DEPARTMENT OF APPLIED HUMAN SCIENCES

IS PHEROMONE DETECTION IN SEXUAL SELECTION APPLICABLE TO
EVERYONE?

Sexual Orientation and its Association with Pheromone Attraction to Masculine Features

Submitted in fulfilment of the requirements for the degree of Master of Social Science, in the
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Master's dissertation

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I, Abigail Wilkinson (209522203), declare that

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Abstract

Most traditional theories in the field of sexual selection generally imply a heterosexual bias when illustrating the biological functionality of sexual behaviour. It is suggested by several traditional theorists that attractive features are often advertisements for reproductive potential and benefits. Putative pheromones are said to be one of these physiological advertisements that indicate reproductive potential.

This study aimed to replicate and expand on the "t-shirt" studies conducted by many authors, introducing the variable of sexual orientation and to note how the evolutionary theorised response to exposure of pheromones applies to all sexual orientations. The primary aim of this study was to assess whether sexual orientation affected individuals' responses and judgements of human putative pheromones and if so, how individuals responded. A sample of 31 participants of different sexes and sexual orientations were asked to smell and rank t-shirts worn by six other male participants. Participants were also asked to provide rankings for the photographs of those same male respondents.

Due to the small sample size and ordinal data, non-parametric tests were used to analyse the data, including the Friedman's two-way ANOVA for ranked data, and the Kendall's coefficient of concordance, to establish whether the participant groups ranked the stimuli concordantly.

The results revealed that heterosexual men ranked the scent stimuli similarly to homosexual women, and that homosexual men ranked the scent stimuli similarly to heterosexual women. Furthermore, both sex and sexual orientation independently affected the rankings of the t-shirts but, however, did not affect the rankings of the visual stimulus. There is scope for future studies, due to the limited sample size and limitations within the study design.

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AND	Androstadienone
ANOVA	Analysis of Variance
BO	Body Odour
CAH	Congenital Adrenal Hyperplasia
CG	Chorionic gonadotropin
DHT	Dihydrotestosterone
EST	Female hormone chemo-signal (1,3,5(10),16-tetraen-3-ol)
F	Feminine
FA	Fluctuating Asymmetry
GnRH	Gonadotropin Releasing Hormone
HeM	Heterosexual Men

HeW	Heterosexual Women
HoM	Homosexual Men
HoW	Homosexual Women
LH	Luteinizing Hormone
M	Masculine
MF	Androgynous
MHC	Major Histocompatibility Complex
O	Oestrogen
OPM	Olfactory/Pheromonal Model
P	Progesterone
PAQ	Personal Attributes Questionnaire
SA	Scent Attractiveness
SM	Scent Masculinity
SO	Sexual Orientation
SS	Scent Stimuli
T	Testosterone
VA	Visual Attractiveness
VM	Visual Masculinity
VNO	Veromonasal Organ
VS	Visual Stimuli

Chapter 1: Introduction

Evolutionary psychology provides a proximate explanation for what drives human behaviour from a biological perspective (Waynforth, 2011). Most importantly to this study, evolutionary psychology can demonstrate why and how sexual behaviour is manifested and what drives individuals to select those partners with whom they choose a sexual partnership (Waynforth, 2011). In the paradigm of evolution two main branches extend, namely natural selection and sexual selection (Darwin, 1864). For the purposes of this study sexual selection was the most pertinent branch of evolutionary psychology with which to align, as the focus of this study was on attraction and mate choice. In pursuit of the goal in understanding the dynamics of attraction, sexual selection and mate choice, it was important to understand how the theories and hypotheses of sexual selection apply to all those individuals who engage in sexual behaviour, including those individuals to whom the traditional evolutionary theories do not always apply.

Sexual selection or mate choice has its meaning in evolutionary theory in contrast to natural selection and refers to the process whereby individuals choose a sexual partner with or without the direct aim of reproduction, although subconsciously this is often a factor (Geary, Vigil, & Byrd-Craven, 2004). Most traditional theories in the field of sexual selection generally imply a heterosexual bias when illustrating the biological functionality of sexual behaviour (Roughgarden, 2008). It is suggested by a number of theorists that the main function of sexual behaviour is reproduction and sexual acts are done so with the subconscious desire to produce healthy and genetically favourable offspring (Darwin, 1864; Emlen & Oring, 1977; Gangestad, 2000; Geary, Vigil, & Byrd-Craven, 2004; Fisher, 1915; Zahavi, 1975). For example, Fisher's runaway hypothesis (1915) in which he argues that attractive traits are passed on to offspring ensuring mate selection in future generations, thus the continuation of a genetic line. Individuals exhibit particular physiological and sometimes social cues, be it in appearance or scent or even social conduct, that signal to other individuals their potential to disseminate benefits to possible offspring should a sexual encounter occur (Geary, Vigil, & Byrd-Craven, 2004; Gangestad, Thornhill, & Garver-Apgar, 2005). Thus, it is said that sexual selection is driven by a subconscious desire to reproduce and the choice in sexual partner is based mainly on the subconscious perception of the quality of children they could produce regardless of whether the conscious aim was to conceive or not (Geary, Vigil, & Byrd-Craven, 2004).

Putative pheromones are said to be one of these physiological cues that indicate reproductive potential. According to Saxton et al. (2008), pheromones are chemical signals released by animals that are said to produce olfactory reactions in other conspecifics (animals of the same species). Many researchers, including Saxton et al. (2008), however, prefer not to recognise that these chemicals are pheromones when studying humans but rather refer to them as chemo-signals. Nevertheless, for the purposes of this study, the terms pheromone and chemo-signal will be used interchangeably acknowledging that the term pheromone is presumptive and putative.

Pheromones are of particular importance in this study as they are the primary focus of this research. Previous "t-shirt" studies have looked particularly at the effect that putative pheromones could potentially have on mate choice and sexual selection by using t-shirts to capture the naturally released body odour (BO) produced by the secretion of pheromones from sweat and asking others about their interpretation of the scent (Thornhill, et al., 2003; Singh & Bronstad, 2001). It is said that women tend to prefer the scent of very masculine and immuno-competent men when they are at the most fertile phase of their menstrual cycle (ovulation) (Thornhill, et al., 2003; Thornhill & Gangestad, 1999). Furthermore, the t-shirt studies have indicated that individuals can discern and rate those scents that come from individuals who have strong and compatible immune systems as more attractive: a compatible immune system indicates a non-relative, which will produce heterozygous alleles in offspring (Wedekind, Seebeck, Bittens, & Paepke, 1995; Thornhill, et al., 2003). Thus, the results from previous t-shirt studies confirm the most often emphasized premise of sexual selection theory, that reproduction is the aim of the game.

Sexual orientation (SO), which provides variation of sexual preference within the sexes, is often considered an anomaly that defies the prescribed evolutionary theories of sexual behaviour and mate choice patterns (Roughgarden, 2008; Rahman & Hull, 2005). Mate choice based on sexually dimorphic traits and signals, which emphasize heritable fitness for offspring, seem irrelevant for homosexual variations within the sexes as homosexual individuals cannot reproduce with those who they prefer as their sexual partners (Bailey, Gaulin, Agyei, & Gladue, 1994; Gobrogge, et al., 2007; Jankowiak, Hill, & Donovan, 1992). It would therefore seem unreasonable to assume that homosexual individuals' select sexual partners with whom they subconsciously wish to procreate with, as procreation is implausible in this context. Homosexual mate choice based on the presence of sexually dimorphic signals may in fact be superfluous as sexually dimorphic traits are considered to indicate

reproductive potential and heritability (Jankowiak, Hill, & Donovan, 1992; Rahman & Hull, 2005).

This current study aims to replicate and expand on the "t-shirt" studies by introducing the variable of SO and to note how the evolutionary theorised response to exposure of pheromones applies to all SOs. This research will replicate previous studies conducted using t-shirts to investigate attraction to sexually dimorphic features and subsequently mate choice in different SOs, however due to the small sample size any interpretations gleaned from the results must be discerned cautiously (Gobrogge, et al., 2007; Jankowiak, Hill, & Donovan, 1992; Rahman & Hull, 2005). This study may provide some tentative insight into the specific mechanisms that influence attraction, pheromone detection and their applicability to the varying SOs and consequently add light to the understanding of sexual behaviour and mate choice.

Chapter 2: Review of Literature

2.1. Introduction: What is Sexual Selection?

Before discussing any further notions, it is first necessary to differentiate between the concepts of gender, sex and SO, to eliminate any possible confusion. Sex refers to the biological differentiation of reproductive organs and genitals, gender refers to the culturally held beliefs and behaviours associated with a particular sex and lastly SO refers to an individual's preference for a sexual partner (either same sex: homosexual; opposite sex: heterosexual; or both same and opposite sex: bisexual) (American Psychological Association, 2012).

In 1859 Darwin proposed the theory of sexual selection in his book *The Origin of the Species* to explain why males in a species often possess auspicious and exaggerated traits as compared to their female counterparts. He realised these traits were often disadvantageous to survival and thus incongruent to his more prominent theory of natural selection (Waynforth, 2011). Darwin (1864) suggested that males compete for access to reproduce with females, and females choose sexual partners to father their offspring based on male display (Roughgarden, 2008). Since Darwin's hypothesis, numerous theories and illustrations of sexual selection have been developed, to explain and understand the dynamics that drive sexual selection and mate choice (Waynforth, 2011; Geary, Vigil, & Byrd-Craven, 2004; Bailey, Gaulin, Agyei, & Gladue, 1994).

From an evolutionary stand point, the collection of sexual selection theory suggests that one's choice of mate –although without conscious awareness- is based contingently on the potential benefits that the chosen mate has for future generations, through reproduction, child rearing and the continuation of a genetic line and thus the evolution of the species (Gobrogge, et al., 2007; Bailey, Gaulin, Agyei, & Gladue, 1994). Mate choice typically is dependent on factors relating to good genes and compatible alleles or time and resource investment that would aid in the rearing of offspring. It is therefore, because of the heterosexual bias toward reproduction in much of the traditional sexual selection theory that there is some, although little, accommodation for and explanation of partner choice for those for whom reproduction is unlikely (Gobrogge, et al., 2007; Iemmola & Camperio Ciani, 2009). Homosexuality for example, defies the traditional sexual selection theories which imply reproduction as the driving force for mate choice, as factors indicative of reproductive value that would influence

the choice of mate for heterosexuals would not seem to be appropriate for homosexual individuals (Gobrogge, et al., 2007). Good child birthing hips, and mutation free inheritable genes, would not be expected to affect an individual's choice of mate when reproduction is not the aim (Iemmola & Camperio Ciani, 2009; Roughgarden, 2008), and thus the traditional sexual selection theories are often considered to be "heterosexist" in their assumptions (Roughgarden, 2008).

2.2. Evolutionary Theories on Sexual Selection

2.2.1. Dimorphism

The difference between the sexes is referred to as sexual dimorphism (Penton-Voak, et al., 2001). In many species, one sex will display an exaggerated feature, be it brightly coloured plumage, large antlers, physical strength or skill, and the other sex will choose a mate depending on the exaggeration of this trait (Darwin, 1864; Geary, Vigil, & Byrd-Craven, 2004; Paul, 2002). In the animal kingdom, many sexual selection strategies are employed, however, most typically and as suggested by Darwin's initial explanation of sexual selection, males compete with and express dominance over other males for access to females in order to promote the reproduction of their genes (intra-sexual selection), and females choose mates based on the male's display of the exaggerated trait or dominance (inter-sexual selection). Males with more exaggerated sexually selected traits will have greater reproductive success (produce more and higher quality offspring) than males with less exaggerated features, who have fewer or no offspring, and thus lower reproductive success (Darwin, 1864; Gangestad & Simpson, 2000).

