Table 4: Female Participants' Mean Scores on all Measures.

	Mean	***SD***
Perceived actual body score	5.58	1.31
Perceived ideal body score	4.08	1.0
Body dissatisfaction score	1.61	0.9
BAS score	3.44	0.62
BMI	23.1	3.5

Construct validity. Validity was assessed by the correlation between body dissatisfaction scores on the BDS and body appreciation scores on the BAS. Results showed a significant negative correlation, r (128) = -.6, p < .05, providing evidence of construct validity.

To provide further validation the correlation between the participants' ratings of their perceived actual body size and their BMI was assessed. This was also found to be significant, r (128) = .77, $p < .05$, suggesting that the scale can be used to accurately assess perception of own body size.

Test-re-test reliability. The correlations between scores for perceived actual body, ideal body and body dissatisfaction from the first testing and five weeks after were analysed to examine for re-test reliability. These were all found to be significant; perceived actual body, r (62) = 0.81, $p < .05$, ideal body, r (62) = 0.89, $p < .05$, and body dissatisfaction, r (62) = 0.82, $p < .05$. This suggests that scores at the first and second testing were highly correlated suggesting that the scale is a reliable measure of body dissatisfaction.

3.3.3.2 Male Version

Descriptive statistics: The descriptive statistics for the male participant sample are presented in Table 5.

Table 5: Male Participants' Mean Scores on all Measures.

	Mean	*SD*
Perceived actual body score	5.07	1.54
Perceived ideal body score	4.9	0.82
Body dissatisfaction score	1.49	0.82
BAS score	3.54	0.64
BMI	24.12	3.83

Construct validity. A significant negative correlation was found between body dissatisfaction on the BDS and body appreciation scores, r (57) = -.46, $p < .05$, providing evidence of construct validity. The correlation between the participants' ratings of their perceived actual body size and their BMI was also found to be significant, r (57) = 0.83, $p < .05$, providing further validation.

*Test re-test reliability***.** To examine re-test reliability original scores for perceived actual, ideal and body dissatisfaction were correlated with scores from 5 weeks after the initial testing. All 3 correlations were found to be significant; perceived actual body, r (18) = 0.96 $p < .05$, ideal body, r (18) = 0.88 $p < .05$, and body dissatisfaction, r (18) = 0.97 $p < .05$.

3.3.4 Discussion

The results of experiment 1b suggest that both the male and female version of the scale are a valid measure of body dissatisfaction. The significant correlations with the BAS suggest that both versions of the scale have good construct validity. Perceived actual body size was correlated with the participants BMI for both male and female versions which indicates that the scale is a useful tool in assessing perception of own body size and provides further evidence of construct validity.

The findings support the use of the scale in body image measurement for females and males. The correlations were stronger for the female version of the scale and the sample was larger for female participants than male participants. This suggests the results are more reliable for the female version and therefore the male version should be used with more caution in the measurement of body dissatisfaction.

3.4 Summary

The results of experiment 1a show that participants can easily detect the differences in body weight between the nine bodies that comprise the scale. This was found in both the male and female bodies suggesting that they are valid to be used in experiments assessing body weight preferences for female and male bodies. When the stimuli are used as a measure of body dissatisfaction the female version was found to be more reliable than the male version, meaning to be used as a scale in the measurement of body dissatisfaction in males the stimuli is not as robust at the female version.

Chapter 4

Visual Pathogen Priming

4.1 Experiment 2a: The effects of visual pathogen primes on body weight preferences

4.1.1 Introduction

The main aim of these experiments was to examine the effects of pathogen priming on preferences for body weight. As outlined in the literature review research (e.g., Marlowe & Wetsman, 2001; Swami & Tovée, 2007c; Tovée et al., 2006) has demonstrated that preferences for female body weight vary cross culturally. Tovée et al. (2006) found significant differences in female body weight preferences between South African Zulu males and UK Caucasian males. It was shown that Zulu males preferred heavier female bodies compared to UK males who preferred lighter female bodies. Yet, Zulu males who had recently immigrated to the UK had body preferences in-line with UK males suggesting that body preferences are not fixed but vary with current environment. This in part is likely to be due to exposure to Western media ideals. However, research in this area (Swami et al., 2011; Swami & Tovée, 2005a, 2005b, 2007a, 2007b) has also indicated that preferences in relation to female and male body weight vary with socio-economic status (SES) highlighting that individuals from lower SES groups prefer heavier bodies compared with those from higher SES groups suggesting that resource access may also be key in the cross cultural differences seen in body weight preferences.

Nelson and Morrison (2005) proposed that the affective and psychological states associated with resource availability provide, on an individual level, implicit information about collective resources that unconsciously influence preferences of attractiveness. To test this idea Nelson and Morrison (2005) examined individual levels of hunger and financial satisfaction in men to see how this would affect their preferences for female body weight. Consistent with their proposal they found that men who felt either hungry or finically poor showed a preference for heavier female bodies compared to men who were feeling satiated or finically rich. Following Nelson and Morrison (2005), Swami and Tovée (2006) also found that men who were hungry perceived heavier female bodies to be more attractive than males who were satiated. In addition to this Pettijohn et al. (2009) found that hungry males prefer females with physically mature characteristics (e.g., older age, taller and heavier) than less mature characteristics (e.g., younger age, shorter and lower weight). Whereas females who were hunger showed a preference for males with mature personality characteristics (e.g., strong, independent, competent). They argue that this is consistent with an environmental security hypothesis. That is to say, personal preference is influenced by how secure individuals feel in their current surroundings such that when individuals experience environmental threats (e.g., food scarcity) they will show adaptive preference shifts for better survival in that environment (e.g., increased preference for heavier, taller, older, more mature mates).

Previous research (e.g., Nelson & Morrison, 2005; Swami & Tovée, 2006) has focused on the effects of environmental factors such as resource scarcity. However, the role of other factors such as actual or perceived levels of disease and pathogen prevalence in the current environment has been neglected. In the past (as is still the case in many parts of the world) pathogens and parasites would have posed a major threat to health and reproductive fitness. Therefore, it is likely that humans have evolved mechanisms to aid with detection of pathogens and disease. Schaller (2001) and Schaller and Duncan (2007) have proposed the idea of a behavioural immune system, which is simply an evolved set of mechanisms that allow individuals to detect cues signalling the potential presence of pathogens, and to reduce contact with them by initiating a physical, psychological or social defence response.

For example, research has shown that the perceived presence, in another person, of morphological or behavioural characteristics that suggest infection or disease (e.g., skin discolouration, emaciation, coughing) can trigger avoidant behavioural and cognitive responses such as disgust, dislike and social out-grouping (prejudice), thereby reducing likely contact and contagion (e.g., Kurzban & Leary, 2001; Oaten et al., 2009; Park et al., 2003; Schaller & Duncan, 2007).

Recently researchers have begun exploring the relationship between pathogens and masculinity/femininity preferences in faces (e.g., DeBruine, Jones, Tybur, Lieberman & Griskevicius, 2010; Fisher et al., 2013; Jones, Fincher, Welling, Little, Feinberg, Watkins & DeBruine, 2013; Little et al., 2011; Watkins et al., 2012). Some of this research has examined the relationship between measures of pathogen disgust and face preferences. For example, it has been shown that men's scores on the pathogen subsection of the TDD scale (Tybur et al., 2009) are positively correlated with greater preferences for femininity in female faces (Jones, Fincher, Welling, Little, Feinberg, Watkins, & DeBruine, 2013). By contrast women's scores on the pathogen subsection of this scale have been found to correlate with greater preferences for masculinity in male faces (DeBruine, Jones, Tybur, Lieberman, & Griskevicius, 2010).

Pathogen priming appears to be a robust effect. However, from the research outlined in the literature review it is evident that pathogen priming studies have only used face stimuli and there is no research which examines the effects of pathogen priming on body weight preferences. Given that current environment and resource scarcity have been shown to affect preferences for body weight (Nelson & Morrison, 2005; Pettijohn et al., 2009; Swami et al., 2011; Swami & Tovée, 2005a, 2005b, 2007a, 2007b) it seems reasonable to expect that exposure to information about pathogen contagion, ought to influence body weight preferences. Therefore, the aim of the current experiment was to examine the effects of visual pathogen primes on body weight preferences. Visual images depicting behavioural and morphological characteristics of illness have previously been shown to promote an actual immune response (Schaller et al., 2010). This suggests that the mere depiction of disease can activate the behaviour immune system. In addition to this visual pathogen primes have been used by Little et al. (2011) when examining face preferences. Similar to Schaller et al. (2010) the images were presented in a slideshow to participants to act as a pathogen prime. Therefore, it was chosen to use visual pathogen primes in experiment 2. The experiment used visual pathogen primes that displayed people suffering from illness type symptoms (e.g., coughing and sneezing).

Although SES has been found to effect body weight preferences (e.g., Swami et al., 2011; Swami & Tovée, 2005a, 2005b, 2007a, 2007b) it was decided not to measure SES in the sample for this experiment. Research which has demonstrated an effect of SES on body preferences has recruited the low SES groups from extremely poor areas. For example, rural hill tribes in Thailand (Swami & Tovée, 2007a) and rural areas of Malaysia (Swami & Tovée, 2005a, 2005b). This type of group is likely to have a level of resource access similar to individuals in developing and poorer countries and the results of this research have therefore shown significant differences in body weight preferences across the groups. However, there is no research to suggest that body preferences vary significantly between different SES groups within the UK. Although health outcomes can vary across SES groups in the UK (Glymour, Avendono, & Kawachi, 2014) there is likely to not be such a distinct divide between rich and poor due to the availability of free National Health Service (NHS) hospitals, surgeries and walk in clinics. In addition, there are also free prescriptions available for people claiming benefits. Therefore, it seems unlikely that individuals from lower SES groups would perceive themselves to be significantly more at risk from illness than those from higher SES groups. In addition, as the current experiment used an opportunistic sample of university students it is likely their level of access to healthcare would be similar as all students are able to register with the university’s health centre.

Therefore, it was decided not to measure the participants' SES because in the UK, and particularly in the current sample, it was not thought that lower SES groups would feel a significantly greater threat of disease than higher SES groups and that this would need to be controlled for.

Another variable that it was decided not to measure, was individual level of hunger. Although this has been shown to effect male preferences for female body weight (Nelson & Morrison, 2005; Swami & Tovée, 2006), this effect has not been found in females. Therefore, as the sample consisted only of female participants, level of hunger was not measured.

In the current experiment the participants either experienced visual pathogen primes, visual non-pathogen related neutral primes or no primes at all. If body weight is a good visual cue to health and resource access, then pathogen priming should result in a change of preference for bodies. It was hypothesised that pathogen priming would cause a shift in body weight preferences towards a healthier body weight with the participants who had received the pathogen prime showing a bigger shift in their body weight preferences compared to the participants who had received the neutral prime or no prime at all. Body weight is an important cue to better health in both male and female and same sex bodies and opposite sex bodies. Healthy bodies of the same sex still have the direct benefits of being pathogen free and reduce the risk of contagion meaning a shift in both ratings of same and opposite sex bodies were predicted.

4.1.2 Method

4.1.2.1 Design

An independent measures design was employed where the participants were arbitrarily placed in 1 of either 3 different conditions. The participants were primed by being presented with visual images that either had an illness theme (*pathogen*) or a neutral, non-pathogen related, theme (*neutral*), a third control group viewed no images (*no prime*).

The participants were asked to indicate which they thought the most attractive, healthy, normal and intelligent body was. This was indicated on a horizontal line, on which the participants had to indicate their preference along the continuum. Their preferences were measured before and after priming and measured as the BMI at the point selected (See Materials section for details), the dependent variable was the difference (shift) in their in their 1st and 2nd body ratings (2nd – 1st).

4.1.2.2 Participants

The sample consisted of 72 female participants (Pathogen n = 26, Neutral n = 24, No Prime n = 22). The mean age of the participants was 21.13 years (*SD* = 6.97). They were all students at Nottingham Trent University and were given research credits for their participation.

4.1.2.3 Materials

Priming stimuli

The pathogen theme images comprised 13 different images depicting people who exhibited characteristics associated with infectious disease (e.g., coughing, sneezing). See Figures 5 and 6 for example images. The 13 neutral images depicted people either smiling or laughing.

Figure 5: Examples of pathogen related visual images

Figure 6: Examples of neutral visual images

A pilot test with different participants (n = 44) was conducted to check that the pathogen images did cause the participants to think of illness in comparison to the neutral images. In this the participants were presented with either pathogen images or non-pathogen related neutral images. Following the priming procedure used in Schaller et al. (2010), the 13 different images were displayed continuously in a random order for 10 minutes with each image being presented for 8 seconds followed by a 4 second blank screen with a fixation point before the next image was displayed. After viewing the images, the participants were asked to write down what they thought the main theme of the images were and how the images made them feel. This was to ascertain whether a) the pathogen and neutral images were categorised differently suggesting the images had distinct themes from each other and b) if the pathogen and the neutral images caused different feelings to be aroused.

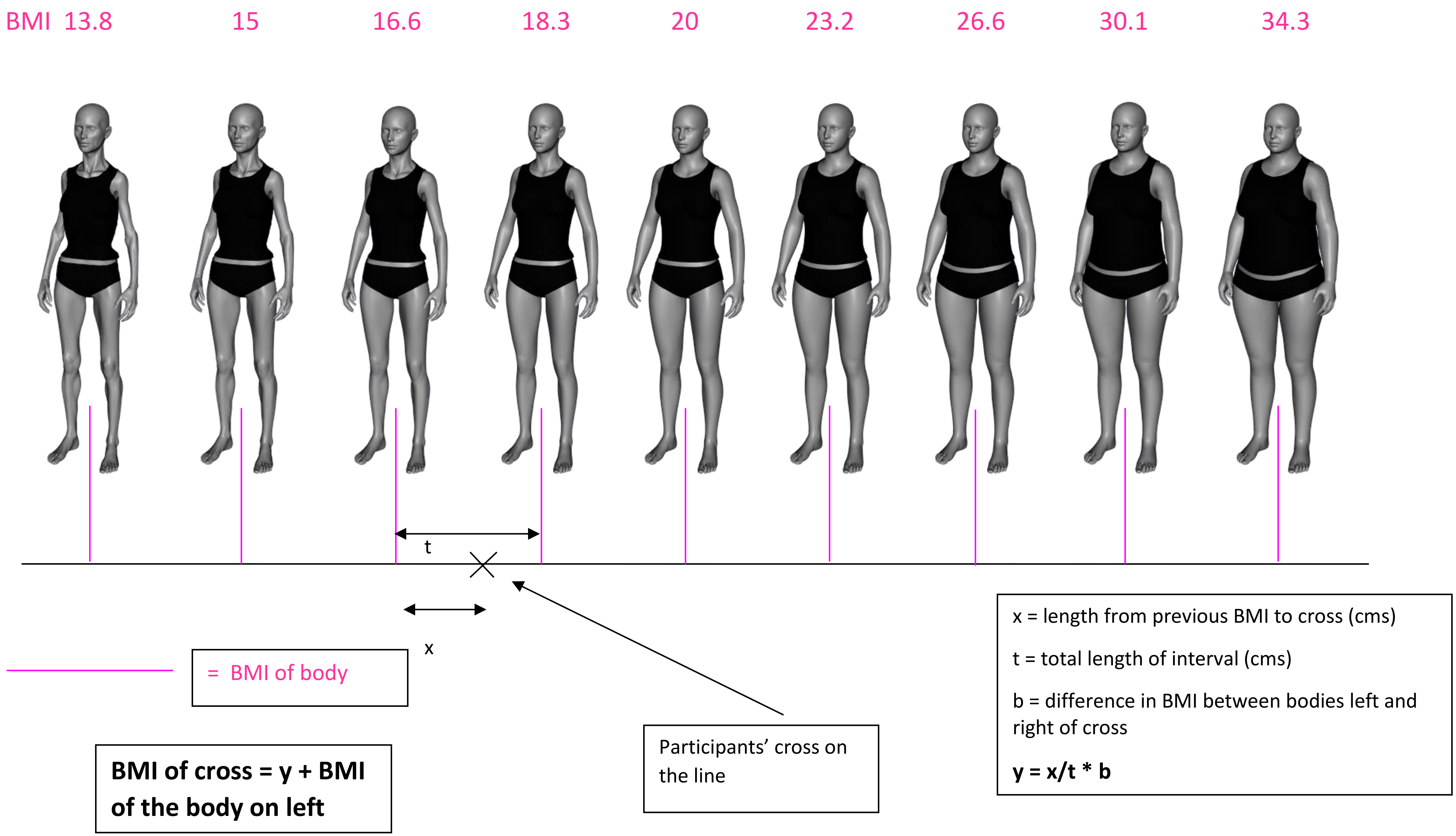
The results of the pilot showed that the participants in the pathogen priming condition used words related to pathogens such as illness, coughing and sneezing to describe the main theme of the images. Whereas the participants in the neutral priming condition used words like happy and smiling which suggests the theme is not pathogen related. In relation to the feelings identified by the participants in each of the priming conditions, it was found that the main feeling identified in the pathogen condition was disgust. This is in line with research (Curtis et al., 2004) which has shown that objects which pose a potential disease threat are reported as being significantly more disgusting than control images which have no disease relevance. Conversely in the neutral priming condition the main feeling identified was happiness.

Therefore, the findings from the pilot study suggest that the pathogen images are valid to use as a pathogen prime with participants using words related to illness to describe the images and identifying feelings of disgust. Pathogen disgust is thought to motivate behavioural avoidance (Tybur et al., 2009, 2013) and would therefore be likely to cause a behavioural immune system response. As these feelings are not caused by the non-pathogen neutral images, with the main feeling being brought about by these images being happiness it would seem that these images are suitable to use as a control set of images that do not cause any association with pathogens or disease.

Body Stimuli

The body stimuli used were the bodies created in experiment 1 (See Chapter 3). These were 9 male and 9 female bodies. The bodies were presented in a normal reading order from left to right, in ascending order of body weight. Below the bodies was a horizontal line, on which the participants had to indicate their preference along the continuum. BMI preferences were calculated by measuring the point on the line where the participant had placed their cross and giving this the corresponding BMI unit score. Figure 7 demonstrates how this was calculated. This is given with the female bodies as an example but was calculated in the same way for the male bodies.

Figure 7 Calculation for conversion of participants' body ratings to BMI units



4.1.2.4 Procedure

The bodies were presented to the participants on a sheet of A4 paper in a booklet for them to indicate their preferences. The participants were presented with the bodies in a random order to rate for attractiveness, health, normality and intelligence, this was done for both female and male bodies. The participants completed each new rating one at a time, on separate sheets of paper meaning each participant completed 8 different ratings.

The participants in the priming conditions were then presented with the visual priming images. Following the method used in Schaller et al. (2010), 13 images were displayed continuously in random order for 10 minutes, with each image being presented for 8 seconds followed by a 4 second blank screen before the next image was displayed. The participants in the *pathogen* condition viewed images relating to illness. The participants in the *neutral* condition were shown neutral images. (See Materials for example images). The participants in the *no prime* condition did not view any images. After priming the participants were given a new booklet of bodies to rate. The bodies were presented in the same way as before on A4 paper.

4.1.3 Results

Out of the 72 participants, 2 of the participants did not complete any intelligence ratings for male and female bodies, 1 participant did not complete any intelligence ratings for female bodies and 1 participant did not complete health ratings for male bodies.

Each participants' BMI preference from the 2nd testing was subtracted from their 1st testing BMI preference giving each participant a score for their shift from the 1st to 2nd testing. These scores were then used in the analysis. Female and male body data were analysed separately. In addition to this, ratings for attractiveness, health, normality and intelligence were analysed separately.

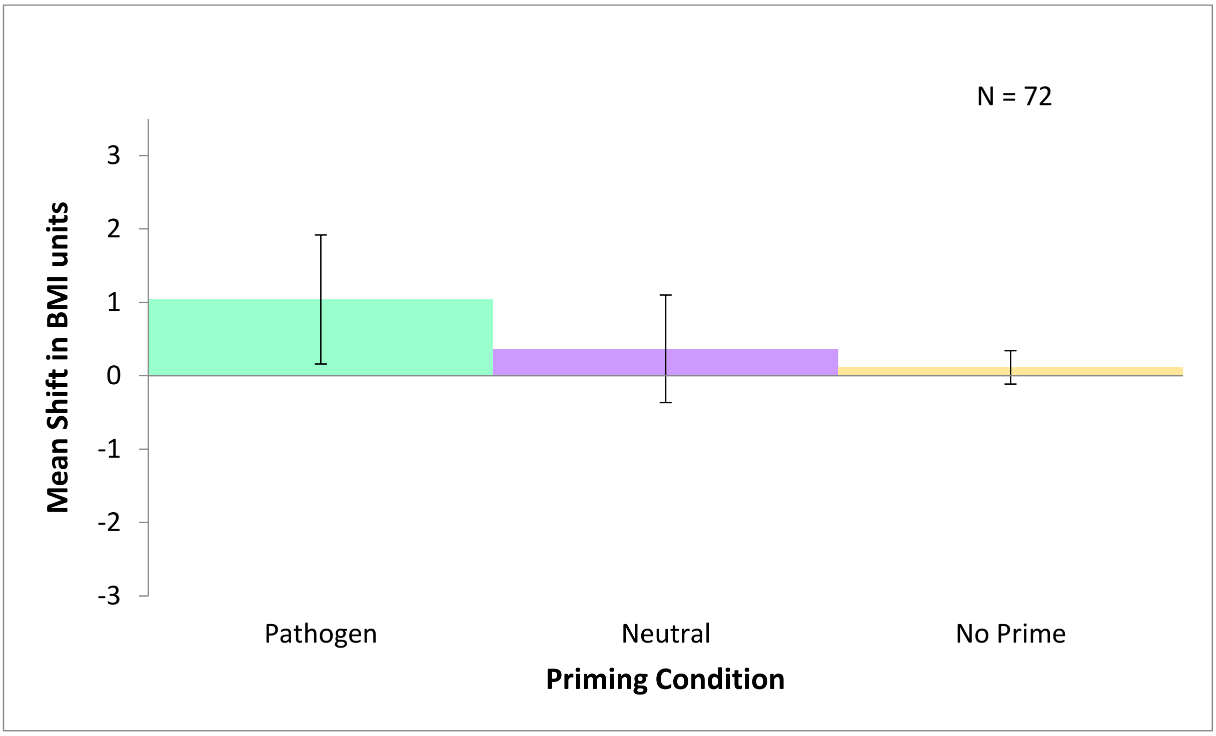
4.1.3.1 Ratings of attractiveness

4.1.3.1.1 Female bodies

A one way (Prime: Pathogen, Neutral, No Prime) independent measures ANOVA was carried out on female body ratings. This showed that there was a significant effect of priming on shift in the participants' ratings of attractiveness for female bodies F (2,69) = 4.42, p < .05, η^2 = .14). Post hoc analysis with Bonferroni corrected t tests indicated that the participants who experienced the pathogen prime experienced a significantly bigger shift compared to those in the no prime condition (p <.05, d = 0.91). There were no significant differences between the pathogen prime condition and the neutral prime condition (p >.05, d = 0.58). However, from looking at Figure 8 it is evident that the confidence intervals for the pathogen condition do not overlap with zero whereas the confidence intervals for the neutral condition do overlap zero. This suggests that there was a shift present in the pathogen condition that was not present in the neutral condition. There was also no significant difference between the neutral prime and no prime condition (p >.05, d =

0.22). Figure 8 illustrates the significant priming effect and shows that participants who experienced the pathogen prime had a positive shift in their attractiveness preferences suggesting that heavier female bodies were now rated as being more attractive.

Figure 8: Mean shift in attractiveness ratings of female bodies from before to after priming presented with 95% confidence intervals.



To further examine the significant effect, the BMI preferences from the first and second rating for each participant were looked at for ratings of attractiveness in female bodies. This has been presented in Figures 9, 10 and 11 so as to see the range of BMI's chosen and to identify where the shifts occurred. Note: Where only on orange symbol is visible this indicates the 2nd testing value was identical to the

1st testing value. The data is presented in ascending order of BMI ratings on the 1st testing.

From looking at Figure 9 it is evident that after pathogen priming, although selecting bodies with a higher BMI than before priming, most of the participants were not selecting BMI's outside of the healthy weight range. It appears the pathogen prime has caused a shift towards the central region of the healthy weight BMI category. Initially BMI preferences tended to be for bodies towards the lower end of the healthy weight category. Therefore, this appears to be a shift towards a healthier body. Figures 9, 10 and 11 demonstrate the range of BMI ratings was similar across all 3 priming conditions.

Figure 9: First and Second BMI ratings for attractiveness in the pathogen priming condition

	Obese	BMI >30
	Overweight	BMI 25 – 30
	Healthy weight	BMI 18.5 - 24.9
	Underweight	BMI < 18.5

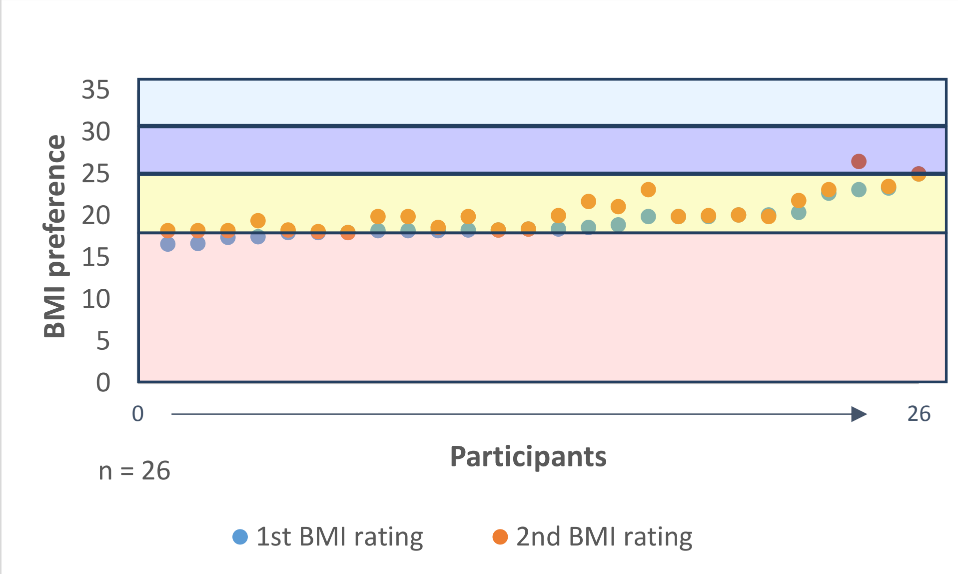


Figure 10: First and Second BMI ratings for attractiveness in the neutral priming condition

	Obese	BMI >30
	Overweight	BMI 25 – 30
	Healthy weight	BMI 18.5 - 24.9
	Underweight	BMI < 18.5

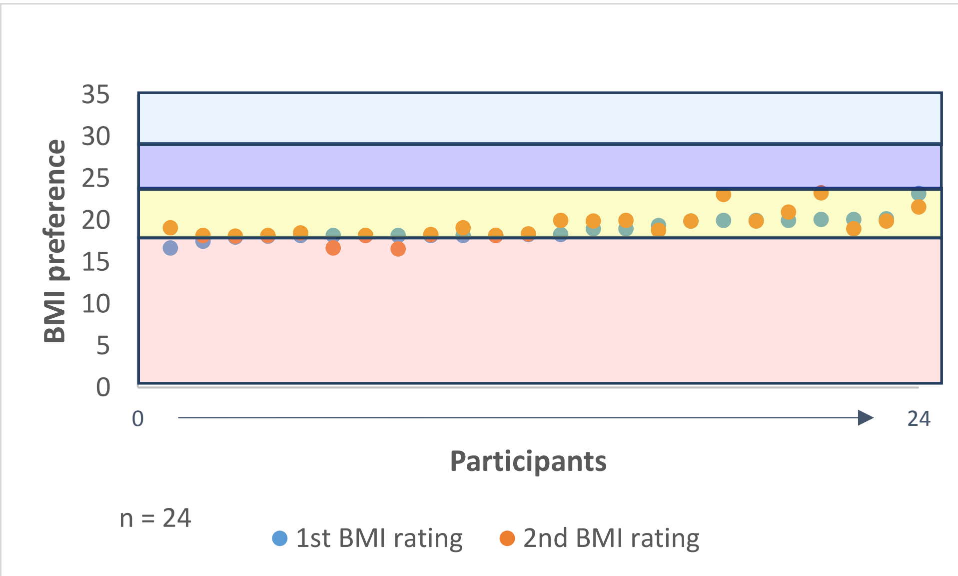
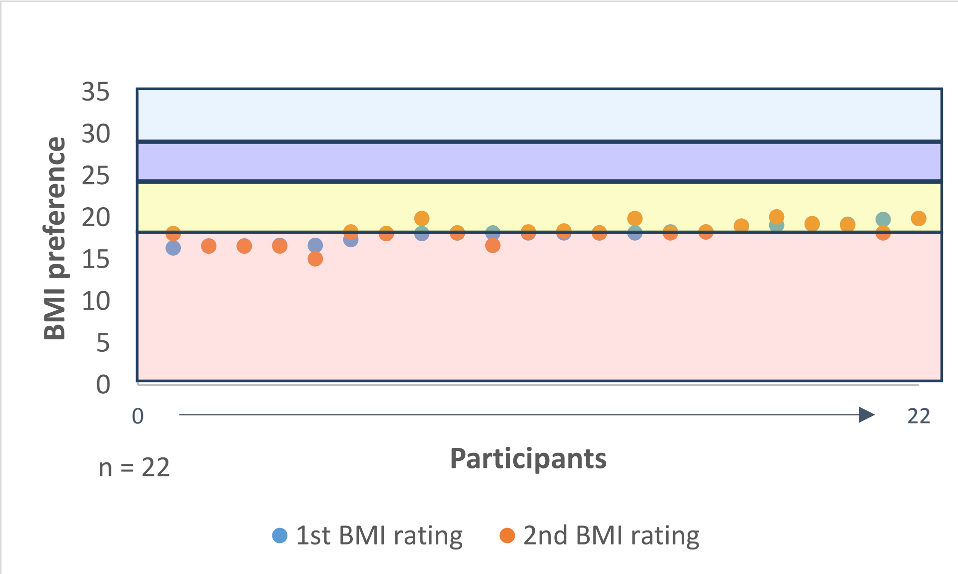


Figure 11: First and Second BMI ratings for attractiveness in the no priming condition

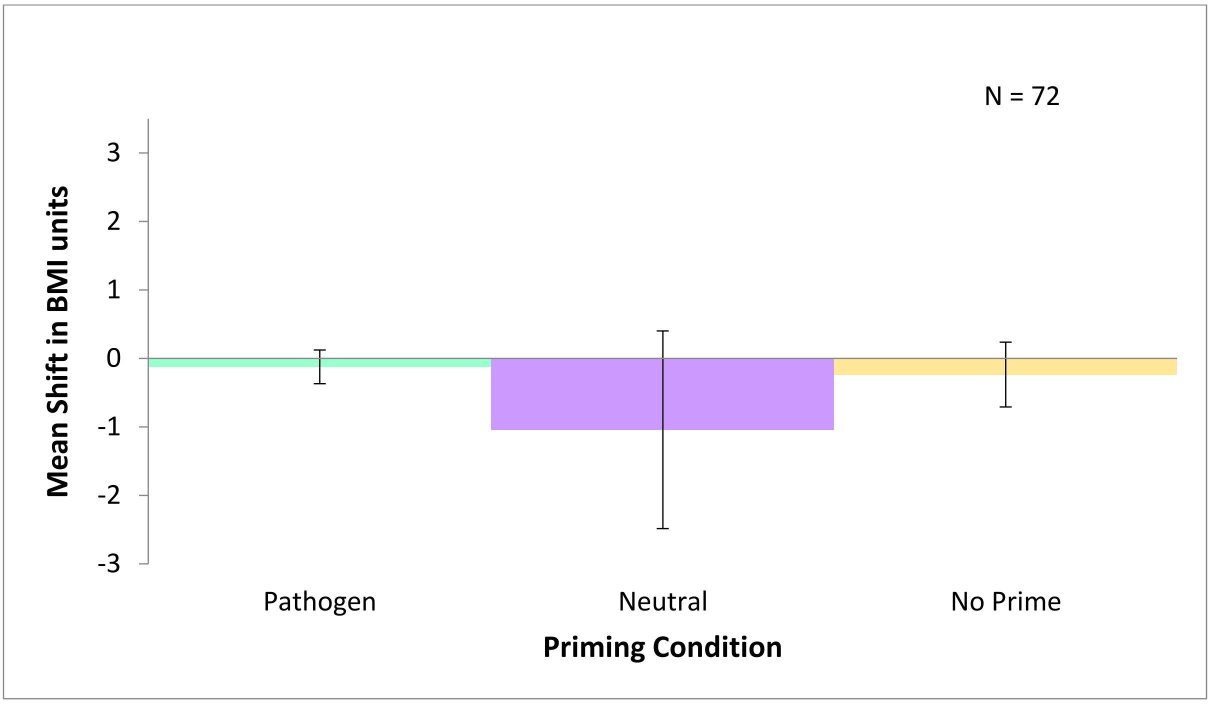
	Obese	BMI >30
	Overweight	BMI 25 – 30
	Healthy weight	BMI 18.5 - 24.9
	Underweight	BMI < 18.5



4.1.3.1.2 Male bodies

A one way (Prime: Pathogen, Neutral, No Prime) independent measures ANOVA was carried out on the male body ratings. This showed no effect of priming on the participants' attractiveness ratings of male bodies, $F(2,69) = 1.94$, $p > .05$, $\eta^2 = .05$). The data are presented in Figure 12.

Figure 12: Mean shift in attractiveness ratings of male bodies from before to after priming presented with 95% confidence intervals.



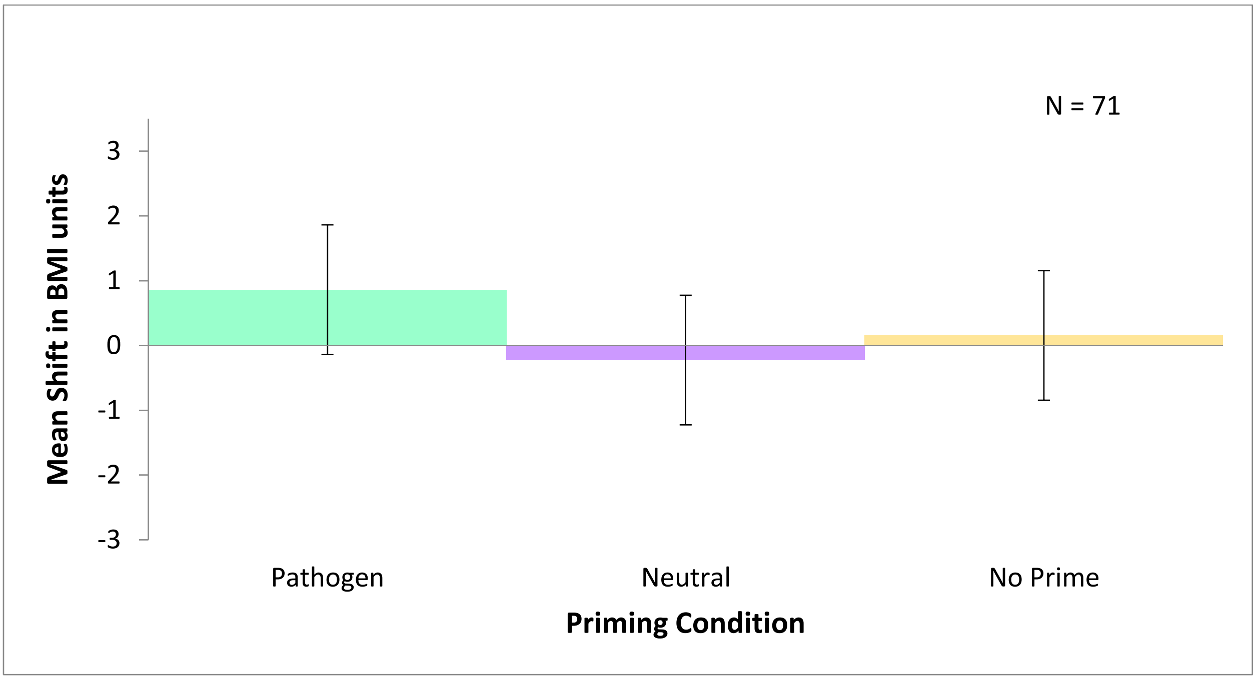
n = 72

4.1.3.2 Ratings of health

4.1.3.2.1 Female bodies

The female body health ratings were analysed using a one way (Prime: Pathogen, Neutral, No Prime) independent measures ANOVA. The results showed that there was a significant shift in the participants' health ratings for female bodies after priming, F (2,69) = 4.38, $p < .05$, $\eta^2 = .12$). Post hoc t tests with Bonferroni corrections indicated that the participants in the pathogen prime condition had a significantly bigger shift in their body preferences compared to those in the neutral prime (p <.05, d =0.73). There was no significant difference between the pathogen prime and no prime condition (p >.05, d = 0.55), and no significant difference between ratings in the neutral and no prime conditions (p >.05, d = 0.35). From looking at Figure 13 it is evident that the participants who had been pathogen primed experienced a significant positive shift in their health preferences for female bodies with heavier bodies now being rated as being healthier.