In humans, males are usually more physically strong, having on average greater muscle mass and larger hands than women. Furthermore, men tend to have heavier set brows, wider and more pronounced jawlines and broader chins and a greater expression of body hair than women (Geary, Vigil, & Byrd-Craven, 2004). The expression of human male sexually selected traits is like that of gorillas, where male gorillas tend to have comparatively larger muscle mass to females, larger facial crests (brows) and much larger hands. Furthermore, male gorillas with the greatest expression of these traits tend to have greater female harems (Breuer, et al., 2010). Bailey, Gaulin, Agyei, and Gladue, (1994) suggest that sex differences evolve because they are favoured by, and thus selected by mates and the expression of male traits tends to suggest male-male competition. Although male gorillas tend to have a similar

expression of sexually selected traits to human males, the exaggeration of these traits as compared to their female counterparts is greatest in the gorilla population; therefore, male-male competition would be greater in the gorilla population as compared to the human population (Breuer, et al., 2010). The traits that appear to be sexually dimorphic are there because they have been previously selected. Thus, sexually selected traits that enhance men's reproductive rate or make them more sexually attractive to potential mates will be favoured and thus passed on to the next generation (Fisher's hypothesis) (Bailey, Gaulin, Agyei, & Gladue, 1994). This is the basic premise for sexual dimorphism and sexual selection.

2.2.2. Sexual Strategies Theory

According to Gangestad and Simpson (2000) and Pillsworth and Haselton (2006) sexual strategies are criteria which subconsciously guide one's choice of mate and reproductive efforts. Sexual strategies may be influenced by environmental pressures such as the co-evolution of bacteria and viruses, the operational sex ratio or by individual variation within a species (Gangestad & Simpson, 2000; Jankowiak, Hill, & Donovan, 1992). Some of the sexual strategies that guide the process of mate selection include:

- Parental investment (Trivers, 1972)
- Good genes selection (Fisher, 1915)
- Handicap hypothesis (Zahavi, 1975)
- Extra-pair copulation theory (Buss, 2000; Gangestad, 2000)
- Age and social status (Buss, 2000)
- Immunocompetance (Thornhill, et al., 2000)
- Alternative or conditional mating tactics (Gangestad & Simpson, 2000).

Operational sex ratio is defined as the ratio of fertilizable females to males within a given population (Geary, Vigil, & Byrd-Craven, 2004; Paul, 2002; Marlowe & Berbesque, 2012). This concept provides a possible explanation for intra-sexual selection (Marlowe & Berbesque, 2012). Typically, male investment in reproduction, and not necessarily mate acquisition, is relatively small in comparison to female investment (Trivers, 2002). In mammalian mating strategies males usually only invest a small deposit of sperm per fertilizable female to ensure reproductive success, whereas the ovum of females is usually much larger and once fertilized, females cannot conceive again until the offspring is born (Geary, Vigil, & Byrd-Craven, 2004; Trivers, 2002; Marlowe & Berbesque, 2012). As

females, may only breed once a season, and males can breed and sire many offspring by different females many times in a season, competition between males for access to fertilizable females is greater (Geary, Vigil, & Byrd-Craven, 2004). Therefore, it stands to reason that in a population where there are fewer females than males, then males need to compete and females choose a mate (Zahavi, 1975; Geary, Vigil, & Byrd-Craven, 2004). In this instance, males who are more competitive and/or display more exaggerated sexually selected traits, will have greater reproductive success than other males, and will more likely be chosen by females and have greater female harems (Darwin, 1864; Paul, 2002; Zahavi, 1975; Trivers, 1972). In populations, where the male to female ratio is equal or there are generally more females to males and monogamy is common, as in the human population, then females may also display exaggerated sexually selected traits, such as larger breasts or increased waist to hip ratio and both sexes will be choosy (Geary, Vigil, & Byrd-Craven, 2004). The basic assertion for the notion of the operational sex ratio as a motivation for intra and inter-sexual selection is that sexual selection is between the sexes, and thus excludes the idea of competition between individuals of one of the sexes for access to members of the same sex. In the traditional sense the expression of sexually selected traits in both sexes is to advertise potential heritable good genes, thus emphasizing reproduction as the assumption for sexual selection. In a homosexual population, the reproductive premise for the operational sex ratio would seem irrelevant as it is very unlikely that homosexual individuals will compete with others for breeding opportunities when their orientation is toward the same sex.

Parental investment is "any investment by the parent in an individual offspring that increases the offspring's chance of surviving (and hence reproductive success) at the cost of the parent's ability to invest in other offspring" (Trivers, 1972, p. 67). Trivers (2002) suggests that this definition is not inclusive of the energy spent in attraction and copulation and refers to parental investment as only that which is invested in the growing and rearing of offspring. According to Palmer and Palmer (2002), long-term mate selection in human females is largely influenced by parental investment. According to Buss (1994, as cited in Palmer & Palmer, 2002) woman only produce around 400 ova in a lifetime and this supply is non-replenish able. Furthermore, women generally only release one fertilizable ovum per month. On the other hand, men can produce millions of sperm per ejaculation (Buss, 1994, as cited in Palmer & Palmer, 2002). Trivers (2002) suggests that this discrepancy in gamete production between the sexes is related to the fact that females tend to invest more physical and biological energy through fertilization, gestation, and post-natal lactation. It is evident then,

that females would benefit most from long-term partners who could invest supplementary resources, nurturance, and protection for herself and her offspring and would be more willing to forgo physical attraction on the grounds of parental investment (Palmer & Palmer, 2002; Geary, Vigil, & Byrd-Craven, 2004). In the animal kingdom or polygynous populations, where males have very little investment, females tend to be the choosiest and tend to choose the most attractive mate. However, in species and populations where monogamy and thus parental investment from both sexes is common such as the human population, then both sexes tend to be choosy and tend to be influenced by factors other than attractiveness when choosing partners (Trivers, 1972).

However, in human sexual behaviour, and a small number of other species in the animal kingdom, individuals may engage in sex acts simply for the pleasure and not necessarily with the conscious desire to procreate (Pawlowski, 1999). This is deemed true as humans and a few other species are said to engage in sexual behaviours throughout the menstrual cycle (although studies indicate greater frequency during ovulation) and it has been suggested that this is due to the hidden oestrus which allows for "constant receptivity" (Pawlowski, 1999). In the human species, oestrus or peak fertility in the menstrual cycle (i.e. ovulation) is visually unapparent, not like, for example, some species of primate where the genital region changes colour and tends to swell at the menstrual phase of peak fertility (Welling & Puts, 2014; Pawlowski, 1999). It is suggested that the notion of "constant receptivity" enables pair bonding, which reinforces monogamy and parental investment in potential offspring (Pawlowski, 1999).

Cultural success in humans or dominance in other species is another trait that females typically use as a criterion for long term mate selection (Geary, Vigil, & Byrd-Craven, 2004). In various cultures across the globe, cultural success is often indicated by social status. Men with a high social status can offer women protection from other men; often have more respect within the community and have access to better resources such as land, nutrition, and wealth which would have direct benefits for both the woman and her offspring (Geary, Vigil, & Byrd-Craven, 2004; Palmer & Palmer, 2002). Adler et al. (1994, as cited in Geary et al., 2004) found that children fathered by highly successful men had lower rates of mortality and were more emotionally and psychologically healthy than children fathered by men of a low socio-economic status. Furthermore, Betzig (1989, as cited in Geary et al., 2004) found that divorce from long-term relationships was largely influenced by a lack or decrease in invested resources within the family, thus reiterating the hypothesis that women's choice in long-term

mates is greatly influenced by their partner's cultural success and access to resources. Personality characteristics such as kindness and understanding, intelligence and commitment are also indicators as to whether men will invest their resources in the relationship and potential offspring (Buss, 1994, as cited in Geary et al., 2004). In a study conducted by Buss (1989, as cited in Geary et al., 2004) women preferred men who were kind, understanding and intelligent over men who had cultural success, as these personality traits appear to indicate a potential for cultural success and possible emotional investment in future offspring. This finding was also supported in a study by Bereczkeki, Voros, Gal and Bernath (1997, as cited in Palmer & Palmer, 2002), which found that in Hungary, women preferred family commitment rather than wealth or cultural success. This factor may also affect mate choice in a homosexual orientation, as this form of attraction is not directly linked with reproduction, but rather resource acquisition by proxy.

Gangested's (2000) notion of fluctuating asymmetry (FA) provides another example of mating tactics employed in sexual selection. FA is any "deviation from symmetry on traits that are symmetrical at the population level" (Gangestad, 2000, p. 54). Deviations from normally symmetrical traits are often indications of poor genetic fitness as they signal deleterious mutations or the effects of toxins and or pathogens (Gangestad, 2000; Penton-Voak, et al., 2001; Thornhill & Gangestad, 1999; Thornhill, et al., 2000). Individuals with low FA (more symmetrical) are most often selected as mates as symmetry indicates high fecundity levels and genetic fitness (Gangestad, 2000; Thornhill, et al., 2000). Although, Thornhill, et al., (2000) noted that mates who have low FA often tend to engage in multiple shorter sexual relationships and thus have less parental investment and provide fewer direct benefits. Therefore, it is suggested that females may choose males with low FA as short-term mates (individuals selected for "one-night stands" or brief sexual encounters), and males who provide more direct benefits as long-term mates (individuals selected for long term relationships) (Gangestad, 2000). Various studies have shown that physical attractiveness and FA are correlated and that attractiveness is an indicator of good health and genetic benefits (Marlowe & Berbesque, 2012; Miller & Maner, 2010; Penton-Voak, et al., 2001; Schieb, Gangestad, & Thornhill, 1999; Thornhill & Gangestad, 1999; Thornhill, et al., 2000; Pillsworth & Haselton, 2006). Furthermore, according to the *Fisherian* runaway model, attractive mates are more likely to be chosen to father attractive offspring, which ensures that future generations will be more attractive, and thus gain better reproductive success (Gangestad, 2000; Gangestad & Simpson, 200; Fisher, 1915). However, men who were

exposed to disease or experienced genetic mutation tend to have a higher FA, and consequently are less likely to be chosen as sexual partners because their FA indicates poor health and genetic fitness which is a preferred inheritable trait for future offspring (Gangestad & Simpson, 2000; Schieb, Gangestad, & Thornhill, 1999; Penton-Voak, et al., 2001). In this light, it is clear that a woman's choice of mate may also be influenced by physical indications of genetic quality (Gangestad, 2000; Geary, Vigil, & Byrd-Craven, 2004).

In contrast, Tomkins and Kotiaho (2001) argue that previous studies have shown very low heritability for fluctuating asymmetrical traits in the animal kingdom (Møller & Thornhill, 1997; Fuller & Houle, as cited in Tomkins & Kotiaho, 2001). Furthermore, although women seem to choose more symmetrical men as sexual partners due to the possibility of good genetic benefits for offspring, studies by Schieb, Gangestad and Thornhill (1999) and Penton-Voak et al. (2001) both suggest that the factor for which women base their choice of sexual partner is more likely the prominence of masculine features and averageness, of which symmetry is a correlate. In addition, Tomkins and Kotiaho (2001) suggest that the preference for facial symmetry in humans is not swayed by the small deviations from symmetry as suggested by FA, but rather directional asymmetry. Directional asymmetry according to Palmer and Strobeck, (1986) is "a consistent bias of a character within a species toward greater development on one side of the body than on the other" (p. 392). Therefore, the small fluctuating asymmetries such as a crooked smile may be considered an attractive quality. However severe asymmetries indicate a genetic mutation.

According to Little and Hancock (2002), the human face is often the focus when judgements of physical attractiveness are made and thus play an important role in mate selection. It is argued that faces that are closest to the average are often considered more attractive than distinctive faces (Little & Hancock, 2002). Averageness with regards to faces denotes how closely a face "resembles the majority of other faces within a population" (Little & Hancock, 2002, p. 452). A preference for averageness stems from an inclination toward genetic heterozygosity, which occurs when genes contain two different alleles, one from the mother and another from an unrelated father (Little & Hancock, 2002). Homozygosity refers to a gene containing two of the same alleles and usually occurs from consanguineous reproduction and can lead to deleterious mutations (Gangestad, Thornhill, & Garver-Apgar, 2005). Heterozygosity ensures greater immune efficiency and variation and allows for better resistance to environmental pathogens and mutations (Little & Hancock, 2002). Heterozygosity is best advertised through averageness, therefore Little and Hancock (2002)

suggest that average looking features are usually considered the most attractive. However, masculine features may also indicate immune efficiency as masculine features indicate a high level of testosterone (T) and thus a good and inheritable immune system. T is an immune suppressant and thus survival and health despite indications of high T indicate immune system efficiency (Penton-Voak, et al., 1999). Although, it is also suggested by Little and Hancock (2002) that women may also admire feminine features in male faces for long term relationships as it suggests a gentler and more cooperative disposition which would be beneficial for parental investment. In congruence to what Little and Hancock (2002) suggest about character preferences, Lippa (2007) argued that slightly feminized male faces are associated with honesty, kindness and increased parental investment and are thus considered to sometimes be more attractive than very masculinised faces. Penton-Voak et al. (1999) suggest that having features that are a combination of both masculine and feminine or average would be most attractive.

The hormone T is said to influence the development of masculine features, such a as prominent jaw line, chin, brow line and body hair in puberty (DeBruine, et al., 2006; Peters, Simmons, & Rhodes, 2009; Penton-Voak, et al., 2001; Penton-Voak, et al., 1999; Pillsworth & Haselton, 2006; Schieb, Gangestad, & Thornhill, 1999) and a greater pursuit in sexual activity (Miller & Maner, 2010). In addition, it is suggested that features of masculinity that indicate high levels of T are indicative of good immunocompetence and therefore good genes (Penton-Voak, et al., 2001; Penton-Voak, et al., 1999; Peters, Simmons, & Rhodes, 2009). Zahavi (1975) suggested that traits that are detrimental to survival and yet appear to be prominent, might suggest that the individual has good genes that allow them to survive, despite the cost on energy that the trait requires. A Zahavian explanation is suggested for the expression of masculinized facial features and immunocompetence (Penton-Voak, et al., 2001; Penton-Voak, et al., 1999; Peters, Simmons, & Rhodes, 2009). It has been suggested that T is an immunosuppressant and thus only individuals with very strong immune systems would be able to develop exaggerated secondary sexual characteristics caused by T and remain healthy (DeBruine, et al., 2006; Pillsworth & Haselton, 2006). During adolescence if males experience a lowered level of T due to illness or genetic mutation they will commonly develop less masculinized features or more feminized features in adulthood which would be less appealing to women looking for short-term sexual mates with which to procreate, as this indicates a lowered immunocompetence (Gangestad & Simpson, 2000; Thornhill, et al., 2000; Gangestad, Thornhill, & Garver-Apgar, 2005).

Another indication of immune competence in individuals is the major histocompatibility complex (MHC) (Thornhill, et al., 2003; Wedekind, et al., 1995). The MHC is a gene complex that is vital for immune responses to most pathogens, and helps the immune system to identify infectious diseases in the body (Thornhill, et al., 2003). According to Thornhill et al. (2003) and Wedekind et al. (1995), the MHC of an individual is advertised through BO. According to Wedekind et al. (1995), MHC indicates immune system compatibility in potential partners. It is suggested that through odour discrimination, individuals tend to avoid other individuals who have a MHC too like their own. According to Wedekind (1995) MHC similarity between individuals implies relatedness which would lead to homozygosity in offspring, if two individuals with similar MHCs reproduced potentially deleterious mutations might occur; this is often referred to as the "heterozygosity hypothesis" (Thornhill, et al., 2003). Furthermore, it has also been suggested that the "rare-allele hypothesis" is responsible for the tendency to select sexual partners with dissimilar MHCs as this ensures greater immune protection from coevolving bacteria and pathogens (Thornhill, et al., 2003). Thornhill et al. (2003), suggests one more hypothesis as a reason for the tendency of individuals to select sexual partners with differing MHC that is the "diverse-genes hypothesis". This is to obtain MHC alleles that digress from parents and other kin, thus improving immune competence (Thornhill, et al., 2003). The notion of the MHC complex leaves scope for future studies on why incest occurs despite the apparent ability for individuals to distinguish relatedness from MHC compounds.

It is inferred that women may choose men who display the phenotypic quality of masculinised features as short-term or extra-pair mates at the time within their menstrual cycle when they are most fertile (ovulation) thus increasing the potential genetic benefits and heritable immunocompetence for their offspring (Peters, Simmons, & Rhodes, 2009; Penton-Voak, et al., 1999). However, it is suggested that women are less likely to choose very masculine looking long-term mates, as they prefer personality attributes associated with parental investment in long- term mates, indicating subterfuge on the part of the woman (Penton-Voak, et al., 1999; Peters, Simmons, & Rhodes, 2009; Buss, 2000). Women are also more prone to engage in extra-pair copulation and cuckoldry at their time of ovulation (Gangestad, 2000). Extra-pair copulation occurs when females in a socially monogamous relationship engage in copulation with a male outside of the relationship (Gangestad, 2000; Gangestad, Thornhill, & Garver-Apgar, 2005; Pillsworth & Haselton, 2006; Pillsworth, Haselton, & Buss, 2004). Cuckoldry occurs when females raise the offspring from an extra-

pair mating in the monogamous relationship, where the monogamous partner carries out paternal responsibilities and donates resources (Trivers, 2002). Women are more prone to engaging in extra-pair copulation at ovulation and can detect genetic fitness in men through odour discrimination (Gangestad, 2000; Pillsworth, Haselton, & Buss, 2004; Thornhill, et al., 2000; Gangestad, Thornhill, & Garver-Apgar, 2005; Thornhill & Gangestad, 1999). In a study conducted by Penton-Voak et al. (1999), female participants were asked to rate photographs of male faces on physical attractiveness; the photographs had been digitally altered to create masculinised and feminised versions of each face. Repeated measures analysis of variance (ANOVA) conducted by Penton-Voak et al., (1999) resulted in a confirmation of the hypothesis that women prefer masculinised facial features when they are near or at their date of ovulation and were less influenced by masculine features at other times of their menstrual cycle. Furthermore, in a study conducted by Thornhill et al. (2000), it was shown that women were most attracted to men who displayed low levels of FA, which is a correlate of masculine facial features at their most fertile phase in the menstrual cycle.

2.2.3. Pheromones

Pheromones are said to be biological chemical signals that are sexually dimorphic and are particularly useful in strategies of mate choice and sexual selection as they subconsciously indicate several informative characteristics (often potentially beneficial to offspring) of the individual who produces them (Grammer, 1993). Pheromones are released as by-products of metabolised hormones. Sexually dimorphic physical features also known as secondary sexual characteristics are produced by hormone surges during puberty, when these hormones are metabolised, they produce by-products known as chemo-signals. These chemo-signals are released in the form of BO, without conscious awareness, and indicate a number of things about an individual, including sex, relatedness, fertility, social status, and health (Hoover, 2011).

The making of a male pheromone

For the purpose of this research only the secretion of male pheromones will be discussed in detail. According to Levin (2004) it is purported by many anthropologists that in the past human secretion of pheromones was once isolated to the genital region, however, due to the evolution of human bipedalism, the secretion of pheromones has moved up the body to the axillae or "armpit" region. The BO produced in the axillae has a special function in social

behaviour and interactions. In humans, the predominant pheromone-like chemicals produced in the body, are known as 16-androstenes, this group of chemical compounds includes 5α-androst-16-en-3- one (androstenone), 5α-androst-16-en-3α-ol (androstenol), and 4,16-androstadien-3-one (androstadienone) and are produced by the metabolism of androgens in the adrenal and ovarian glands (Havlicek, Murray, Saxton, & Roberts, 2010). These chemical compounds are commonly found in urine, saliva, blood plasma and in the sweat found in the axillae, where they are said to influence BO (Havlicek, et al., 2010). Havlicek et al. further suggests the specific concentrations of the three 16-androstenes in the axillae are strongly associated with sex and age, thus suggesting that these chemical compounds are expressive of sexual dimorphism and thus indicative of being a sexually selected trait.

There are three types of gland found in the axillae; these glands secrete different chemicals which all have a unique function and in combination with skin surface bacteria produce an individual's unique BO. According to Havlicek et al. (2010) the apocrine gland is responsible for the secretion of pheromones.

Table 1: Axillary glands and their secretions		
Gland	Chemical	Function
Apo eccrine	Fluid: mainly water, salt, lactic acid, ascorbic acid, urea	Thermal regulation occurs during perspiration. The secreted fluid on the surface of the skin evaporates, cooling the body as it does (Romanowski & Schueller, 2009).
Apocrine	Androgen-steroids (16-androstenes), lipids, proteins, cholesterol	Secretes hormone-derived chemicals (steroids) which are altered by naturally occurring bacteria on the skin of the axilla (Havlicek, Murray, Saxton, & Roberts, 2010).
Sebaceous	Sebum: lipids, triglycerides, wax esters, squalene	Lubricates skin and hair

Havlicek et al. (2010) purport that once the 16-androstenes are secreted in the axillae they are at first odourless, however, they are then exposed to a number of bacteria, including *Corynebacteria, Micrococcus*, and *Staphylococcus,* which is the cause of BO. These bacteria act on and metabolise the 16-androstenes, to produce altered androstenes or as referred to in this study, pheromones. According to Havlicek et al. (2010), the *Corynebacteria* are the main

cause of the acute smell of the axillae and only metabolise androstadienone and androstadienol. The transformation of these androstenes by *Corynebacteria* is a vital action in the function of pheromones as a conduction of social and sexual behaviour.

The Veromonasal organ (VNO)

For some time, there has been fair debate around how pheromones or chemo-signals are processed in human beings (Kohl, 2008; Shepherd, 2006). Most scientists in the area of pheromones believe that there is a much-specialised area of the olfactory organ found in the nose which detects pheromones and sends the sensory electrical impulse to the hypothalamus of the brain (Keverne, 1999; Savic, Berglund, Gulyas, & Roland, 2001). However, some scientists do believe that the much larger olfactory pathways also process pheromones (Shepherd, 2006; Chen, Zhou, Chen, He, & Zhou, 2013). According to Levin (2004), the VNO is "a small, bilateral, blind tubular chemosensory organ found at the base of the nasal cavity in many animals", and is responsible for the detection of pheromones in many animal species. Although there is no definitive evidence that the VNO exists in humans or functions as prescribed, many scientists have shown that exposure of pheromones to that particular region of the nasal cavity does induce specific brain activation specific to sex and arousal in the sympathetic nervous system (Levin, 2004).