Figure 13: Mean shift in health ratings of female bodies from before to after priming presented with 95% confidence intervals.



To examine further the significant effect found in health ratings of female bodies the BMI preferences from the first and second testing for each participant were looked at. In Figure 14 each participant's BMI from both ratings has been presented so as to see the range of BMI's chosen and where the shifts occurred. Note: Where only on orange symbol is visible this indicates the 2nd testing value was identical to the 1st testing value. The data is presented in ascending order of BMI ratings on the 1st testing.

Figure 14 shows that typically participants' BMI preferences appear to be shifting further into the healthy weight BMI category. Therefore, this shift appears to be a shift towards a healthier body. Looking at Figure 14 it can be seen that 1 participant selected a BMI in the overweight category before priming and on their second testing this preference has shifted down into the healthy weight category, therefore it may be that if preferences are initially for overweight bodies the shift will be downwards towards a healthier body. From Figures 14, 15 and 16 it is clear that the range of BMI' s being selected as being the healthiest is similar across all three conditions with only 1 participant in the pathogen priming condition and 1 participant in the neutral priming condition initially selecting an overweight BMI.

Figure 14: First and Second BMI ratings for health in the pathogen priming condition

	Obese	BMI >30
	Overweight	BMI 25 – 30
	Healthy weight	BMI 18.5 - 24.9
	Underweight	BMI < 18.5

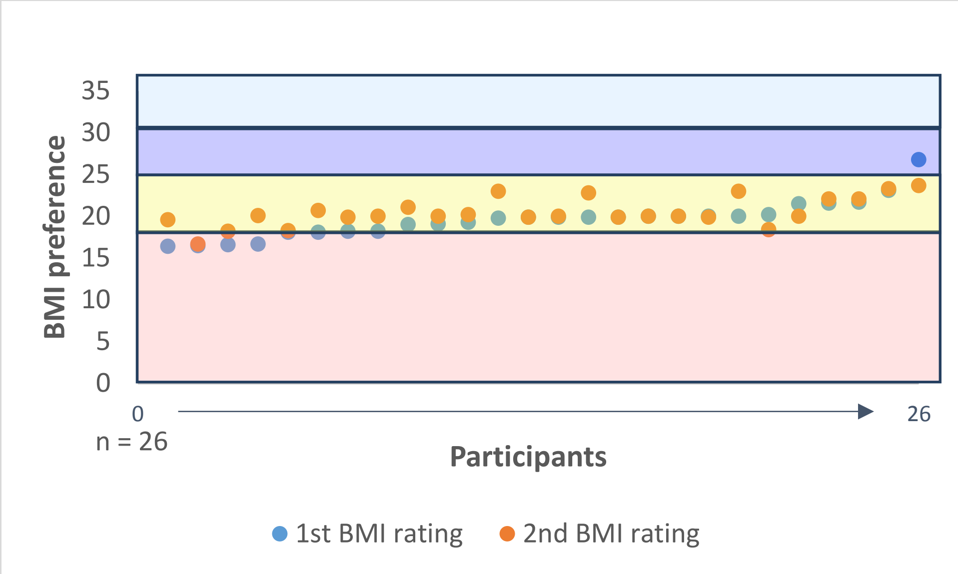


Figure 15: First and Second BMI ratings for health in the neutral priming condition

	Obese	BMI >30
	Overweight	BMI 25 – 30
	Healthy weight	BMI 18.5 - 24.9
	Underweight	BMI < 18.5

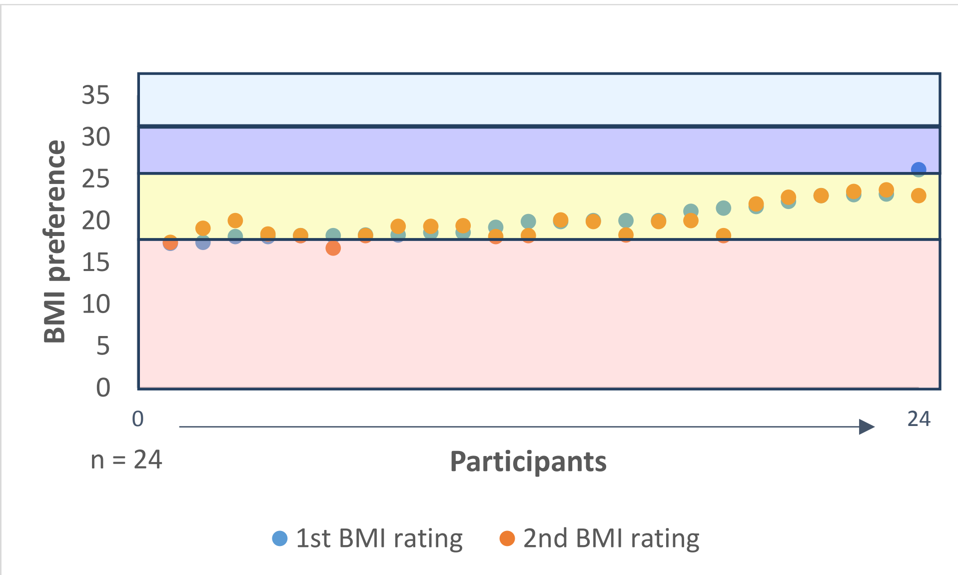
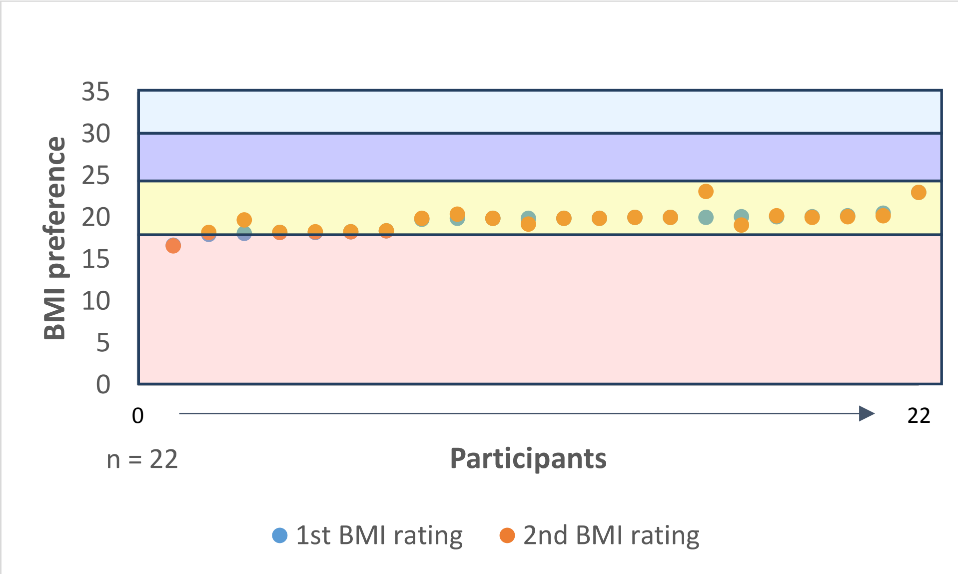


Figure 16: First and Second BMI ratings for health in the no priming condition

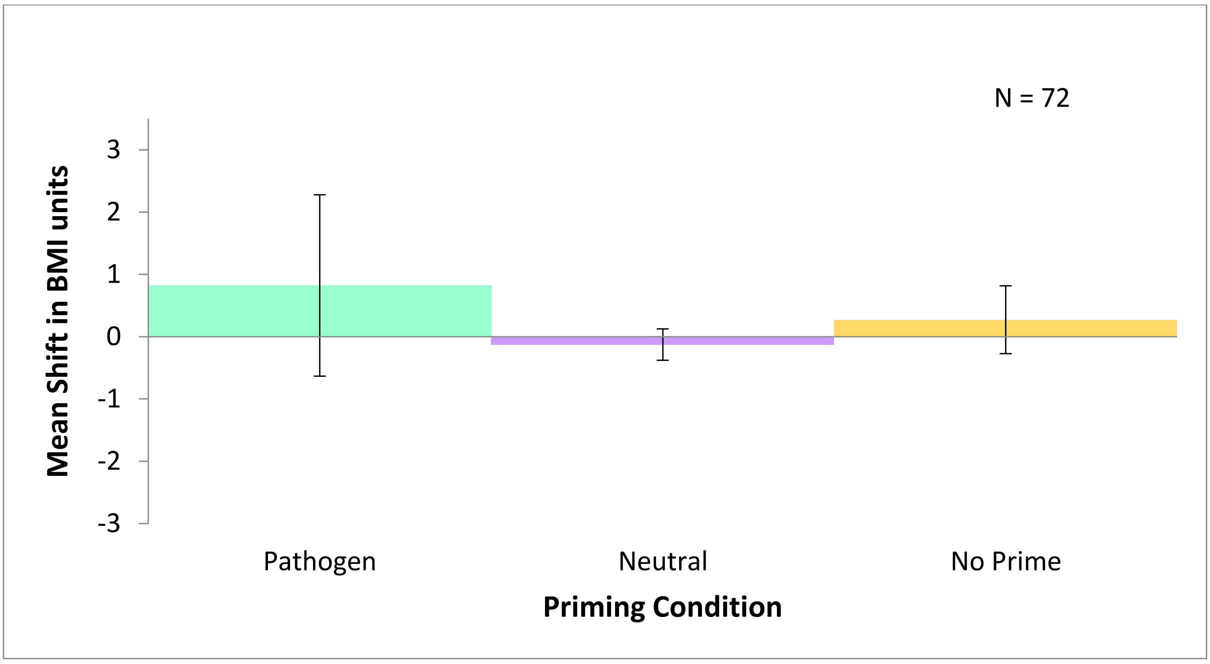
	Obese	BMI >30
	Overweight	BMI 25 – 30
	Healthy weight	BMI 18.5 - 24.9
	Underweight	BMI < 18.5



4.1.3.2.2 Male bodies

The male body health ratings were analysed using a one way (Prime: Pathogen, Neutral, No Prime) independent measures ANOVA. This found no effect of priming on the participants' health ratings of male bodies, F (2,68) = .1.61, p >.05, η^2 = .04. This is illustrated in Figure 17.

Figure 17: Mean shift in health ratings of male bodies from before to after priming presented with 95% confidence intervals.

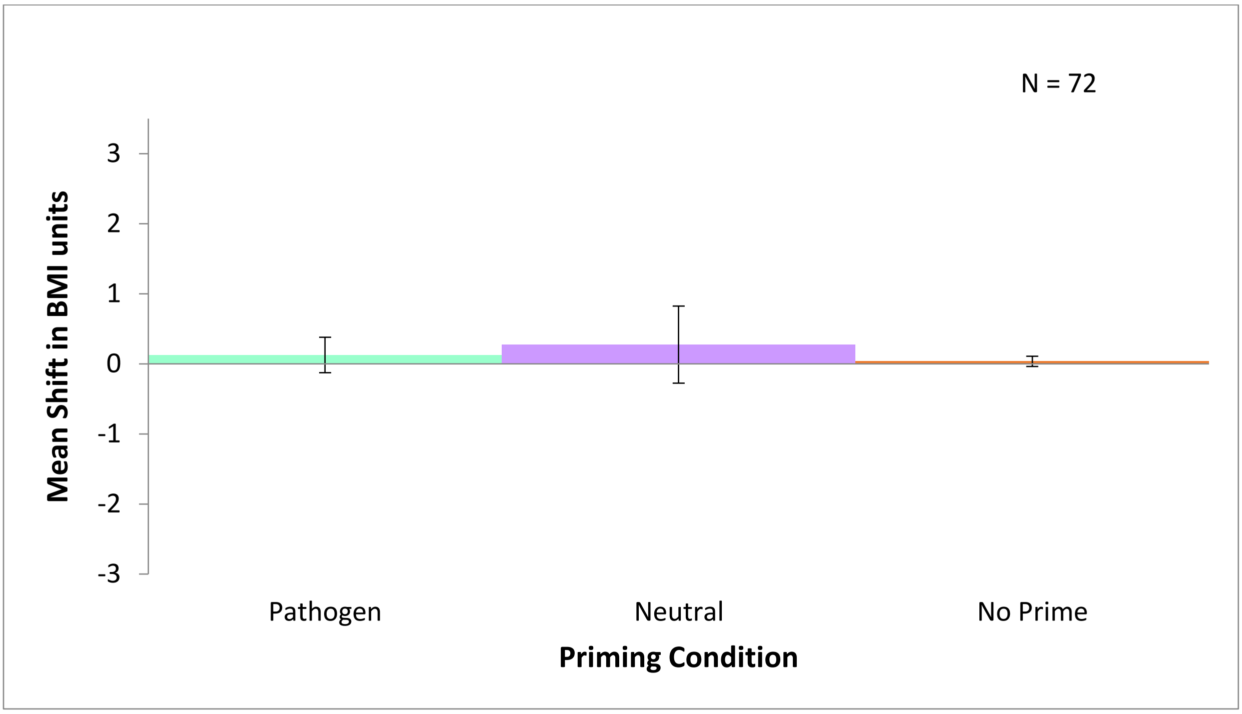


4.1.3.3 Ratings of normality

4.1.3.3.1 Female bodies

Ratings of normality in female bodies were analysed using a one way (Prime: Pathogen, Neutral, No Prime) independent measures ANOVA. This showed no significant effect of priming on ratings of normality in female bodies, F (2, 69) = .08, p >.05, η^2 = .00. This suggests that priming participants did not alter normality preferences. Figure 18 shows that there were no significant differences between the 3 priming conditions.

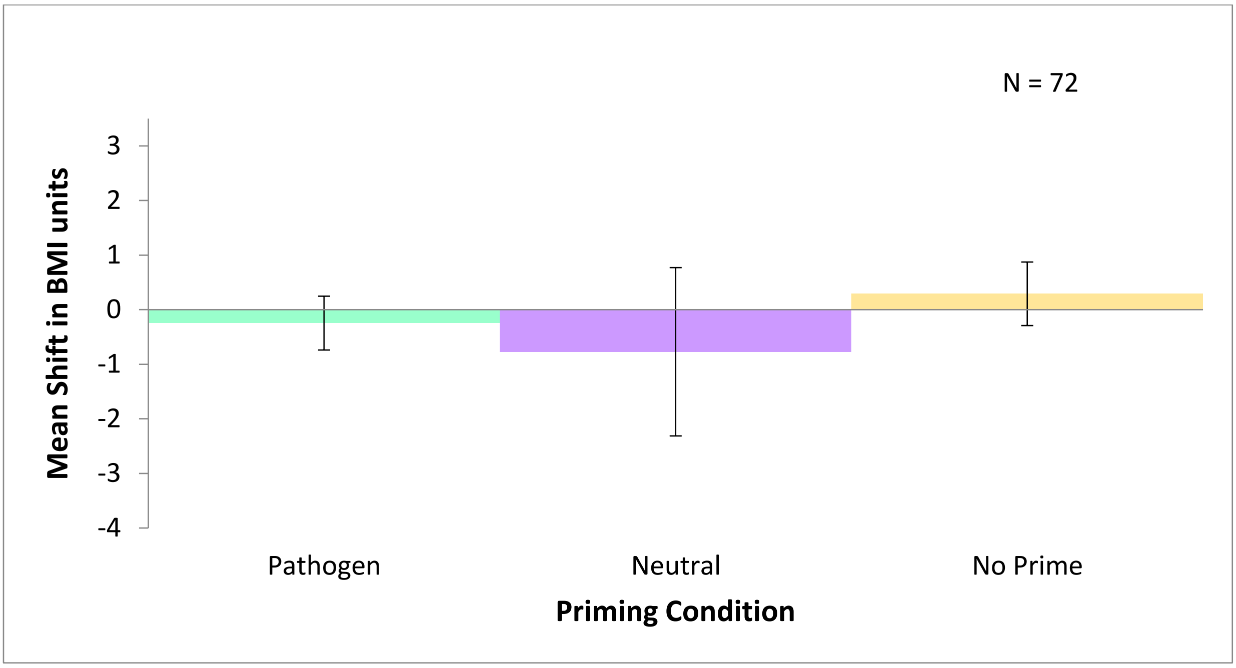
Figure 18: Mean shift in normality ratings of female bodies from before to after priming presented with 95% confidence intervals presented with 95% confidence intervals.



4.1.3.3.2 Male bodies

Ratings of normality in male bodies were analysed using a one way (Prime: Pathogen, Neutral, No Prime) independent measures ANOVA. This showed no effect of priming on normality ratings in male bodies, F (2,69) = 1.05, p >.05, η^2 = .03. This is shown in Figure 19 which illustrates that there were no significant differences between the 3 conditions.

Figure 19: Mean shift in normality ratings of male bodies from before to after priming presented with 95% confidence intervals.

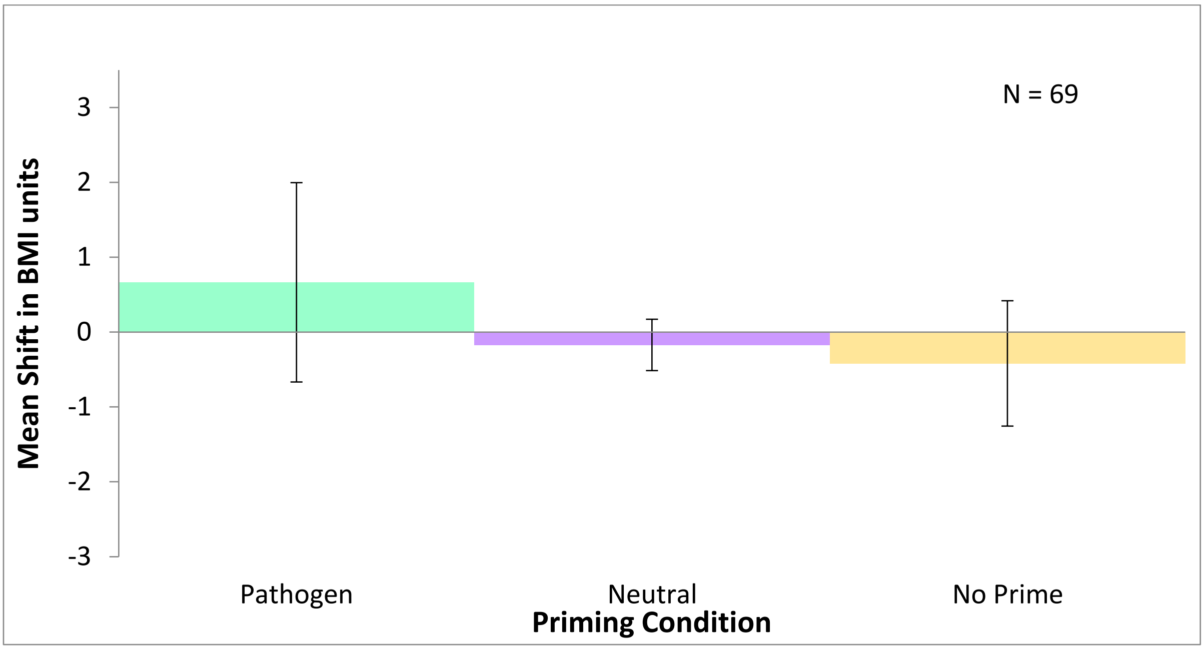


4.1.3.4 Ratings of intelligence

4.1.3.4.1 Female bodies

A one way (Prime: Pathogen, Neutral, No Prime) independent measures ANOVA was carried out on intelligence ratings in female bodies. This showed that there was no significant effect of priming on intelligence ratings of female bodies, F (2, 66) = 2.64, p >.05, η^2 = .07. This suggests that priming did not cause any effect on the participants' ratings of intelligence in female bodies. Figure 20 illustrates that there were no significant differences between the 3 conditions.

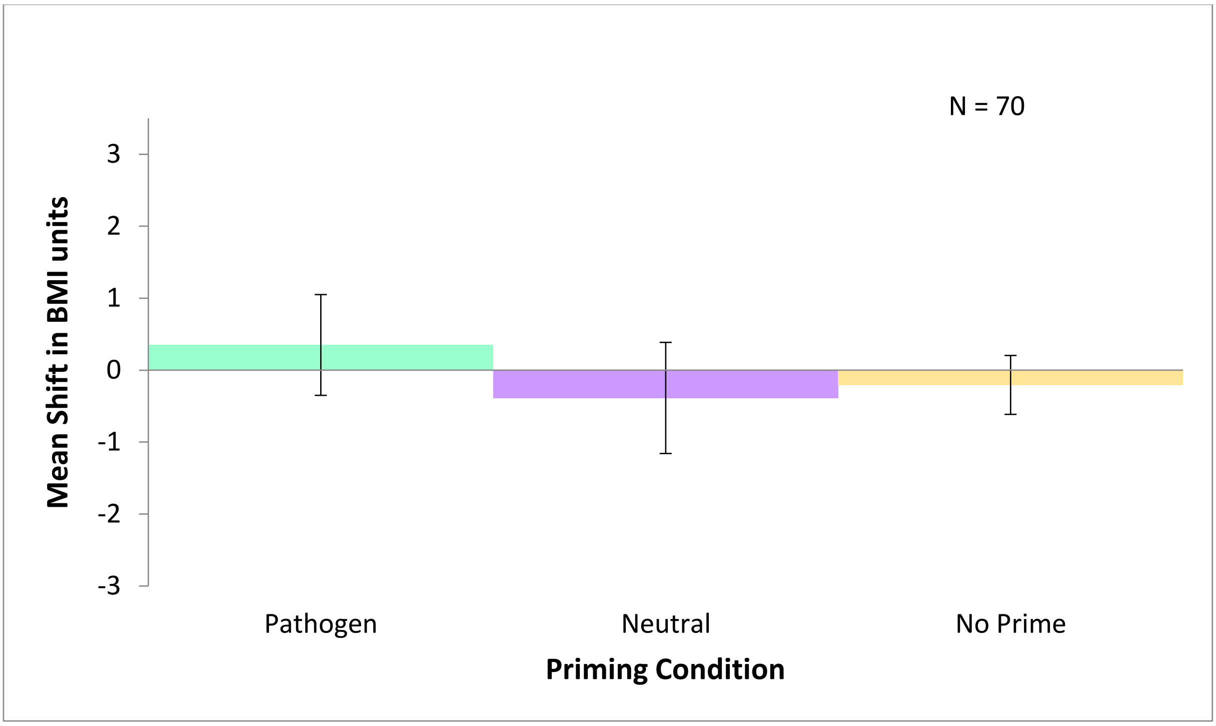
Figure 20: Mean shift in intelligence ratings of female bodies from before to after priming presented with 95% confidence intervals.



4.1.3.4.2 Male bodies

A one way (Prime: Pathogen, Neutral, No Prime) independent measures ANOVA was carried out on intelligence ratings in male bodies. This showed no effect of priming on intelligence ratings in male bodies, F (2,67) = .82, p >.05, η^2 = .02. This can be seen in Figure 21 which demonstrates that there were no significant differences between the conditions.

Figure 21: Mean shift in intelligence ratings of male bodies from before to after priming presented with 95% confidence intervals.



4.1.4 Discussion

The main finding of experiment 2a was that pathogen priming appears to affect body weight preferences using a female sample. The results suggest that priming the participants with visual images related to pathogens changed judgements of what is perceived to be an attractive and healthy female body weight. Specifically, the participants rated heavier female bodies as being more attractive and healthy following the pathogen prime. However, it is not clear from the findings if this effect is present in male bodies as well as female bodies.

Heavier bodies may be preferred following a pathogen prime due to the health benefits associated with slightly increased levels of body fat. It appears from looking at the 1st and 2nd BMI ratings for attractiveness and health that when pathogen priming caused a shift towards a heavier body this did not result in bodies which were in the overweight or obese category now being selected as most attractive or healthy. Instead it seems that bodies in the central region of the healthy weight category are favoured after pathogen priming. From looking at the participants' preferences before priming it is clear that the participants' favoured BMI's on the border between the underweight and heathy weight categories. This is likely to be caused by social influences in western society that places value on extreme thinness. Therefore, the shift towards a heavier body exhibited after pathogen priming is, in this context, a shift towards a healthier body due to the initial preference for thin bodies.

As there was difficulty collecting large amounts of male data using this particular opportunity sample it was decided to use only female participants in the analysis due to the small number of male participants that could be recruited. Therefore it could be argued that the findings may not be applicable to males. Previous research (e.g., Tovée & Cornelissen, 2001; Tovée et al., 2002; Tovée et al., 2006) has suggested that male and female participants' ratings of attractiveness for female bodies are significantly correlated. In addition to this Tovée et al. (2006) calculated interclass variation between male and female participants' ratings of bodies to access the extent to which the groups were rating bodies in the same way. This was done separately for Caucasians, South African Zulu's, South African Zulu migrants and British Black Africans. It was found that in all ethnic groups there was a high level of agreement between males and females. Other research (e.g., Swami, Antonakopoulos et al., 2006; Swami & Tovée, 2005a; Tovée et al., 2002) has also demonstrated high levels of intraclass reliability between males and females. When rating bodies suggesting that males and females rate bodies in a similar way. Therefore, it is possible that effects seem here would also be evident in a male sample. However the present research has chosen to focus on a female sample.

4.2 Experiment 2b: The effects of visual pathogen primes on body dissatisfaction and own body preferences

4.2.1 Introduction

The findings from experiment 2a suggest that pathogen priming changes what we perceive to be an attractive and healthy body in others. However, is not known if pathogen priming will affect the way we perceive our own body. It is feasible to suggest that if pathogen priming can change preferences for other's body weight it could change judgments of own or idealised body weight and as a result body dissatisfaction.

Therefore, the main aim of the current experiment was to examine the effects of pathogen priming on participants' own body ratings. In a pathogen rich environment, it may be beneficial to be an optimal body weight. A very low or high body weight could result in a weakened immune response and many other health complications meaning illness could have serious consequences or even be fatal if the body cannot fight infection as well. The experiment followed the same design as experiment 2a with the participants' rating their body dissatisfaction both before and after priming. It was suggested in experiment 2a that in line with previous research there may be no differences between females' and males' body weight preferences. However, body dissatisfaction is known to differ between females and males, with males not always having such a strong drive for thinness and being as prone to wanting to gain weight as they are to lose it (Strother, Lemburg, Stanford, & Tuberville, 2012). Therefore, the results found in this experiment will not be able to be presumed to be necessarily similar for a male sample. Although it would have been possible to collect data for both female and male participants, the scale developed in Experiment 1b was found to have greater validity for the female version therefore in the present experiment it was decided to only measure body dissatisfaction in a female sample.

It was hypothesised that after pathogen priming the participants would show a greater desire for a healthier ideal body weight. This then may increase their level of body dissatisfaction if it creates a greater discrepancy between ideal and actual body weight, conversely it may lower the participants' body dissatisfaction if a preference for a healthier ideal body decreases the discrepancy between ideal and actual body weight.

4.2.2 Method

4.2.2.1 Design

An independent measures design was used in which the participants were in either 1 of 3 different priming conditions. The participants were primed by being presented with visual images that either had an illness theme (*pathogen*) or a neutral non-pathogen theme (*neutral*), a third control group viewed no images (*no prime*). The participants' own body image was measured before and after priming. This was measured by asking the participants to choose their ideal body weight and their actual body weight, the discrepancy between the two is their body image score. Their ideal and actual body weight preference was measured as the BMI of the body selected.

4.2.2.2 Participants

The sample consisted of 66 females (Pathogen n = 24, Neutral n = 22, No Prime n = 20) who were all students at Nottingham Trent University. The mean age of the participants was 21.24 years (*SD* = 7.24). They were given research credits for their participation. These were the same participants who participated in experiment 2a.

4.2.2.3 Materials

The body stimuli used was the body scale created in experiment 1b, which was designed to measure body image. This scale was found to have good validity and test re test reliability (see Chapter 3 for an overview).

The bodies were presented to the participants on a sheet of landscape A4 paper, from left to right in ascending order of body weight. Below the bodies was a horizontal line, on which the participants had to indicate which body they thought was closest to their ideal body and which they thought was closest to their actual body weight. This was done on separated sheets of paper for ideal and actual ratings. Scores were obtained by measuring the point on the line where the participant had placed their cross and giving this the corresponding BMI unit score. The difference between the participants' ideal and actual BMI scores was their body dissatisfaction score. A negative score suggests a desire to be thinner, a positive score indicates a desire to be heavier and a score of zero means no discrepancy between ideal and actual body weight and therefore no body dissatisfaction.

4.2.2.4 Procedure

The participants were presented with the bodies to rate, the order for ideal and actual ratings was counterbalanced. The participants in the priming conditions were then presented with the same visual images described in Section 4.1.2.3. These images were displayed continuously in a random order for 10 minutes. Each individual image was presented for 8 seconds followed by a 4 second blank screen before the next image was displayed. The participants in the *pathogen* condition viewed images relating to illness. The participants in the *neutral* condition were shown neutral images. The participants in the *no prime* condition did not view any images. After priming the participants were given new body stimuli to rate again with the bodies being presented in the same way as before.

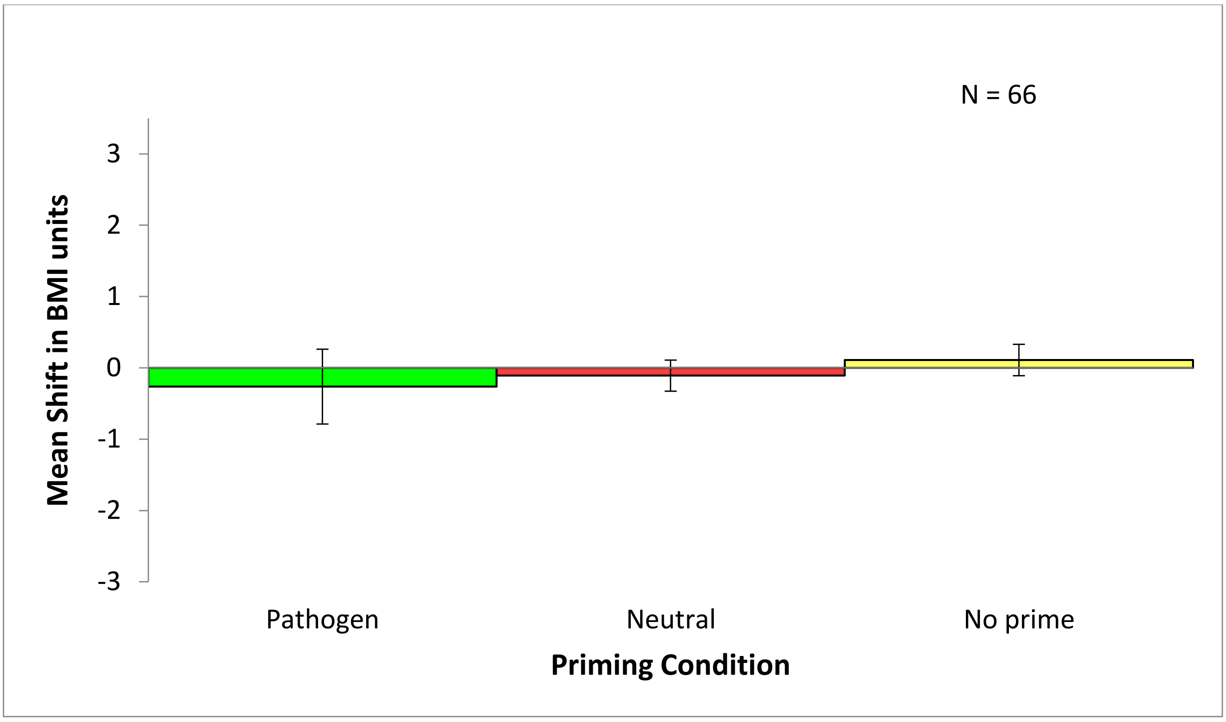
4.2.3 Results

Participants' ideal and actual BMI preference from the 2nd testing was subtracted from their 1st testing ideal and actual BMI preferences giving each participant a score for their shift in ideal and actual BMI preference. Body dissatisfaction was calculated as the discrepancy between ideal and actual BMI preference. Body dissatisfaction scores from the 2nd testing were then subtracted from from the first testing scores to calculate the shift in body dissatisfaction.

4.2.3.1 Actual body ratings

A one way independent measures (Prime: Pathogen, Neutral, No Prime) ANOVA showed no significant effect of priming on actual body ratings, F (2, 63) = .21 p >.05, η^2 = .01, suggesting that priming participants did not alter their perceived actual body rating. Figure 22 shows that there were no significant differences between the 3 priming conditions.

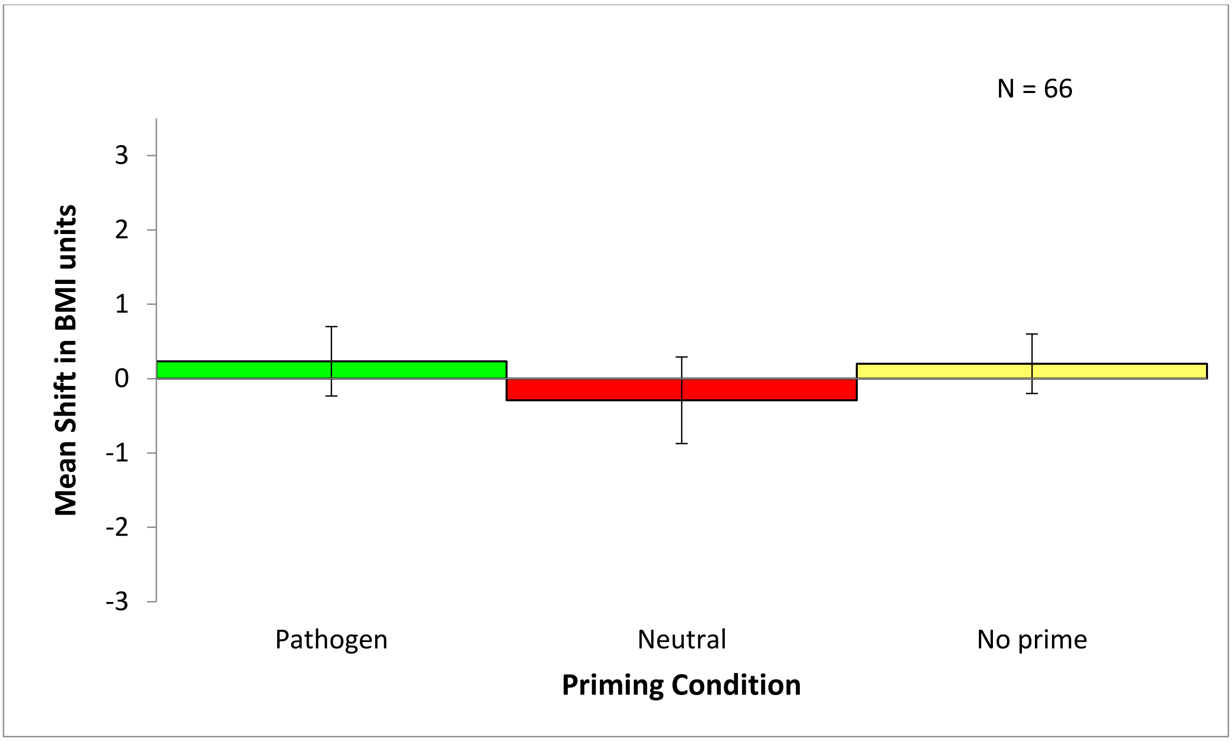
Figure 22: Mean shift in actual body ratings from before to after priming presented with 95% confidence intervals.



4.2.3.2 Ideal body ratings

A one way (Prime: Pathogen, Neutral, No Prime) independent measures ANOVA showed that there was no significant effect of priming on ideal body ratings, F (2, 63) = 1.93, p >.05, η^2 = .06. This suggests that priming did not cause any effect on what the participants chose to be an ideal body weight. Figure 23 illustrates that there were no significant differences between the 3 conditions.