Olfactory nerve cells

Hypothalamus

VNO pit
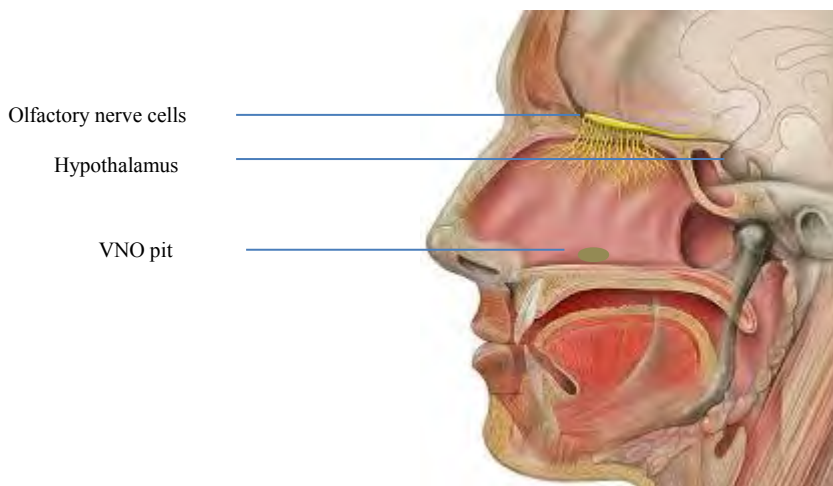
Figure 1: Area in nasal cavity where the VNO may be found

2.2.4. Putative Pheromones as a Beckoning Quality

Karlson and Luscher (1959) who were credited with being the first to discover and coin the term "pheromone" described pheromones as "substances which are secreted to the outside by an individual and received by a second individual of the same species, in which they release a specific reaction for example a definitive behaviour, or a developmental process" (p.55). This definition of pheromones gives substance to the model proposed by Kohl (2008) to address the causal link between nature and nurture in the context of sexual preferences and behaviour. Kohl (2008) introduces the olfactory/pheromonal model (OPM) and includes the behaviourist notion of classical conditioning to demonstrate in this model how attraction and behaviour unfold. According to Kohl (2008), pheromone stimuli present in the environment influence the hormone levels in other individuals typically of the opposite sex, this then leads to autonomic arousal which then reinforces a sexual attraction which may potentially lead to sexual behaviour.

Social Environment
Mammalian pheromones

Nueroendocrine Response
Effects hormone levels

Sexual Attraction
Conditions visual preferences
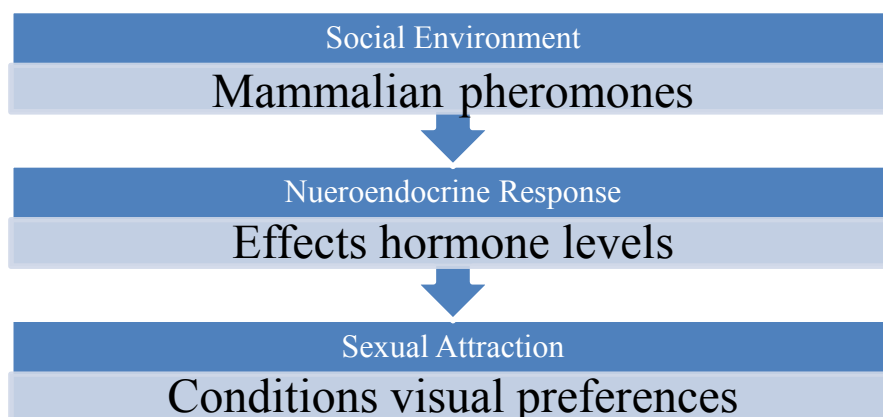
Figure 2: Diagram of the OPM suggested by Kohl (2008)

In the OPM the degree of sexual attractiveness for visually attractive human features are unconsciously influenced by the effect that putative human pheromones have on hormone levels within the body. Sexually dimorphic hormones produce sex specific visual characteristics as well as hormone dependant pheromones. These pheromones are released into the environment and associated unconsciously by other individuals with the visual characteristics of the individual who secreted the pheromones, thus the "conditioning of … human visual response to olfactory/pheromonal input" (Kohl, 2008, p. 316).

According to Kohl (2008), pheromones stimulate the production of Gonadotropin releasing hormone (GnRH) in the hypothalamus of other individuals. GnRH is considered the most fundamental hormone across species in the functioning of reproduction as it controls the release of other sex hormones. GnRH stimulates the production of Luteinizing hormone (LH) in the pituitary gland in the brain. LH then stimulates the ovaries in women to produce oestrogens (O) and prompt ovulation in the first phase of the menstrual cycle or the production of progesterone (P) which readies the womb for pregnancy in the second phase of the menstrual cycle. In men LH stimulates the production of T in the Leydig cells of the testes. The hormones T, O and P all cause specific behaviours in the individuals. For example, T in men acts on the brain causing autonomic arousal and behaviour indicative of competition for status (Grammer, 1993). The metabolism of T also leads to the production of pheromones which would be released via sweat or urine (Kohl, 2008).

Androstadienol, androstenone and androstadienone (AND), found in the sweat of men, is considered to be the scent signal of sexual dimorphism to which women respond during ovulation (Grammer, 1993). Androstenol, and AND, (both metabolised by *Corynebacteria*) which are described as having a sandalwood smell, have been shown to induce positive sexual descriptions by women toward men, however, the pheromone, androstenone, appears to produce negative sexual descriptions (Filsinger et al., 1985, and Cowley et al., 1977, as cited in Grammer, 1993). The results produced by Grammer's (1993) study suggest that at the time of ovulation women's judgment of androstenone is neutral whereas at a non-ovulating phase of a women's cycle the scent of male BO is unpleasant. Ovulation in the menstrual cycle is considered the most fertile phase and male pheromone exposure at this phase is discernible as the most attractive. This may explain why men who have higher levels of T and are more sexually assertive have greater sexual success (Grammer, 1993; Eisenegger, Haushofer, & Fehr, 2011). Men who have higher levels of T and produce higher concentrations of 16-androstenes will seek sexual encounters more often than low T producing males. Men who have higher T levels are considered more assertive and competitive than men with lower T levels and therefore will approach a greater number of women (Eisenegger, et al., 2011). These men will approach a combination of women at differing times in their menstrual cycle and will most likely find sexual success with ovulating women who are attracted to both the scent of male pheromones and the presence of masculine features (Grammer, 1993; Penton-Voak, et al., 1999; Kohl, 2008).

In humans, the pheromone AND found in sweat and 1,3,5(10),16-tetraen-3-ol (EST) found in the urine of pregnant women have been proven to activate the anterior hypothalamus stimulating the production of GnRH and consequently LH and other sex hormones, thus evoking sexually arousal (Savic, Berglund, Gulyas, & Roland, 2001). When women are exposed to AND, it has been shown to improve disposition and temperament because of the effect that androstadienone has on the endocrine and autonomic system (Wyart, 2007, as cited in Saxton, et al., 2008). Furthermore, it is suggested that not only does AND have a positive effect on mood and emotional reactions in women, but it also affects women's sexual responses, thus indicating the importance of pheromones in reproduction (Hoover, 2011; Saxton, et al., 2008). Although many studies have proven the existence of and fundamental function of pheromones, most have been conducted in laboratory settings and so fail to incorporate the realistic occurrence of other olfactory stimuli as well as the pheromones from other competing individuals present in most social environments, thus, it has been difficult to draw real-world conclusions about the effects of AND and other pheromones.

Saxton et al. (2008) chose to test the effects of AND in three separate speed-dating scenarios. Speed dating requires a number of women to sit at tables as different men move from woman to woman at three-minute intervals. In all three experiments conducted by Saxton et al. (2008) the women who attended the speed-dating event were exposed to different chemicals, either water, clove oil or AND. As the men sat with each woman, she was required to rate each man's attractiveness out of seven and specify whether they would like another meeting. Photographs of the women were rated by the men. The results produced by the first speed-dating event showed that women exposed to AND were more generous when rating the men's attractiveness. However, the results of the other two speed-dating events did not produce significant results. Possible reasons given for these differences in outcomes by Saxton et al. (2008) are context, participant age, male presence, and possibly an experimenter effect. The first event was strictly controlled by the experimenters who may have affected the participant's behaviour, thus biasing the results more positively for the first experiment.

The pheromone AND, much like androstenol and androstenone, are by-products of T and the odours produced are indicative of high T levels in men. This odour is often consequently suggestive of elevated social status and dominance (Huoviala & Rantala, 2013). Huoviala and Rantala (2013) suspect that AND influences how men, as well as women, interact with each other. According to Huoviala and Rantala (2013) male pheromones do not only signal mating potential to females, they also influence other males. It is suggested that the scent of AND

indicates the presence of a dominant male and would thus make all other males subconsciously more generous and cooperative in order to avoid rejection by the more dominant male and raise their social status (Huoviala & Rantala, 2013). In their study, Huoviala and Rantala exposed a sample of men to the pheromone AND and another sample of men to a control substance. They then invited the men to play a game known as the ultimatum game (Huoviala & Rantala, 2013). Here individuals are required to divide a given amount of money between themselves and an anonymous benefactor (Huoviala & Rantala, 2013). If the offer is accepted by the benefactor, they both keep the money. However, if the offer is rejected then neither person receives any money (Huoviala & Rantala, 2013). Huoviala and Rantala (2013) found that the men exposed to the AND were more generous with the money than the control group and furthermore, that the experimental group accepted much lower offers than the control group. However, men with high levels of T, although willing to make generous offers if exposed to AND, were less likely to accept low offers (Huoviala & Rantala, 2013).

2.3. The T-shirt studies

The T-shirt studies conducted in the past by several researchers stand as inspiration for the current study. The following authors conducted studies using worn t-shirts as a signal of BO.

- Wedekind et al. (1995)
- Thornhill and Gangestad (1999)
- Singh and Bronstad (2001)
- Thornhill et al. (2003)
- Miller and Maner (2010)
- Trouton et al. (2012)

These studies were all based on the understanding that pheromones or chemo signals indicate information about potential mates. This information indicates sex, SO, MHC-compatibility, and hormone levels indicative of "good breeder" potential (Thornhill, et al., 2003; Wedekind, et al., 1995).

2.3.1. Aim

According to Wedekind et al. (1995), the aim of their study was to assess whether women found the scent of men with a dissimilar MHC as more pleasant than those with a similar

MHC. They aimed to show that MHC affects both the scent of an individual as well as BO preferences. Thornhill et al. (2003) also aimed to assess whether MHC affected the attractiveness of scent. They aimed to replicate previous studies and look at how opposite sexes attract to scent. Not only did Thornhill et al. (2003) study the olfactory mechanism of MHC detection, but they also looked at the link between FA and scent and how it relates to MHC. Thornhill et al. (2003) wished to establish with their study whether the chemicals or pheromones which indicate MHC are linked to the same pheromones which indicate FA and attractiveness. Both Wedekind (1995) and Thornhill et al. (2003) used the t-shirt study design to explore these aims.

In another t-shirt study conducted by Thornhill and Gangestad (1999) the aim was to assess whether there was a relationship between FA and pheromones or BO attraction across both sexes. According to Thornhill and Gangestad (1999) low FA is a positive determinant of attractiveness, and they hypothesised that symmetrical features would be expressed in BO and signal phenotypic quality in a potential mate, especially where males are the sex object and women, being the choosers, are in their follicular phase. In line with the idea that ovulation influences BO, both studies conducted by Miller and Maner (2010) and Singh and Bronstad (2001), focused on how the scent of women at follicular and luteal phases differed in their ability to elicit endocrinological responses in men. Miller and Maner (2010) aimed to measure the change in T levels after men were exposed to T-shirts worn either by ovulating or non-ovulating women. Singh and Bronstad (2001) however, asked male participants to supply subjective judgements about the T-shirts worn by either ovulating or non-ovulating women.

The last t-shirt study conducted that will be reviewed here was implemented by Trouton et al. (2012), and is the most like this current study as it also included SO as a factor. The research conducted by Trouton et al. (2012) however, used t-shirts worn by women as the stimulus object and was also based on the premise that women in the follicular phase elicited positive sexual responses in the opposite sex. The primary aim of the investigation was to establish whether the "ability to detect female fertility is primarily a function of biological sex, SO, or a combination of both" (Trouton, et al., 2012, p. 469). This aim is most in line with the rationale of the current study.

2.3.2. T-shirt Study Methodology

In all of the t-shirt studies a stimulus or treatment was created in the form a worn t-shirt, these t-shirts once collected were asked to be rated, ranked or assessed on the pleasantness, or attractiveness of the scent by a set of participants (Wedekind, et al., 1995; Singh & Bronstad, 2001; Thornhill & Gangestad, 1999; Thornhill, et al., 2003; Miller & Maner, 2010; Trouton, et al., 2012). The studies differed in their research aims, item format and design and subsequently analysis, however all studies measured the preference of scent in terms of attraction, and included sex as a factor of difference between groups. All the studies used an experimental approach with a focus on the study of sexual selection, specifically how this relates to the function of pheromones (Wedekind, et al., 1995).

Although there are subtle differences between how the t-shirt stimuli were obtained, the main sequence of procedures remained constant amongst the studies.

Odour collection

Firstly, to create the scent stimuli, the researchers asked a number of participants (sample size differed between studies) to wear identical cotton t-shirts for either two or three consecutive nights, this was dependant on the researcher (Thornhill & Gangestad, 1999). In all the studies, extraneous and possibly contaminating odours were controlled by providing the participants with a set of instructions to minimise strong odours from affecting BO. These instructions common to all the studies included instructions to avoid using recreational drugs, alcohol and tobacco products whilst wearing the t-shirt, furthermore, participants were asked to refrain from sexual activity and or sleeping next to another person. They were also asked to avoid eating strong smelling foods, for example, garlic, onion, spices etcetera, and using deodorant, fragranced soaps, talcum powder, after-shave etcetera, whilst wearing the t-shirts. In most of the studies the participants were given fragrance free soap to wash with, which made cosmetic scent uniform and a few researchers also provided the participants with a fragrance-free detergent too wash linen. The t-shirts were kept in reseal able plastic bags in a freezer when they were not in use.

For those studies for which scents from ovulating and non-ovulating women were required, an estimation based on menstruation dates was used where individuals were asked to wear separate t-shirts for each phase (follicular and luteal) of their menstrual cycle, furthermore, it was also required that women who provided their scent not be taking any hormone altering

pills, such as oral contraceptive pills (Miller & Maner, 2010; Singh & Bronstad, 2001; Trouton, et al., 2012). For those studies concerning MHC similarity, blood samples were necessary to conduct genetic analysis, to ascertain the type of MHC compounds participants had (Wedekind, et al., 1995; Thornhill, et al., 2003). In addition, studies concerned with FA and scent correlations also included a measure of visual FA from body measurements and photographs. Thornhill et al. (2003) and Thornhill and Gangestad (1999) ascertained the FA of t-shirt wearing participants by measuring the left and right sides of various limbs including facial features, as well as taking a portrait photograph. These measures did not indicate any significant directional asymmetry; however, there was subtle asymmetry as expected of FA.

Odour attractiveness rating procedure

In the study conducted by Wedekind et al. (1995) women were asked to rate the scent of six t-shirts worn by men. The women recruited as judges also had blood tests done to determine their MHC. Half of the t-shirts that each woman rated came from men who had similar MHC compounds and the other half, dissimilar MHC compounds. The t-shirts were all placed in separate boxes with a triangular hole cut out from which the women could sniff t-shirts. The women were asked to rate the scent of each of the six t-shirts out of 10 on three criteria: intensity, pleasantness and sexiness. In the analyses, the ratings of men with similar MHC compounds were compared to the ratings of men with dissimilar MHC compounds.

For the study conducted by Thornhill and Gangestad (1995), participants were also required to rate each of the t-shirts out of ten and as before on the criteria of intensity, pleasantness and sexiness. However, in this case both sexes rated approximately ten t-shirts worn by the opposite sex and were instructed not to touch the t-shirts, but to merely open the bag and sniff. Women raters were asked about contraceptive pill use as well as the date of last menstruation in order to ascertain ovulation. For this study, another sample of both sexes was recruited to judge facial attractiveness of the opposite sex out of ten from the photographs taken. Thornhill et al. (2003) used the very same procedure for odour attractiveness rating as Thornhill and Gangestad (1999), as well as using both men and women to rate scent attractiveness (SA) and visual attractiveness (VA) of the opposite sex. Similarly, to Wedekind et al., (1995), Thornhill et al. (2003) also obtained blood samples from all the participants in order to compare MHC similarity and dissimilarity.

Singh and Bronstad's (2001) study was similar to the previous two studies in terms of the SA rating procedure. As before, individuals were asked to rate t-shirts out of 10 on the criteria of

pleasantness, intensity and sexiness. However, this study differed in that it asked only men to rate 18 pairs of t-shirts worn by women (one t-shirt worn at the follicular phase and the other at the luteal phase) and participants were not informed of the ovulatory status of any of the t-shirts wearers. Participants were asked not to handle the t-shirts at all. Linear regression analysis was used to assess whether menstrual cycle phases elicited different ratings of intensity, pleasantness and sexiness. Trouton et al. (2012), replicated Singh and Bronstad's (2001) particular t-shirt study, in that only women wore t-shirts, and they were also sorted into 18 pairs of follicular and luteal phase worn t-shirts, the same rating method and criteria were used. The only difference between this and other studies is that SO was included as a factor in the analysis and the Klein sexuality grid was used to determine this.

In the study conducted by Miller and Maner (2010) the aim was to assess whether menstrual cycle phase predicted endocrinological responses in men, i.e. whether the T level in men increased when exposed to the scent of ovulating women. Miller and Maner (2010) used eight t-shirts obtained from four women, each woman supplied two t-shirts, one worn at the follicular phase and the other at the luteal phase. Each male judging participant was given one of the worn t-shirts to smell. For this study, each of the men was required to give a baseline sample of saliva before smelling the t-shirt, and then again 15 minutes after smelling the t-shirt in order to ascertain any possible changes in T levels present in the saliva. An analysis of co-variance was used to determine whether T levels were affected by ovulation, where ovulatory status of t-shirts was the independent variable and the measure of baseline T was the covariate.

2.3.3. Results of Previous T-shirt Studies

2.4. Sexual Orientation

According to Miller and Maner (2010), the scent of a woman at her follicular phase (ovulation) does produce an endocrinological response in men leading to a rise in the male hormone T present in saliva. According to the t-shirt study conducted by Miller and Maner (2010) men produced this physiological response just by smelling the scent of a woman, a visual cue was not necessary to produce this arousal, although the effect size was very small ($F=5.85$, $p=0.02$, $\eta^2=0.09$). This result also suggests that men can distinguish and are more attracted to women who are at their most fertile phase (i.e. ovulation) from those women who are not. This finding is supported by the results of the earlier t-shirt study conducted by Singh

and Bronstad (2001), in which they found that male raters found the t-shirts worn at the follicular phase more pleasant than those worn at the luteal phase (t=3.87, p<0.001, no ES available). Therefore, according to, Miller and Maner (2010) and Singh and Bronstad (2001), female pheromones subconsciously express when a woman is ovulating and subsequently her fertility which is rated as significantly more attractive than the scent of a women at the luteal phase.

Thornhill and Gangestad (1999) discussed and examined how pheromones or scent can indicate the phenotypic and genetic quality of men as well as attractiveness and FA. According to their findings, facial attractiveness is positively correlated with body scent attractiveness (SA) for both sexes. Furthermore, it was shown that women's preference for scent belonging to highly visually rated attractive men was highest at the follicular phase (r=.42), suggesting that women prefer attractive men with low FA and thus good genes as fathers for potential offspring as these are rated most attractive at the most fertile phase of the menstrual cycle. Thornhill et al. (2003) found a number of interesting results from their study. Firstly, only men showed a preference for the scent of women with MHC dissimilarity (r = -0.033, t_{47} = 1.74, P = 0.040), however, women preferred the scent of men with heterozygous MHC alleles (r = 0.309, P = 0.03), and showed no preference for the scent of MHC dissimilarity. According to Thornhill et al. (2003) ovulation did not affect women's ratings of male scent, and in fact the preference for heterozygous MHC alleles was greater in women at the luteal phase of their cycle, this is in contradiction to the findings of other studies. Their results did however; confirm that men preferred the scent of women at the follicular phase (r = 0.334, P = 0.021) which is in congruence with other studies (Miller & Maner, 2010; Singh & Bronstad, 2001). Furthermore, MHC dissimilarity, heterozygosity and allelic rarity all failed to correlate with both FA and facial attractiveness. The findings produced by Thornhill et al. (2003) disaffirm those of Wedekind et al. (1995), as Wedekind et al. found that females tended to rate men with a dissimilar MHC genetic compound as more pleasant than those with a similar MHC genetic compound (p=0.04, no effect size reported). Furthermore, this finding was counter to the results for women who took 'the pill'.

According to the findings of Trouton et al. (2012), heterosexual males were the only group to distinguish between t-shirts worn at the follicular phase from those worn at the luteal phase, as they found follicular phase t-shirts to be more pleasant and sexy than luteal phase t-shirts (t=2.79, p=0.012, d=.62). Lesbian women and heterosexual men regarded the t-shirts in

general as more intense, pleasant and sexy than gay men and heterosexual women. This suggests that both sex and SO influence the perception of attractiveness on BO.

2.4.1. Androgyny: Understanding Gender Roles

It is undeniable that the sexes behave differently and that men typically behave more assertively and competitively and are generally less anxious than women are (Feingold, 1994). Thus, it is considered anomalous when an individual models the typical behaviour of the opposite sex. This idea that individuals endorse and are inclined to endorse traits that are not only typical of their own sex but also the opposite led to a drastic change in the study of gender and sex in the social sciences in the early 70s (Feingold, 1994). Furthermore, Feingold suggests that there are three models which explain gender differences. The first is a biological model which suggests an innate chemical and hormonal sexual dimorphism dictates individual behaviour. Secondly a sociocultural model is suggested, that emphasizes a social expectancy hypothesis based on stereotyping and a "self-fulfilling prophecy" concept, where social roles dictate behaviour and behaviour reinforces social roles. The last model is a biosocial model where "current gender differences may, then, be a consequence of sociocultural factors that are a vestige of bygone eras" (Feingold, 1994, p. 431). These sociocultural factors stem from biological circumstances necessary when modern technology was not available. Men are biologically physically stronger and less anxious than women are and thus were better at hunting and more laborious tasks (Feingold, 1994). Whereas women are biologically inclined to care for infants because of a hormonal attraction to 'cuteness' that men do not possess so intrinsically and thus were better equipped to care for children (Sprengelmeyer, et al., 2009).

Bailey et al. (1994) suggests that gender conformity, be it with the same sex or opposite, defines the way individuals behave, particularly regarding sexual selection and mate choice. For decades' scientists, have been trying to find a way to measure gender conformity and in some cases, non-conformity (androgyny) that would aid in understanding how individuals cooperate as well as inform our knowledge of sexual behaviour and its connection to gender. According to Bem (1974) androgyny is the "difference between [an individual's] endorsement of masculine and feminine personality characteristics" (p.155). According to Bailey et al. (1994) homosexual individuals just as heterosexuals would, conform to a range of masculine or feminine gender roles and it is interesting to note how conformity to

particular roles affects sexual selection and partner choice across differing SOs. According to Anderson (1986) the notion of androgyny stemmed from exigency as previous measures of masculinity and femininity were defined as opposites along a continuum, where having more masculine traits meant have less feminine ones and vice versa; thus, disallowing an individual to possess traits from both genders or from neither.

Measures of androgyny, which were first developed in the early 70s changed the understanding of sex and gender roles significantly (Berzins, Welling, & Wetter, 1978) and offered an alternative measurement to the traditional polarisation of sex roles (Anderson, 1986). According to Bem (1974), with the introduction of measures of androgyny, male and female gender traits were no longer opposites on a single continuum, but rather became continuums in their own right.