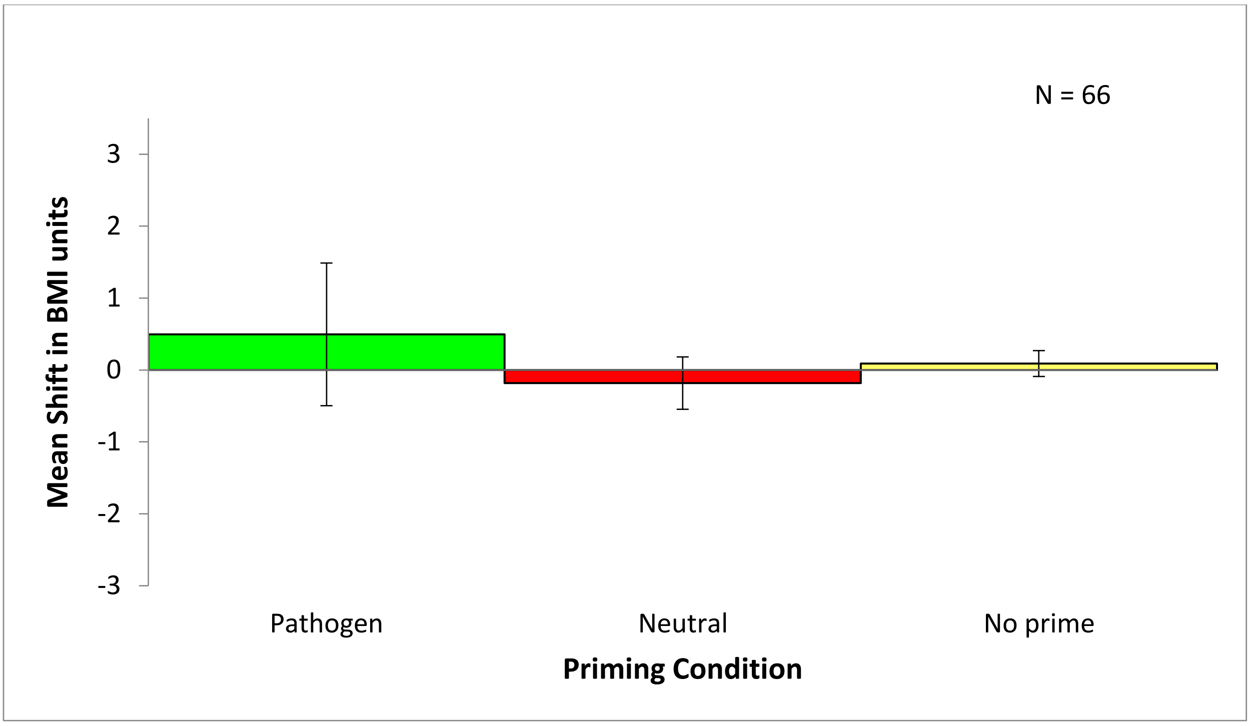
Figure 23: Mean shift in ideal body ratings from before to after priming presented with 95% confidence intervals.



4.2.3.3 Body dissatisfaction ratings

A one way (Prime: Pathogen, Neutral, No Prime) independent measures ANOVA was carried out on body dissatisfaction levels. This showed that there was no significant effect of priming on body dissatisfaction scores, F (2, 63) = .55, p >.05, η^2 = .02. This indicates that priming did not cause an effect on the participants' body dissatisfaction levels. Figure 24 demonstrates that there were no significant differences between the different conditions.

Figure 24: Mean shift in body dissatisfaction ratings from before to after priming presented with 95% confidence intervals.



4.2.4 Discussion

The findings from the current experiment suggest that pathogen priming does not have an effect on perception of actual body weight, preferences for ideal body weight or levels of body dissatisfaction. Experiment 2a has demonstrated an effect of pathogen priming on what is perceived to be an attractive and healthy body weight in others however it appears this effect is not found in individuals' judgments of themselves.

It is possible that this is because in pathogen rich environments detection and avoidance of infected individuals is a greater priority. Prevention is better than cure and therefore the avoidance of individuals with poor health would be a higher priority than maintaining or improving our current health. Consequently, pathogen priming would not cause us to pay more attention to health cues related to ourselves and therefore would not result in any effects on body dissatisfaction levels or perception of our ideal body weight. In conclusion the findings from experiment 2b therefore suggest that the effects of pathogen priming are limited to body weight judgments of others and do not alter the way we perceive our own body.

4.3 General Discussion

The findings from experiment 2a demonstrate an effect of pathogen priming on preferences for body weight in female bodies. The findings are consistent with the hypothesis based on Schaller and Duncan's (2007) proposed behavioural immune system and are in line with previous research (e.g., Oaten et al., 2009; Park et al., 2003; Schaller et al., 2010) that has indicated that the perceived presence of illness in others can trigger avoidant behavioural and psychological responses such as disgust, negative attitudes or even a biological immune system response. This can be seen to be adaptive since the avoidance of individuals who appeared to be less healthy would reduce the risk of infection by pathogens.

The findings are also consistent with the Environmental Security Hypothesis (Pettijohn et al., 2009) - which puts forward the idea that that individuals construct their preferences based on how secure they feel in their current environment. Therefore, it would seem in experiment 2a the pathogen prime is used as a cue to an increased level of pathogens and is causing the participants to change their preferences in line with this state of environmental threat. Nelson and Morrison (2005) proposed that people use implicit cues about collective resources to construct their preferences. Along with Swami and Tovée (2006), Nelson and Morrison have found that the subjective experience of resource deprivation (i.e., food and money) can affect preferences for female body weight with heavier female bodies being preferred by hungry males. This is particularly relevant here as it has been found in this experiment that there is a shift towards heavier bodies in attractiveness and health preferences, following pathogen priming using implicit cues that signal a risk to health. It is thought that this is because low body weight can be associated with disease, illness and a weakened immune system in pathogen rich environments (Marlowe & Wetsman, 2001; Swami & Tovée, 2007a; Tovée et al., 2007). Lower body mass might also indicate reduced access to resources, at least in less westernised societies where only individuals with access to resources would be able to gain body weight. Increased body fat has other health benefits, indeed the larger the fat stores when entering a period of starvation or chronic energy deficiency, the longer the survival period or the less threatening it is (Norgan, 1997).

Fisher et al. (2013) identified a correlation between reported higher levels of pathogen disgust in men and preferences for thinner female faces. This runs contra to the current findings, as based on their findings it might be expected that experimentally priming for pathogens would lead to a preference for a thinner body. Fisher et al. suggested that reported pathogen disgust in men is correlated with an increased preference for thinner female faces because overweight individuals are perceived to be unhealthy and therefore males who showed greater pathogen disgust had greater preferences for thinner faces as these were are thought to be healthy. However, although in modern society obesity is linked with poor health, extreme thinness is also related to poor health outcomes, higher mortality, problems with fertility in females and is associated with eating disorders. Therefore, it is beneficial to be in a healthy BMI weight range and this is what has been found here.

The findings here show that pathogen priming did not typically lead to the participants selecting obese, or even overweight bodies, as now being attractive or healthy. From looking at the BMI preferences for both before and after priming it is clear that pathogen priming does not typically cause bodies outside the healthy weight BMI category to be selected. Instead it results in bodies within the healthy weight range being selected as most attractive and healthy. In Western society there is a preference for extreme thinness in females and therefore initially a large number of participants selected bodies which were around the underweight and healthy weight category boundary. Since bodies selected prior to priming had low BMI's the shift towards a heavier body does signal a shift towards a healthier body. Therefore, from this data it is evident that whilst a shift towards a heavier body was found, in this context this was a shift towards a healthier body. It has been suggested that adipose tissue plays a role in the function of the immune system (Pond 1996), and higher levels of body fat may have health benefits. Therefore, it would be healthier and advantageous in a pathogen heavy environment for a slightly heavier body to be selected compared to an underweight body.

In experiment 2a the effects of pathogen priming were not demonstrated in ratings of health or attractiveness in male bodies. Therefore, it may be possible that pathogen priming is not as strong in preferences for male body weight. One possible reason for this is that reduced body weight can have much more serious consequences for females than for males. Females need a certain level of body fat to menstruate and consequently a low body weight will result in infertility (Frisch, 1987; Frisch & McArthur, 1974). Male's however can maintain a low body weight and still be reproductive. Therefore, it is possible that body weight is a better visual cue to health in female bodies than males. Another possibility is that muscularity is a better cue to both the perceived attractiveness and health of male bodies. Therefore, a further experiment could test this by having male body stimuli that varies in muscularity instead of body weight. It is possible that pathogen priming effects will be seen in muscularity preferences in male bodies.

The findings from experiment 2b suggest that pathogen priming only affects body weight preferences of others and not preferences for own body weight. This is possibly because even though a pathogen prime may activate the behavioural immune system, and cause individuals to become more aware of cues of health, this may not necessarily lead to a change in judgments regarding own and ideal body weight. Although a healthy body weight may be beneficial in a pathogen heavy environment, the behavioural immune system evolved to aid us with both the detection and behavioural avoidance of others who are infected, therefore it may not be as beneficial to have increased awareness of health cues when making judgments regarding ourselves compared as to when making judgments about others.

It is also possible that cultural effects are stronger when making judgments regarding own body weight. In western society there is a great amount of pressure for females to be thin and this is likely to be strongest when regarding one's own body weight than others. Therefore, it may be that cultural effects are too strong for pathogen priming to cause an increased preference for a heavier and healthier ideal body weight in one's self. Even though an increased body weight may provide some health benefits the desire to be thin may outweigh this even when under increased levels of perceived pathogens. Research suggests that what is considered to be an attractive body weight is lower then what is perceived to be a healthy body weight suggesting that a desire to be thin can outweigh the need to be healthy. However, these effects would most apparent when making body weight judgments regarding own body weight.

The effect of the pathogen prime was only found in ratings of attractiveness and health and not in ratings of normality and intelligence. It appears that the pathogen prime has made participants more attentive to cues of health and consequently shifted their preferences towards a heathier body. Normality preferences may not have been effected as individual preference for what is perceived as being most normal may be not be related to health and an increased preference for healthier bodies. Research has shown a significant correlation between actual measures of intelligence and attractiveness (Kanazawa, 2011) and intelligence and better health (Gottfredson & Deary, 2004). Therefore, it may have been expected that the participants' ratings of intelligence would shift following a pathogen prime if ratings of attractiveness and health are effected. It is possible that ratings of intelligence were not effected by the pathogen prime as the participants seemed to struggle with this rating compared to the others (attractiveness, health and normality) with some of the participants saying they found it hard to select which body they found most intelligence. This reluctance was not verbalised by the participants regarding the other ratings, therefore this may have lessened any effects in intelligence ratings if participants were unsure of their ratings to begin with.

The current experiments examined pathogen priming using a visual pathogen prime to create awareness of illness and disease. However, there are some potential problems with using this type of prime, for example even though the participants are unaware of the purpose of the experiment they are aware they are being primed and this could result in demand characteristics. Also the priming method used here, although a replication of previous successful method, lasted around 10 minutes and it is possible that the participants lose attention during this time, therefore a prime that is short lasting may possibly be more effective. There are other possible priming methods, such as a written or spoken prime, that could be used to achieve a priming effect that may overcome the problem of participants losing attention if the information presented was shorter in length. It is also not known if and how different types of priming modalities (e.g., visual vs written) may have different effects. Therefore, the next chapter aims to look at the effects of pathogen priming using a different priming modality. Examining the effects of pathogen priming on preferences for body weight using a different priming method will also test the strength of this effect.

To summarise it would seem from the findings of the experiments presented in this chapter that pathogen priming appears to affect body weight judgments of female bodies leading to a preference for a heavier body. However, these effects of pathogen priming are limited to the body weight judgments of others and do not alter the way we perceive our own body. It is also not clear if this effect is always present in male bodies as well as female bodies. Therefore, the next experiments will aim to further test the robustness of pathogen priming and establish its presence in male bodies. It will also use a different type of prime to see if priming effects can be established across different types of primes.

Chapter 5

Verbal Pathogen Priming

5.1 Experiment 3: The effects of verbal pathogen primes on body weight preferences

5.1.1 Introduction

Following from the previous experiments the aim of experiment 3 was to further examine the effects of pathogen priming on body weight preferences. It was decided to use verbal primes in the current experiment. This will establish if the priming effect can be demonstrated using primes with a different modality. Any effects found in this experiment would support the findings of experiment 2 and provide further evidence for the effects of pathogen priming on preferences for body weight.

In the current experiment the verbal primes used were intended to make the participants become aware of pathogen levels in their current environment. This type of verbal prime is a novel method that has yet to be used in a pathogen priming experiment. In previous pathogen priming studies visual primes (e.g., Little et al., 2011; Schaller et al., 2010) and written primes (e.g., Lee & Zietsch, 2011; Makhanova et al., 2015) have both been used. A verbal prime is a variation of a written prime with information being orally presented to the participants. Presenting participants with written information has been found to work effectively as a pathogen prime therefore it was thought that presenting participants with a spoken scenario would also be effective. The pathogen prime used in the current experiment was intended to cause awareness of current environmental pathogen levels. Therefore, the verbal primes used here have the benefit that the participants are considering their own level of pathogen threat in their current environment rather than being given general information to read. Since the behavioural immune system is highly sensitive to cues that signify the potential presence of infectious illness in others using a contagion prime should activate a behavioural immune system response. Research (Makhanova et al., 2015) has shown that presenting participants with a fake news article about a HINI flu pandemic worked as a pathogen prime. Therefore, causing the participants to become aware of illness in their current environment should also act as a pathogen prime. This was thought to be an effective prime to use in undergraduate students as the experiment was conducted in the Autumn term, when flu and cold type illnesses are particularly prevalent amongst students and the general population as a whole.

The type of prime used here presented an actual pathogen threat to the participants whereas previous primes used in the literature and the visual images used in experiment 2 did not pose an actual threat. It is unclear if, or how, different types of pathogen primes may cause different responses. The primes used in this experiment were incidental primes and were presented to the participants as a statement that was apparently unrelated to the experiment. Therefore, the participants were primed to reflect on their own health status whist being unaware of the priming process. This is in contrast to experiment 2 where the visual primes were explicit and the participants would have been aware that the process was part of the experiment. This therefore could have resulted in some demand characteristics. Consequently, experiment 3 should be less susceptible to this.

Experiment 3 used the same methodology as experiment 2 with the participants rating bodies both before and after being primed. Following from the findings of experiment 2a, it was hypothesised that relative to the neutral and no prime conditions, people who experienced the pathogen prime should show a shift in their body weight preferences. Specifically, (as seen in experiment 2a) it was expected that there should be a shift towards a more central region of the healthy BMI range. In keeping with previous findings, any shift was only predicted to be seen in ratings of attractiveness and health and not in ratings of normality and intelligence.

5.1.2 Method

5.1.2.1 Design

An independent measures design was used in which the participants were arbitrarily placed in 1 of 3 different conditions. There were 2 different priming conditions and third no prime condition. The participants were primed verbally by being either presented with a statement about illness (*pathogen*), a non-pathogen related neutral statement about the location of the experiment (*neutral*) or a third control group experienced no conversation (*no prime*).

The participants' attractiveness, health, normality and intelligence preferences were collected before and after priming, the dependent variable was the difference (shift) in their in their 1st and 2nd body ratings (2nd – 1st).

5.1.2.2 Participants

This experiment consisted of 92 female participants (Pathogen n =32, Neutral n = 30, No Prime n = 30). The mean age of the participants was 19.57 years (*SD* = 6.36). They were students at Nottingham Trent University and were given research credits for their participation.

5.1.2.3 Materials

Priming Stimuli

The participants in the priming conditions were presented with a short (approx. 1 minute), apparently incidental, piece of verbal information to prime them. They believed this to be unrelated to the experiment. Primes were either a pathogen prime which involved asking the participant to consider their own health and the environment or a non-pathogen neutral prime. This involved the experimenter making a statement about the location of the experiment as this was thought to be neutral topic not related to health.

Pathogen Prime:

Experimenter:

Thanks for coming today. A lot of people have cancelled today because they are feeling unwell. A lot of people seem to be ill at the moment. I had a cold last week. Have you been ill recently?

Participant:

Open response from participant

Experimenter:

Affirmative response (restricted to positive discourse markers such as 'uh-hu', 'yep', 'ok', 'I hope you are feeling better').

Let's move on to the next bit of the experiment.

Neutral Prime:

Experimenter:

Thanks for coming today. A lot of people haven't come today because they couldn't find the room. A lot of people seem to be having difficulty finding this room. Did you find the room ok?

Participant:

Open response from participant

Me:

Affirmative response (restricted to positive discourse markers such as 'uh-hu', 'yep', 'ok').

Let's move on to the next bit of the experiment.

Body stimuli

The body stimuli were presented to the participants in the same way as experiment 2, from left to right in ascending order of body weight. BMI preferences were obtained by measuring the point on the line where the participant had placed their cross and giving this the corresponding BMI unit score (see Chapter 4, Section 4.1.2.3, Figure 7 for details).

5.1.2.4 Procedure

The bodies were presented to the participants on a landscape sheet of A4 paper, from left to right in ascending order of body weight. Below the bodies was a horizontal line, on which the participants had to indicate where along the continuum they thought the most attractive, healthy, normal and intelligent body might lie. This was done on separated sheets of paper for each new rating and male and female bodies were presented separately.

The participants were presented with the bodies to rate for attractiveness, health, normality and intelligence, one at a time, on 4 separate a sheets, in random order. The participants in the priming conditions were then primed with the verbal prime. The participants in the *pathogen* condition received the pathogen prime. The participants in the *neutral* condition received the neutral prime. (See Materials for details). The participants in the *no prime* condition were not primed. After priming the participants were given a new booklet of bodies to rate. The bodies were presented in the same way as before on A4 paper.

5.1.3 Results

Out of the 92 participants, 2 of the participants did not complete any male body ratings, 2 of the participants did not complete the normality and intelligence ratings for male and female bodies and 2 of the participants did not complete health ratings for male and female bodies.

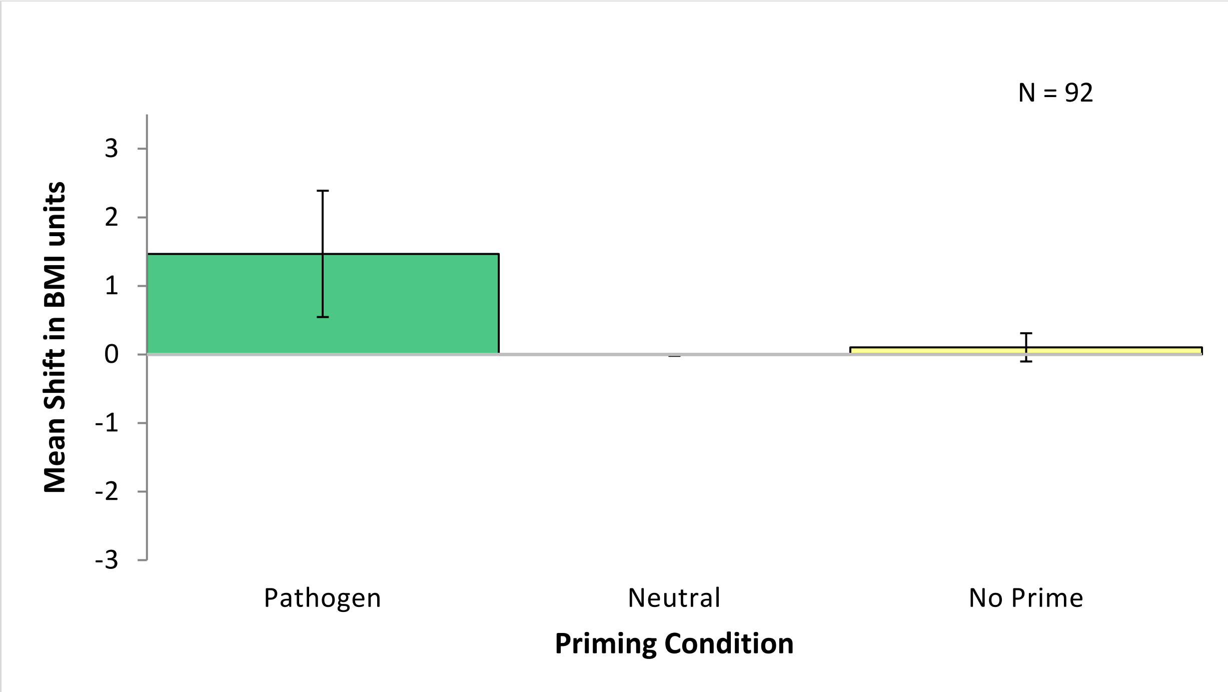
As in experiment 2, each participants’ BMI preference from the 2nd testing was subtracted from their 1st testing BMI preference giving each participant a score for their shift from the 1st to 2nd testing. These scores were then used in the analysis.

5.1.3.1 Ratings of attractiveness

5.1.3.1.1 Female bodies

A one way (Prime: Pathogen, Neutral, No Prime) independent measures ANOVA was carried out on female body ratings. The results showed a significant effect of type of prime on the shift in the participants’ ratings of attractiveness in female bodies, F (2, 89) = 12.23, p <.05, η^2 = .21. Post hoc analysis using Bonferroni corrected t tests showed that the participants who experienced the pathogen prime experienced a significantly bigger positive shift compared to those in the neutral prime (p <.05, d = 1.06) and the no prime conditions (p <.05, d = 0.92). There was no significant difference between the participants in the neutral and the no prime condition (p >.05, d = 0.11). From looking at Figure 25 it seems that the participants who had been primed for pathogens experienced a significant positive shift in their attractiveness preferences for female bodies with heavier bodies now being rated as more attractive. Whereas the participants in the neutral and no prime condition had only a small shift in preference.

Figure 25: Mean shift in attractiveness ratings of female bodies from before to after priming presented with 95% confidence intervals.



To further examine this significant effect, the BMI preferences from the first and second rating for each participant were looked at. Note: Where only on orange symbol is visible this indicates the preference at the 2nd testing is identical to the 1st testing preference. The data is presented in ascending order of BMI ratings on the 1st testing.

In Figure 26 each participant's score for both ratings has been presented so as to see the range of BMI's chosen and where the shifts occurred. Looking at the both of these BMI ratings for each of the participants, Figure 26 shows that pathogen priming appears to be causing a shift towards the central area of the healthy weight category. It did not cause a shift which resulted in the participants selecting overweight or obese bodies. Although the participants are selecting bodies with a higher BMI than before priming, this shift is further into the healthy weight category and is therefore a shift towards a healthier body. Across all conditions it can be seen, from looking at Figures, 26, 27 and 28, that in only 2 cases was a body in the overweight category selected as most attractive. This shows that there are individual differences in body weight preferences but in general it can be seen that bodies towards the lower end of the healthy weight category were preferred across all three priming conditions.

<u>Figure 26: First and Second BMI ratings for attractiveness in the pathogen priming condition</u>

	Obese	BMI >30
	Overweight	BMI 25 – 30
	Healthy weight	BMI 18.5 - 24.9
	Underweight	BMI < 18.5

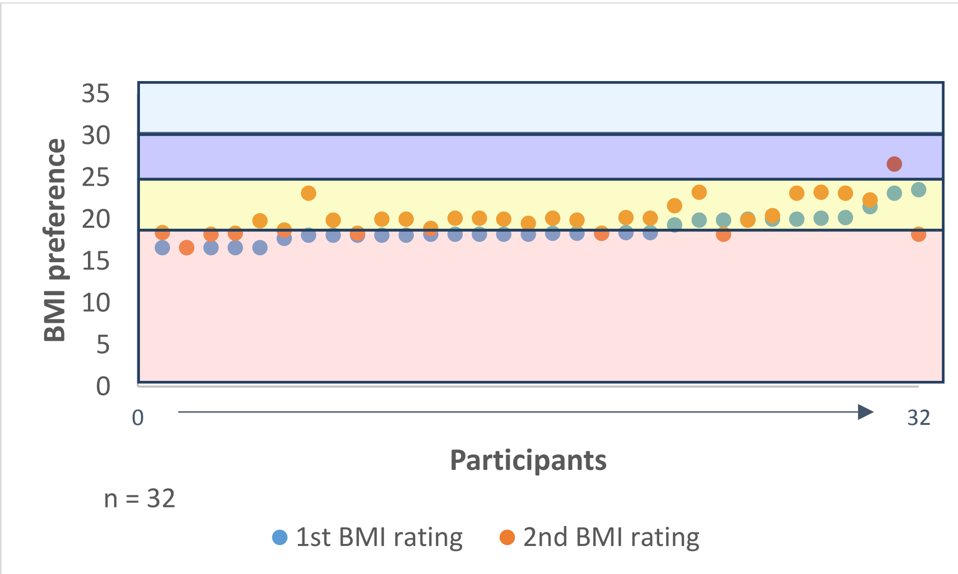


Figure 27: First and Second BMI ratings for attractiveness in the neutral priming condition

	Obese	BMI >30
	Overweight	BMI 25 – 30
	Healthy weight	BMI 18.5 - 24.9
	Underweight	BMI < 18.5

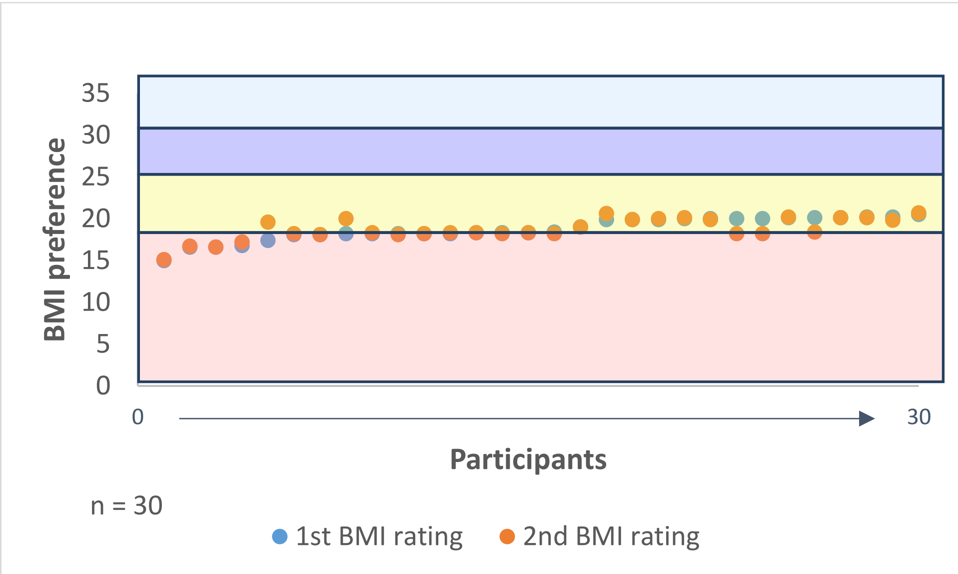
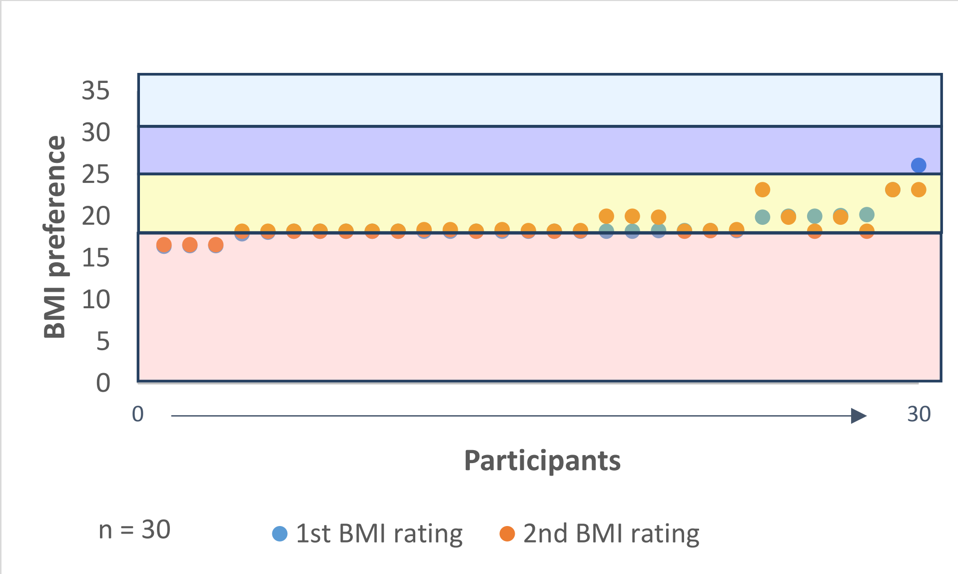


Figure 28: First and Second BMI ratings for attractiveness in the no priming condition

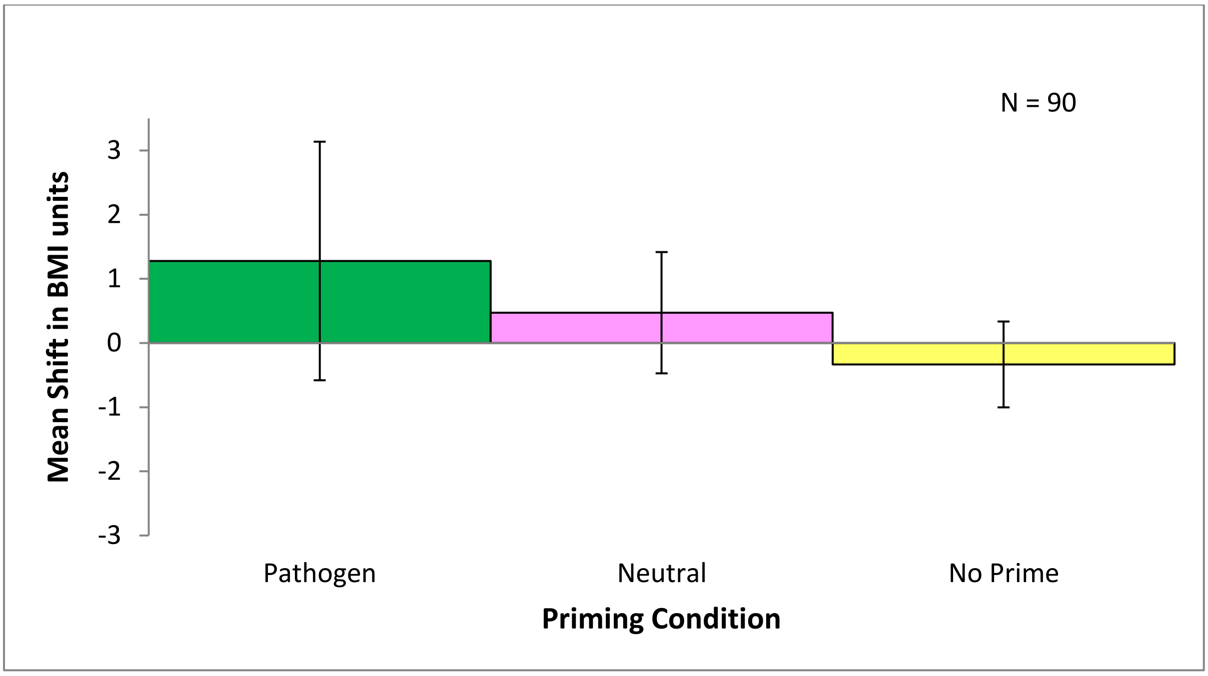
	Obese	BMI >30
	Overweight	BMI 25 – 30
	Healthy weight	BMI 18.5 - 24.9
	Underweight	BMI < 18.5



5.1.3.1.2 Male bodies

A one way (Prime: Pathogen, Neutral, No Prime) independent measures ANOVA was carried out on male body ratings. This showed no significant effect of priming on attractiveness preferences, $F\,(2,87) = 2.83$, $p > .05$, $\eta^2 = .06$. Figure 29 shows that the participants who had been pathogen primed did have a positive shift in their attractiveness preferences suggesting that heavier bodies were now rated as being more attractive. However, this shift was not large enough to be significant.

<u>Figure 29: Mean shift in attractiveness ratings of male bodies from before to after priming presented with 95% confidence intervals.</u>



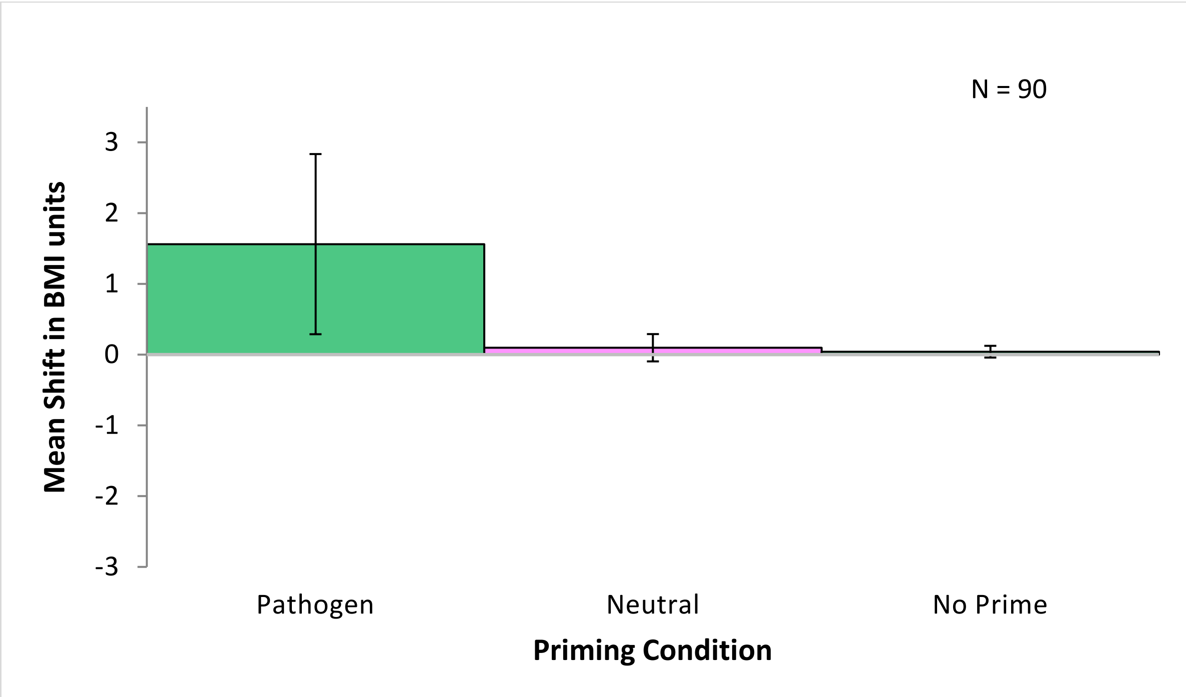
5.1.3.2 Ratings of health

5.1.3.2.1 Female bodies

A one way (Prime: Pathogen, Neutral, No Prime) independent measures ANOVA was carried out on female body ratings. The results showed that there was a significant effect of priming on shift in health ratings for female bodies, F (2,87) = 7.12, $p < .05$, $\eta^2 = .14$ suggesting that priming participants for pathogens appears to change their preferences for health in female bodies. Post hoc Bonferroni corrected t tests indicated that the participants who experienced the pathogen prime had a significantly bigger positive shift in attractiveness preferences than those in the neutral (p <.05, d = 0.82) or no prime conditions (p <.05, d = 0.81).

There was no significant difference between the participants in the neutral and no prime conditions (p >.05, d = 0.03). Figure 30 indicates that preferences for health in female bodies shifted more after pathogen priming compared to neutral or no priming, with heavier bodies now being rated as being healthier by those who had received the pathogen prime.

Figure 30: Mean shift in health ratings of female bodies from before to after priming presented with 95% confidence intervals.



To examine further the significant effect found in health ratings of female bodies the BMI preferences from the first and second rating for each participant were looked at. In Figure 31 each participants' score for the first and second rating has been presented so as to see the range of BMI's chosen and where the shifts occurred. Note: Where only on orange symbol is visible this indicates the preference at the 2nd testing is identical to the 1st testing preference. The data is presented in ascending order of BMI ratings on the 1st testing.

Figure 31 demonstrates that pathogen priming appears to cause a shift towards the higher end of the healthy weight BMI category. From Figure 31 it can be seen that 2 participants selected bodies in the overweight category at the second rating, suggesting again that there are individual differences in body weight preferences. However, from Figures 31, 32 and 33 it is clear that the range of BMI ratings were similar across all conditions with bodies in the healthy weight category usually being preferred.

<u>Figure 31: First and Second BMI ratings for health in the pathogen priming condition</u>

	Obese	BMI >30
	Overweight	BMI 25 – 30
	Healthy weight	BMI 18.5 - 24.9
	Underweight	BMI < 18.5

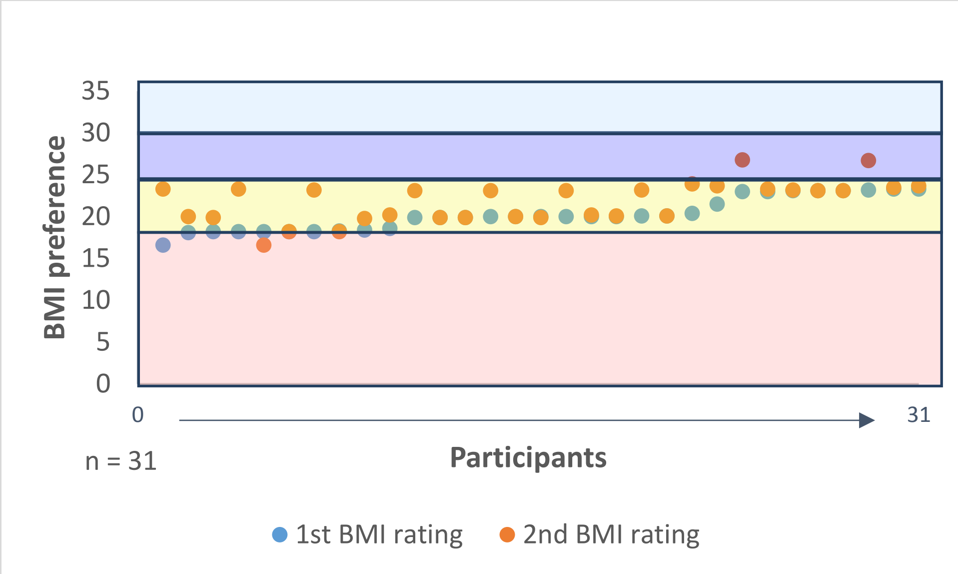
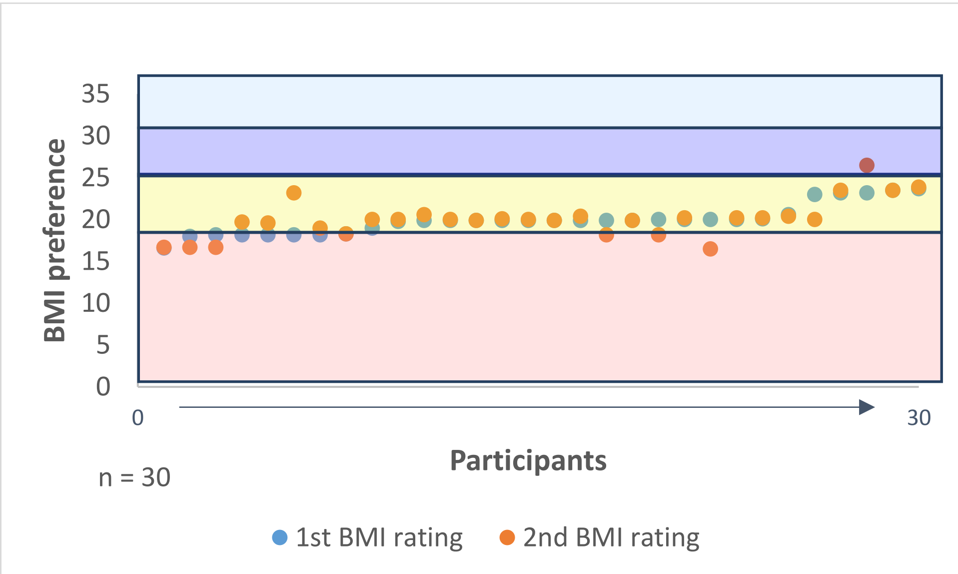


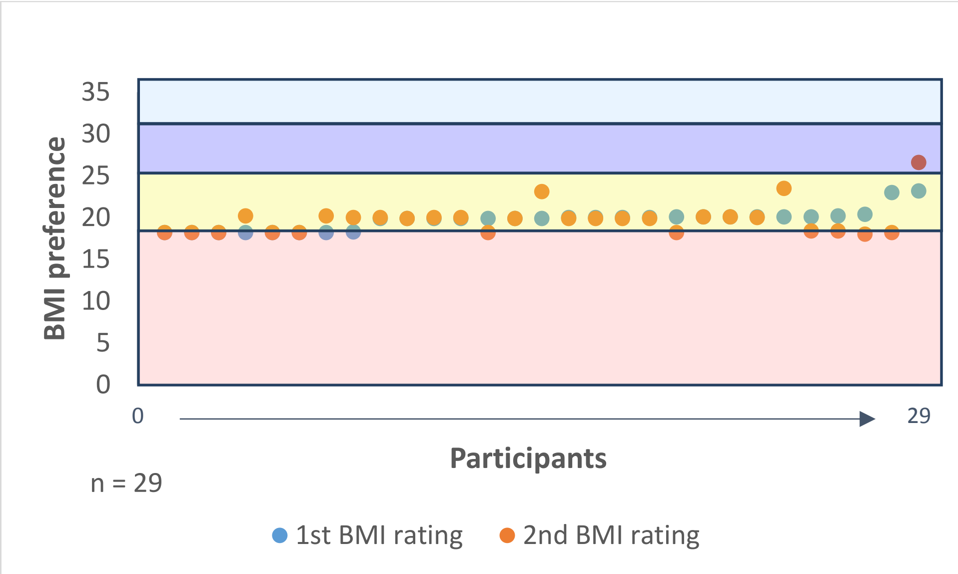
Figure 32: First and Second BMI ratings for health in the neutral priming condition

	Obese	BMI >30
	Overweight	BMI 25 – 30
	Healthy weight	BMI 18.5 - 24.9
	Underweight	BMI < 18.5



<u>Figure 33: First and Second BMI ratings for health in the no priming condition</u>

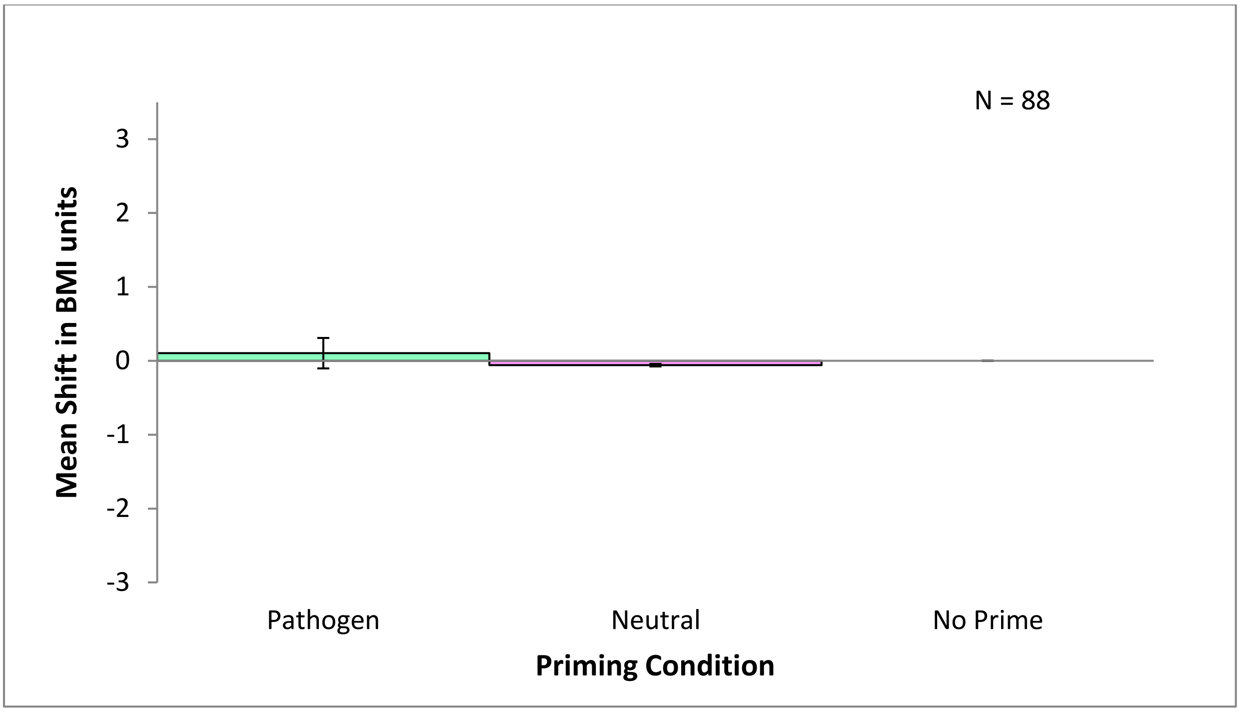
	Obese	BMI >30
	Overweight	BMI 25 – 30
	Healthy weight	BMI 18.5 - 24.9
	Underweight	BMI < 18.5



5.1.3.2.2 Male bodies

The male body health ratings were analysed using a one way (Prime: Pathogen, Neutral, No Prime) independent measures ANOVA. This showed no effect of priming on health ratings of male bodies, F (2,85) = .39, p >.05, η^2 = .00. Figure 34 demonstrates that there were no significant differences between the 3 conditions.

Figure 34: Mean shift in health ratings of male bodies from before to after priming presented with 95% confidence intervals.

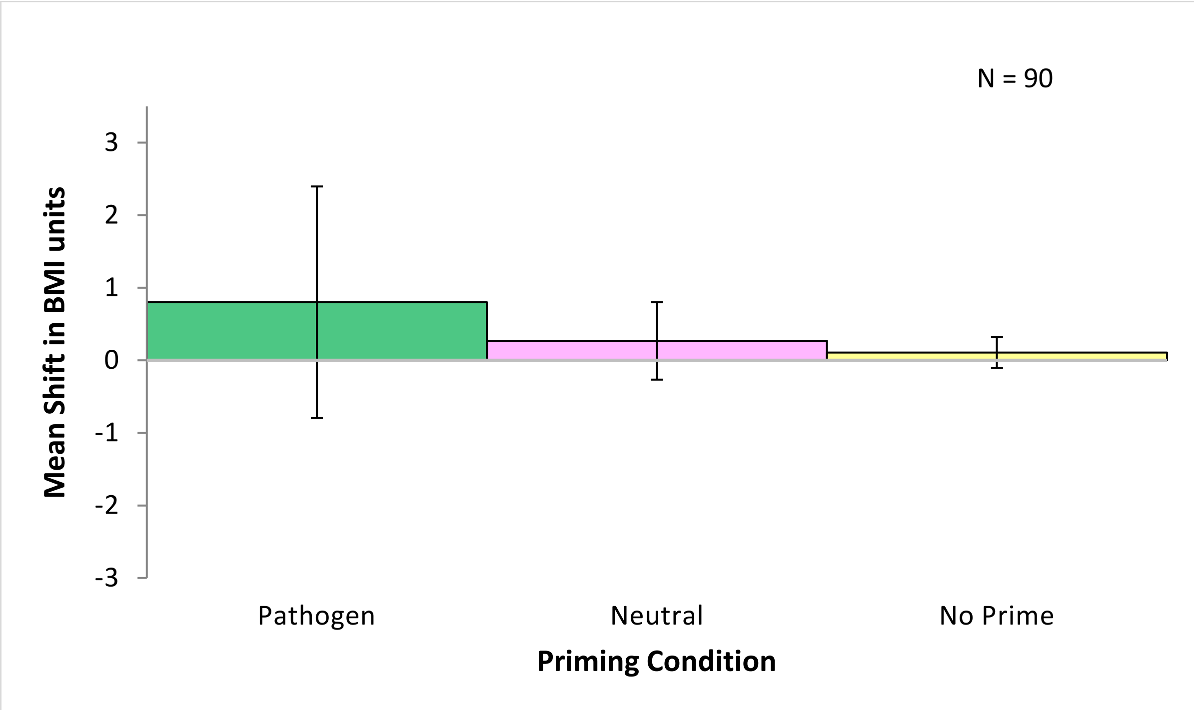


5.1.3.3 Ratings of normality

5.1.3.3.1 Female bodies

A one way (Prime: Pathogen, Neutral, No Prime) independent measures ANOVA was carried out on normality ratings in female bodies. This found no significant effect of priming on ratings of normality, F (2, 87) = .82 p >.05, η^2 = .02, suggesting that priming the participants did not cause any effect on preferences for normality in female bodies. Figure 35 demonstrates that there were no significant differences between each of the priming conditions.

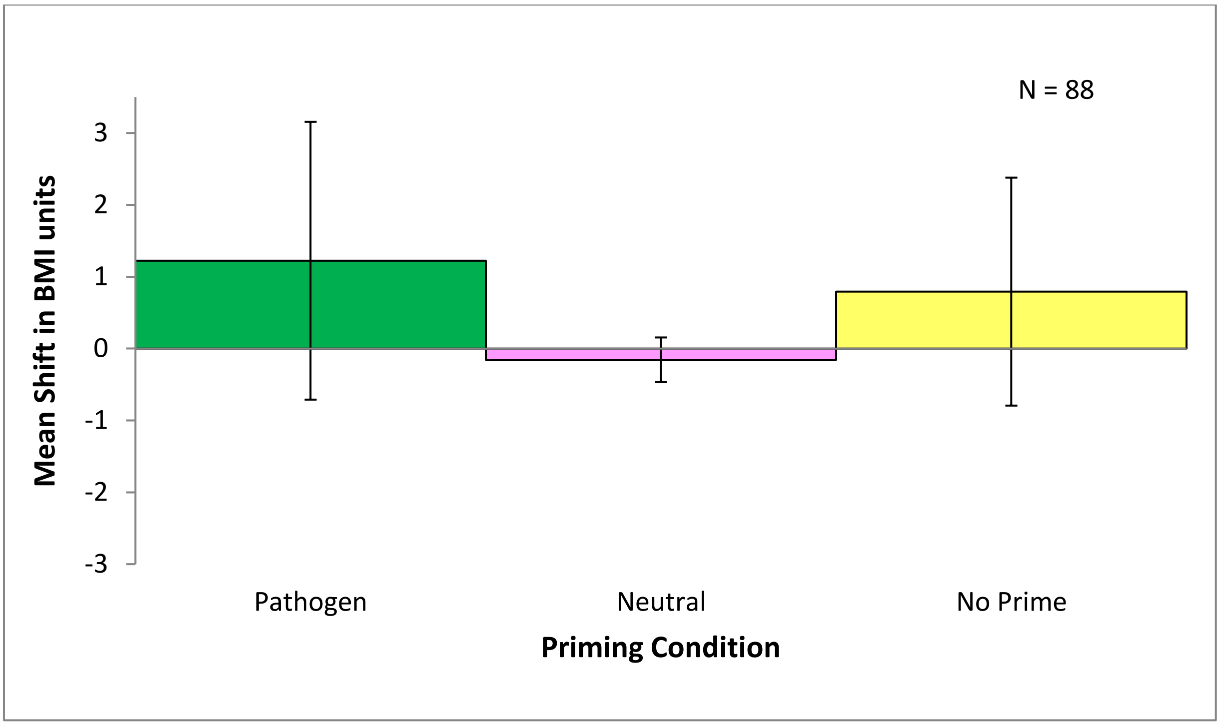
Figure 35: Mean shift in normality ratings of female bodies from before to after priming presented with 95% confidence intervals.



5.1.3.3.2 Male bodies

The male body ratings were analysed using a one way (Prime: Pathogen, Neutral, No Prime) independent measures ANOVA. The results showed that there was no significant effect of priming on ratings of normality in male bodies, F (2, 88) = 2.06 p >.05, η^2 = .04, suggesting that priming the participants did not alter normality preferences. Figure 36 illustrates this showing no significant differences between the 3 priming conditions.

Figure 36: Mean shift in normality ratings of male bodies from before to after priming presented with 95% confidence intervals.

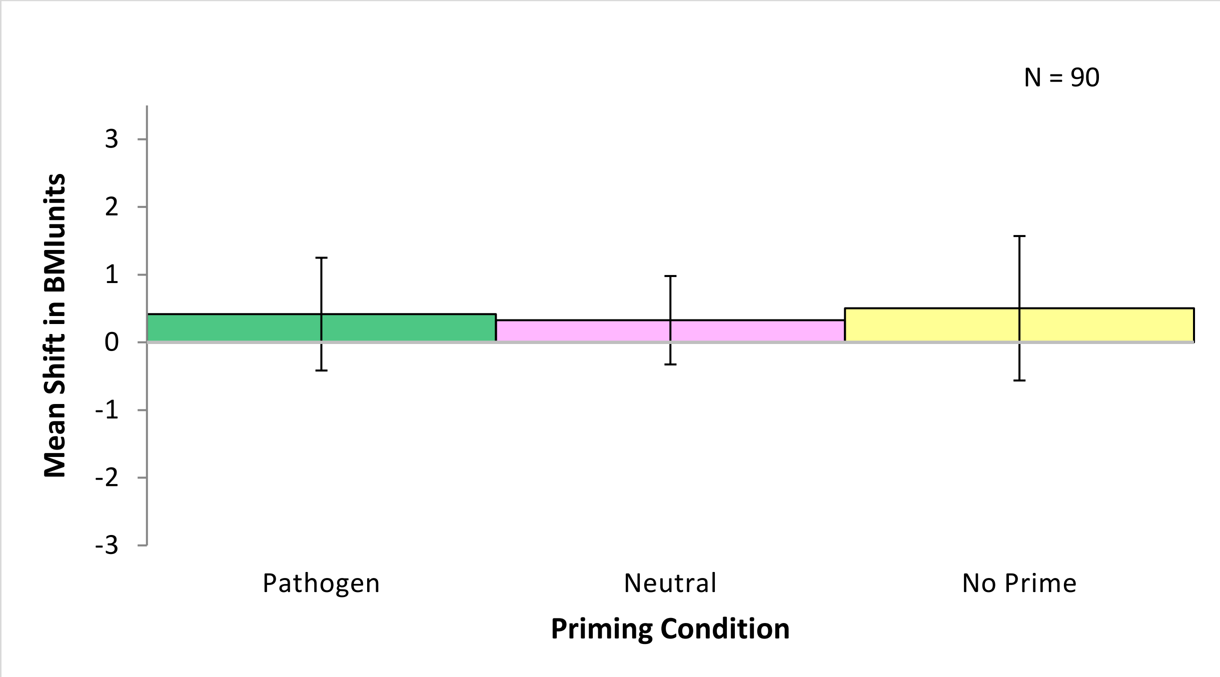


5.1.3.4 Ratings of intelligence

5.1.3.4.1 Female bodies

Ratings of intelligence in female bodies were analysed using a one way (Prime: Pathogen, Neutral, No Prime) independent measures ANOVA. The found no effect of priming on intelligence ratings in female bodies, F (2,87) = .07, p >.05, η^2 = .00. This is demonstrated in Figure 37 which shows no significant difference in shift in intelligence ratings between the 3 conditions.

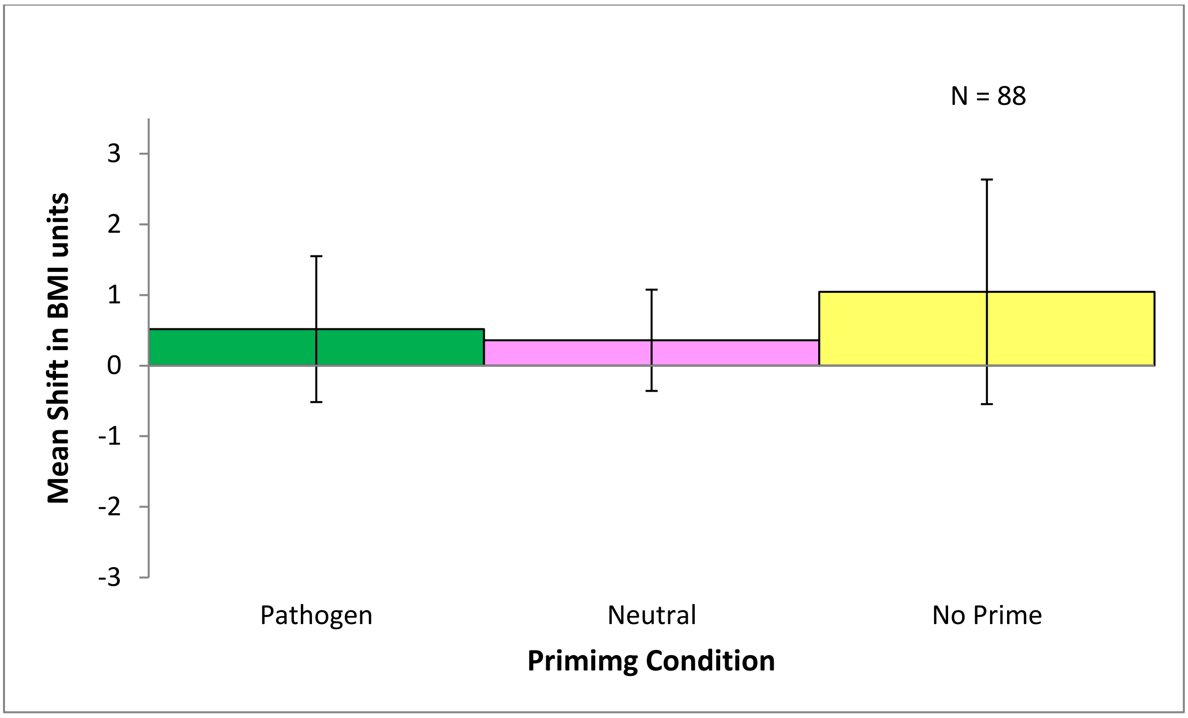
Figure 37: Mean shift in intelligence ratings of female bodies from before to after priming presented with 95% confidence intervals.



5.1.3.4.2 Male bodies

Ratings of intelligence in male bodies were analysed using a one way (Prime: Pathogen, Neutral, No Prime) independent measures ANOVA, this showed no effect of priming on intelligence ratings in male bodies, F (2,85) = .81, p >.05, η^2 = .02. Figure 38 demonstrates that there were no significant differences between the 3 conditions.

Figure 38: Mean shift in intelligence ratings of male bodies from before to after priming presented with 95% confidence intervals.



5.1.4 Discussion

The findings from the current experiment suggest that pathogen priming causes a shift in attractiveness and health preferences for female body weight using a female sample. This supports the findings from experiment 2a which also demonstrated this effect. The findings provide further support to the idea that increased pathogen awareness can cause a change in body weight preferences, supporting the notion of a behavioural immune system (Schaller, 2011; Schaller & Duncan, 2007; Schaller & Park, 2011) The findings are in line with research (e.g., Faulkner et al., 2004; Makhanova et al., 2015; Murray & Schaller, 2012; Navarrete & Fessler, 2006; Park et al., 2003) in this area that supports the behavioural immune system hypothesis and also previous research (Nelson & Morrison, 2005; Pettijohn et al., 2009; Swami & Tovée, 2006) that has indicated that preferences for body weight can vary as result of perceived levels of resource access.

The current experiment demonstrated that an effect can be found across different priming methods, this suggests that it is a relatively robust finding. Furthermore, this type of verbal prime is a novel method of priming that has not previously been used in other pathogen priming studies. It can be argued that when participants are presented with visual primes they are aware they are being primed and this could result in demand characteristics, therefore the type of incidental prime, used here, can be used to prime the participants without them becoming aware of the priming process. As an effect was demonstrated here using incidental priming it would suggest that the effect found in experiment 2 was not due simply to the participants being aware of the priming process.

As mentioned in the discussion of Chapter 4 it could be argued that experimentally priming for pathogens might lead to a preference for a thinner body as in current Western society obesity is linked to poor health as much as being underweight is. However, from looking at the BMI preferences from the first testing for attractiveness and health it can be seen that bodies with low BMI's were selected, particularly in attractiveness ratings. Therefore, as in experiment 2, here a shift towards a heavier body seems to be a shift towards a healthier body and further into the healthy weight BMI category. Meaning that although a shift towards a heavier body was found this did not result in people showing a preference for an obese body. It is likely that social and media pressure has led to a preference for very thin bodies resulting in bodies with lower BMI's being perceived as being attractive and healthy. The findings suggest that when participants are being primed they are moving away from this social preference to a now healthier body weight.

In line with experiment 2 the results showed no effects in ratings of intelligence and normality. As with experiment 2 some of the participants had difficulty with the intelligence ratings and this could have affected the results. It seems from the findings of experiment 2 and this experiment that perceived normality is not effected by pathogen priming. Experiment 2a found no significant effects in ratings of attractiveness or health in male bodies and this was also demonstrated here with no significant effects being shown in attractiveness and health preferences for male body weight. Much of the research which has examined body preferences has only examined preferences for female body weight (e.g., Marlowe et al., 2005; Swami et al., 2011; Swami & Tovée, 2006, 2007a; Tovée et al., 2006). The current experiment indicates that preferences for male body weight are possibly not affected by environmental factors, or not to the same extent as female body weight preferences. Nelson and Morrison (2005) suggested that female preferences for male bodies did not alter as a result of resource scarcity. However, they did not ask participants to make same sex judgments therefore it is possible that the effect would have been found in female preferences for female body weight. Little et al. (2011) and Watkins et al. (2012) have shown that exposure to information about pathogens affected female preferences for male faces, suggesting that females shift their preferences for faces in relation to pathogen related information. It would seem possible that preferences for male bodies would also be affected by pathogen threat as weightier male bodies within a healthy range, like female bodies, should also appear healthier and less likely to be effected by disease.

It is also possible that body weight is not such an important cue in male bodies compared to female bodies. In females low weight in particular is associated with infertility (Frisch, 1987; Frisch & McArthur, 1974). Therefore, as a cue to health body weight may be more important in female bodies than males. Research has suggested that muscularity, as sometimes indicated by WCR, is a significant cue to the perceived attractiveness of male bodies (Maisey et al., 1999; Swami & Tovée, 2005b). Therefore, it is possible, as muscularity in males signifies physical strength and possibly health, that females would select male bodies with increased muscularity after being primed for pathogens. However, as the male body stimuli used here varied only in body fat it is not clear if the participants are selecting heavier male bodies as they perceive these to be more muscular. Male body stimuli that varies in muscularity rather than body weight would need to be used to establish if this theory is correct.

This experiment was conducted during autumn and at a time when flu and other similar illnesses are particularly prevalent, therefore it is possible that if the experiment was conducted in summer the prime used would not be as effective if these type of illness were not as prevalent. However, depending on the time of year the content of the prime could be changed for example in summer it could include information about a subjectively foreign illness which could have been acquired on a holiday or a trip.

Finally, increased anxiety has been shown to alter face preferences (Pettijohn & Tesser, 2005; See Section 1.4.1 of the literature review) and men under greater stress have been shown to have a greater preference for heavier bodies (Swami & Tovée, 2012). Therefore, it is possible that the effects of pathogen priming seen here reflect a general increased threat response. Consequently, it is a possibility that the effects found here are part of a general threat mechanism rather than being specific to pathogen related threat. The prime used in experiment 2 is unlikely to have caused high levels of anxiety in the participants, or when the participants in the pilot study were asked to identify the main theme of the images it is likely that fear or a similar construct would have been identified instead of illness. Here in experiment 3 it is unlikely that presenting the participants with a brief verbal statement about illness would have increased their anxiety levels, however it is a possibility. Therefore, the effects of anxiety on body weight preferences will be further explored in the next chapter.

To summarise it would seem from the findings of experiment 3 that pathogen priming appears to effect body weight preferences leading to a preference for a healthier body. The next chapter will examine the effects of threat and anxiety on body weight preferences. The aim is to establish whether these effects are specific to pathogen threat or threat more generally. In addition, it is not clear why this effect is always present in male bodies as well as female bodies. Therefore, further experiments will aim to establish if this is because muscularity is a stronger cue to health than body weight in male bodies.

Chapter 6

Threat Priming and Body Weight Preferences

6.1 Experiment 4: The effects of verbal threat priming on body weight preferences

6.1.1 Introduction

The previous experiments have examined the effects of pathogen priming on preferences for body weight. The results suggested that pathogen priming does affect preferences for body weight although this seems to be mainly be for female bodies. This chapter aims to further explore the notion of general threat and increased anxiety and the effects this may have on body weight preferences.

The environmental security hypothesis suggests that a variety of environmental threats can cause individual preference to alter (Pettijohn & Tesser, 1999, 2005). Research (Pettijohn & Tesser, 1999) has shown that in times of social and economic depression preferences for facial features in American actresses altered with mature facial features being preferred in these conditions. However, this finding was not demonstrated with popular American actors (Pettijohn & Tesser, 2003). Pettijohn and Jungeberg (2004) also found that when looking at facial and body characteristics of Playboy Playmates, in difficult social and economic times in the USA, the Playmates of the Year tended to have more mature characteristics (older, heavier and taller). In addition to this when looking at at Number 1 songs in the USA from 1955 to 2003 it was found that in less threatening social and economic conditions female performers with larger eyes and male performers with larger eyes and smaller chins were favoured (Pettijohn & Sacco, 2009)

To experimentally examine these effects Pettijohn and Tesser (2005) manipulated their participants to experience increased anxiety levels. As increased anxiety is associated with threat it was thought heightened anxiety levels would be indicative of environmental threat. In the experiment Pettijohn and Tesser had two threat conditions, a low threat one in which the participants were told they would experience mild electric shocks which would cause minimal pain and a high threat condition in which they told the participants they would experience electric shocks that would be painful. When comparing these two conditions it was shown that the participants in the high threat condition showed a greater preference for faces with small eyes compared to the participants in the low threat condition who preferred larger eyes. This was thought to be because larger eyes are a neotenous facial feature and therefore smaller eyes may signal maturity, suggesting that when individuals feel under threat they show a preference for facial characteristics that imply maturity. This suggests that as well as socioeconomic threats general threat, as indicated by increased anxiety, can alter face preferences.

It appears that stress may also affect body weight preferences. Research (Swami & Tovée, 2012) found that males who took part in the Trier Social Stress Test (TSST) rated heavier female bodies as being more attractive compared to controls. The TSST is a test which involves the participant taking the role of a job applicant and making a presentation to an interviewing panel. The TSST has been shown to increase cortisol levels which are indicative of an increase in psychological stress (Kirschbaum, Pirke, & Hellhammer, 1993). The findings from Swami and Tovée (2010) suggest that the experience of stress caused by the TSST can cause males to show a preference for heavier female bodies.

Experiment 4 aimed to see if inducing general anxiety as an indicator of threat affected preferences for body weight. This was to establish if any previous effects of pathogen priming were actually just manifestations of a general threat response. It was decided to use a prime similar to the manipulation used in Pettijohn and Tesser (2005) rather than the TSST used by Swami and Tovée (2012). Although the TSST manipulation employed in Swami and Tovée has been shown to increase stress levels this type of manipulation could have also caused a reduction in self-confidence or self-esteem as it involved role play and performance. A reduction in self-esteem could have then also affected body size preferences. Here in line with Pettijohn and Tesser (2005) the participants were informed of a second experiment that would involve electric shocks. This was presented as a verbal prime to the participants in a similar way to the verbal pathogen prime in experiment 3. Informing the participants that they might soon experience an electric shock should increase perception of threat and increase anxiety/stress levels but also avoid creating a situation which may alter self-esteem levels. Furthermore, it has been suggested that the TSST is more effective in males than females, with males producing twice the amount of cortisol levels as a response to psychological stress compared to females (Foley & Kirschbaum, 2010; Kirschbaum, Wust, &

Hellhammer, 1992). Therefore, the TSST may not be as effective or appropriate to use in a sample of female participants. In addition to this it may be possible to prime threat by simply asking the participants to complete a questionnaire measuring their anxiety levels. Previous pathogen priming studies (Lee & Zietsch, 2011; Watkins et al., 2012) have used the Perceived Vulnerability to Disease (PVD) questionnaire as a written prime suggesting that this is a suitable type of experimental prime to use. Therefore, a questionnaire measuring anxiety levels was used as a second threat prime condition.

It was hypothesised that the participants who had experienced the anxiety threat primes would show a greater shift in their body weight preferences compared to the participants who had received the neutral prime or no prime at all. It was predicted this shift would be towards a healthier body as this would be in line with findings from experiments 2 and 3 and with Swami and Tovée's (2012) findings. As effects were only seen in ratings of attractiveness and health in experiments 2 and 3 it was not necessarily expected to see effects in ratings of normality and intelligence but these were still included because there was a possibility that a threat prime may work differently to a pathogen prime.

6.1.2 Method

6.1.2.1 Design

An independent measures design was used in which the participants were arbitrarily placed in 1 of 4 different priming conditions. The participants were primed using a verbal prime in which they were presented with a verbal information regarding a possible electric shock experiment and administered the Stait Trait Anxiety Inventory (STAI) Form Y *(Verbal Threat*). A second group were simply primed by being administered the STAI Form Y (*Written Threat*). In the same way as experiment 3 the third group were primed verbally by having a non-threatening neutral conversation about the location of the experiment (*Neutral*), and a fourth group experienced no prime at all (*No prime*).

The participants' attractiveness, health, normality and intelligence preferences were measured before and after priming, the dependent variable was the difference (shift) in their in their 1st and 2nd body ratings (2nd – 1st).

***6.1.2.2** Participants*

The participants were 80 females who were students at Nottingham Trent University. They were given research credits for their participation. The mean age of the participants was 20.09 years (*SD* = 0.71). There were 20 participants in each of the 4 conditions. Participants in the Neutral and No Prime conditions were taken from experiment 3.

***6.1.2.3** Materials*

Body stimuli: The bodies were presented to the participants in the same way as in previous experiments, on a sheet of landscape A4 paper. They were presented in ascending order of body weight from left to right. Below the bodies was a horizontal line, on this line the participants had to indicate, with a cross, which they thought the most attractive, healthy, normal or intelligent body was. This was done on separated sheets of paper for each new rating. As in previous experiments the position of the cross on the line was converted into the corresponding BMI value to give a BMI preference score.

Priming Stimuli

The participants in the priming conditions were presented with a short (approx. 1 minute), apparently incidental, piece of verbal information to prime them.

Verbal Threat Prime:

Experimenter:

Thanks for coming today. There is a second part to this experiment which involves mild electric shocks. A lot of people haven't wanted to take part in this second part. Would you like to take part? You don't have to if you'd rather not.

Participant:

Open response from participant

Experimenter:

Ok thanks we'll just finish this bit first / No that's ok let's move on to the next bit of the experiment.

Neutral Prime:

Experimenter:

Thanks for coming today. A lot of people haven't come today because they couldn't find the room. A lot of people seem to be having difficulty finding this room. Did you find the room ok?

Participant:

Open response from participant

Experimenter:

Affirmative response (restricted to positive discourse markers such as 'uh-hu', 'yep', 'ok').

Let's move on to the next bit of the experiment.

Stait Trait Anxiety Inventory (STAI; Spielberger, 1968, 1977): Form Y was administered to the participants. This is measure of trait anxiety levels. Both sections of the STAI have been shown to have good convergent and discriminant validity with other measures of anxiety and related constructs. It also demonstrates good test re test reliability at several time intervals (average r =0.88) (Spielberger, 1968, 1977).

6.1.2.4 *Procedure*

The participants were presented with the bodies to rate for attractiveness, health, normality and intelligence on separate sheets, in random order. The participants were then primed accordingly. The participants who received the verbal threat prime were told the next part of the experiment would involve electric shocks. The participants in the neutral prime condition received a neutral verbal prime. The participants in the written threat prime condition were given the STAI to complete. The participants in the no prime condition received no primes. After priming the participants were given a new booklet of bodies to rate. After the experiment had finished the participants in the verbal threat prime condition were informed there would be no electric shocks as part of their debrief.

6.1.3 Results

Each participants' BMI preference from the 2nd testing was subtracted from their 1st testing BMI preference giving each participant a score for their shift from the 1st to 2nd testing. These scores were then used in the analysis. Female and male body data were analysed separately. In addition to this, ratings for attractiveness, health, normality and intelligence were analysed separately.

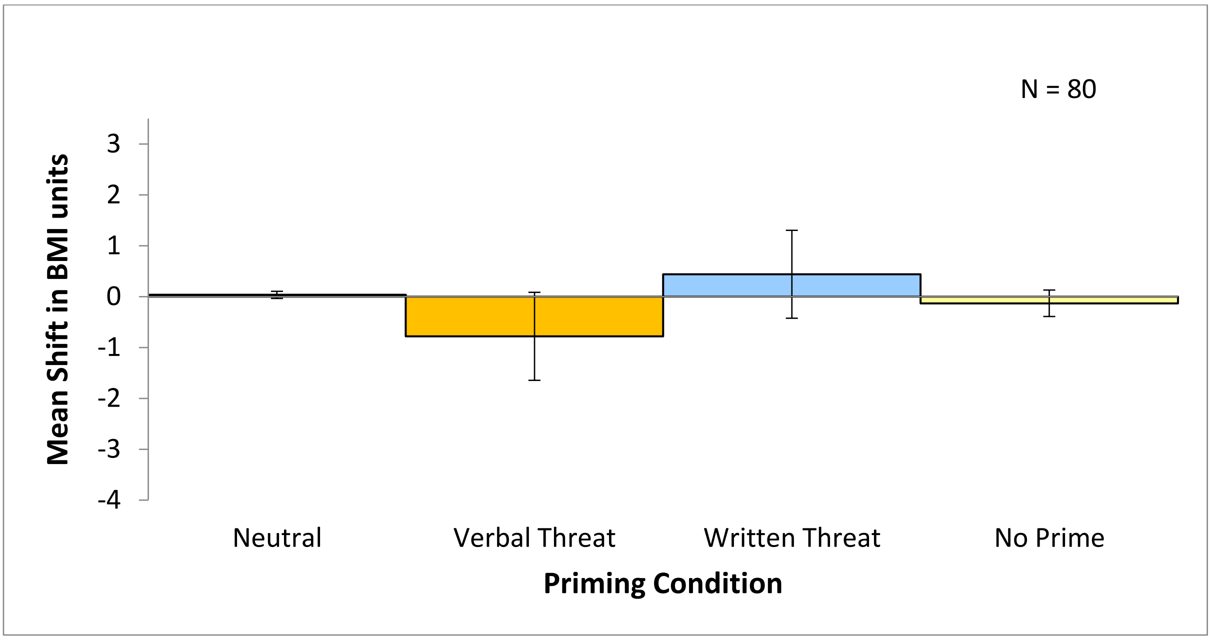
6.1.3.1 Ratings of attractiveness

6.1.3.1.1 Female bodies

A one way (Prime: Neutral, Verbal Threat, Written Threat, No Prime) independent measures ANOVA was carried out on female body ratings. This showed that there was a significant effect of priming on shift in the participants' ratings of attractiveness for female bodies, F (3, 76) = 5.47, p <.05, η^2 = .18. Post hoc analysis using Bonferroni corrected t tests showed that the participants who experienced the verbal threat prime experienced a significantly bigger shift compared to those who experience the written threat prime (p <.05, d = 1.07). All other comparisons were non-significant.

Looking at Figure 39 it is evident that there is a negative shift in the verbal threat prime and a positive shift in the written threat prime. However neither of these shifts are significantly different from the control conditions (neutral prime and no prime) suggesting that the effect is being caused by the shifts occurring in opposite directions.