Figure 3: Androgyny continua

The introduction of an androgynous continuum meant an acknowledgement that individuals could endorse both masculine and feminine traits or endorse neither (Berzins, et al., 1978). It also recognised that exhibition of either masculine or feminine traits were dependent on context and situation rather than sex (Bem, 1977). According to Berzins, et al. (1978) measures of androgyny were better than traditional measures of masculinity and femininity at predicting interpersonal interactions and behaviour. One of the main reasons why gender-typing was so criticised was because, "behaviours thought to be 'natural' correlates of biological sex differences, to be exemplified by 'appropriately' masculine men and feminine women, ha[d] lost their stereotypic potency" (Berzins, et al., 1978, p. 126).

2.4.2. The Personal Attributes Questionnaire (PAQ)

The PAQ is a questionnaire designed by Spence, Helmreich and Stapp in 1975, to measure sex role orientation, or how much an individual conforms to a particular gender (Choi, 2004). However, the PAQ does not expressly term the constructs it measures as masculinity or femininity, but rather instrumentality and expressiveness (Spence & Helmreich, 1978). The PAQ is said to contain three subscales which firstly measure the endorsement of masculine typed characteristics (M), secondly the endorsement of feminine characteristics (F), and lastly the endorsement of androgynous characteristics (MF). According to Ward (2006), the use of the MF scale is rarely used in current studies due to low reliability scores, however the M and F scales produced by the PAQ have been used in a number of more recent studies, to measure sex differences, gender roles and agency and communion (Abele, 2003; Cox, et al., 2004; Dade & Sloan, 2000; Toller, Suter, & Trautman, 2004). The psychometric properties of the PAQ by Spence et al. (1975) and Helmreich et al. (1981) will be discussed in chapter 3.6.

PAQ and sexual orientation

According to Finlay and Schmeltema (1991), there has been much research implemented in the past concerned with gender alignment and SO, most predicting that lesbian women will adopt more 'masculine' behaviour patterns and gay men more 'feminine' traits. It is suggested that there is more consistency in findings regarding measures of masculinity between SO by sex groups however, little consistency for measures of femininity. Finlay and Schmeltema (1991) conducted a study in which they compared the PAQ scores of masculinity, femininity and androgyny between groups divided by both sex and SO. Their results indicated that lesbian women had higher masculinity scores than heterosexual women and that gay men had lower masculinity scores than heterosexual men. Femininity however, only differed by sex and not by SO. According to Finlay and Schmeltema (1991) their results are confirmatory of previous findings in the same research area.

2.5. The Basis for Differences in Sexual Orientation

It has been the trend throughout history to explain or even "cure" homosexuality as a deviation from that which society and even science had deemed normal or natural (Byne & Parsons, 1993). Certainly, most religions do not accept homosexuality as a natural state and even Freud assumed that homosexuality occurred, almost as though an affliction would, because of sexually dysfunctional parental influence and a "premature fixation on one's

psychosexual development" (Ellis & Ames, 1987, p. 233) . These understandings of SO suggest that heterosexuality is the norm and that homosexuality the anomaly to what is considered by some to be natural (Byne & Parsons, 1993). However, differences in SO are not anomalous in nature at all, as homosexuality occurs in many species of animal other than humans (Roughgarden, 2008). Furthermore, Byne and Parsons (1993) criticized the many previous biological studies that have tried to explain homosexuality as using pejorative terminology. This study accepts that differences in SO or sexual partner preference occur naturally and rather than exploring why there are differences in SO, this study aims to investigate whether the criteria for which individuals select their sexual partners is similar or different across different orientations.

Although the main aim of this study is not to explain why differences in SO occur it is necessary to identify the various explanations and theories that contribute to understanding both homosexuality and heterosexuality as this may influence attraction to whichever sex an individual is inclined to. If SO is indeed a genetic phenomenon and influenced by hormones and bodily enzymes, then pheromone attraction and a person's olfactory ability may also be affected, which would support the hypothesis that attraction for homosexual individuals would be similar to heterosexual individuals of the opposite sex. On the other hand, if SO is a social phenomenon, it is reasonable to assume that a biological attraction to the opposite sex would still occur regardless of orientation.

2.5.1. Biological Explanations

From a Darwinian evolutionary perspective, homosexuality as a human trait should have diminished, as the lack of reproduction between homosexual partners would disallow the continuation of those genes predisposing individuals to homosexuality (Miller, 2000; Camperio Ciani & Pellizzari, 2012; Camperio-Ciani, Corna, & Capiluppi, 2004). This 'Darwinian paradox' was the basis for why the idea that SO is a genetic phenomenon was most often dismissed (Hamer & Copeland, 1993; as cited in Miller, 2000; Camperio Ciani, Iemmola, & Blecher, 2008). However, according to Blanchard (2001), Blanchard and Klassen (1997), Iemmola and Ciani (2009), and Camperio Ciani and Pellizzari (2012) research has found that SO may in fact be biological and or genetic. Several biological theories have been proposed to explain why differing SOs occur. These theories stem from understanding how genetic predispositions and biological factors affect sexual dimorphism in the developing foetus (Ellis & Ames, 1987; Byne & Parsons, 1993).

According to Ellis and Ames (1987) the development of sexual dimorphism occurs in five dimensions. The first of the five dimensions in mammalian sexual dimorphism is genetic dimorphism. Two genetic chromosomal patterns exist which define whether an individual will be male or female. The first of the two genetic patterns occur when two identical sex chromosomes (XX) are present, which produces the female sex; the second genetic pattern contains two different sex chromosomes (XY) which determines a male sex. It is due to hormones on the Y chromosome that the masculisation of the foetus develops. The second of the five dimensions which predicts sexual dimorphism is genital. Genital dimorphism refers to the differentiation of reproductive organs. Regardless of the genetic orientation of the foetus, the initial genital and biological structure of the mammalian foetus is female (Byne & Parsons, 1993; Bao & Swaab, 2011). In utero, the mother will produce two hormones Chorionic gonadotropin (CG) and luteinizing hormone (LH). The hormone CG crosses the placental barrier causing the formation of sex hormones in the foetus and determines whether gonad development will lead to ovaries or testes. In the male foetus, genes found specifically on the Y chromosome synthesize CG to form T which then leads to the masculisation of the foetal genital structure. The first change in the male foetus that stems from the production of T is the formation of Leydig and Sertoli cells which make up the gonadal primordium (the primitive testicular structure). Leydig cells are activated by CG to synthesize testicular T, which is vital in the masculinisation of the brain and genetalia. Sertoli cells suppress the formation of female reproductive organs, i.e. the uterus and ovaries. A metabolic by-product of the synthesis of T by a chemical known as 5α-reductase in the Leydig cells is called dihydrotestosterone (DHT). The chemical DHT is the primary trigger for the development of the external male sex organ. As females, do not possess a Y chromosome and therefore lack the necessary genes to synthesize CG into T or DHT, the production of the male genetalia does not occur, rather, ovaries develop instead of testes and the production of female hormones from the ovaries and brain lead to the development of the uterus and fallopian tubes.

The third if the five dimensions of sexual dimorphism in mammals as described by Ellis and Aimes (1987) is the formation of secondary sexual characteristics or non-genital morphological changes. In males, this occurs in two phases, the first is the organisational phase which occurs in utero and where permanent developments are generated by T. During this phase, T is synthesized to produce a number of receptor sites on various cells within the body which when ready will bind with T in the blood. The activation phase is the second

phase of the formation of secondary sexual characteristics and begins during puberty. At puberty in males a surge of T is produced, which is then received by the pre-established receptor sites on various cells (i.e. muscle and hair cells) that change the functioning of the cell. This is what causes the physical changes in the male body during puberty. If the initial T surge does not fill the receptor sites, less masculinized features develop, and puberty may be staggered. For females, the lack of T receptor sites results in little to no change in muscle mass or hair growth during puberty. However, ovaries start to produce O and P which lead to the development of female secondary sexual characteristics

The fourth and fifth dimensions of sexual dimorphism mentioned by Ellis and Ames (1987) and Bao and Swaab (2011) are the neurological and behavioural dimensions. The sexual organization of the brain occurs during the early stages of the foetal development, however, independently of genital and secondary sexual development (Bao & Swaab, 2011). According to Byne and Parsons (1993), foetal brains from both genetic patterns are primarily female and it is the supply of T to the developing brain that causes the defeminisation and subsequently masculinisation of the male brain. This is a critical stage of neuro-hormonal development and typically occurs within the first six months of gestation (Ellis & Ames, 1987). During this stage of brain differentiation two developments occur. First to development is SO and second to develop is the predisposition to sex specific behaviour. SO, determines sexual partner preference and sex-specific behaviour determines to which sex-type behaviour one is likely to conform to, for example the male organized brain will engage typically in behaviours that are physical and require processes of spatial reasoning. Sex-type behaviour also includes behaviours typical of one's sex during sexual encounters such as thrusting in men. According to the prenatal neuro-hormonal hypothesis during this critical phase of neural development in the first six months of gestation, an increase or lack of T supply will lead to differing SOs depending on the sex of the foetus (Bao & Swaab, 2011; Ellis & Ames, 1987). Where low levels of T produced by the male foetus will lead to the likelihood of homosexuality in males and high levels of T produced by the mother that cross the placental barrier will lead to a partial or complete defeminisation and masculinization of the female foetal brain and potentially homosexuality in women. Differences in male SO occur most frequently due to the complex nature of the masculinisation of male genitals and brain from the basic female structure, which implies that potentially any change at any of the phases of masculinisation may alter the way the foetus develops.

According to this hypothesis the most common occurrences which alter sex and or SO are firstly a 5α-reductase deficiency. As mentioned previously, 5α-reductase is responsible for the production of DHT, which is responsible for the formation of the penis and externalisation of the testes. Males with this condition still possess testes and produce T however, the testes are internal and genetalia appear female because of the lack of DHT to form male genitals. Although these individuals are biologically male they appear to be physically female and are often raised as females however displaying both the behaviour and heterosexual preference typical of men, thus their SO is often confused as homosexual. During puberty, however, some formation of masculinization occurs due to the surge of T produced by the internalised testes.

A second biological complication that may affect sex and SO development is androgen insensitivity syndrome. Androgen insensitivity is caused by a complete or partial lack of T receptor sites on cells, which means that T cannot bind with the necessary cells to produce male non-genital morphology. According to Ellis and Ames (1987) this causes a failure to form male genatalia and affects brain differentiation at the critical period when SO and behaviour are developed. Furthermore, it leads to an inhibition of the formation of secondary sexual characteristics such as increased muscle mass and hair production during puberty. Thus, in severe cases, individuals appear, behave and show heterosexual preference typical of females, thus indicating a real homosexual tendency as these individuals are biologically male.

Another biological explanation which may affect SO is an H-Y antigen inhibition. It is suggested that in utero; at the early stages of pregnancy certain women have an immune reaction to the H-Y antigen, a by-product of T produced by the male foetus (Blanchard, 2001; Blanchard & Klassen, 1997). According to Blanchard and Klassen, (1997) H-Y antigens are only found in males and are said to be vital in the sexual differentiation of the brain. With each successive male born, the mother's H-Y antibodies strengthen and increasingly inhibit H-Y antigens in the male foetuses (Blanchard, 2001). Therefore, if the H-Y antigens are inhibited in later born males, the theory suggests that the lack of masculinisation during the critical stage of foetal sexual brain differentiation may lead to male homosexual tendencies.

Although there is much research and evidence that supports genetic homosexuality in males, very little research has been conducted around homosexuality in women. However, Miller (2000) proposed that homosexuality in women occurs much like homosexuality in males,

where the foetus is exposed to both environmental and genetic influences in utero thus causing the female foetus to develop in a more masculinized way. This may cause females to develop a "tomboy" personality and adopt a more masculine gender role (Miller, 2000). Kimura (1996) suggests that a condition known as congenital adrenal hyperplasia (CAH) is the cause for the development of "tom boyishness" in girls. CAH is caused by an exposure of the female foetus to an excess of androgen (Kimura, 1996). Kimura claims that girls with CAH are often born with masculinized genitalia, and can perform well in tasks that require spatial functioning (considered a masculine ability). Miller (2000) further suggests that "tom boyishness" does not necessarily indicate homosexuality; in fact, Miller suggests that "tom boyishness" in women may even lead to greater reproductive success with men as women who are slightly more masculine can assert themselves better than very feminine women and thus may be more competitive, and consequently able to compete more adequately for access to attractive men (Miller, 2000).