Figure 39: Mean shift in attractiveness ratings for female bodies from before to after priming presented with 95% confidence intervals.



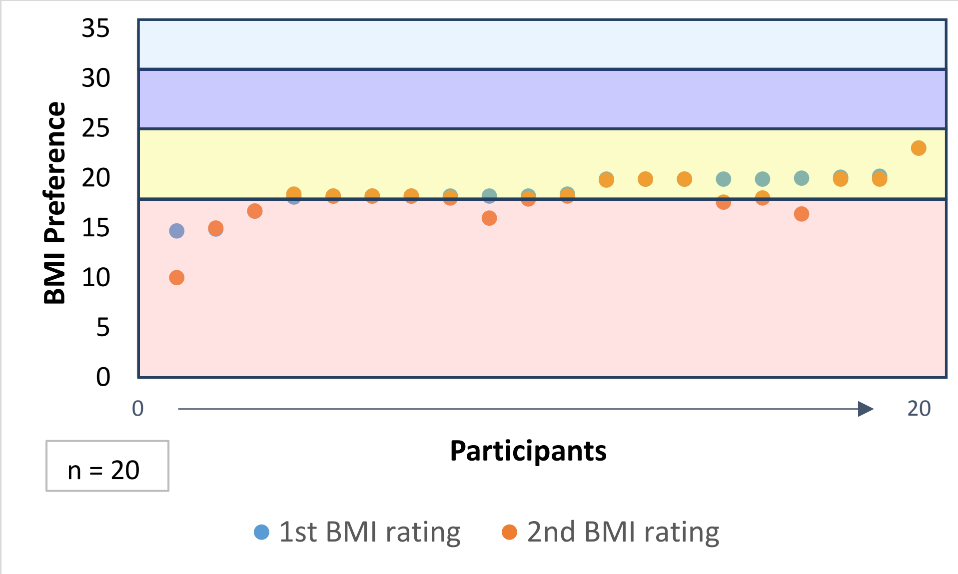
To further examine this significant effect found in attractiveness ratings the BMI preferences for the first and second rating for each participant were looked at and are shown in Figure 40. Note: Where only on orange symbol is visible this indicates the 2nd testing value was identical to the 1st testing value. The data is presented in ascending order of BMI ratings on the 1st testing.

From looking at Figures 40 and 41 it is evident that a number of the participants in the threat priming conditions had no shift from the first to second rating which explains why neither of these conditions were significantly different from the neutral priming or no prime conditions.

It is clear that similar to experiments 2 and 3 the participants' initial BMI preferences were typically for BMI's at the low end of the healthy BMI range. Therefore, as in the previous experiments the shifts seen in the written threat prime (Figure 41) are a shift towards a healthier body. However, from Figure 40 it can be seen that there were only negative shifts present in the verbal threat priming condition. This shift towards a thinner body results in bodies which are in the underweight category being selected therefore this is not a shift towards a healthier body suggesting that two primes are causing different effects and may be working in different ways. However as neither of these primes were significantly different from controls both effects are smaller than the effects demonstrated in experiments 2 and 3.

Figure 40: First and Second BMI ratings for attractiveness in the verbal threat priming condition

	Obese	BMI >30
	Overweight	BMI 25 – 30
	Healthy weight	BMI 18.5 - 24.9
	Underweight	BMI < 18.5



<u>Figure 41: First and Second BMI ratings for attractiveness in the written threat priming condition</u>

	Obese	BMI >30
	Overweight	BMI 25 – 30
	Healthy weight	BMI 18.5 - 24.9
	Underweight	BMI < 18.5

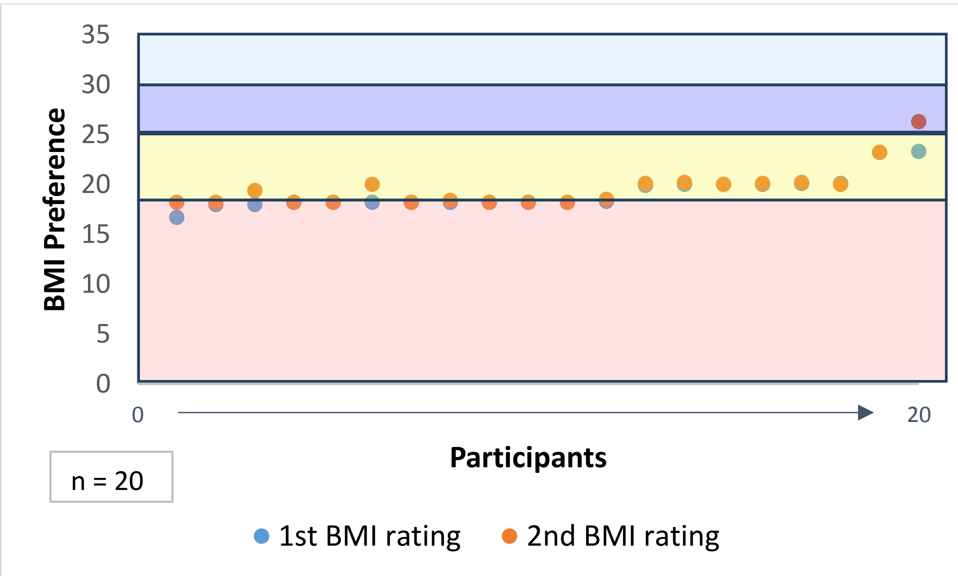


Figure 42: First and Second BMI ratings for attractiveness in the neutral priming condition

	Obese	BMI >30
	Overweight	BMI 25 – 30
	Healthy weight	BMI 18.5 - 24.9
	Underweight	BMI < 18.5

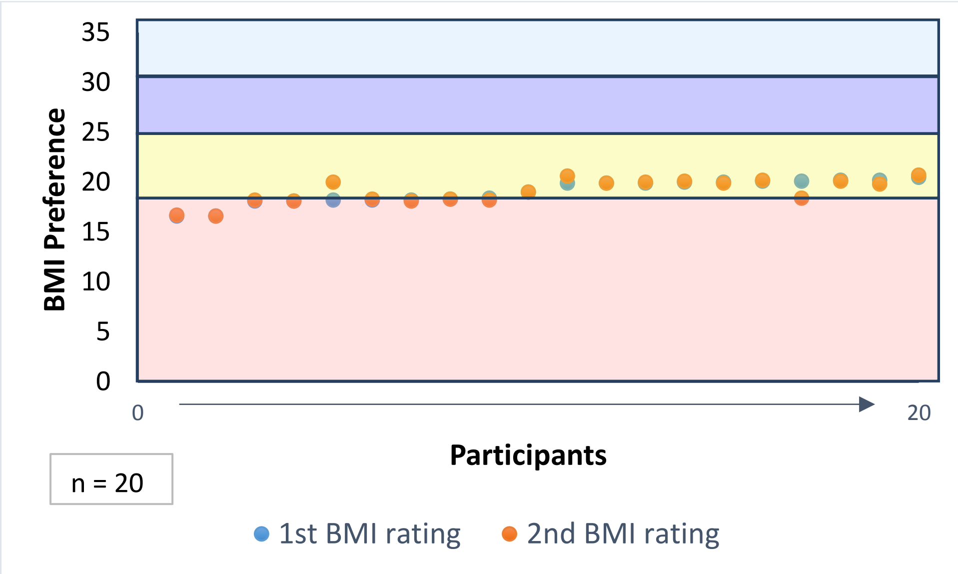
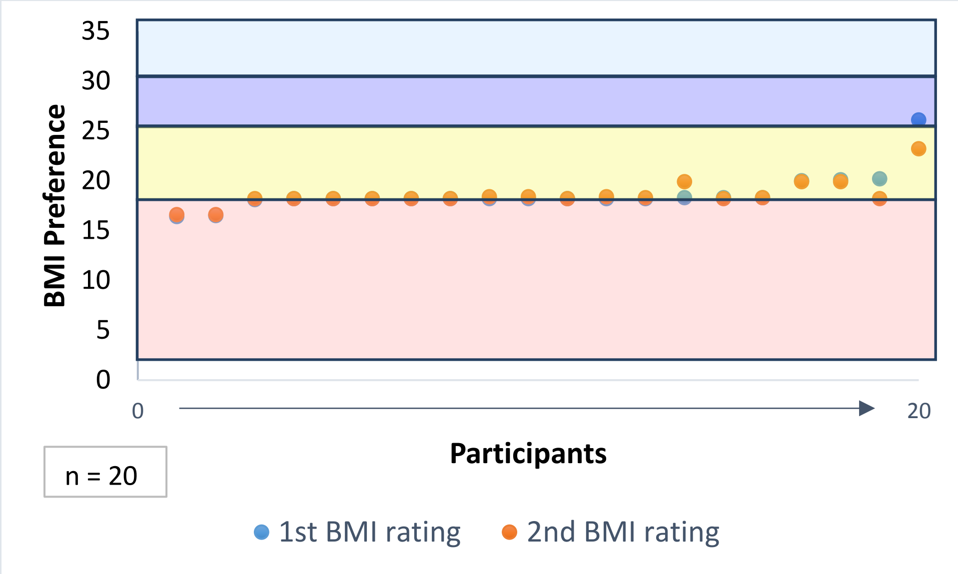


Figure 43: First and Second BMI ratings for attractiveness in the no priming condition

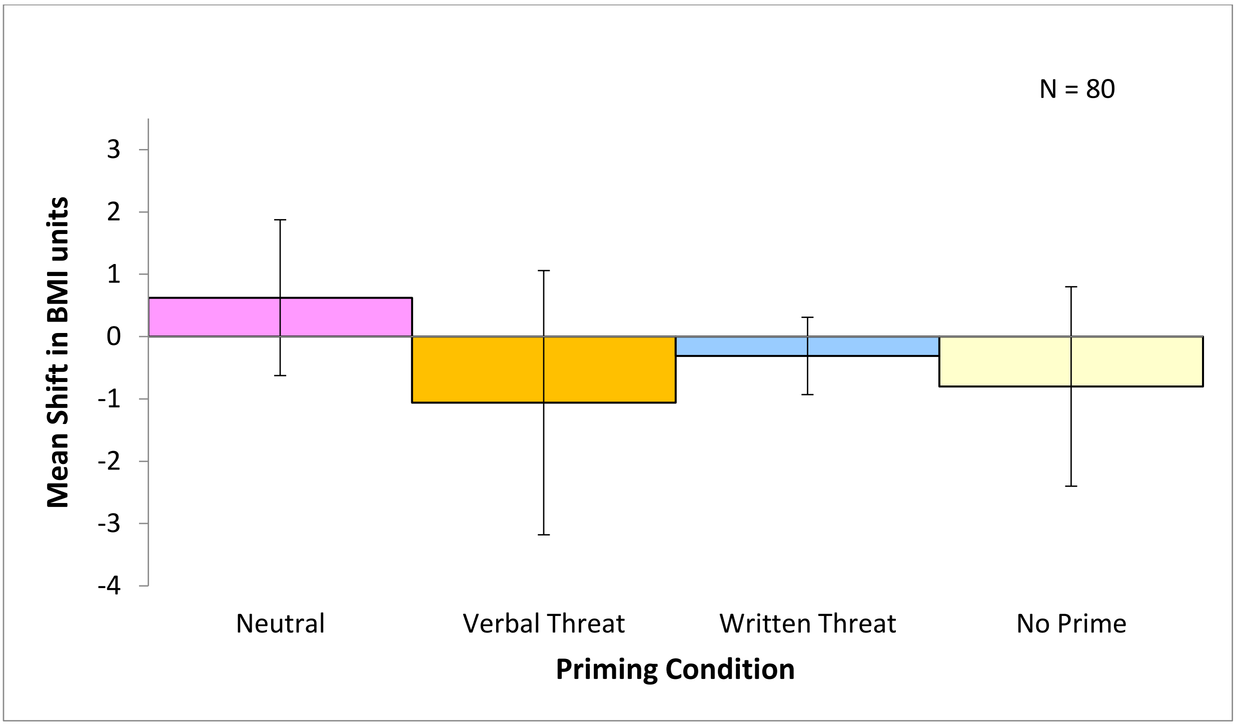
	Obese	BMI >30
	Overweight	BMI 25 – 30
	Healthy weight	BMI 18.5 - 24.9
	Underweight	BMI < 18.5



6.1.3.1.2 Male bodies

A one way (Prime: Neutral, Verbal Threat, Written Threat, No Prime) independent measures ANOVA was carried out on the male body ratings. This showed no effect of priming on the participants' attractiveness ratings of male bodies, F (3,76) = 1.34, p >.05, η^2 = .05, suggesting that priming participants did not cause any effect on shifts in attractiveness preferences in male bodies. Figure 44 illustrates this showing that there were no significant differences between each of the priming conditions.

Figure 44: Mean shift in attractiveness ratings for male bodies from before to after priming presented with 95% confidence intervals.

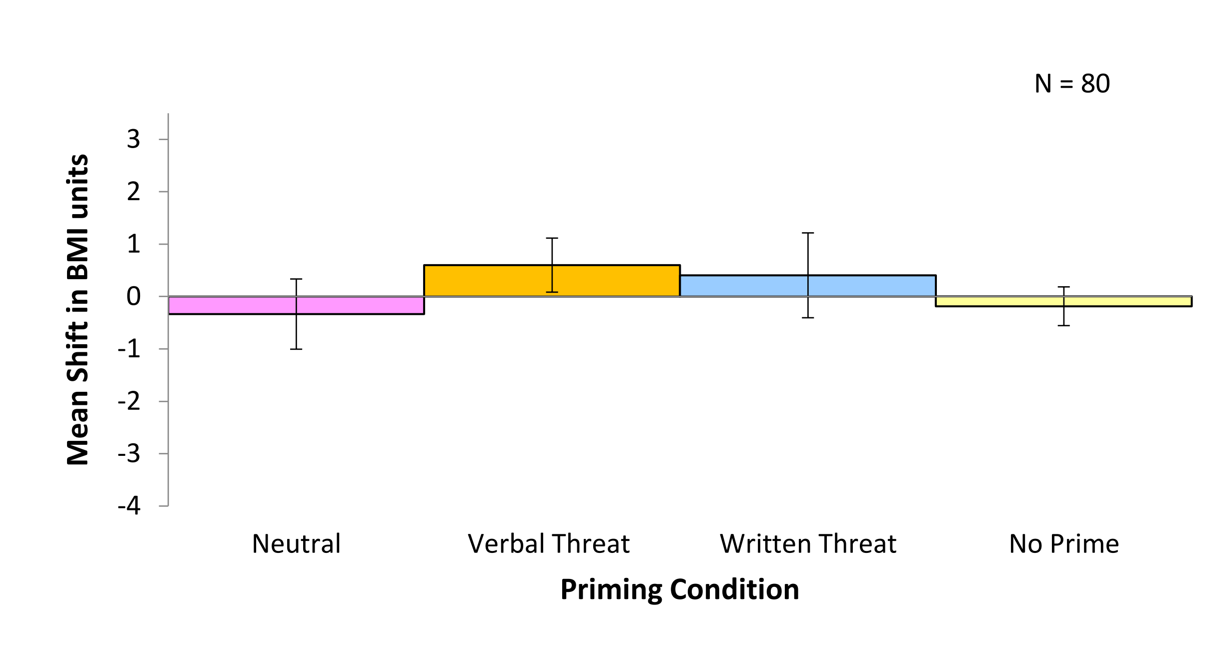


6.1.3.2 Ratings of health

6.1.3.2.1 Female bodies

The ratings of health for female bodies were analysed using a one way (Prime: Neutral, Verbal Threat, Written Threat, No Prime) independent measures ANOVA. The results found no significant effect of type of prime on shift in ratings of health, F $(3,76) = 1.77$, $p > .05$, $\eta^2 = .07$, suggesting that priming participants did not cause any effect on shifts in health preferences. Figure 45 demonstrates that there were no differences between each of the priming conditions.

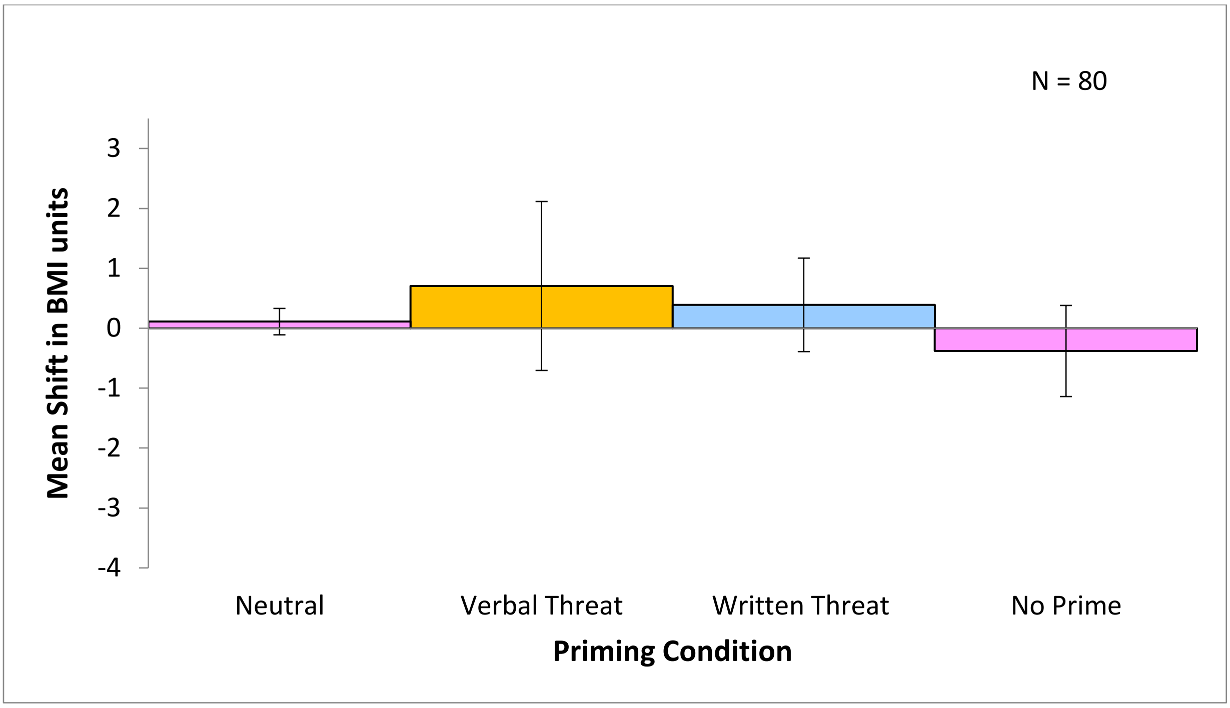
Figure 45: Mean shift in health ratings for female bodies from before to after priming presented with 95% confidence intervals.



6.1.3.2.2 Male bodies

The ratings of health for male bodies were analysed using a one way (Prime: Neutral, Verbal Threat, Written Threat, No Prime) independent measures ANOVA. This showed that there was no significant effect of type of prime on shift in ratings of health, F (3,76) = .79, p >.05, η^2 = .03. This suggests that priming participants did not significantly alter shifts in ratings of health. Figure 46 highlights that there were no differences between each of the priming conditions.

Figure 46: Mean shift in health ratings for male bodies from before to after priming presented with 95% confidence intervals.

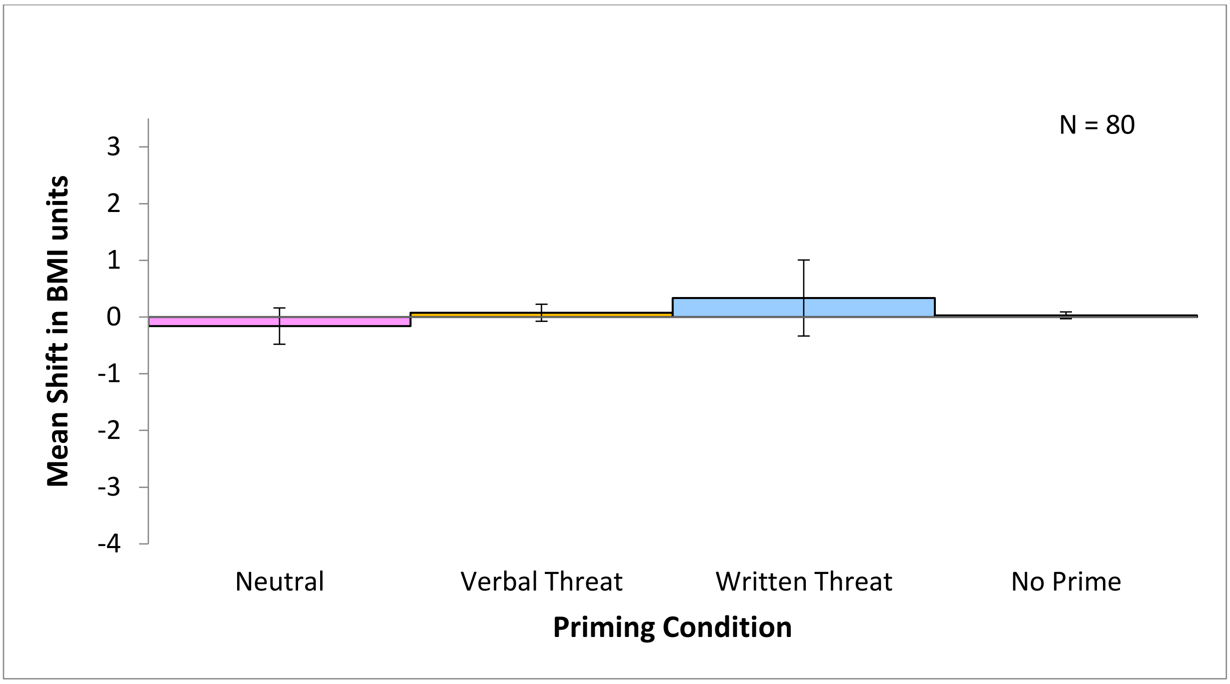


6.1.3.3 Ratings of normality

6.1.3.3.1 Female bodies

The female body normality ratings were analysed using a one way (Prime: Neutral, Verbal Threat, Written Threat, No Prime) independent measures ANOVA. The results showed that there was no significant effect of type of prime on shift in ratings of normality, F (3,76) = .24, p >.05, η^2 = .01, suggesting that priming participants did not alter shifts in normality preferences. Figure 47 illustrates this showing that there were no differences between each of the priming conditions.

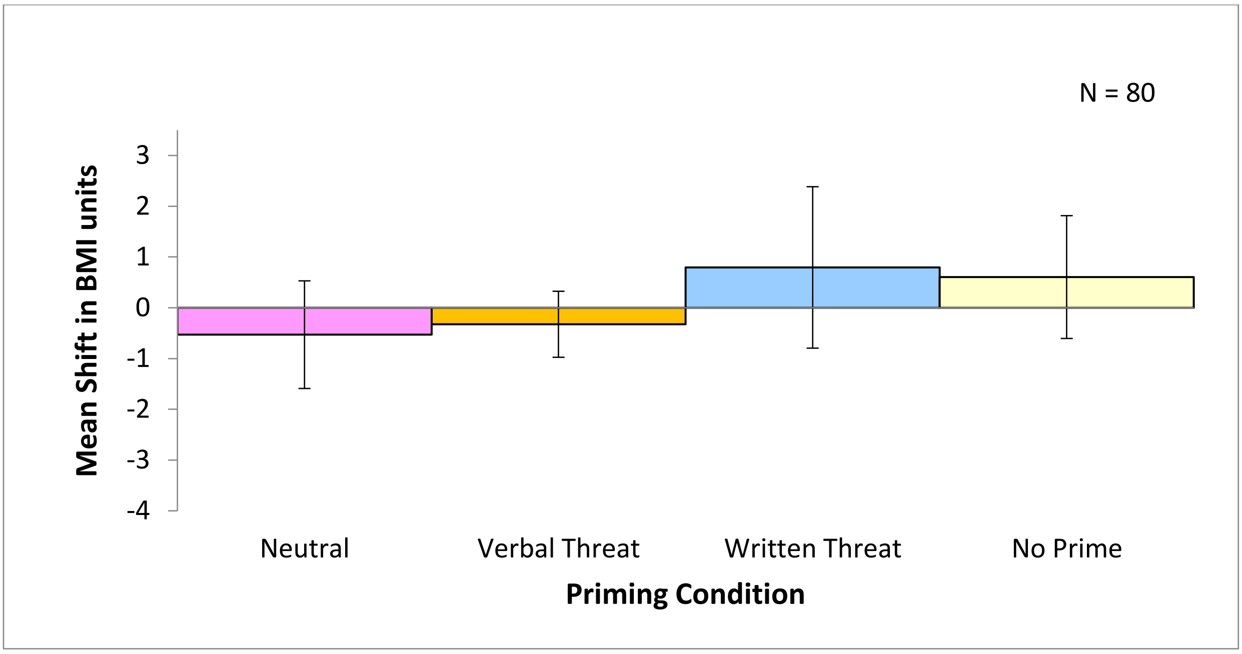
Figure 47: Mean shift in normality ratings for female bodies from before to after priming presented with 95% confidence intervals.



6.1.3.3.2 Male bodies

Ratings of normality in male bodies were analysed using a one way (Prime: Neutral, Verbal Threat, Written Threat, No Prime) independent measures ANOVA. The results showed no significant effect of priming on shift in body preferences, F (3,76) = 1.57, p >.05. η^2 = .06, suggesting that priming participants did not alter shifts in normality preferences. Figure 48 shows that there were no significant differences between the four conditions.

Figure 48: Mean shift in normality ratings for male bodies from before to after priming presented with 95% confidence intervals.

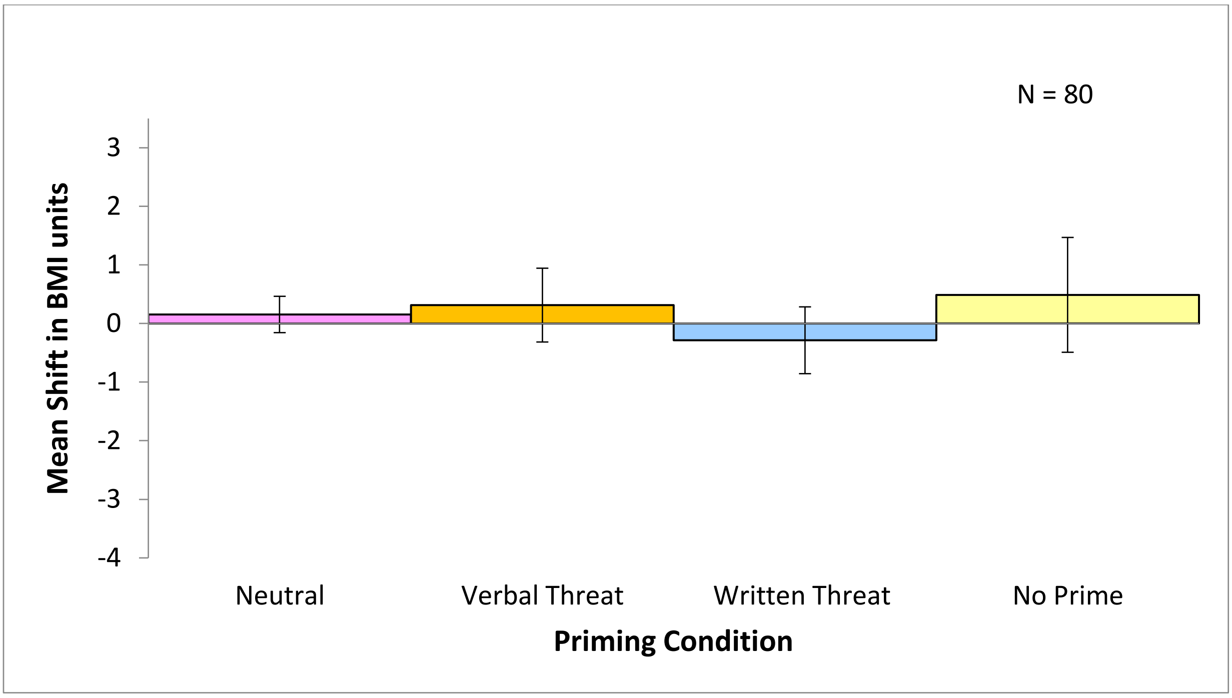


6.1.3.4 Ratings of intelligence

6.1.3.4.1 Female bodies

A one way (Prime: Neutral, Verbal Threat, Written Threat, No Prime) independent measures ANOVA was carried out on intelligence ratings in female bodies. This showed that there was no significant effect of type of prime on shift in intelligence ratings, F (3, 76) = 1.03, p >.05. η^2 = .04. This suggests that priming participants did not cause any effect on the shift in the participants' ratings of intelligence. Figure 49 shows that there were no significant differences between the four conditions.

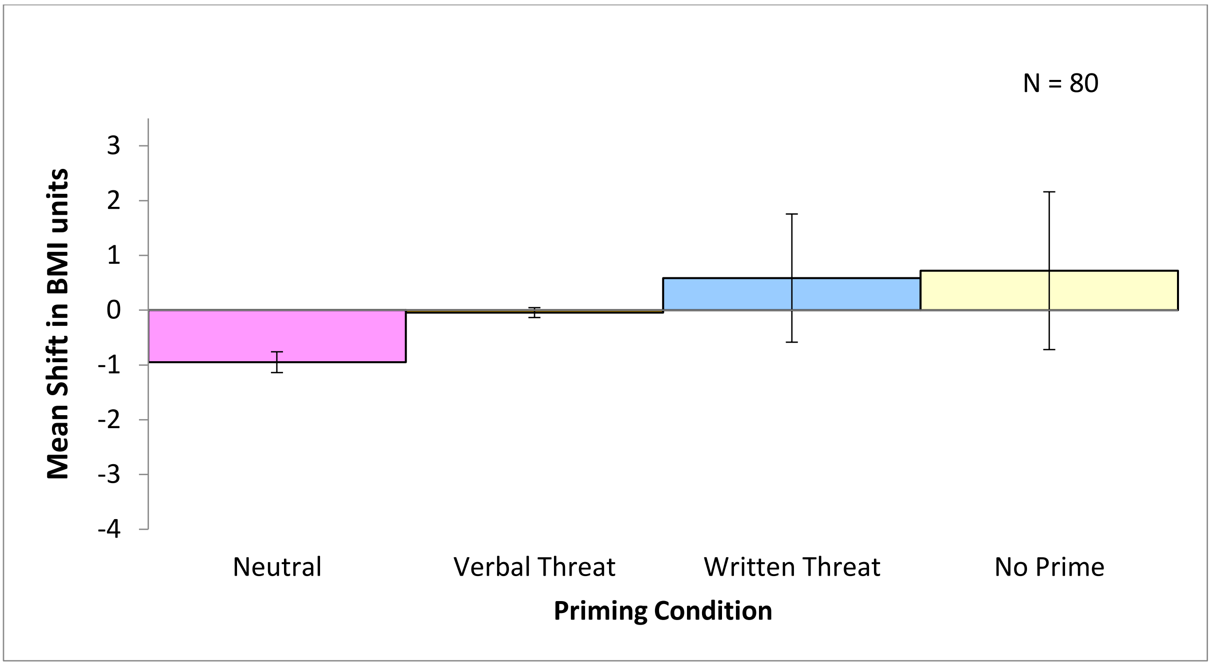
Figure 49: Mean shift in intelligence ratings for female bodies from before to after priming presented with 95% confidence intervals.



6.1.3.4.2 Male bodies

A one way (Prime: Neutral, Verbal Threat, Written Threat, No Prime) independent measures ANOVA was carried out on intelligence ratings in male bodies. The results showed that there was no significant effect of type of prime on shift in intelligence ratings, F (3,76) = .99, p >.05, η^2 = .04. This suggests that across the priming conditions there were no significant differences in shifts in the participants' ratings of intelligence. Figure 50 shows that there were no significant differences between the four conditions.

Figure 50: Mean shift in intelligence ratings for male bodies from before to after priming presented with 95% confidence intervals.



6.1.4 Discussion

A significant effect in ratings of attractiveness for female bodies was observed however this was not evident in health, intelligence or normality ratings. It was found that the participants who had received the verbal threat prime experienced a negative shift in their preferences for body weight whereas the participants who experienced only the written threat prime experienced a positive shift in their attractiveness preferences. As the pathogen priming version of this experiment only yielded a significant shift in ratings of attractiveness and health it was not necessarily expected to see shifts in ratings of normality and intelligence in this experiment either. In addition, as pathogen priming relates directly to health, whereas general threat priming does not, it may be possible that ratings of health would also not be affected by a general threat prime. This may explain why only a significant effect was observed in attractiveness ratings.

A positive shift, as seen in the questionnaire primed group, is consistent with previous research (Swami & Tovée, 2012) which has suggested that men who are under psychological stress show a preference for a heavier female body. This shift was not large enough to be significantly different from the neutral and no prime condition, therefore it is possible that this type of general threat prime is not as strong as the pathogen primes used in experiments 2 and 3. This could be because a general threat does not have as great effect on body weight preferences as a pathogen threat. Previous experiments have primed for pathogens by using questionnaires asking the participants to consider their vulnerability to disease (e.g., Lee & Zietsch, 2011; Watkins et al., 2012) therefore this seems to be an effective priming method and it is possible in this instance that asking the participants to consider their anxiety levels caused some kind of priming effect. It is also possible, as the questionnaire was asking questions about generalised anxiety, that the written threat prime actually acted as a pathogen prime if it brought about associations with mental illness. Lund and Boggero (2014) demonstrated that people implicitly associate mental illness with disease. Therefore, as anxiety is related to many mental health problems it could have caused the participants to think of mental illness or their own mental health, meaning the questionnaire may actually have acted as a pathogen prime. This could be why the effect was not as strong as seen in experiments 2 and 3 as the connection to disease would not have been as explicit as in the actual pathogen primes used previously.

Research has shown that preferences for body weight are affected by stress levels (Swami & Tovée, 2012), this was linked to heavier bodies being perceived as being more mature and research that suggests that mature characteristics are preferred when experiencing environmental threat (e.g., Pettijohn et al., 2009; Pettijohn & Tesser, 1999, 2005). Body weight is more directly related to pathogen resistant than the ability to handle general threat consequently body weight preferences are more likely to be effected by pathogen threat than general threat. Therefore, as increased body weight provides a good visual cue to infection resistance and better health in addition to also being a cue to maturity, this will mean that body weight preferences are more likely to alter following a pathogen prime than a general threat prime.

The negative shift towards a thinner body demonstrated in the verbal threat prime would suggest that this effect is different to the positive shifts seen in experiments 2 and 3 following pathogen primes. Therefore, a shift towards a heavier body was not seen with this prime because the shifts seen in experiments 2 and 3 are due to an increased preference for cues of health as a result of a perceived pathogen threat. The findings of this experiment suggest that the pervious findings are more likely to be a behavioural immune response and not a general threat mechanism. This suggests that the pathogen priming effects are separate to general threat effects and are specifically due to a behavioural immune response causing an increased preference for cues of health and the behavioural avoidance of pathogens. As both general environmental threats (e.g., Pettijohn et al., 2009; Pettijohn & Sacco, 2009; Pettijohn & Tesser, 1999) and pathogen threats (e.g., Lee & Zietsch, 2011; Little et al., 2011) appear to alter individual preferences it will always be hard to ever completely separate the effects of a pathogen threat and a general threat but it seems likely that different mechanisms are involved in the response to these threats.

It is not known if either of the primes caused physical symptoms of anxiety and fear such as increased heart rate and blood pressure. It is possible that the verbal threat prime in some cases may have not caused the participants to experience anxiety or fear at the thought of an electric shock experiment, for example, if they were less concerned by pain, did not intended to actually conduct that part of the experiment or believed it would be safe so was nothing to worry about. However, with any prime used individual differences within the participants could influence the effectiveness and magnitude of response. For example, the TSST used by Swami and Tovée (2012) to induce stress may have a greater effect on some of the participants than others. For example, it has been suggested that sex, genetics and previous trauma can all effect the stress response caused by the TSST (Foley & Kirschbaum, 2010) meaning this type of prime is also subject to individual differences.

No significant effects were found in male bodies suggesting that increased general threat does not affect preferences for male body weight. This is consistent with research that suggests that although preferences for mature facial features in American actresses increased during times of social and economic depression, preferences for facial features of American actors were not found to vary in the same way (Pettijohn & Tesser, 1999, 2003). The findings of this experiment are also in line with experiments 2a and 3 which found no effects of pathogen priming on male body weight preferences. Swami and Tovée's (2006) experiment looking at the affects of hunger on body weight preferences did not examine male body weight so it is not known if it would have been effected. However, Pettijohn et al. (2009) found that hunger influenced female's judgments of male personality characteristics rather than physical characteristics and this was thought to be due to the participants placing greater value on personality rather than appearance when judging males. Therefore, this experiment again suggests that male bodies are not affected in the same way as female bodies. The next chapter will aim to examine in more detail the effects of pathogen priming on male bodies by looking at another cue to the perceived attractiveness and health of bodies: muscularity.