Another theory is suggested which implicates a genetic factor on the X-chromosome (maternal line) for the occurrence of homosexuality in men (Miller E. M., 2000; Camperio Ciani, et al., 2012; Camperio Ciani & Pellizzari, 2012; Camperio-Ciani, Corna, & Capiluppi, 2004; Iemmola & Camperio Ciani, 2009). It has been suggested that a genetic factor (Xq28) made up of specific alleles putatively located on the X-chromosome discovered by Hamer et al. (1993, as cited in Miller 2000), however, without replication, is responsible for the antagonistic fecundity potential between sexes (Rahman, et al., 2008; Iemmola & Camperio Ciani, 2009; Camperio Ciani, et al., 2012). The discovery of this genetic factor is said to be the inspiration for what Camperio-Ciano, et al. (2004) refer to as the "sexually antagonistic model" and Rahman et al. (2008) refer to as the "liability threshold model" or more colloquially the "fertile female" hypothesis. It has been suggested than an accumulation of specific alleles on this genetic factor leads to an increase in the brain feminisation of an individual, and women who possess these alleles have demonstrated enhanced fecundity and are more likely to have larger families (Camperio Ciani, et al., 2012; Rahman, et al., 2008; Miller, 2000). Furthermore, it has been proposed that women who carry this genetic factor are more likely than others to have at least one homosexual son (Camperio-Ciani, et al., 2004) as it has been implied that this genetically inheritable factor that is claimed to contain feminising alleles, would cause homosexuality in males (Rahman, et al., 2008). Confirmatory studies have shown that mothers of homosexual men (HoM), are more fecund and have more fecund female relatives than mothers of only heterosexual men (HeM) (Camperio Ciani, et

al., 2012; Camperio Ciani & Pellizzari, 2012; Rahman, et al., 2008; Camperio Ciani, Iemmola, & Blecher, 2008; Camperio-Ciani, et al., 2004). This genetic theory offers an explanation for the "Darwinian paradox" that homosexuality creates, as it suggests that although fecundity or reproduction is unlikely in HoM, the gene that is said to be responsible for HoM, increases the fecundity in women (Camperio Ciani, et al., 2008; Iemmola & Camperio Ciani, 2009; Miller, 2000).

2.5.2. Social Explanations

Rahman and Hull (2005) suggest the kin selection hypothesis as another explanation for the evolutionary occurrence of homosexuality. Wilson (1975, as cited in Rahman & Hull, 2005) first proposed the theory of kin selection as an explanation for homosexuality and suggested that homosexual individuals did not need to expend energy in mate selection, acquisition, and reproduction. Therefore, homosexual individuals could aid their kin in terms of resources and energy investment, providing indirect benefits for the family (Salais & Fischer, 1995, as cited in Rahman & Hull, 2005). It is further suggested that homosexual men (HoM) are more altruistic and empathetic than heterosexual men (HeM), thus fitting in with the theory of altruistic kin selection (Salais & Fischer, 1995, as cited in Rahman & Hull, 2005). However, Rahman and Hull (2005) oppose this notion in saying that there is no clear evidence that kin selection altruism is the same as stereotyped altruism displayed by HoM. Moreover, Rahman and Hull (2005), point out further problems with the theory of kin selection as an explanation for homosexuality. Firstly, homosexual individuals do expend energy on mate selection and acquisition although not for reproductive purposes, and secondly many homosexual individuals find that familial acceptance is often contrary to what this theory espouses (Rahman & Hull, 2005). Furthermore, Bobrow and Bailey (2001, as cited in Rahman & Hull, 2005), found that HoM did not provide any more or better benefit to their kin than HeM, thus proving the inadequacy of kin selection as an explanation for homosexuality. Wilson's initial theory, despite being potentially offensive toward HoM has also neglected to include homosexual women (HoW) in the theory.

Daryl Bem (1996) provides another theory that includes both genetic and social explanations for the development of SO. According to Bem (1996), much of the literature and research around attraction and SO is "dominated by biological essentialists" (p.320) and evolutionary scientists that emphasize homosexuality as a deviation of what is considered normal sexual behaviour. Both heterosexual and homosexual individuals engage in complex and intricate

sexual strategies that have been the source of investigation for scientists for centuries, however, with the tendency to claim that heterosexuality is the norm and homosexuality the anomaly (Bem D. J., 1996). Bem (1996) asserts that his theory does not discriminate against any gender or orientation and furthermore, includes both social identity theory and evolutionary theory.

The structure of this theory of SO begins with genetics. Pre-natal hormones of the mother will affect the temperament with which the child is born, for example, as mentioned earlier, CAH in girls and the H-Y antigen in boys as well as the exposure of the foetus to pre-natal androgen may produce certain traits in the child. These temperaments will predispose children to enjoying certain activities more than others, for example, male typical activities include competitive and physical sports and play, and female typical activities include playing with dolls and less competitive sports, etc. Furthermore, children will be attracted to other children who enjoy similar activities. Therefore, boys more often seek out other boys to play with as they will share common interests; these children are referred to as gender conforming (Bem, 1996). However, children who prefer sex atypical activities and are more likely to seek out peers of the opposite gender and will be gender non-conforming. Children who conform to gender typicality will view the opposite sex as the out-group, or as Bem (1996) refers to them, the "exotic". On the other hand, gender non-conforming children will view children of their same sex as the out-group and may even feel alienated from them. Bem (1996) suggests that due to the unfamiliarity of children with their out-group, they will feel a heightened sense of autonomic arousal in their presence; this is often expressed as disdain or dislike of the out-group. For example, boys will most often tease young girls who are in their presence and many "tomboy" girls will receive disapproval and derision from gender conforming girls. Bem (1996) states this phase quite plainly here, "every child, conforming or non-conforming, experiences heightened, nonspecific autonomic arousal in the presence of peers from whom he or she feels different" (p. 321). In the last phase of the theory, a switch occurs, where, what was once considered exotic or the out-group becomes the object of attraction. Bem (1996), describes this phase as that of exotic becoming erotic. Individuals, who once found that the opposite sex was dissimilar and unlikable, now find the opposite sex as sexually attractive, thus producing heterosexual individuals and individuals who viewed the same sex as the out-group will now develop a same sex SO. Thus, according to Bem (1996) SO is derived both from a genetic predisposition as well as from socialisation.

There appears to be no definite theory that can explain SO. Miller (2000) suggests that homosexuality is merely a quirk that stems from natural intra-sexual variation and Buss (2008, as cited in Russock, 2011) states "that there is no reason to assume that homosexuality is a single phenomenon and, therefore, there may not be a single explanation for both male and female homosexuality" (p.310).

Bailey, Gaulin, Agyei, and Gladue, (1994) however, provide three possible sexual strategies that homosexual individuals may employ in the selection of a mate. The first is that they may adopt the patterns of behaviour displayed by heterosexuals of the same sex, by heterosexuals of the opposite sex and lastly homosexuals may adopt an *exaggerated* display of the same or opposite sex heterosexual patterns of behaviour.

2.5.3. Partner Preferences for Homosexual Individuals

In recent years, the roles of biological cues in evolutionary theory that are believed to influence attraction and mate choice have come under much debate. Blumstein and Schwarts (1983, as cited in Jankowiak, Hill, & Donovan, 1992) for example, reported that there was little difference between homosexual and heterosexual individuals concerning attraction. This assumption lends evidence to challenge the hypothesis that homosexual individuals are more alike in behaviours and biology to opposite sex heterosexual individuals. Symons (1979, as cited in Jankowiak, Hill, & Donovan, 1992) supported this argument as he noted, "that differences by sex appear greater than by sexual orientation" (p.75). Meaning that biologically, the criteria upon which attractiveness is evaluated, is inherent to sex and not to the SO or the preference of mate (Jankowiak, Hill, & Donovan, 1992). Furthermore, this would mean that the biological markers said to indicate fertility and inheritable fitness and consequently attractiveness to the opposite sex, are in fact also influencing same sex attraction.

According to Bailey, et al., (1994) and Lippa (2007) men are often more prone to engage in casual sex with multiple partners than women, as they do not carry the burden of risking pregnancy as women do. Furthermore, Lippa (2007) suggests that men prefer quantity in offspring whereas women will prefer quality, thus, women often earn the title of being "sexually cautious" (Bailey, et al., 1994). Although HeM are more likely to enjoy a more promiscuous sex life than women, it is suggested by Bailey, et al. (1994) that HoM show an even greater number of casual sexual liaisons than HeM. It is suggested that this is not due to a greater enjoyment of casual sex, but rather, the fact that HoM are interested in men, who are

typically less sexually cautious and will therefore be more willing sexual partners (Bailey, et al., 1994; Russock, 2011; Gobrogge, et al., 2007). Therefore, because both HoM and HeM regard "uncommitted sex" with a similar enthusiasm it can be said that the reason HoM tend to have more casual sex than HeM is "because of a difference in opportunity rather than a more fundamental psychological difference" (Bailey, et al., 1994, p. 1088). Gobrogge et al. (2007) found similar results in their study, in which they found that HoM were more likely than HeM to seek sexual encounters rather than relationships. In this instance a hyper masculine profile is associated with HoM; this is an exaggerated display of a same sex heterosexual pattern of behaviour as suggested by Bailey et al. (1994). The notion of hyper masculinity in homosexual men is illustrated quite precisely in the artworks of Tom of Finland, where depictions of exaggerated male genetalia and homosexual group sex are common. On the other hand, Bailey et al. (1994) found that women in general seem less inclined to casual or uncommitted sex than their male counterparts regardless of their SO.

According to Buss (2000), in long term relationships HeM tend to experience sexual jealousy much more than women. Buss (2000) suggests that the sexual jealousy experienced by men is due to paternal uncertainty where sexual encounters outside of a relationship by women could lead to cuckoldry. On the other hand, heterosexual women (HeW) tend to be most affected by emotional jealousy as they fear loss of care and resources due to infidelity (Buss, 2000). According to Bailey et al., (1994) homosexual women (HoW), much like HeM are more sexually jealous, and, HoM are less jealous in general. This lack of sexual jealousy amongst HoM is probably due to the lack of value on sexual exclusivity in the homosexual community, and the fact that reproduction between men is not possible and therefore cuckoldry and paternal uncertainty would be superfluous (Bailey, et al., 1994; Buss, 2000). The strategy of jealousy in homosexual individuals seems to mimic the mate choice strategies of opposite sex heterosexual individuals, which is one of the three strategies suggested by Bailey et al. (1994).