In conclusion, as the effect seen here was not as strong as seen when using a pathogen prime it would seem unlikely that the effects of pathogen priming are due to a general mechanism that is responsive to any kind of environmental threat. Therefore, although it is apparent that the current environmental context does affect individual preference, with individuals seeming to implicitly alter their preferences as a result of current conditions, general environmental threat and pathogen threat may work by different mechanisms and therefore have different effects. It seems that increased threat and anxiety does not result in a consistent effect on body weight preferences suggesting that a specific threat in the form of a perceived increase in pathogen levels has a greater effect on preferences for body weight. This is possibly because pathogen threat activates a behavioural immune response causing more attention to cues of health. This is particularly relevant to body preferences due to the relationship between body weight and health.

Chapter 7

Pathogen Priming and the Perception of Male bodies

7.1 Experiment 5

The previous experiments have demonstrated effects of pathogen priming on preferences for body weight, with pathogen primes causing attractiveness and health preferences for female bodies to shift towards a healthier BMI. This effect was not significant in preferences for male bodies. It is not clear why this was found but one possibility is that it is related to body weight being a less salient cue to the perceived attractiveness and health of male bodies, instead other factors such as muscularity may be important cues.

In comparison to female bodies there has been less research into the perceived attractiveness and health of male bodies. It has been suggested that compared to female bodies BMI does not play such an important role in attractiveness preferences for male bodies (Maisey et al., 1999; Swami, Smith et al., 2007). It would seem that in male bodies both body weight and muscularity play an important role when making attractiveness judgments (Fan et al., 2005; Maisey et al., 1999). Upper body muscularity appears to be an important cue to the attractiveness of male bodies. Muscularity is often indicated by the WCR and this has been shown to be a strong predictor of attractiveness in male bodies (Coy et al., 2014; Maisey et al*.,* 1999; Swami, Smith et al., 2007; Swami & Tovée, 2005b; Swami

& Tovée, 2008). Specifically, men with a low WCR (around 0.7) are perceived as being more attractive, with a low WCR giving an 'inverted triangle' shape which is consistent with upper body muscle and strength (Maisey et al., 1999; Swami & Tovée, 2008). However, it seems that this is in combination with leanness suggesting that a male body still has to be lean to be considered attractive (Fan et al., 2005; Maisey et al*.,* 1999; Swami & Tovée, 2005b). It appears that the relationship between perceived attractiveness and body weight is not as straight forward in male bodies compared to female bodies.

There are limited measurement options available for assessing the overall amount of muscle an individual has. One measure often used in males has been the WCR, however it does not account for increased muscularity around other parts such as the arms and legs. This could be particularly problematic as limbs (e.g., arms) are known to increase in circumference as muscle mass increases (Lukaski, 1996). In addition, it has been demonstrated (McCreary, Karvinen, & Davis, 2006) that, in males, flexed bicep measurements are the only measurements to be significantly related to scores on the Drive for Muscularity Scale (McCreary, Sasse, Saucier, & Dorsch 2004) suggesting that this is a measure males use themselves when assessing their own muscularity. This was thought to be because the arm is often in full view of an individual and tends to have lower levels of body fat, meaning increases in bicep measurements are more closely related to muscularity. Therefore, as WCR is calculated using only the widest chest circumference and the narrowest waist circumference, this is only a rough guide to a body's total muscle mass and will not take into account muscularity increasing over the whole body.

Another commonly used measure is fat free mass (Heyward & Stolarczyk, 1996) or the fat free mass index (FFMI; Kouri, Pope, Katz, & Oliva, 1995; Schutz, Kyle, & Pichard, 2002). Fat free mass, often known as lean body mass, is all residual lipid free chemicals and tissues whereas fat mass is the absolute amount of body fat and includes all extractable lipids from adipose and other tissues (Heyward & Stolarczyk, 1996). The FFMI has been used in the identification of weight lifters who abuse steroids to achieve high muscle mass (Kouri et al., 1995) and in the measurement of muscularity among males suffering from muscle dysmorphia (Olivardia, Pope, & Hudson, 2000). As FFMI accounts for muscularity levels over the whole body it may be a more accurate measure of muscularity than the WCR.

From the findings in experiments 2 and 3 it was suggested that heavier bodies are perceived as being more attractive and healthy after pathogen priming as these are healthier bodies. This is owing to the participants' preferences for very low BMI's before priming meaning this shift has taken BMI preferences into the healthy weight BMI category. Therefore, participants are selecting healthier bodies as a result of pathogen priming. As muscularity is indicative of strength it is possible that in male bodies a more muscular body could indicate better health and physical fitness. Men with a lower WCR are rated as being more physically dominant and in better physical shape (Coy et al., 2014). Therefore, it is possible pathogen priming could cause an increased preference for muscularity if muscularity is a cue to health in male bodies.

The main aim of experiment 5 was to examine the effects of pathogen priming further on the perception of male bodies. This will establish if the findings of the previous experiments could be attributed to muscularity being a better cue to health in male bodies compared to body weight. This was done using a new set of male body stimuli that varied in muscularity. As these stimuli had not previously been tested the purpose of experiment 5a was to test the new male body stimuli to ensure participants could distinguish the differences in muscularity between the bodies. Experiment 5b was a replication of experiment 2 using the new stimuli to establish if pathogen priming would affect preferences for muscularity in male bodies.

7.2 Experiment 5a: Stimuli development

7.2.1 Introduction

In order to look at the effects of pathogen priming on preferences for muscularity in male bodies, a set of male body stimuli that varies in muscularity needed to be created. The stimuli consisted of computer generated bodies which were created using the same software (DAZ studio) as the original stimuli set. This makes the findings directly comparable to previous experiments. However, as detailed in Chapter 3 there are many other benefits of using computer generated stimuli. This type of stimuli offers more ecologically valid life like figures than line drawn stimuli which has often been used when researching muscularity in male bodies. Owing to the limited amount of research into male bodies there has been very little stimuli developed in this area. There is no male version of the PFRS meaning current male body stimuli is even more restricted than female body stimuli.

Although WCR is one indicator of muscularity due to the reasons outlined in Section 7.1 it was chosen not to use WCR here but instead use the FFMI as a measure of muscularity. Although WCR may be a quick and simple measure to use in crude line drawn stimuli, with computer generated stimuli a measure such as FFMI can be easily calculated. This will be more appropriate to use with the current stimuli as they have been designed to increase in muscularity across the whole body and a measure that captures this is therefore needed. The FFMI has previously been used successfully to assess muscularity (e.g., Kouri et al., 1995; Olivardia et al., 2000)

The main aim of experiment 5a was to test the new stimuli by establishing that the participants could accurately tell the difference in muscularity between the bodies created. It was hypothesised that the participants would be able to successfully detect the differences in muscularity between bodies when they were presented to them in a forced choice task.

7.2.2 Method

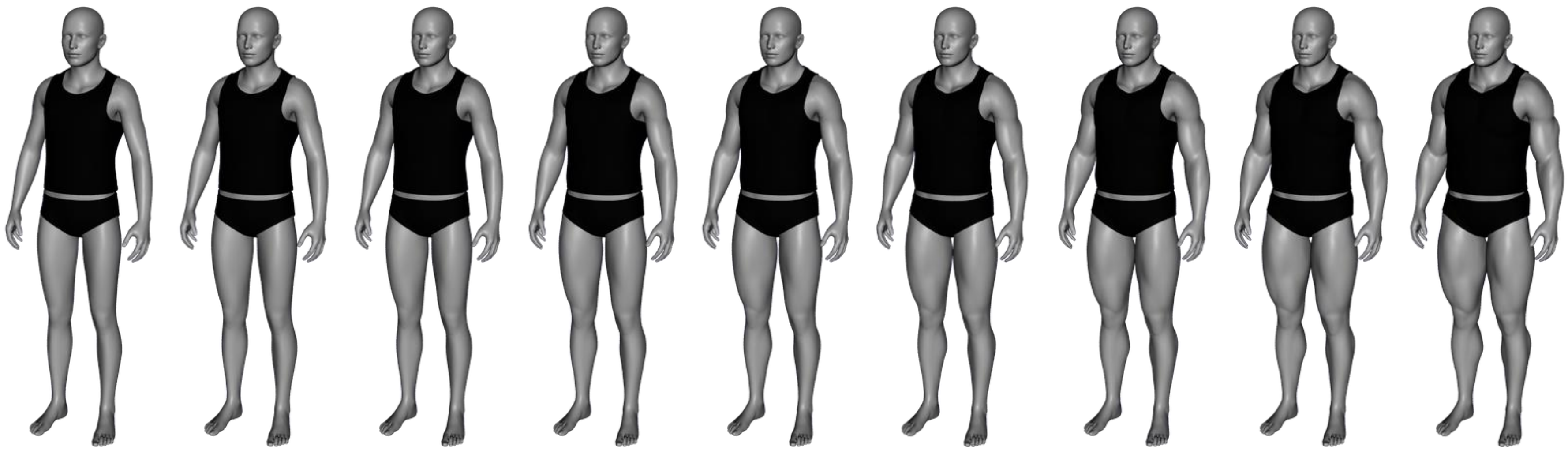
7.2.2.1 Participants

The participants were 50 females who were all students at Nottingham Trent University. The mean age of the sample was 20.82 years (*SD* = 5.51). The participants were given research credits for taking part.

7.2.2.2 Materials

Body Stimuli: The stimuli were developed by using body number 5 from the original male body stimuli. Using DAZ Studio 4 software (www.daz3d.com) this body was systematically altered to create 8 more bodies which were successively more muscular than the original body. This means 9 male bodies were created in total which ranged in muscularity (see Figure 51). To create each body, the original body (body 1 on Figure 51) was increased in muscularity, using the software by, 11% (body 2), 22% (body 3), 33% (body 4), 44% (body 5), 55% (body 6), 66% (body 7), 77% (body 8) and 88% (body 9) to create the remaining bodies (See Figure 51).

Figure 51: Male bodies in ascending order of muscularity.



Body 1 Body 2 Body 3 Body 4 Body 5 Body 6 Body 7 Body 8 Body 9

To calculate the FFMI for body 1, first the percentage body fat was calculated as being 13.55%. This was calculated using the BMI and an estimated age of 25 years. The method for obtaining the BMI (20), height (1.73 m) and weight (62.49 kg) of body 1 (previously body 5 in original stimuli set) is detailed in Chapter 3 Section 3.2.2.2. Body fat percentage is calculated using the following formula:

$$(\text{BMI} \times 1.2) + (\text{Age} \times 0.23) - 16.2 \quad = \quad (20 \times 1.2) + (25 \times 0.23) - 16.2 = 13.55$$

Once body fat percentage is known the fat mass and fat free mass can be calculated from the weight of the body. Therefore, body 1's weight is 62.49 kg meaning fat mass = 8.5 kg and fat free mass = 53.99 kg.

The FFMI is then calculated by dividing the fat free mass (kg) by the height (m) squared:

$$\frac{\text{Fat free mass (kg)}}{\text{Height}^2} \qquad \frac{53.99}{1.73^2} \qquad = 18.06$$

As the FFMI was calculated as being 18.06 for body 1 this was calculated for the remaining bodies by increasing it by the same percentage the bodies were increased in muscularity by. The FFMI for each body is shown in Table 6 below.

Table 6: FFMI's for male body stimuli

Body	**Fat Free Mass Index**
1	18.06
2	20.05
3	22.03
4	24.02
5	26.01
6	27.99
7	29.98
8	31.97
9	33.95

A FFMI of 16.7 - 19.8 in males is classed as being normal (Kyle, Schutz, Dupetuis, & Pichard, 2003). Schutz et al. (2002) found the median FFMI to be 18.9 in a group of healthy young males whereas Mr America winners (from 1939 -1959) were found to have a mean FFMI of 25.4 (Kouri et al., 1995). It was suggested by Kouri et al. (1995) that a FFMI exceeding 25 may be an indication of possible steroid use, as some of the participants in their sample using steroids had FFMI's exceeding 30 (mean FFMI of athletes using steroids was 24.8). This was not evident in non-steroid using athletes where FFMI's never exceeded 25 (mean FFMI 21.8).

As with the original stimuli all of the bodies were depicted wearing black briefs and a T shirt, so the body is clearly visible. All the bodies were depicted at an angle to enable more visual information to be made available that would not be possible by using a simple front view. The faces were not removed or obscured to keep the ecological validity of the image and all the bodies were in grey scale to remove any race biases

2AFC task: As in experiment 1a, a 2AFC task was used as a measure of participants' accuracy in distinguishing the differences in muscularity between the bodies. In the task the participants were presented with pairs of bodies. The participants had to decide which body they thought was the most muscular out of the pair. All possible pair combinations, with each body being presented on both the left and right, were presented. The percentage of combinations where the participants correctly identified the most muscular body was used to assess the participants' skill in distinguishing the muscularity differences between the bodies. This highlights if the stimuli are distinct from each other.

7.2.2.3 Procedure

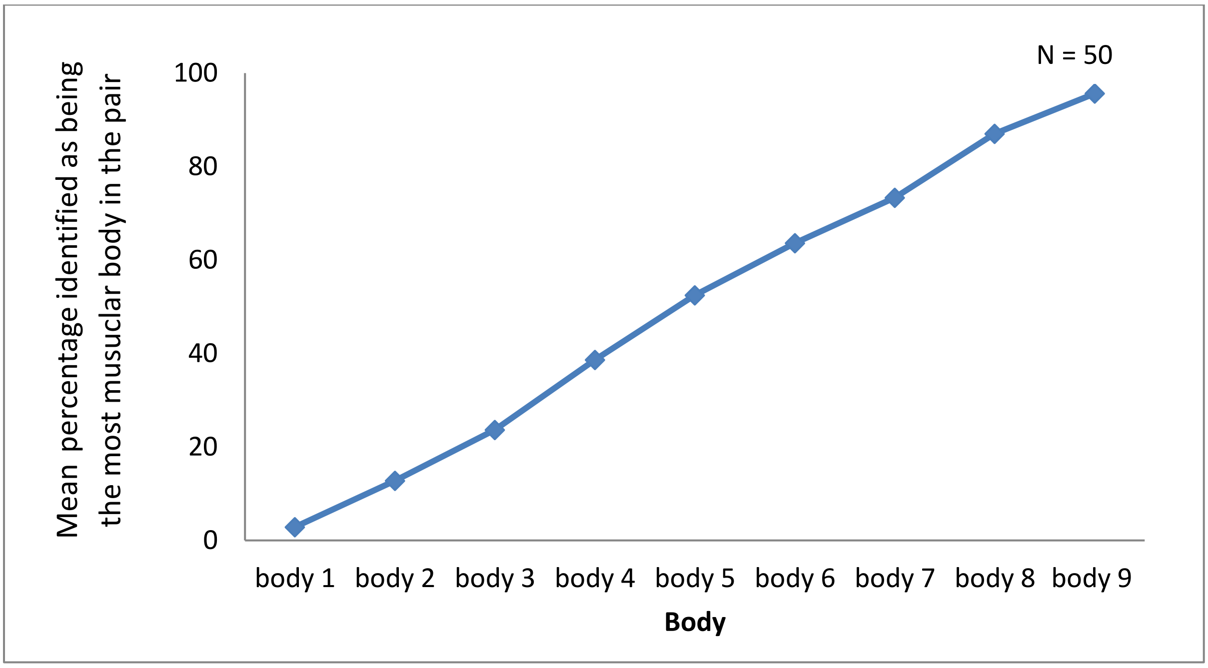
The participants were given the2AFC task in which they were presented with pairs of bodies using SuperLab 4.5 (www.superlab.com), on a 44.3 x 25.4 cm colour monitor. A total of 81 body combinations in total were presented to each participant in a random order. The participants had to decide which body they thought was the most muscular body out of each pair.

7.2.3 Results

The data were analysed to identify if the participants had correctly identified the most muscular body out of each body pair. Same body pairings were removed from the analysis meaning 72 pair combinations for each participant were analysed. For the purpose of this experiment bodies were numbered 1-9 in ascending order of muscularity (1=least muscular, 9= most muscular).

The results showed that on average the participants were able to correctly identify the most muscular body 95.75 % (*SD* 4.32) of the time. This suggests that the differences in muscularity between the 9 bodies are clearly identifiable. Figure 52 shows the mean percentage each body was selected as being the most muscular body, in the 2AFC task pair, out of the total amount of times each body was presented. By looking at Figure 52 it is clear that body 9 was selected as being the most muscular 95.63% of the time it was presented in a pair whereas body 1 was only selected as being the most muscular 2.88% of the time it was presented in a pair.

Figure 52: Mean percentage each body was identified as most muscular in the 2AFC task



As shown in Figure 52 it is evident that body 9 was identified as being the most muscular the greatest percentage of the time and body 1 the least. No two bodies have the same percentage suggesting that muscularity differences between the bodies are identifiable.

7.2.4 Discussion

The results suggest that the participants can easily detect the differences in muscularity between all the nine male bodies created. This suggests that these new stimuli are suitable for examining preferences for muscularity in male bodies.

The new stimuli were computer generated so they could be directly compared with the original stimuli. Using computer generated stimuli meant the male body could be systematically altered to vary in muscularity. WCR has sometimes been thought of to be indicative of muscularity with high WCRs being found attractive as this occurs from a large chest. However, it is preferences in muscularity itself and not WCR that the next experiment aims to investigate. As mentioned WCR does not account for increasing muscle mass in other parts such arms and legs. Therefore, as these stimuli were designed to increase muscularity over the whole body and not just the chest, WCR was not used as a measure and instead the FFMI has been used. It is evident from the findings of this experiment that visually the bodies vary in perceived muscularity and FFMI has been calculated and shown to increase for each body.

In summary the bodies created do visually capture different levels of muscularity and muscularity differences between all nine of the new male bodies were easily detectable. This suggests they are suitable for use in studying preferences for muscularity and to be used in examining the effect of pathogen priming on preferences for muscularity

7.3 Experiment 5b: The effects of visual pathogen priming on preferences for muscularity in male bodies

7.3.1 Introduction

The main aim of experiment 5b was to examine the effects of pathogen priming on preferences for muscularity in male bodies. As more muscular bodies may signal better health and/or access to resources, it was predicted that there would be a shift in muscularity preferences after experiencing a pathogen prime such that more muscular bodies would now be preferred. As only attractiveness and health preferences for body weight were affected by the pathogen prime in previous experiments. It was expected that only these ratings would be affected here.

7.3.2 Method

7.3.2.1 Design

An independent measures design was used in which the participants were arbitrarily placed in 1 of either 3 different priming conditions. The participants were primed using visual images that either had an illness theme (*pathogen*) or a non-pathogen neutral theme (*neutral*), a third control group viewed no images (*no prime*).

The participants' attractiveness, health, normality and intelligence preferences were measured before and after priming, the dependent variable was the difference (shift) in their 1st and 2nd body ratings (2nd – 1st).

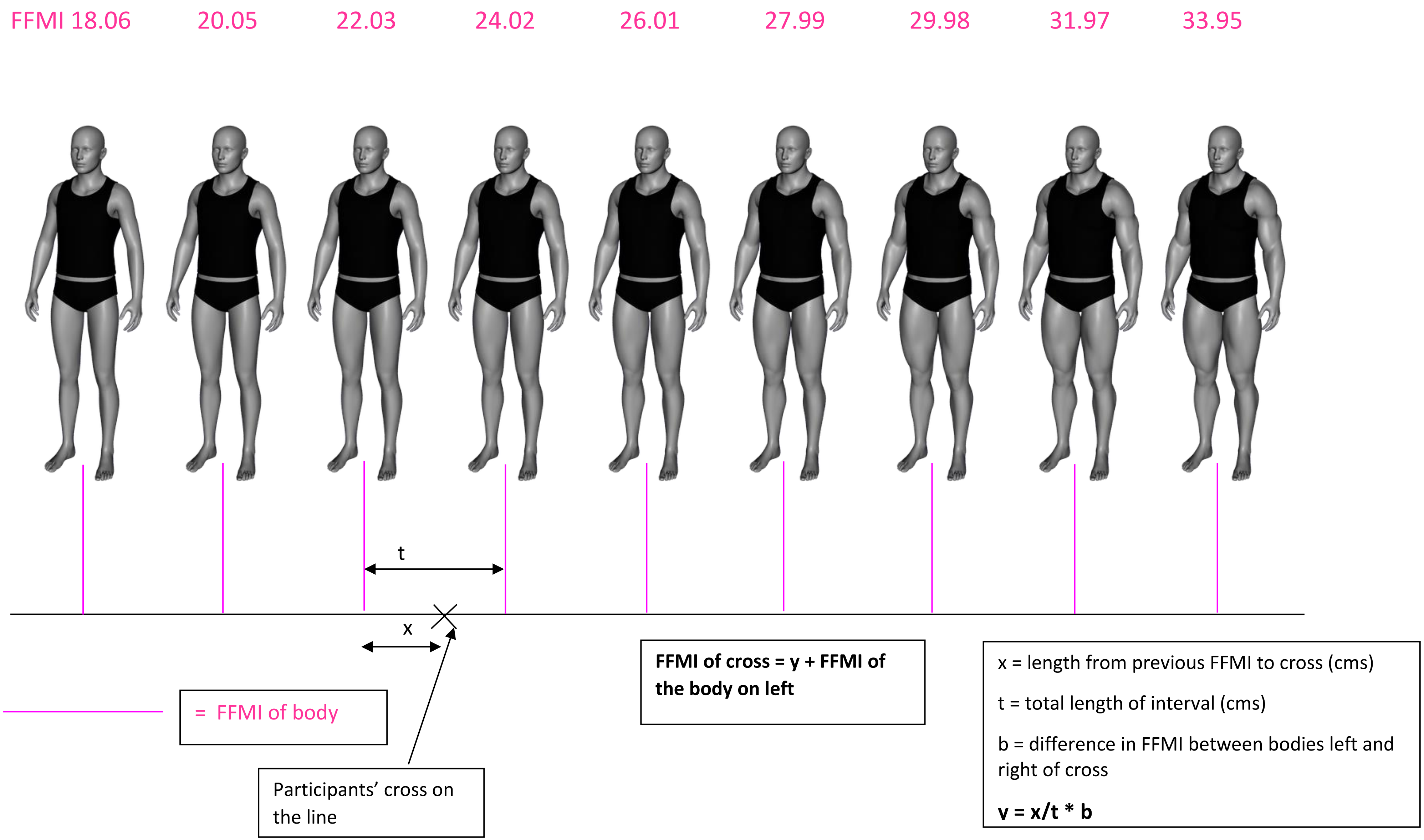
7.3.2.2 Participants

The participants were 64 females (Pathogen n = 24, Neutral n = 20, No Prime n = 20) who were all students at Nottingham Trent University. The mean age of the participants was 21.16 years (*SD* = 5.59). They were given research credits for their participation in the experiment.

7.3.2.3 Materials

The 9 male bodies were presented to the participants on a landscape sheet of A4 paper. They were presented in ascending order of muscularity from left to right. Below the bodies was a horizontal line, on this line the participants had to indicate which they thought the most attractive, healthy, normal or intelligent body was. This was done on separated sheets of paper for each new rating. Scores were obtained by measuring the point on the line in centimetres where the participant had placed their cross and this was converted to the corresponding FFMI unit. Figure 53 demonstrates how this was calculated.

Figure 53: Calculation for conversion of participants' body ratings to FFMI units



Priming Stimuli: The priming stimuli were the same as those used in Experiment 2 (see Section 4.1.2.3). These were 13 different pathogen theme images depicting people who exhibited characteristics associated with infectious disease (e.g., coughing, sneezing), and 13 non-pathogen related neutral images which depicted people either smiling or laughing. See Figures 54 and 55 for example images.

Figure 54: Examples of pathogen related visual images

Figure 55: Examples of neutral visual images

7.3.2.4 Procedure

The procedure was the same as experiment 2. The participants were presented with the bodies to rate for attractiveness, health, normality and intelligence, one at a time, on 4 separate a4 sheets of paper, in a random order. The participants in the priming conditions were then presented with the visual images (See Figures 54 and 55). The 13 different images were displayed continuously in random order for 10 minutes. Each image was presented for 8 seconds followed by a 4 second blank screen before the next image was displayed. The participants in the *pathogen* condition viewed images relating to illness. The participants in the *neutral* condition were shown the neutral images. The participants in the *no prime* condition did not view any images. After priming the participants were given a new booklet of bodies to rate. The bodies were presented in the same way as before on A4 paper.

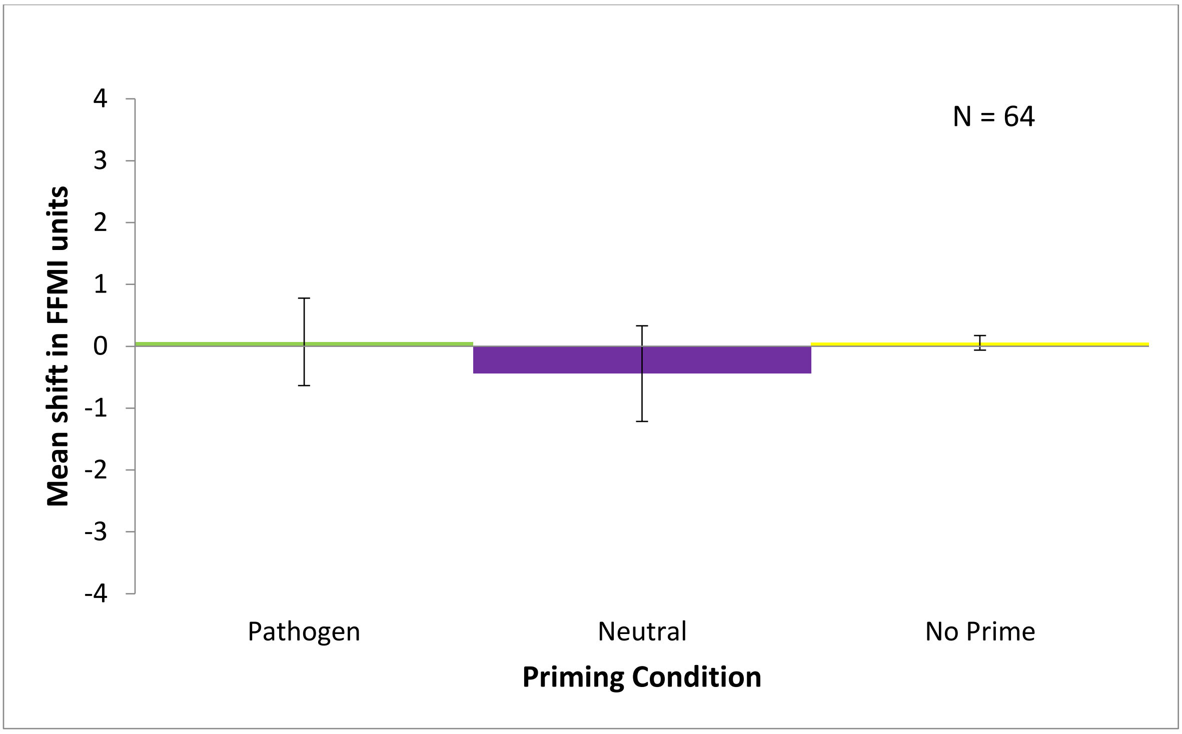
7.3.3 Results

Each participants’ FFMI preference from the 2nd testing was subtracted from their 1st testing FFMI preference giving each participant a score for their shift from 1st to 2nd testing. These scores were then used in the analysis. The ratings for attractiveness, health, normality and intelligence were analysed separately.

7.3.3.1 Ratings of attractiveness

A one way independent measures ANOVA (Prime: Pathogen, Neutral, No Prime) was carried out on attractiveness ratings. The analysis showed that there was no significant effect of type of prime on shift in ratings of attractiveness, F (2, 61) = 0.7, p >.05. η^2 = .22, suggesting that priming the participants did not cause any effect on attractiveness preferences for male bodies. Figure 56 illustrates this showing that there were no differences significant between each of the priming conditions.

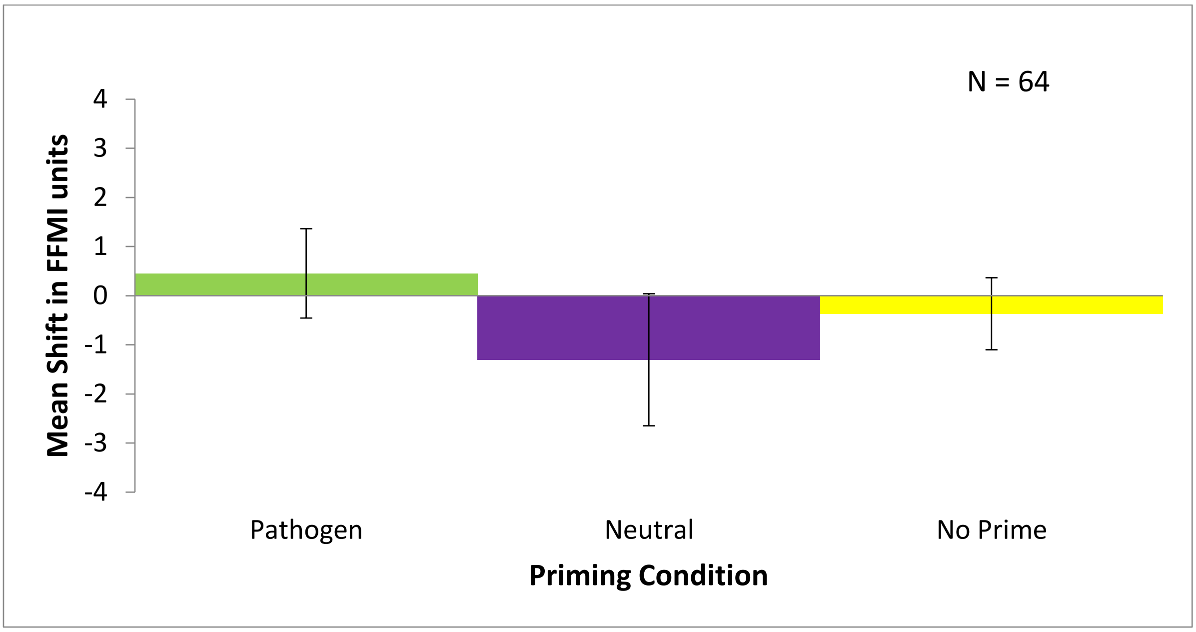
Figure 56: Mean shift in attractiveness ratings of male bodies from before to after priming presented with 95% confidence intervals.



7.3.3.2 Ratings of health

A one way independent measures ANOVA (Prime: Pathogen, Neutral, No Prime) was carried out on health ratings. This showed a significant effect of priming on shifts in health ratings, F (2, 61) = 7.48, p <.05. η^2 = .2. Post hoc analysis was conducted using Bonferroni corrected t tests. This showed that there was a significant difference between the pathogen and neutral priming conditions (p <.05, d = 1.11). There was no significant difference found between the pathogen and no priming condition (p >.05, d = 0.59) and the neutral and no priming condition (p >.05, d = 0.61). Looking at Figure 57 it is apparent that there is a positive shift in muscularity preferences after pathogen priming. However, there also appears to be a negative shift in preferences after receiving the neutral prime. The confidence intervals for both conditions overlap zero suggesting that there is no shift from zero.

Figure 57: Mean shift in health ratings of male bodies from before to after priming presented with 95% confidence intervals



To further examine the significant effect, the FFMI preferences from the first and second rating for each participant were looked at for ratings of health. This has been presented in Figures 58, 59 and 60. Note: Where only on orange symbol is visible this indicates the 2nd testing value was identical to the 1st testing value. The data is presented in ascending order of FFMI ratings on the 1st testing.

From looking at Figures 58 and 59 it can be seen that participants' preferences shifted towards a more muscular body in the pathogen priming condition but towards a less muscular body in the neutral priming condition. Figures 58, 59 and 60 demonstrate the range of FFMI ratings was similar across all 3 priming conditions with participants rating bodes between 20 and 25 as healthiest. This suggests that slightly increased muscularity is perceived as being healthier as in males FFMI's of 16.7 - 19.8 is considered to be a normal range.

Figure 58: Participants' First and Second FFMI ratings of health in the pathogen priming condition

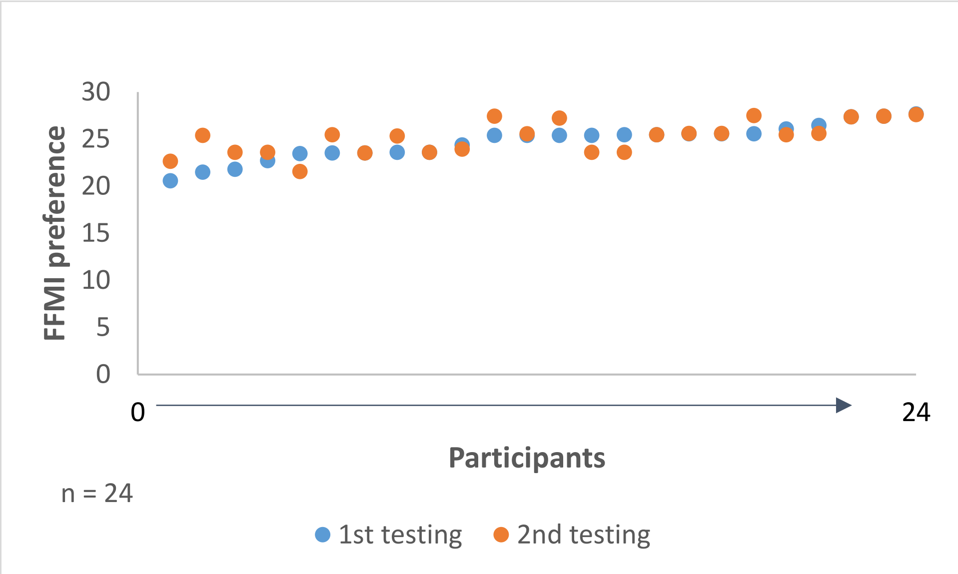


Figure 59: Participants' First and Second FFMI ratings for health in the neutral priming condition

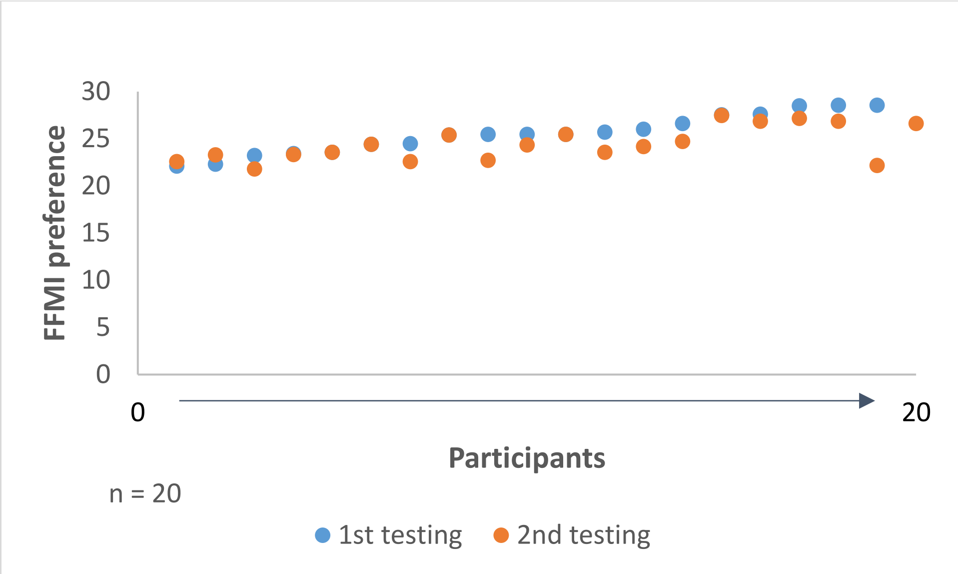
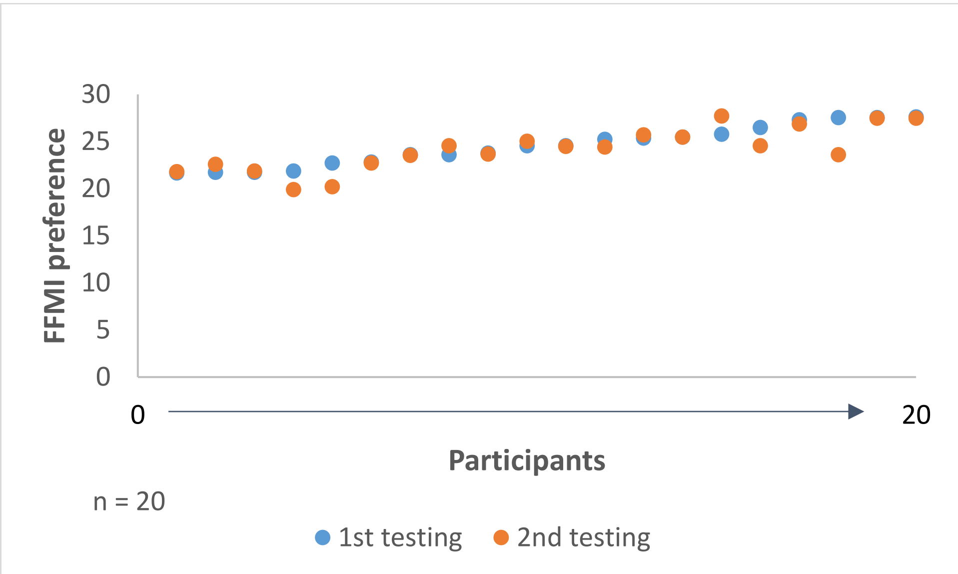


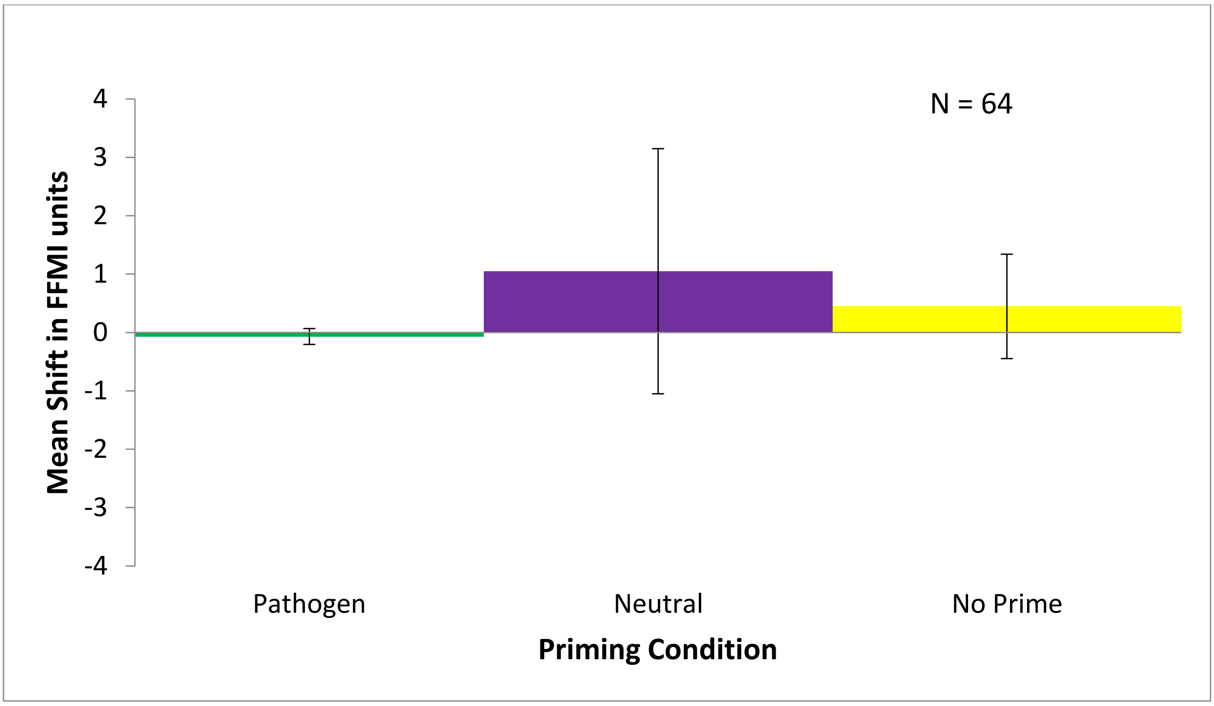
Figure 60: Participants' First and Second FFMI ratings for health in the no priming condition



7.3.3.3 Ratings of normality

A one way independent measures ANOVA (Prime: Pathogen, Neutral, No Prime) was carried out on normality ratings. This found no significant effect of type of prime on shift in ratings of normality, F (2, 61) = 0.64, p >.05. η^2 = .02, suggesting that priming the participants did not cause any effect on normality preferences. Figure 61 demonstrates that there were no differences between each of the priming conditions.

<u>Figure 61: Mean shift in normality ratings of male bodies from before to after priming presented with 95% confidence intervals.</u>

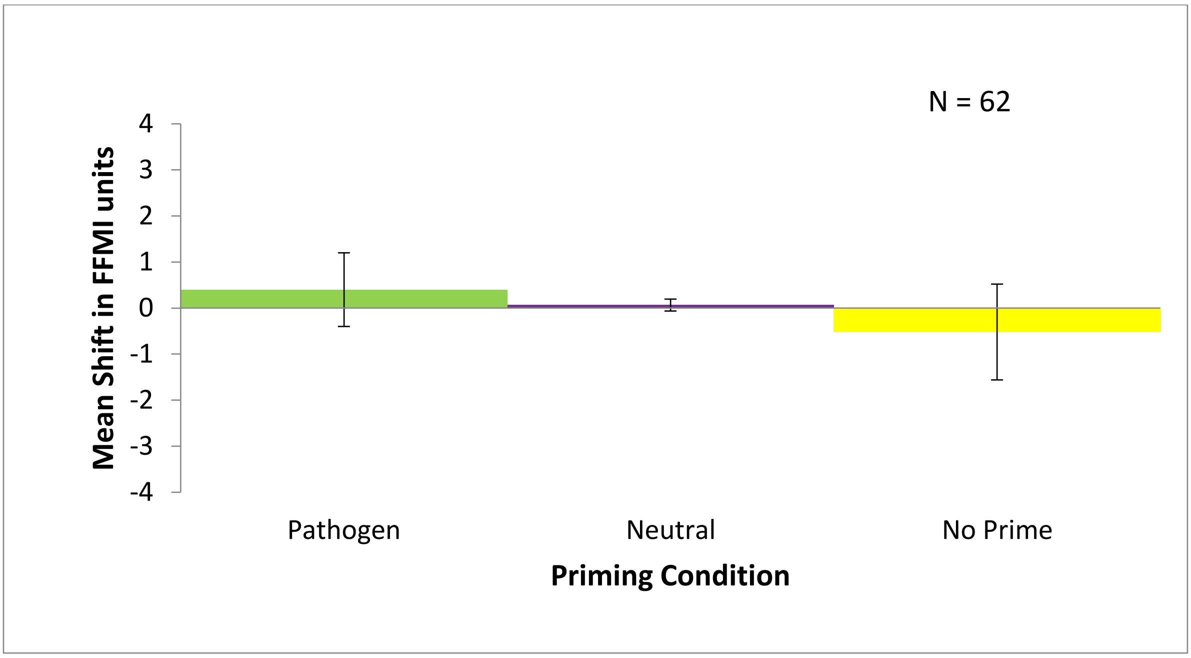


7.3.3.4 Ratings of intelligence

A one way independent measures ANOVA (Prime: Pathogen, Neutral, No Prime) was carried out on intelligence ratings. The analysis showed that there was no significant effect of type of prime on shift in intelligence preferences, F (2, 59) =

1.31, *p* >.05. η^2 = .04. This suggests that priming the participants did not cause any effect on their ratings of intelligence. Figure 62 shows that there was a positive shift in ratings of intelligence for the participants who had been pathogen primed, although it is evident that this was not large enough to significant.

Figure 62: Mean shift in intelligence ratings of male bodies from before to after priming presented with 95% confidence intervals.



7.3.4 Discussion

The results suggest that pathogen priming does not affect preferences for muscularity in male bodies. No significant effects of priming were observed in ratings of attractiveness, intelligence or normality. For ratings of health the results showed a significant effect with a significant difference between the participants who had received the neutral prime and the pathogen prime. However, neither of these conditions were different from the no prime condition or from zero according to the confidence intervals plotted on the graph.

In the previous experiment the effects of pathogen priming were not as strong in preferences for male bodies, and it is possible that this was owing to muscularity being a more important cue to the perceived health of male bodies compared to body weight. However, this experiment, using male bodies varying in muscularity, has shown no significant effects of pathogen priming on body preferences. Therefore, it seems muscularity may not be a better cue to the general health of a male body.

It was thought that if muscularity signified better health then more muscular bodies would be preferred after pathogen priming. As this effect was not found it is possible that muscularity is not a good visual cue to better health. Body weight is related to better health and having a BMI outside of the healthy weight category can result in many negative health consequences (Flegal et al., 2005; Mokdad et al., 2003; Ritz & Gardner, 2006; Wilson et al., 2002). However, being muscular does not have such clear health benefits. Although some individuals may associate being muscular with increased exercise and a healthy diet this implicit association may not be present for everyone. Therefore, it is possible that the effects of pathogen priming seen in body weight preferences would not be as apparent in muscularity preferences if increased muscle is not a clear cue to better health.

It therefore seems that the effects of pathogen priming previously only being demonstrated in in preferences for female body weight is not due to muscularity having greater importance than body weight in male bodies. It is possible that the effects are due to a same sex bias as the result is only present in female participants rating female bodies. It could be participants are more focused on their own sex when judging bodies. Therefore, it is possible that using a male sample the effect would be found in male bodies instead of female bodies. However, it is also likely that although body weight is a good visual cue to better health in both males and females it is more important in female bodies because there are negative consequences for reproduction that result from being out of a healthy weight range. Consequently, meaning pathogen priming is more effective for female bodies.

Chapter 8

Discussion

8.1 Summary of Findings

The main aim of the thesis was to experimentally examine the effect of perceived levels of pathogen threat on body weight preferences in both female and male bodies. This was explored in a series of experiments. A summary of the aims and findings for each experiment are presented in Table 7.

Table 7: A Summary of the Aims and Findings for Each Experiment in this Thesis.

	Aim	***Findings***
Experiment 1a (Chapter 3)	To validate female and male body stimuli that varies in BMI	All body weight differences between the bodies were easily detectable making them suitable for use
Experiment 1b (Chapter 3)	To validate stimuli for use in body dissatisfaction measurement	The stimuli were found to be valid and reliable for use as a scale to measure body dissatisfaction.
Experiment 2a (Chapter 4)	To examine the effects of visual pathogen primes on body weight preferences	Visual pathogen priming created a significant shift in the participants' attractiveness and health body weight preferences in female bodies
Experiment 2b (Chapter 4)	To examine the effects of visual pathogen primes on own body dissatisfaction	Pathogen priming caused no effects to the participants' own body dissatisfaction

Experiment 3 (Chapter 5)	To examine the effects of verbal pathogen primes on body weight preferences	Verbal pathogen priming created a significant shift in the participants' attractiveness and health body weight preferences in female bodies
Experiment 4 (Chapter 6)	To examine the effects of a verbal general threat prime on body weight preferences	General threat priming affects preferences but this effect is different to a pathogen priming effect and it is likely the two effects are different.
Experiment 5a (Chapter 7)	To validate male body stimuli that varies in muscularity	Muscularity differences between the bodies were easily detectable.
Experiment 5b (Chapter 7)	To examine the effects of pathogen primes on muscularity preferences in male bodies	Pathogen priming caused no significant shifts in the participants muscularity preferences

As shown in Table 7 experiments 1a and 1b were concerned with developing a set of stimuli that was valid for use in the thesis. Experiments 2a, 2b and 3 used these stimuli to examine the effect of pathogen priming on body weight preferences. The results of experiments 2a and 3 showed a shift following increased pathogen threat which is consistent with the notion (c.f. Nelson & Morrison, 2005) that implicit cues regarding resource access and availability will affect preferences for body weight. The findings from experiments 2a and 3 saw the participants shift their preferences for attractiveness and health towards a higher BMI. Before priming participants' preferences tended to be for low BMI's which is possibly due to social and cultural influences and a desire for extremely thin bodies in western society. Therefore, a shift towards a heavier body is a shift towards the healthy weight BMI category and therefore towards healthier bodies. In experiments 2a and 3, there were only 3 participants who had an attractiveness or health preference in the overweight BMI category at their first testing. Two of these participants were in the pathogen priming condition and their preference shifted downwards (towards a thinner body) into the healthy weight BMI category. Meaning it seems that if preferences before priming are for heavier bodies the shift may be towards a thinner body. Therefore, it would appear that pathogen priming causes the participants to shift their body weight preferences towards a healthier body weight which in this thesis was a preference for slightly heavier bodies as these were healthier bodies.

The findings from experiments 2a and 3 support the notion that preferences for bodies are not fixed but vary with environmental context and ecological conditions. The findings also support the hypothesis based on the proposed behavioural immune system (Schaller, 2011; Schaller & Duncan, 2007; Schaller & Park, 2011) and also support other research examining the behavioural immune system (e.g., Faulkner et al., 2004; Makhanova et al., 2015; Murray & Schaller, 2012; Navarrete & Fessler, 2006; Park et al., 2003). The results from experiments 2a and 3 are also consistent with research (Little et al., 2011; Watkins et al., 2012) using faces which has shown that pathogen primes cause an increased preference for cues of health in faces.

Experiments 2a and 2b used visual primes whereas experiment 3 used verbal primes suggesting that this effect is not modality specific. In addition to this, the results from experiment 2b suggest that pathogen priming altered preferences for female body weight but not levels of own body dissatisfaction. These findings suggest that it may not be as beneficial to have an increased preference for certain health cues when making judgments regarding ourselves. It is also possible that social and cultural effects may be strongest regarding own body preference and this weakens the pathogen priming effect as the desire for a thinner body is so strong it outweighs the need for a healthier body.

Since pathogen primes could also present a potential threat it is possible that the effects would be seen with a more generalised threat prime. Experiment 4 examined the effects of using a general threat prime on preferences for body weight. The verbal threat prime caused a shift in attractiveness preferences towards a thinner body suggesting that this is a different effect to that caused by pathogen primes. Therefore, the results indicate that it is unlikely that the effects of pathogen priming are due exclusively to a possible increase in general threat levels.

It is possible that general threat does affect preferences for body weight. This is consistent with the Environmental Security Hypothesis (Pettijohn & Tesser, 1999, 2005) which states that unsafe environmental conditions can alter individual preference suggesting that many types of general threat may affect body preferences. However, the findings here show that the threat prime caused a shift in the opposite direction to that seen in experiments 2a and 3. A shift towards a heavier body may not have occurred with the threat prime because this is linked to a preference for a healthier body which is due to an increased preference for health cues and is directly related to the threat of disease. This suggests that the pathogen priming effects are separate to general threat effects and are specifically related to a behavioural immune response causing an increased preference for cues of health.

Traditionally research has focused on female bodies as opposed to male bodies as, from an evolutionary perspective, indicators of physical attractiveness and hence genetic fitness are seen to be more important in females than males (Shackelford, Schmitt, & Buss, 2005). This thesis aimed to examine both preferences for female and male body weight as previous research had focused mainly on female bodies. The effects in experiment 2a and 3 were only found to significant in ratings of female bodies opposed to male bodies. It is possible that body weight is a more important cue to health in female bodies because body weight is essential for reproduction in females and a very low body weight can result in infertility (Frisch, 1987; Frisch & McArthur, 1974). Male's however can maintain a low body weight and still be reproductive. Therefore, to explore this further experiment 5 looked at the effects of pathogen priming on muscularity preferences in male bodies. The results were not significant, suggesting that the earlier findings (Experiments 2a and 3) were not likely to be due to muscularity being a more important cue to health than body weight in male bodies. Body weight may be a better visual cue to health in female bodies compared to males and therefore pathogen priming is more effective in judgments of female body weight.

In addition, the findings also provide some of the first experimental evidence that what is perceived to be an attractive and healthy body is sensitive to information about putative pathogen prevalence in the local environment. The remainder of the chapter will discuss and reflect on the findings of this thesis in more detail and offer suggestions for future research.

8.2 The Behavioural Immune System

It was hypothesised that pathogen primes would trigger the behavioural immune system, making individuals more attentive to cues of health which would result in a change in body weight preferences. The behavioural immune system is an evolved set of mechanisms that aid us with the behavioural avoidance of pathogens (Schaller, 2011; Schaller & Duncan, 2007; Schaller & Park, 2011). It allows individuals to detect potential cues of disease in others and engage in behaviours that prevent contracting pathogens from these individuals. This can then act as a first line of defence against pathogens preventing them coming in contact with our bodies. The behavioural immune system has evolved to respond not to the actual presence of parasites but to the perceived presence of parasites as indicated by sensory or perceptual cues (Schaller & Park, 2011). Which once perceived the cues can trigger behavioural and cognitive responses.

The findings shown in experiments 2a and 3 are consistent with the experiments' hypotheses based on the proposed behavioural immune system. Previous research (Oaten et al., 2009; Park et al., 2003) has indicated that the perceived presence of illness in others can trigger avoidant behavioural and psychological responses such as disgust, negative attitudes or even a biological immune system response (e.g., Schaller et al., 2010). The findings from experiment 2a and 3 suggest that both presenting an individual with visual images depicting symptoms of illness and providing an individual with a verbal prime intended to increase awareness of environmental pathogen load consequently caused a change in body weight preferences. In line with previous research the findings here show that increasing pathogen prevalence causes a change in behaviour with attractiveness and health preferences altering.

The findings from experiment 2a and 3 support other research (Ackerman et al., 2009; Makhanova et al., 2015; Schaller et al., 2010; Tybur et al., 2011) that has also demonstrated effects of the behavioural immune system using experimental priming. For example, Makhanova et al. (2015) demonstrated that in white participants pathogen priming resulted in an increase in out grouping behaviour towards black target faces. Tybur et al. (2011) showed that participants who had been pathogen primed reported greater intentions to practice safe sex. Along with this research the findings in this thesis suggest that pathogen primes can result in a change in behaviour, in this case preferences for body weight, and therefore provide further evidence for the behavioural immune system.

The findings in this thesis are also in line with research (e.g., DeBruine, Jones, Tybur, Lieberman, & Griskevicius, 2010; Jones, Feinberg, Watkins, Fincher, Little, & DeBruine, 2013; Jones, Fincher, Welling, Little, Feinberg, Watkins, Al-Dujaili, & DeBruine) which has suggested a relationship between levels of pathogen disgust and face preferences. This research has suggested that individuals who rate higher on measures of pathogen disgust show greater preferences for masculinity/femininity in faces. Furthermore, research with faces has shown that pathogen priming individuals will cause an increase in preferences for more masculine characteristics (Lee & Zietsch, 2011) and increased sexual dimorphism in both male and female faces (Little et al., 2011; Watkins et al., 2012). The findings from experiments 2a and 3 indicate that a pathogen priming effect is present in preferences for bodies highlighting a relationship between concerns about pathogen threat and body weight.

Experiment 2b suggested that this relationship is not apparent when making judgments regarding one's own body. It was suggested that this occurs because even though a shift towards a healthier own body weight may be beneficial in a pathogen heavy environment, the behavioural immune system evolved to aid us with both the detection and behavioural avoidance of others who are infected. Therefore, it may not be as beneficial to have increased awareness of cues of health when making judgments regarding ourselves compared as to when making judgments about others.

The findings from experiment 4 suggested that the pathogen priming effect may not be simply a generalised threat effect, meaning the effects are not due simply to increased anxiety incidentally brought about by a pathogen prime. It was seen in experiment 4 that there was a significant effect on attractiveness ratings for female bodies with preferences shifting towards a heavier body for the participants who were primed using only a questionnaire and towards a thinner body for those who were primed using a verbal prime. It is possible that the questionnaire prime, as it was asking questions about generalised anxiety, could have produced an effect similar to a pathogen prime if it caused the participants to question their mental health. Research (Lund & Boggero, 2014) has shown that people are more likely to implicitly associate mental illness with disease over danger. Consequently, it may be that the questionnaire prime brought about implicit associations with illness.

The verbal prime in which the participants were asked to take part in an electric shock experiment should have had little association with illness or disease. A shift towards a thinner body was seen here and therefore suggests that this effect is different to the one present after pathogen priming. Therefore, it is likely that a shift towards a heavier body was not seen with this prime because the preference for a healthier body is because of an increased preference for cues of health and is directly related to the threat of disease. Therefore, the effects seen in experiments 2a and 3 seem to be directly related to the behavioural avoidance of pathogens rather than a general response to any threatening situation that causes increased anxiety levels.

8.3 Body Weight and Health

The findings from experiment 2a and experiment 3 suggest that pathogen priming can cause a shift in body weight preferences. This in line with the suggestion proposed by Nelson and Morrison (2005) who claimed that individuals use implicit cues about collective resources to construct their preferences. Along with Swami and Tovée (2006), Nelson and Morrison found that the subjective experience of resource deprivation can affect preferences for female body weight with heavier female bodies being preferred by hungry and financially poorer males. The findings from this thesis also support this suggestion as it has been shown here that there is a shift towards a healthier body weight following pathogen priming using implicit cues that signal a risk to health. Such behaviour is also consistent with the Environmental Security Hypothesis (Pettijohn & Tesser, 1999, 2005) which puts forward the idea that individuals construct their preferences based on how secure they feel in their current environment. Consequently, if pathogen primes are used as cues which implicitly suggest an increased level of pathogen prevalence this will lead individuals to engage in behaviours and show preferences in line with this state of environmental threat. For example, in experiment 3 the verbal pathogen prime caused the participants to become more aware of the environmental pathogen load resulting in a change in body weight preferences. Similarly, in experiment 2 the visual pathogen images prime the participants to become aware of pathogen prevalence leading them to shift their preferences for attractiveness and health in bodies.

This change in body weight preferences is thought to be because body weight provides an indication of health as it is associated with actual health measures and being out of a healthy weight range has many negative health related implications, for example decreased immunity and higher death rates are linked to being underweight (Flegal et al., 2005; Ritz & Gardner, 2006) and cardiovascular disease and diabetes are prevalent in obese individuals (Mokdad et al., 2003; Wilson et al., 2002; World Health Organisation, 2011). In addition to this research has shown that individuals use body weight, as indicated by BMI, when judging the health of a body (Swami, Miller, Furnham, Penke & Tovée, 2008) also suggesting that it is used as a health cue. Ultimately in pathogen rich environments, bodies in a healthy weight range would be preferred as they signal resource access, better health and less chance of being contagious hence increasing survival and reproduction. It was not predicted prior to conducting the experiments which direction pathogen priming would cause body weight preferences to shift towards. The results showed a shift towards a heavier body which as mentioned is thought to be because the participants' initial attractiveness and health preferences were for bodies with a low BMI, therefore in this context slightly heavier bodies may be a cue to better health as they are more clearly within the healthy BMI range. It is likely that if participants initially had higher BMI preferences the shift towards the healthy weight BMI category would be downwards towards a thinner body. This was evident in participants who did initially have preferences for overweight bodies, who had a shift towards a thinner body as a result of the pathogen prime. Consequently, pathogen priming is causing preferences to shift into the healthy weight BMI category.

There is a prevailing problem with obesity particularly in western society (World Health Organisation, 2011) and it is not typically associated with positive outcomes (Mokdad et al., 2003; Wilson et al., 2002; World Health Organisation, 2011). This apparently runs contra the findings here therefore it might have been expected to see a shift towards a thinner body instead of a heavier body since the negative health outcomes associated with being overweight mean thin bodies may signal better health. Indeed, research (Fisher et al., 2013) with faces showed that participants with higher levels of pathogen disgust showed a preference for thinner faces suggesting that thin faces were perceived as healthier than fatter ones. However even though obesity is associated with poor health equally so is being underweight. Very low body weight can be associated with disease, illness and a weakened immune system in pathogen rich environments (Marlowe & Wetsman, 2001; Swami & Tovée, 2007a; Tovée et al., 2007) suggesting that a certain level of body fat is beneficial for better health. Although being overweight has negative health implications (such as hypotension, diabetes) these are normally a result of being overweight whereas weight loss and being underweight can be a symptom of infectious disease. Obesity is a condition seen in modern western society brought about as a result of excess food and a sedative lifestyle and therefore, since weight loss is so often associated with illness, individuals may be just as likely if not more so to make an association between being underweight and disease than being overweight.

In addition to this the desire for a thin body in western females is not likely to be caused by the belief that being thin is healthy but from the media reinforcing the thin ideal (Myers & Crowther, 2007). Indeed, research (e.g., Stephen & Perera, 2014; Tovée et al., 2007) suggests that what is perceived to be an attractive body weight is typically lower than what is perceived to be a healthy body weight (see Chapter 1 Section 1.7). Therefore, although it could be argued that pathogen priming could cause an increased preference for a lower body weight, it would be unlikely to expect this as the preference seen in Western society for extreme thinness does not seem to occur from thinness being linked to better health but from the media reinforcing a thin ideal. It is likely that the effects seen here are still being moderated by cultural influence as most of the preferred body weights are at the lower end of the healthy weight category, whereas in a non-westernised culture it is likely that preferences for the most attractive body would have a higher BMI than seen here, with much more value being placed on body weight in these settings. As discussed the priming effect causes a shift in preference that due to the original preference for a thin body the shift is towards a heavier body as it is arguably a healthier body. This explains why a shift towards a thinner body was not exhibited in the findings here as due to the low BMI of bodies originally selected a shift towards a thinner body would not have been a healthier body and would have resulted in a BMI even further outside the healthy weight range being selected. However, in participants who initially had preferences for heavier bodies a shift downwards into the healthy BMI category was seen.

A slightly heavier body may also be a healthier body because of the previously discussed problems with very low body weight and fertility. Females need a certain level of body fat to menstruate and therefore without these fat levels will not be able to conceive, carry a baby in any way or lactate. (Frisch, 1987; Frisch & McArthur, 1974). In addition, fat stores are beneficial for a successful pregnancy (Doherty et al., 2006; Neggers & Goldenberg, 2003) suggesting that regarding female health and reproductively being underweight is a serious negative consequence. This could in part explain why the effects seen are not as strong in male bodies as males, unlike females, do not need to have high body fat levels to remain reproductively healthy. Therefore, if a preference for a heavier body is related to the health benefits of greater levels of adiposity then this should be more prominent in female bodies. Essentially body weight may be a better and more crucial cue to health in female bodies compared to male bodies. Therefore, it seems the effect cannot simply be transferred from female to male bodies and may be unique to female bodies.

8.4 Contributions

This thesis has made a unique contribution to knowledge by providing the first research in the area of body weight preferences and pathogen priming. This thesis has given a greater understanding of body weight preferences and how the manipulation of certain situational and environmental cues can cause a change in body preferences. Previous research (e.g., Tovée et al., 2006) had shown that body weight preferences are not fixed and can vary with ecological conditions, furthermore this was shown to occur on an individual level with hungry males preferring heavier bodies (Nelson & Morrison, 2005; Swami & Tovée, 2006). However other situational and environmental factors and their potential affects on body weight preferences had previously not been examined. Research had shown that individuals have an evolved behavioural immune system that causes them to become more vigilant in pathogen heavy environments and implicitly change their behaviour accordingly. Therefore, it was probable to suggest that pathogen prevalence may affect preferences for bodies. A small amount of research (Lee & Zietsch, 2011; Little et al., 2011; Watkins et al., 2012) with faces has shown effects of pathogen priming, with increased preferences for sexual dimorphism being shown in individuals who had received a pathogen prime. However, this phenomenon had yet to be examined in preferences for body weight and this thesis has begun to do this.

The findings of this thesis have implications for several theories. The main the theories used, the predictions that were made from these theories and how the findings supported these are described in Table 8.

Table 8: A Summary of the Main Theories Used in this Thesis, the Predictions Made from these Theories and How the Findings Support the Theory.

Theory	*Predictions made from theory*	*Findings*
Environmental Security Hypothesis (Pettijohn et al., 2009) states that individuals will alter their preferences in line with their current level of environmental threat.	Participants will alter their preferences for body weight after pathogen priming due to the change in perceived environmental security. The pathogen threat created by the prime will cause a shift in body weight preferences	The findings suggest that pathogen primes are used as cues which implicitly suggest an increased level of pathogen prevalence this causes participants to show a preference in line with this state of environmental threat
Nelson and Morrison's (2005) proposed theory suggesting implicit cues to resource availability influence individual preferences	Implicit cues regarding the current environmental pathogen level will cause a shift in preferences for body weight	The findings show a shift towards a healthier body weight following pathogen primes suggesting participants are using implicit cues that signal a risk to health to construct their individual preference
Behavioural Immune System Hypothesis (Schaller, 2011; Schaller & Duncan, 2007; Schaller & Park, 2011) suggests that individuals have an evolved behavioural immune system which aids them with the detection of signals that indicate pathogen threat and causes them to engage in behaviours that reduce change of contamination	Pathogen priming will activate the behavioural immune system, making participants' more attentive to cues of health. As body weight is a good cue to the health of an individual this will result in a change in body weight preference	The findings suggest that making individuals more attentive to cues of health through pathogen priming causes an increased preference for cues of health resulting in a shift in preference towards a healthier body weight.

From Table 8 it can be seen that the findings provide support for three different theories, providing further evidence of the unique contribution to knowledge of the thesis. The thesis is the first research to bring together research in the area of body weight preferences and research relating to the behavioural immune system. Therefore, by doing this the thesis can provide support for a range of theories.

The behavioural immune system has been suggested to have some cross cultural implications for behaviour (see Chapter 1 Section 1.6.1). Individuals become more vigilant to cues of infection when in environments where individuals are, or they perceive themselves to be, under increased vulnerability to pathogens. This can then cause variations in behaviours across populations due to differences in pathogen prevalence in the local environment. For example, research has shown a greater use of culinary spices (Sherman & Billing, 1999) in cultures where there is greater threat of disease, which is thought to be because they can act as a natural antibiotic and a defence against pathogen. There are also lower levels of extroversion (Schaller & Murray, 2008) which may result in less contact with others and therefore less chance of contracting an infection. High levels of extroversion also suggest greater impulsivity and a tendency to take risks and deviate from norms which is not advantageous when pathogen threat is high. Higher levels of collectivism are also found in populations with higher pathogen prevalence (Fincher et al., 2008; Thornhill et al., 2009) which would suggest a more conformist and cautious attitude which may be of greater benefit in conditions where there is a greater threat of disease.

As this thesis demonstrates that pathogen priming can cause a change in the way we perceive bodies it is possible that the cross cultural differences seen in body preferences (See Chapter 1 Section 1.3) could also be because of a greater threat of illness or disease in certain cultures or socio economic groups. For example, a preference for a heavier body is well documented in certain African cultures such as the Hadza people and certain populations of South African Zulus (Marlowe & Wetsman, 2001; Tovée et al., 2006) and these groups experience a much greater threat of pathogens than in the UK. The shifts seen in experiments 2a and 3 suggest that individuals may show an increased preference for health cues when under perceived pathogen threat. In these types of cultures a heavier body weight would be even more likely to signal better health and resistance to illness. Therefore the findings in this thesis, that pathogen primes can cause an increased preference for a healthier body weight, could indirectly contribute to research on cross cultural differences in preferences for body weight.

Research on the behavioural immune system has consisted of many cross cultural studies and studies involving correlations between measures of individual levels of concern about pathogen threat and behaviours. Experimental pathogen priming is a method that does not have some of the problems seen in cross cultural and individual differences research. For example, when using cross cultural research, it can be argued that correlations between variables can sometimes be over interpreted in this type of research. Maurage et al. (2013) point out that countries with higher levels of chocolate consumption have more Nobel Prize winners but there is no evidence to suggest that individuals who consume more chocolate are more likely to win a Nobel Prize. Therefore, experimental methods provide support for previous research using other methods but overcome some of the problems associated with them. Therefore, the findings seen here can inform this developing research area.

The thesis was the first research to develop and validate a set of computer generated body stimuli. The stimuli were also used to develop and validate a scale to measure body dissatisfaction. The Body Dissatisfaction Scale (Mutale, Dunn, Stiller & Larkin, 2016) was found to exhibit good construct validity and test-retest reliability over a five-week period. It was shown that participants could easily detect the subtle differences in body weight between the different bodies on the scale. The significant correlations with the BAS suggest that both the female and male version of the Body Dissatisfaction Scale have good construct validity. Perceived actual body size was highly correlated with participants BMI for both male and female versions, which indicates that the Body Dissatisfaction Scale is a useful tool in assessing perception of one's own body size and provides further evidence of construct validity.

Chapter 3 identified the many problems with the existing stimuli used in body perception research. Therefore, this thesis has been able to develop a new set of computer generated stimuli that has positively contributed to current stimuli. The stimuli used are more lifelike in appearance than previous line drawn stimuli (e.g., Thompson & Gray, 1995) and overcome some of the problems with photographic stimuli (e.g., Swami, Salem, Furnham & Tovée, 2008a) such as biases in judgements associated with certain racial groups. It also controls for unwanted variation in body part ratios, inherent in real human beings both across and within the sexes. Using computer generated stimuli may never be as ecological valid as using real life images. However, given the problems with maintaining control and consistency over photographic stimuli computer generated bodies provide a valuable alternative, particularly when wanting to measure body preferences in an experimental setting where greater control is needed.

A future version of the stimuli where the bodies are rotated and presented in three dimensional formats could be developed using the same software. The use of more life-like computer generated stimuli is also particularly useful as it allows for the presentation of stimuli in more realistic settings, which could not be achieved with line-drawn stimuli. Therefore, the current stimuli are not limited to the use of images simply being presented in isolation. Future research could see the bodies, for example, being presented against various computer generated backgrounds or settings to allow for a more realistic presentation.

The Body Dissatisfaction Scale (Mutale et al., 2016) is not restricted to being used in an experimental setting to measure body dissatisfaction as it also has practical applications. The scale can also be used in a clinical setting to measure body dissatisfaction. For example, the Body Dissatisfaction Scale is currently being used in eating disorders clinics within the NHS in England to measure body dissatisfaction in eating disordered patients. The scale is time efficient and easy to administer either in a digital or paper format making it practical to use in a clinical setting. In addition, the current stimuli were used to develop both a male and female version of the Body Dissatisfaction Scale. This improves on other stimuli in the field which only have a female version available (e.g., the PFRS) therefore limiting measurement to only female body dissatisfaction. The Body Dissatisfaction Scale has both a female and male version meaning it can be used with both female and male patients in a clinical setting and in research.

8.5 Critique

As the effects seen here have been demonstrated in an experimental setting it can never be fully clear if this is an accurate representation of a real life setting and potential pathogen exposure. However, it is likely that in real world settings individuals in pathogen risky environments would have prolonged and persistent exposure to disease, illness and associated risks. Consequently, it will always be difficult to fully replicate these types of cues in an experimental situation with a brief priming process. However, as effects have been found during the experiments in this thesis it would seem that the primes used were essentially effective in creating concerns about pathogen threat. In a real life environment cues would be more constant and prevalent than a prime meaning it is likely the effects seen in this thesis are underestimating much larger effects also seen in real world settings. However, although it can be suggested from the current findings that individuals under threat from disease may find female bodies in the healthy weight BMI category more attractive and healthy, it cannot be fully known if this translates to a real life setting and if this would lead to people selecting mates and acquaintances with perceived healthier bodies because of their current environment.

Another way to overcome the problems with using a prime to imitate an actual pathogen threat would be to use participants who are currently experiencing an illness. It is likely that compared to individuals who are in good health they may show a preference for healthier bodies. This would be interesting to attain as any significant effects would suggest that illnesses and actual pathogen prevalence will also affect preferences for bodies. This would build on cross cultural research looking at actual levels of pathogen prevalence but would still have the control and benefits of an experimental method.

Research (e.g., Marlowe & Wetsman, 2001; Swami & Tovée, 2007a; Tovée et al., 2006) has shown that in developing countries and in lower SES groups heavier bodies are preferred. In developing countries there is a much greater threat of disease and poor healthcare, also lower SES groups would experience a greater threat of illness as there is less access to healthcare and lack of readily available medicines. Consequently, the differences in body weight preferences seen between developed and developing countries and low and high SES groups could be due to different levels of environmental pathogens and pathogen threat. In this thesis the SES of the participants was not explicitly measured even though previous research has showed some effects of SES on body preferences. Socio-economic status is difficult to measure particularly as it often relies on self-report from the participants. If provided with a general definition this could still have caused misunderstanding and inconsistency between what the participants understand to be low or high SES. SES is typically measured using one or all of the three main components that comprise it. These are education, occupational level and income. When measuring SES, if using income and occupation level as components, there is always issues with the classification of students, the elderly and the unemployed (Shavers, 2007). As the participants used throughout this research were university students it would not be appropriate to use occupational or income measures to attain their SES status. It is problematic to infer participants’ SES purely based on their education and the knowledge that all the participants were university students. Nottingham Trent University is a diverse new university with typically takes students from a range of socio-economic backgrounds. Therefore, it would be difficult to class the participants to be all of a relatively high SES status purely on the basis of their educational level.

Previous research which has examined SES and found difference in body preferences (See Chapter 1 Section 1.3) has recruited their low SES groups from extremely poor areas such as rural hill tribes in Thailand (Swami & Tovée, 2007a) and rural areas of Malaysia (Swami & Tovée, 2005a, 2005b). Therefore, this type of group is likely to be more similar to individuals in developing and poorer countries and the results of this research have therefore mirrored the cross cultural differences found in body preferences. There is no research to suggest that body preferences vary significantly between SES groups within the UK as there is not such a distinct divide between rich and poor. Furthermore, within the UK there is free healthcare available to all meaning it is unlikely that individuals from poorer backgrounds would feel significantly more at risk from illness than those from more affluent backgrounds. In addition to this due to state benefits it is unlikely those in lower SES groups have less resource access than their higher SES counterparts. Indeed, in developed Countries (e.g., UK, Germany, Greece, Spain), particularly for women, obesity is more prevalent in lower SES then in higher SES settings (McLaren, 2007; Sobal & Stunkard, 1989; World Health Organisation, 2014) suggesting that food is in abundance and readily available even to the poorest in society. As this thesis and other research has demonstrated that body preferences are not fixed it is likely that even within a SES group, body preferences will vary depending on the individual's particular level of resource access. While it is clear that there are established cross cultural differences in body weight preferences with those in poorer countries preferring heaver bodies, in a purely UK sample it is unlikely that we would find significant differences in body preferences across SES groups as those in low SES groups still have a good level of resource access.

Consequently, it was chosen not to measure or infer the SES of the participants' not only due to the methodological problems with measuring SES, particularly with students, but also due to the fact that in the UK it was not thought that lower SES groups feel a greater threat of disease than higher SES groups. Therefore, although there will always be individual variation across the participants' perceived vulnerability to disease and access to resources it was not thought that this could be controlled for by measuring SES.

In this thesis current menstrual cycle position of the participants was not measured and included in any analysis. It is possible that this could have potential effects on the data as some research (Little, Jones, & Burriss, 2007) suggests that females in the follicular, fertile phase of the cycle prefer a more muscular male body compared to females in the luteal phase. Thus there are possible cyclic effects on body preferences that have not been captured here. Commonly, research (e.g., Little et al., 2007; Penton-Voak & Perrett, 2000; Penton-Voak, Perrett, Castles, Kobayashi, Burt, Murray, & Minamisawa, 1999) that has measured the menstrual cycle has often used a standard 28 day model to infer participant's current cycle position based on a self-report measure of previous onset of menses. Research (Wegienka & Baird, 2005) has shown that only 56% of females can accurately recall the exact date of their last menstrual period, therefore the accuracy of using self-report measures to infer cyclic position is questionable. Although a fertility indicator could have been used this was not practical or affordable in this research. Therefore, due to the problems with using self-report measurement and the fact that it would have inhibited data collection by only being able to use females with a 28 day cycle it was chosen not to look at cyclic effects in this thesis. However, future research could examine this further to see if females are more likely to be affected by pathogen priming at certain points in their cycle.

8.6 Recommendations for Future Work

There is no reason to suggest that the behavioural immune system would only be present in human animals. It is possible that the behavioural immune system is a general evolutionary mechanism that may be present in all animals. Therefore, any animal might reasonably show an increased preference for cues of health in members of their species when they experience an actual or perceived increase in pathogen prevalence.

Therefore, one area for further research would be to examine the effects of perceived or actual increased levels of pathogen prevalence in other animal species. Research (Fisher & Rosenthal, 2006) with the swordtail fish*, Xiphophorus birchmanni,* has demonstrated that females will alter their mate preferences when they are food deprived. It was shown that female fish who had been food deprived preferred well fed male swordtail fish compared to male swordfish who were under nourished. This effect was not as strong in the female swordtail fish that had not been food deprived. This effect is in line with the research (Nelson & Morrison, 2005; Swami & Tovée, 2006) in humans suggesting that hungry males prefer heavier females. Therefore, it would be interesting to know if the effects seen in this thesis are present in other non-human animal species who are under threat from disease and pathogens. This could be tested in an experimental setting, similar to Fisher and Rosenthal's study, whereby a group are exposed to a mild illness commonly found in that species and then have their mate preferences monitored afterwards. This can then be compared with a group not exposed to illness. If research showed these effects to be present in other animals this would open many other avenues for further research.

Another future area of research to be considered is what type of real world information may have a priming effect and what implications this could have. For instance in modern Western society there is an increasing problem with obesity. In England 61.9% of adults and 28% of children are classed as overweight, with obesity associated health problems costing the country's National Health Service over £5 billion a year (Department of Health, 2013). In recent years the British government has attempted to tackle this by making individuals more aware of healthy eating choices and encouraging healthier behaviours. For example, Change4Life is a government public health campaign in England aimed at reducing obesity. This and other similar campaigns have featured advertisements and advice which focused on unhealthy foods and the negative health implications associated with being overweight such as high blood pressure, greater risk of some cancers and diabetes. These messages could in themselves act as brief primes as they could potential cause increased worry or concern about illness and an unhealthy diet. If, as seen in this thesis, increased awareness of illness concepts causes a preference for a heavier body these attempts to reduce obesity in society could actually be counter intuitive. If this type of information does indeed have a priming effect, they could lead to an increased preference and acceptance of heavier bodies. This suggestion remains purely speculative and further research would be needed to examine this to establish if this type of information does indeed act as a prime in an experimental situation. If this is the case than this would provide a whole new area (the effects of pathogen primes on health related behaviours) for research. In addressing and dealing with the problems of obesity in modern society, researchers have seemed to lose sight of the fact that the human body evolved with a capacity to store fat and that this ability has had an adaptive advantage. Most medical research has seeked proximate solutions to obesity and evolutionary perspectives on body weight have been neglected (Norgan, 1997). An evolutionary perspective highlights the unrecognised and overlooked benefits of body weight and perhaps closer attention to the evolution and the psychology behind body weight and how we perceive bodies would have fruitful results in the treatment and prevention of obesity.

This thesis only used female participants throughout. Although research (e.g., Swami, Antonakopoulos et al., 2006; Swami & Tovée, 2005a; Tovée et al., 2002, 2006) has demonstrated no differences between male and female’s body preferences further research may want to use a male sample to confirm the effect is present in male’s preferences for body weight. Also as mentioned it is possible that if the effect is due to a same sex bias then it may not be present in male participants’ ratings of female bodies but of male bodies instead.

8.7 Thesis conclusions

The main aim of this thesis was to explore potential effects of pathogen priming on preferences for body weight. This thesis has demonstrated altered body weight preferences after pathogen priming, specifically a preference shift towards bodies in the healthy BMI range following priming. Social and cultural influence are likely to have moderated judgments of what is an attractive and healthy body weight resulting in either underweight bodies or bodies at the lower end of the healthy weight category being found most attractive and healthy without any priming effects. Therefore, in the findings the pathogen priming effect seems to be causing individuals to shift their preference to a heavier body as this is also a healthier body. This effect appears to be most robust and prevalent in female bodies compared to male bodies. The effect seems to be distinct from effects of anxiety and general threat and only occurs in body weight judgments regarding others, with levels of body dissatisfaction remaining unaffected by pathogen primes.

As acknowledged exposure to pathogens in the real world is likely to be more prolonged and possibly more effective than the primes used in an experimental setting, meaning the effects found in real world settings are even more likely to result in altered body preferences. Therefore, pathogen prevalence could play a role in mediating the body size preferences seen across different parts of the world.

In conclusion it has been shown that pathogen priming causes individuals to shift their body weight preferences with heavier bodies being found more attractive and healthy. This is thought to be because initially bodies with low BMI's were preferred, a shift towards a heavier body is a shift towards a healthier body. Therefore, in this context slightly increased body weight signifies better health, pathogen resistance and access to resources. The findings are consistent with the behavioural immune system hypothesis (Schaller, 2011; Schaller & Duncan, 2007; Schaller & Park, 2011) and recent work showing shifts in face preferences following exposure to a pathogen prime (e.g., Little et al., 2011). The current research builds on previous methods of priming by demonstrating that a contagion threat can also influence individual preferences for bodies. The findings also complement research that relates resource scarcity (e.g., Nelson & Morrison, 2005) and environmental security (e.g., Pettijohn et al., 2009) to within and cross cultural differences in preferences for bodies. Accordingly, the thesis has proposed that preferences for bodies are not fixed but can vary depending on current environmental information.

Furthermore, the findings might, in part, also inform research on cross cultural differences in what constitutes a desirable body weight.

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Appendices

Appendix A

Publications:

Mutale, G. J., Dunn, A. K., Stiller, J., & Larkin, R. (2016). Development of a Body Dissatisfaction Scale Assessment Tool. *The New School Psychology Bulletin.13(2), 47-57*

Development of a Body Dissatisfaction Scale Assessment Tool

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Abstract

The present research details the development of a new pictorial scale (Body Dissatisfaction Scale) to be used in the measurement of body dissatisfaction. The scale comprises nine female and nine male images of computer generated bodies that increase successively in body weight. Using a sample of 190 students (female = 130, male = 60) results found that the new scale exhibits good validity with participants being able to correctly identify body weight differences between all bodies in the scale. Evidence for construct validity was demonstrated by significant correlations between ratings of perceived actual body size using the current scale and participants' BMI. Body dissatisfaction measured using the current scale was also negatively correlated with a measure of body appreciation. Test retest reliability remained stable over a 5 week period. The scale improves on previous pictorial scales by offering both male and female versions while offering improved realism and consistency between images.

Keywords: Body Image; Body Dissatisfaction; Body Weight; Scale Development

As the occurrence of eating disorders in young women has grown in Western society in recent years (Smink, van Hoeken & Hoek, 2012), research into body image dissatisfaction has increased, with a large amount of research highlighting a link between body image disturbances and eating disorders (Garner, 2002; Cattarin & Thompson, 1994). Indeed, a large number of females and males in Western society are dissatisfied with some aspect of their bodies (Tiggemann, 2011). Consequently, the measurement of body dissatisfaction is an important aspect of research concerned with body image dissatisfaction and disturbances

Grogan (2008) defines body dissatisfaction as "a person's negative thoughts about his or her own body (p.4)". This includes judgements about size and shape, muscle tone and generally involves a discrepancy between one's own body type and an ideal body type. Although there are several techniques for measuring a discrepancy between an individual's own body weight and their ideal body weight, figure rating scales are most commonly used (e.g. Gardner, Jappe, & Gardner, 2009; Stunkard, Sorensen, & Schulsinger, 1983; Thompson & Gray, 1995). This type of scale typically consists of a set of drawn stimuli that vary in body weight from underweight to overweight. To measure body dissatisfaction participants are normally asked to choose a figure they think (a) best represents their perceived actual body shape and (b) best represents their ideal body shape. Body dissatisfaction is then defined as the discrepancy between a participant's actual and ideal body.

There has been extensive use of these type of figure rating scales (e.g. Gardner, Jappe & Gardner, 2009; Stunkard, Sorensen, & Schulsinger, 1983; Thompson & Gray, 1995) to represent different body weights when researching body dissatisfaction. This has proved useful in enabling researchers to keep the properties of stimuli consistent while changing waist to hip ratios, body mass and size. However, there are various problems with these types of stimuli. For example, line-drawn figures have been said to lack realism and ecological validity and can therefore often appear unrealistic (Tassinary & Hansen, 1998). Thompson and Gray (1995) noted that previous line drawn scales have figures with disproportionate arms and legs, differential thickness between right and left arms, or a lack of separation between the arms and bodies in obese drawings. This has led to further criticism of research into physical attraction (e.g. Singh, 1993; Swami, Furnham, & Joshi, 2008) that has previously relied on line-drawn stimuli (Bateson, Cornelissen, & Tovée, 2007; Gardner, Friedman, & Jackson, 1998). Often line-drawn figures (e.g. Singh, 1993) that vary in waist to hip ratio (WHR) are modified by altering the width of the torso, but this also changes apparent Body Mass Index (BMI), meaning it is not possible to say whether attractiveness ratings are made on the basis of WHR, BMI or both. In addition, these figures are usually drawn by a professional artist (e.g. Thompson & Gray, 1995). Therefore, the increase in body weight between figures is subject to the artist's estimation of increase in body weight, rather than a metrically precise increment. This results in inconsistent size differences between successive figures (Gardner, Friedman, & Jackson, 1998).

To address some of the previous problems with the measurement of figural stimuli, Gardner, Jappe and Gardner (2009) developed a line-drawn figure rating scale where the bodies were based on real body dimensions. However, although these bodies can be said to change in size, the way real bodies do, using line-drawn stimuli still lacks realism (Tassinary & Hansen, 1998). Therefore, to address these issues with line-drawn stimuli Swami, Salem, Furnham and Tovée (2008a) developed The Photographic Figure Rating Scale (PFRS). This scale comprises 10 photographic images of real women varying in BMI from extremely thin to obese and has been used to assess body dissatisfaction.

Although the PFRS offers improvement on line-drawn scales by using images of real bodies this can cause problems when trying to maintain consistency. For example, it has been noted that the bodies used in the PFRS vary in leg length (Swami, Salem, Furnham, & Tovée, 2008a). This is problematic since leg to body ratio has been shown to affect attractiveness preferences in female bodies (Swami, Einon, & Furnham, 2006) and therefore, when being used in the measurement of body dissatisfaction, some bodies may appear more attractive not because of their size but because of a more appealing leg to body ratio. In addition, the bodies used in the PFRS had their faces obscured in order to maintain consistency across images. It could be argued that this also reduces the ecological validity of the images as bodies in real life are rarely seen without faces. Most importantly, there is currently no male version of the PFRS.

Accordingly, our goal was to develop and report the psychometric evaluation of a new pictorial measure of body image that has two comparable versions which can be used with both females and males. The Body

Dissatisfaction Scale (BDS) comprises images of computer generated bodies. Using computer generated bodies improves on the drawn stimuli used in previous figure rating scales (e.g. Thompson & Gray, 1995; Stunkard, Sorensen, & Schulsinger, 1983). Computer generated images are more realistic and life-like while also being able to accurately control size and shape differences between successive bodies. Using computer generated stimuli allows variation in body proportions, such as leg to body ratio, to be controlled for. This cannot be controlled for when using photographic images. It also gives greater control over variation in physical characteristics like skin and facial features (identity). Therefore, as skin and facial features can be controlled, there is no need to obscure faces in the BDS and presenting a body with the face will likely increase the ecological validity of the scale.

Although using computer generated stimuli can never be completely ecologically valid, it can reduce some of the problems found when using photographic images and is especially useful in an experimental setting where greater control is needed. Indeed, the use of computer generated stimuli is being used increasingly in body perception research (e.g. Tovée, Edmonds, Vuong, 2012; Crossley, Cornelissen, & Tovée, 2012). However, there is currently no pictorial scale using computer generated stimuli that has been psychometrically evaluated for measuring body dissatisfaction. This study is the first to develop and test a scale using this new type of computer generated stimuli.

The aim of our research was to examine the validity and test-retest reliability of both the female and male version of the BDS. Similar to previous research (e.g. Swami, Salem, Furnham, & Tovée, 2008a; Thompson & Gray 1995) the scale was initially tested for validity by assessing the extent to which participants could successfully distinguish the size differences between the nine bodies. It was expected that, for the scale to be valid, participants would be able to do this successfully. In line with previous research (Swami, Salem, Furnham, & Tovée, 2008a), construct validity was assessed by examining the correlation between the BDS and a measure of positive body image. It was hypothesized that these variables would be negatively correlated. In addition, the correlation between participants' perceived actual body size ratings and their Body Mass Index (BMI) was also used to asses construct validity. It was predicted that there would be a positive correlation between participants' BMI and their perceived actual body. Finally, test-retest reliability was examined by the correlation of body dissatisfaction scores from a first and second testing and this was expected to be positively correlated to show reliability.

Method

Participants

Participants were 130 females and 60 males. They were all Psychology students from Nottingham Trent University. Participants were given research credits in exchange for taking part in the research.

Of the female participants, 76.9% were White European, 10.8% were of Asian descent, 7.7% had mixed ethnicity and 4.6 % were of African Caribbean descent. Of the male participants, 83.3% were White European, 8.3% were of

Asian descent, 5.1% were of African Caribbean descent and 3.3% were of mixed ethnicity.

Materials

Body Dissatisfaction Scale (BDS). The scale was developed by creating an average sized body using DAZ Studio 4 software (www.daz3d.com). Using this software the average sized body was systematically altered to create 4 bodies which were successively thinner than the original body and 4 bodies which were larger than the original body. Thus, nine bodies were created in total which range from extremely thin to obese. This was done for both the female (see Appendix A1) and male bodies (see Appendix A2) creating two versions of the scale.

Following Crossley, Cornelissen and Tovée (2012) the bodies, without clothing, were then exported out of DAZ studio into 3ds Max (www.autodesk.com). 3ds Max is able to estimate the height of the body in real world measurements (cms). In addition, 3ds Max calculates the volume of the body. Once volume is known the weight of the body can be estimated by multiplying the density of either the average young female body (1.04 g/cm^3) or the average young male body (1.06 g/cm^3). This enables the BMI of each body to be calculated by dividing the weight (kg) by the height (m) squared (see appendix B for measurements, weights and BMIs). The BMIs of the nine bodies in both the female and male scale range from underweight to obese: bodies 1-3 are underweight, bodies 4-6 are in the normal range and bodies 7-9 are overweight/obese.

All the bodies are depicted at a 25 degree angle to enable more visual information about the 3D shape of the body to be made available. This gives a more realistic portrayal of the human body shape that would not be achieved by using simple front view bodies. Gardner, Jappe and Gardner (2009) recommended omitting facial and body features in pictorial stimuli that reflect obvious Caucasian ethnicity. However, since removing or obscuring the facial features would reduce the ecological validity of the images, the bodies are instead presented in grey scale and without hair to minimize the effects of race or ethnicity. It is therefore thought that when presenting the bodies in this way there would be little effects of perceived ethnicity. All bodies are depicted wearing black shorts and a T shirt, so the size and shape of the body is clearly visible.

The BDS scale can be used to measure body dissatisfaction by numbering the bodies from 1 to 9 (in ascending order of size); each body is scored as one body unit. Participants are asked to choose the body they would most like to look like (ideal) and the body they thought was closest to their perceived actual body shape (actual). The discrepancy between the participant's selected actual and ideal body was the participant's body dissatisfaction score. For example, if a participant chose body number 5 as their actual body and body number 2 as their ideal body their body dissatisfaction score would be 3. A higher score means a greater discrepancy between perceived ideal and actual body chosen meaning greater dissatisfaction. This difference score does not reflect the direction of the body dissatisfaction and participants may have chosen an ideal body that was thinner or fatter than their chosen actual body. The highest body dissatisfaction score a participant could receive would be 8 if they selected body 1 and body 9. If a participant has no body dissatisfaction i.e. they selected the same number body for both their perceived ideal and actual body, they would have a score of 0.

Body Appreciation Scale (BAS; Avalos, Tylka, & Wood-Barcalow, 2005). The BAS **c**omprises 13 items which are intended to measure body appreciation. Items are statements for which participants are asked to choose a response (never, seldom, sometimes, often, always) to. Some example items from the BAS include "I feel that my body has at least some good qualities" and "My self-worth is independent of my body shape or weight." Items are scored on a 5 point scale (1 = *never*, 2 = *seldom*, 3 = *sometimes*, 4 = *often*, 5 = *always*) and are averaged to obtain an overall body appreciation score. A higher score indicates higher body appreciation. The BAS has been shown to have good internal consistency (Cronbach's alpha = .94). Construct validity was demonstrated by a positive correlation with a tendency to evaluate one's appearance favorably (r = .68) and negative correlations with body preoccupation (r = -.79) and eating disorder symptomatology (r = -.60). In addition, test-retest reliability was found to be good (r = .9) over a 3 week period.

Initial validation task. Following Swami, Salem, Furnham and Tovée's (2008a) and Thompson and Gray's (1995) validation of the PFRS and the CDFRS, the BDS was tested for validity by assessing the extent to which participants could successfully identify the body weight differences between the 9 bodies. In Swami, Salem, Furnham and Tovée (2008a) and Thompson and Gray (1995), participants were asked to order the images from thinnest to heaviest and the percentage of correctly positioned bodies was used to establish validity. In the current research, participants were given a two alternative forced choice (2AFC) task in which participants were presented with pairs of bodies. Participants had to decide which body they thought was the thinnest body out of the pair. All possible pair combinations were presented in a random order. The percentage of combinations where the participants correctly identified the thinnest body was used to assess the ability of participants to distinguish the body weight differences between all bodies and therefore validity of the BDS.

In order for the scale to be valid it is essential that participants are able to see that all the bodies vary in body weight. It is not sufficient to tell participants that bodies are presented from thinnest to fattest before the scale is used. In addition, this means that in further research the bodies do not need to always have to be presented from thinnest to fattest and could be presented in a variety of ways if it is established that participants can distinguish weight differences between all the bodies.

Test-retest reliability. Test-retest reliability was examined by the correlation of body dissatisfaction scores from the initial testing and then again after 5 weeks. There is no evidence to establish that one particular time period is best for reliability testing in pictorial body dissatisfaction measurement scales. The length of time does affect the reliability of a measure to the extent that the first testing may influence the second testing. Previous studies have used 1 week (Thompson & Gray 1995) and 3 weeks (Swami, Salem, Furnham, & Tovée, 2008a). The current research chose 5 weeks as it seemed a suitable amount of time for the first testing to no longer have an effect on the second testing.

Demographics. Participants were also asked their age, sex, ethnic origin and self-reported height and weight. Height and weight was used to calculate each participant's BMI.

Procedure

Participants were presented with the bodies as a scale on paper, with images going from left to right, from thinnest to fattest so as to measure their perceived body dissatisfaction. Bodies were numbered from 1 to 9 (in ascending order of size) and each body is scored as one body unit. Participants were asked to choose the body they would most like to look like (ideal) and the body they thought was closest to their perceived actual body shape (actual). This was a categorical judgment and participants could only choose one body each time. Female participants were presented with the female version of the scale and male participants were administered the male version.

Participants were then given the two alternative forced choice task to complete. Participants completed this task in SuperLab 4.5 (www.superlab.com) on a 44.3 x 25.4 cm screen. Participants had to decide which body they thought was the thinnest body out of each pair.

Five weeks after the initial test, participants were invited to use the new rating scale to measure their body image again. Of the original sample, 64 female participants and 20 male participants returned to complete the scale for a second time.

Results

Female Version

Descriptive statistics. The descriptive statistics for the female participants are presented in Table 1.

Table 1: Female Participants Mean Scores on all Measures.

	Mean	*SD*
Perceived actual body score	5.58	1.31
Perceived ideal body score	4.08	1.0
Body dissatisfaction score	1.61	0.9
BAS score	3.44	0.62
BMI	23.1	3.5

Initial validation. Participants were assessed on their performance on the 2AFC validation task. Same body pairings were removed from the analysis meaning 72 pair combinations for each participant were analyzed. Due to a computer error, two of the pair combinations were displayed incorrectly for 30 of the participants and therefore the responses for these combinations were removed from the analysis.

The results showed that on average participants were able to correctly identify the thinnest body 97.63% (*SD* = 2.44) of the time. A chi-square analysis showed that amount of times participants correctly identified the thinnest body was significantly higher than chance $\chi^2(1, N = 130) = 8440.82$, $p < .001$. This validation task was conducted as to attain whether participants were able identify the thinnest body out of pair and therefore be able to detect body weight differences between the bodies. The high percentage correct found here suggests that participants are accurately able to detect the body weight differences between the nine bodies.

***Construct validity*.** Validity was assessed by the correlation between body dissatisfaction scores on the BDS and body appreciation scores on the BAS. Results showed a significant negative correlation, $r(128) = -.60$, $p < .001$, providing evidence of construct validity. To provide further validation the correlation between participants' ratings of their perceived actual body size and their BMI was assessed. This was also found to be significant r (128) = .77, $p < .001$, suggesting that the scale can be used to accurately assess perception of own body size.

Test-retest reliability. The correlations between scores for perceived actual body, ideal body and body dissatisfaction from the first testing and five weeks after were analyzed for re-test reliability. These were all found to be significant; perceived actual body, $r(62) = 0.81$, $p < .001$, ideal body, $r(62) = 0.89$, $p < .001$, and body dissatisfaction, $r(62) = 0.82$, $p < .001$. Scores obtained at the first and second testing were highly correlated suggesting that the scale is a reliable measure of body dissatisfaction.

Male Version

***Descriptive statistics*.** The descriptive statistics for the male participant sample are presented in Table 2.

Table2: Male Participants Mean Scores on all Measures.

	Mean	*SD*
Perceived actual body score	5.07	1.54
Perceived ideal body score	4.9	0.82
Body dissatisfaction score	1.49	0.82
BAS score	3.54	0.64
BMI	24.12	3.83

Initial validation. Participants were assessed on their performance in the 2AFC validation task. In total, 72 pair combinations were analyzed for each participant to identify if participants had correctly selected the thinnest body out of each pair. Due to a computer error, one of the pair combinations was displayed incorrectly for seven of the participants and therefore the responses for these combinations were removed from the analysis.

Results showed that participants were able to correctly select the thinnest body 98.04% (SD = 1.82) of the time when the bodies were presented in pairs. A chi-square analysis showed that amount of times participants correctly identified the thinnest body was significantly higher than chance $\chi^2(1, N = 60) = 3980.70$, $p < .001$. Being able to correctly identify the thinnest body out of each pair of bodies suggests that body weight differences between the nine male bodies are easily identifiable.

Construct validity**.** A significant negative correlation was found between body dissatisfaction on the BDS and body appreciation scores, $r(57) = -.46$, $p < .001$, providing evidence of construct validity. The correlation between participants' ratings of their perceived actual body size and their BMI was also found to be significant, $r(57) = 0.83$, $p < .001$, providing further validation.

Test - retest reliability**.** To examine test-retest reliability, original scores for perceived actual body, ideal body, and body dissatisfaction were correlated with scores from five weeks after the initial testing. All three correlations were found to be significant; perceived actual body, $r(18) = 0.96$ $p < .001$, ideal body, $r(18) = 0.88$ $p < .001$, and body dissatisfaction, $r(18) = 0.97$ $p < .001$.

Discussion

The results of the present research suggest that both the male and female version of the BDS exhibit good construct validity and test-retest reliability over a five-week period. It would appear that participants can easily detect the subtle differences in size between the nine bodies on the scale. The significant correlations with the BAS suggest that both the female and male version of the BDS have good construct validity. Perceived actual body size was highly correlated with participants BMI for both male and female versions, which indicates that the BDS is a useful tool in assessing perception of one's own body size and provides further evidence of construct validity.

The findings support the use of the BDS in body image measurement for females and males. The current scale offers improvement on scales which have used line-drawn stimuli (e.g. Stunkard, Sorensen, & Schulsinger, 1983; Thompson & Gray, 2005) by offering greater realism and providing more life-like figures. By using computer generated figures, it also avoids the problems associated with using images of real people (e.g. PFRS) such as biases in judgements associated with certain racial groups. It also controls for unwanted variation in body part ratios, inherent in real human beings both across and within the sexes.

Another advantage of using the BDS is that it is time efficient and easy to administer either in a digital or paper format. A future version of the scale where the images are rotated and presented in three dimensional formats could be developed using the same software. The use of more life-like computer generated stimuli, like the bodies used in the BDS, is also particularly useful as it allows for the presentation of stimuli in more realistic settings, which could not be achieved with line-drawn stimuli. Therefore, the current stimuli is not limited to the use of images simply being presented in isolation. Future research could see the bodies for example being presented against various computer generated backgrounds or settings to allow for a more realistic presentation.

Although the current research provides a male version of the scale that is directly comparable with the female version it has been questioned if bodyweight is a strong predicator of physical attractiveness in males. Some research has suggested that upper body muscularity is a more important indicator of attractiveness (Swami & Tovée, 2008; Swami & Tovée, 2005; Maisey, Vale, Cornelissen, & Tovée, 1999). Therefore, a male version of the scale which varies in the muscularity of the body shape may be useful. Notwithstanding muscularity, BMI does appear to be a significant predictor of male physical attractiveness (Maisey, Vale, Cornelissen, & Tovée, 1999). Males are concerned with their body weight (Pope, Phillips, & Olivardia, 2000) with research suggesting around half wanting to lose weight and half wanting to gain muscle (Drewnowski & Yee, 1987). Therefore, it would seem that body weight is still an important component of perceived body dissatisfaction in males.

In addition, a male version of the scale which varied in muscularity would not be directly comparable with the female version. Also, the stimuli in the BDS, like the PFRS, can also be used in an experimental setting to measure attractiveness and health preferences for body weight (e.g. Swami & Tovée, 2006). In this way the stimuli can be used to ask participants which body they find most attractive and healthy. In this type of experiment, it would be necessary to have both a male and female version of the scale that both varied in BMI to ensure the results were directly comparable with each other. Although males and females may not be equally concerned about their body weight, when measuring body dissatisfaction in an experimental setting it would be extremely useful to have a measure that is identical for males and females. Therefore, although a version of the male scale that varied in muscularity would be useful, the current version of the male scale is still necessary.

One limitation of the current research is that the sample was larger for female participants than for male participants, potentially suggesting that the results are more reliable for the female sample. Therefore, findings of the male version should be treated with more caution than the female version. However, the male version of the scale has good face validity and appears to be measuring body dissatisfaction. A-priori power analysis is useful in achieving a reliable sample size on which to judge statistical effects. However, selecting an appropriate sample size and calculating power is complex (see Baguley, 2012; Hoenig & Heisey, 2001). Post-hoc power analyses are particularly problematic because such analyses tend to involve transforming the p-values of the effects being explored. This is problematic because it is paradoxical, as it would involve using significant or non-significant p-values to confirm that a given effect is (accordingly) significant or non-significant (see Hoenig & Heisey, 2001; Thomas, 1997). Therefore, it was decided not to run and report post-hoc power analyses. The apparent strength of the correlations and the near ceiling performance on the repeated measures 2AFC body detection task are used instead as indicators of sufficient power for both the female and male version. Consequently, this does not mean that the male version should not be used, especially since, as mentioned, there is currently a lack of scales that have both female and male versions.

A further limitation is the use of an opportunity sample meaning the participants were all students which is not representative of the population as a whole. As this scale was primarily being developed to be used in a set of experiments with students, it is certainly valid to be used in the context for which it is intended. Further research could aim to validate the scale with a more diverse sample. In addition, it could be argued that using self-reported weight and height to calculate BMI is not as accurate as using the actual weight and height of participants. However, previous research has suggested that self- report measures of weight and height are highly correlated with participants' actual weight and height (Spencer, Appleby, Davey, & Key, 2001), and it is time consuming to collect the actual weight and height of participants. Therefore, using self-report measures is a more time efficient method. Finally, although the stimuli used are more life-like in appearance than previous line drawn stimuli (e.g. Thompson & Gray, 1995), computer generated stimuli may never be as ecologically valid as using real life images. Nonetheless, given the problems with maintaining control and consistency over photographic stimuli, computer generated bodies provide a useful alternative, particularly for researchers wanting to measure body dissatisfaction in an experimental setting.

Future research should aim to develop and validate a version of the BDS so that it can be successfully used with children. Body image measurement with young children can be particularly difficult. As a consequence, researchers often use pictorial scales as other measures can be too complex, placing increased cognitive demands on younger children. However pictorial scales in this area are limited to line-drawings (e.g. Collins, 1991) which have similar methodological problems to line drawn stimuli used with adults. A version of the BDS that could be used with children would be useful for the assessment of body dissatisfaction in young children. Future research also aims to further validate the scale and demonstrate its reliability.

In conclusion, the current research suggests that both the male and female version of the BDS show good construct validity and test-retest reliability is stable over a five-week period. The current scale has improved realism on previous line drawn scales while avoiding the consistency issues associated with the use of photographic stimuli. In addition, it is convenient and easy to administer, consequently making it a useful tool in the measurement of body dissatisfaction.

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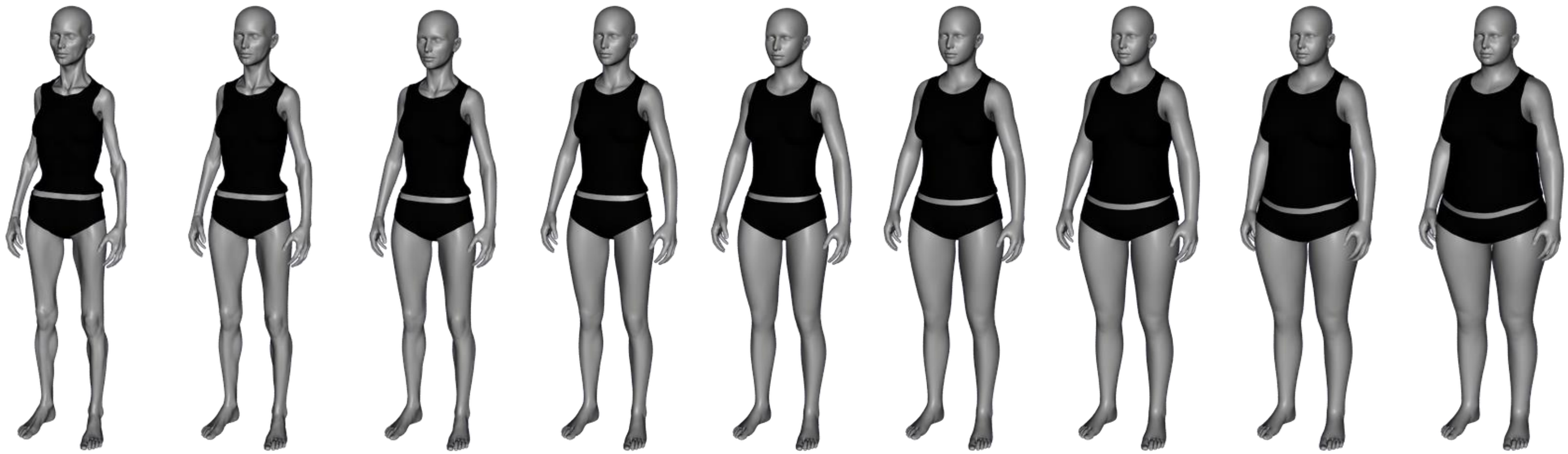
Appendix A1

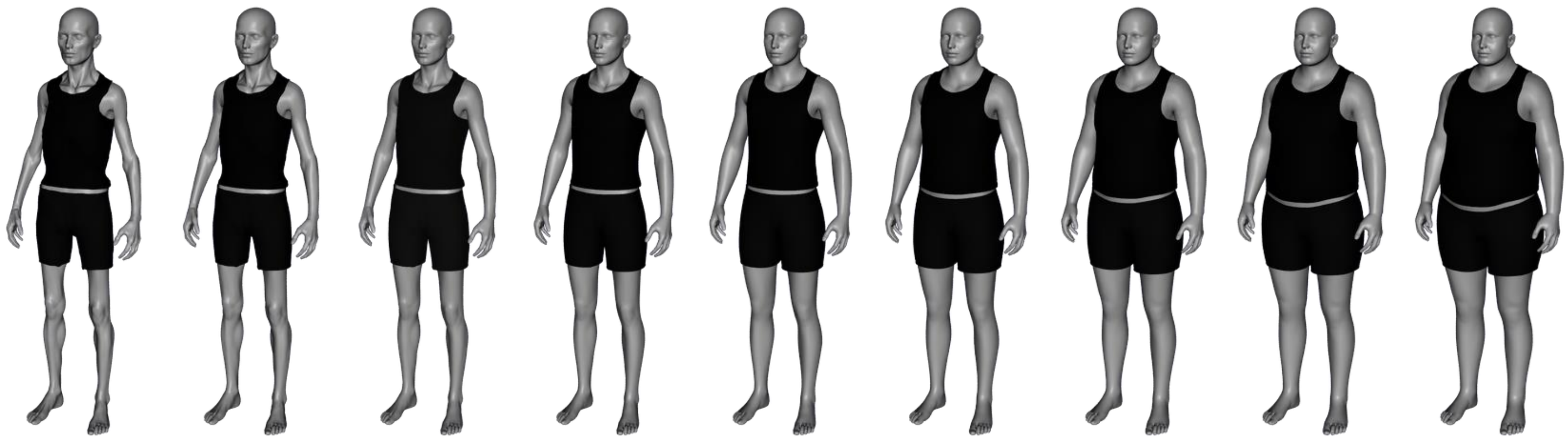
Female body stimuli



Body 1 Body 2 Body 3 Body 4 Body 5 Body 6 Body 7 Body 8 Body 9

Appendix A2

Male body stimuli



Body 1 Body 2 Body 3 Body 4 Body 5 Body 6 Body 7 Body 8 Body 9

Appendix B

Female body measurements

Body	Height (cm)	Volume	Density (g/cm³)	Weight (g)	Weight (kg)	Height (meters)	Body Mass Index
1	172.62	39433.94	1.04	41011.3	41.01	1.73	13.76
2	172.62	43104.1	1.04	44828.26	44.83	1.73	15.04
3	172.62	47421.31	1.04	49318.16	49.32	1.73	16.55
4	172.61	52287.9	1.04	54379.42	54.38	1.73	18.25
5	172.61	57364.37	1.04	59658.94	59.66	1.73	20.02
6	172.62	66488.58	1.04	69148.12	69.15	1.73	23.21
7	172.63	76290.74	1.04	79342.37	79.34	1.73	26.62
8	172.64	86402.47	1.04	89858.57	89.86	1.73	30.15
9	172.65	98237.68	1.04	102167.2	102.17	1.73	34.27

Male body measurements

Body	Height (cm)	Volume	Density (g/cm³)	Weight (g)	Weight (kg)	Height (meters)	Body Mass Index
1	172.62	40862.48	1.06	43314.23	43.31	1.73	14.54
2	172.62	44786.76	1.06	47473.97	47.47	1.73	15.93
3	172.62	49155.39	1.06	52104.71	52.10	1.73	17.49
4	172.61	53826.42	1.06	57056.01	57.06	1.73	19.15
5	172.61	58956.77	1.06	62494.18	62.49	1.73	20.97
6	172.62	68373.29	1.06	72475.69	72.48	1.73	24.32
7	172.63	78023.91	1.06	82705.34	82.71	1.73	27.75

8	172.64	88868.72	1.06	94200.84	94.2	1.73	31.61
9	172.65	101008.7	1.06	107069.2	107.07	1.73	35.92