According to Bailey et al., (1994) HeW care more about the social status of potential mates than any of the other three groups do. It is suggested that homosexual individuals are less concerned with status as the potential for offspring is diminished and thus the need for potential status dependant resources, which would aid in child rearing (Bailey, et al., 1994). HeW, on the other hand; often prefer mates with a high status as they may offer better resource investment in potential offspring (Gangestad, 2000). However, according to Lippa (2007) in today's post- modern societies, women are more able to earn and govern resources

for themselves and their offspring and therefore are less likely to look for this quality in their partners. Thus, Lippa (2007) suggests that traditional gender roles and qualities endorsed as attractive by societal standards are becoming superfluous in westernised, post-modern and feminist cultures. Therefore, because women are less likely to look for financial support and status in men they can now base mate choice on more physical criteria, thus adopting a more traditional approach to mate choice based on attractiveness and appearance of masculinity (Lippa, 2007). Nevertheless, most individuals will tend to seek out partners with a similar social status to their own in long term relationships (Gobrogge, et al., 2007). Lippa (2007) investigated whether mate preferences were dependant on sex, SO, or social/cultural influences. Some theorists assume that sexually selected traits in women, such as submissiveness and youth, are preferred by men because they advocate traditional gender roles espoused by culture. However, Lippa (2007) argues that if this theory is true, homosexual individuals will be less likely to base mate choice on culturally endorsed traits, as homosexual individuals are less likely to conform or adhere to societal norms and expectations. Lippa, (2007) suggests that homosexual individuals often exhibit traits of the opposite sex heterosexual individuals, however, this gender role shift is less apparent in mate preference, where criteria for mate preference is more alike to heterosexual same sex individuals. Lippa (2007), much like Gobrogge et al. (2007), found that partner preferences differed more significantly between sexes than SO. Interestingly HoM endorsed similar preferred traits to HeW, such as dependability, communication skills, honesty and financial security. Lippa (2007) suggests that these trait preferences are in congruence with preferences traditionally adopted by a feminine role, for example the desire to be financially cared for and espousing a "people-oriented approach to relationships" (p.205). Furthermore, HoW, similarly to HeM, considered intelligence to be a very important trait. However, homosexual individuals in general were less concerned with traits emphasizing societal expectations, such as parental investment and religiosity. In their study, Jankowiak, Hill and Donovan (1992) predicted that SO would not affect attractiveness ratings as much as sex would, and that sex differences would indicate typical reproductive strategies displayed by men and women. They found that rankings of attractiveness were most affected by sex and age, and least affected by SO, thereby verifying their predictions.

In Lippa's (2007) study, although homosexual individuals showed similar preferences to the opposite sex heterosexual individuals, there were more common trait preferences with the same sex heterosexual individuals. For example, much like heterosexual men, homosexual

men ranked physical traits, such as age and good looks as a higher priority when selecting mates and women in general preferred character traits to physical traits (Lippa, 2007). Physical attractiveness as a criterion shows no significant intra-sexual difference according to Bailey et al. (1994). Men in general rated physical attractiveness as very important however, a slight significant difference was found between homosexual and heterosexual females. Homosexual females rated physical attractiveness as much less important in potential mates as any of the other three groups did (Bailey, et al., 1994). This finding was repeated in a study conducted by Jankowiak, Hill and Donovan (1992), in which HeM rated women's attractiveness according to physical features, but HeW's rating of men and HoW's rating of other women's attractiveness tended to be based on emotional attributes. Bailey et al. (1994) suggests that this finding negates the socialization explanation of female beauty (which is emphasized more than male beauty in modern society), therefore, if socialization was true then female beauty should influence HoW much like HeM in mate choice. However, HoW do not rate female beauty as an essential influencing factor when choosing a mate, thus emphasizing the criterion of physical attractiveness as a sex difference and not a difference relating to SO (Bailey, et al., 1994). Jankowiak, Hill, and Donovan, (1992) reported a comment made by Blumstein and Schwartz (1983) which reflects the same finding as Bailey et al. (1994), "[w]hile some lesbians respond to the dictates of fashion, many inhabit a culture scornful of what they consider male standards of female attractiveness, which they reject as indicators of women's worth" (p. 75). These results are in congruence with a study conducted by Russock (2011) in which he analysed personal advertisements. From the results, it was found that homosexual females were less inclined to be influenced by physical attractiveness as this trait was offered and looked for significantly less than the other three groups (females looking for males, males looking for males and males looking for females). On the other hand, both HoM and HeM regarded physical attractiveness as an important factor when offered or looked for personal advertisements (Russock, 2011). This may be linked to the testosterone driven tendency for men to engage in status seeking or "competitive" behaviour (Eisenegger, Haushofer, & Fehr, 2011), where the acquisition of an attractive mate may increase their social status.

The results produced by Lippa's (2007) study showed that character trait preferences were strongly influenced by culture and nationality regardless of sex. For example, female submissiveness and male social status were less sanctioned in Western cultures than in non-Western traditional cultures. However, physical trait preference was not influenced by culture

or nationality (Lippa, 2007). Men, regardless of SO, culture or nationality regarded physical attractiveness as highly important in comparison to women (Lippa, 2007). Thus, it could be presumed that physical attraction, unlike character preference, is affected by a biological urge and not a social obligation (Lippa, 2007). This indicates what previous literature has shown, that although certain aspects of homosexual preferences seem to echo the preferences of opposite sex heterosexual individuals, most mate selection criteria are sex dependant and not SO dependant.

In a study conducted by Bailey et al., (1994), results showed that homosexual individuals were less concerned with age than heterosexual individuals were. This is possibly due to the reproductive benefits that are associated with age that would be non-essential in mate selection amongst homosexual individuals (Bailey, et al., 1994). It is generally noted that HeM are attracted to women who are at peak fecundity and fertility, thus women in their twenties are considered most attractive to HeM, regardless of the man's age (Geary, Vigil, & Byrd-Craven, 2004). It is thus suggested that men prefer younger female partners as they remain more fertile for longer, therefore ensuring maximum reproductive success for HeM (Geary, Vigil, & Byrd-Craven, 2004). Jankowiak, Hill, and Donovan, (1992) confirmed this pattern of behaviour in age preference in their study. It was shown that men preferred younger women and women preferred older men. Biologically men do develop at a slower rate than women, taking longer to mature, thus the tendancy for women to prefer older men may be a function of biology. Subsequently, age preference should therefore not be a significant influence in homosexual mate choice as it is directly related to reproductive potential. Bailey, et al., (1994) illustrated this point by showing that "preference for younger partners was significantly lower for HoM than for HeM" (p. 1090). Gobrogge et al. (2007) suggests that age preference regardless of SO is most often dependant on the type of relationship that an individual is seeking. Men who are seeking short-term sexual encounters regardless of orientation, are more likely to seek younger mates whereas men (regardless of orientation) who seek longer term relationships are more inclined to choose mates based on social compatibility and experience and hence similar ages to their own, rather than reproductive potential and benefits (Gobrogge, et al., 2007). On the contrary to Gobrogge et al's (2007) results, Jankowiak, Hill, and Donovan (1992) found that homosexual individuals (regardless of sex) preferred younger mates, although there was some variation in what was considered attractive for homosexual females. Some homosexual females and a few heterosexual females preferred or commented that older individuals were more sexually

attractive but that this was not suggestive of social or experiential compatibility (Jankowiak, Hill, & Donovan, 1992).

Jankowiak, Hill and Donovan (1992), found that their rankings of attractiveness were most affected by the sex of the judges and the age of ranked subjects and least influenced by the SO of the judges, thereby verifying their predictions. It is suggested that men more often rank their preferred mate's attractiveness according to physical appearance and attributes which signal health, for example, skin tone, hair and eyes as well as whether other men will also find their partner attractive, thus elevating the man's status (Jankowiak, Hill, & Donovan, 1992). Women on the other hand attributed attractiveness to an emotional or personal quality perceived in the individual being judged (Jankowiak, Hill, & Donovan, 1992). Women found men who they perceived to look happy, thoughtful or smart to be most attractive; these attractiveness judgements are what Weinrich (1987, as cited in Jankowiak, Hill, & Donovan, 1992) refers to as "limerant" attractions, and men would espouse "lusty" attractions. Interestingly, Jankowiak, Hill and Donovan (1992) found that HeW, unlike HoW ranked other women (not men) with "lusty" descriptions, perhaps as a way of comparing the potential competitors in the game of sexual selection. HoW, for whom women are the sex object, alternatively, expressed limerant motivations for their attraction.

2.5.4. Putative Pheromone Attraction in Homosexual Individuals

According to Savic, Berglund, and Lindstrom (2005), sexual selection is greatly dependant on pheromone secretion in the animal kingdom. Sex specific responses have been shown to activate the anterior hypothalamus of animals in various studies in response to the secretion of putative pheromones (Paredes, Tzschentke &, Nakach, 1998, as cited in Savic et al., 2005). According to Berglund, Lindstrom and Savic (2006) the anterior hypothalamus is an area of the brain that is said to be responsible for reproductive functions including hormonal and pheromonal sensory integration, which subsequently influences sexual attraction, behaviour, and preference. It has been shown that activation of the anterior hypothalamus differs across sex, thus, providing evidence that this area of the brain is sexually dimorphic. Furthermore, hypothalamic activation also differs across SO in the presence of certain chemical stimuli (pheromones, chemo signals) (Berglund, et al., 2006). Thus, these findings will aid greatly in understanding the nature of pheromonal attraction regarding SO, although they raise contradictory questions concerning Lippa (2007) and Little and Hancock's (2002) arguments about the biology of attraction and SO.

Much research has been done to establish whether behaviour and influencing factors related to mate choice in homosexuals is more closely related to the behaviours and influences of the same sex or opposite sex (Russock, 2011; Bailey, Gaulin, Agyei, & Gladue, 1994). It has been suggested that homosexual mate choice much like heterosexual mate choice varies amongst individuals and that the behaviour displayed and factors influencing mate choice differ from opposite sex similarities to same sex similarities depending on the individual and situation (Russock, 2011; Jankowiak, Hill, & Donovan, 1992). Furthermore, Gobrogge et al. (2007), argues that homosexual individuals, unlike heterosexual individuals will make judgments about potential mates based on factors that are not related to reproduction. Although the ultimate reason for sexual selection between homosexual and heterosexual individuals are very different, the criteria for inducing selection may be similar to both SOs (Gobrogge, et al., 2007). Therefore, according to previous research, homosexuals may have similarities with both the same sex and the opposite sex when it comes to mate choice; however, the specifics of what similarities and differences are most influential is of particular interest in this study, particularly in the case of pheromone attraction to physically masculine men. Although much research has been conducted that provides information about visual and social related mate preferences in homosexual individuals, not much research has been conducted around pheromone detection in homosexuals (Bailey, Gaulin, Agyei, & Gladue, 1994; Gobrogge, et al., 2007; Jankowiak, Hill, & Donovan, 1992). For this reason, the following research will aim to investigate whether there is a difference in the ability to detect pheromones considered very masculine and attractive, produced by men, between homosexual and heterosexual individuals in both men and women. However, due to the small samples drawn in this study the results should be considered tentatively.

Savic et al., (2005) investigated the effects of the AND and EST chemicals on the brain of individuals with varying SOs. They aimed to measure whether homosexual men responded to the chemicals similarly to heterosexual men or women or both and what patterns of response and attraction occurred. The findings that Savic et al. (2005) produced showed that AND and EST do indeed produce sexually dimorphic responses as well as responses related to SO. The results showed that hypothalamic activation for homosexual men exposed to AND chemicals were similar to that of HeW and quite dissimilar to HeM. In addition, exposure to EST also produced results that showed activation of different brain areas between HeM and HoM, therefore providing biological evidence that pheromone attraction is affected by SO as well as sex. These results greatly contradict the views and findings expressed by Jankowiak et al.,

(1992) and Lippa (2007) who found that differences in attraction were more significant regarding sex than SO.

Berglund, Lindstrom, and Savic (2006), expanded on the studies conducted by Savic et al. (2001) and Savic et al. (2005) with a study which examined the influence of pheromones on HoW in comparison to HeW and HeM. There has been little research conducted concerning the chemosensory processing of attraction in lesbian women, and it was predicted that much like HoM, who differed more by SO than by sex with regards to chemosensory processing and attraction, that HoW will process pheromones more similarly to HeM than HeW (Berglund, Lindstrom, & Savic, 2006). The results of Berglund et al's., (2006) study confirmed this prediction as HoW who were exposed to EST, showed hypothalamic activation that was similar to that of HeM and deviated from the responses shown by HeW.

Chapter 3: Methodology

3.1. Aims

Previous studies in the evolutionary school of thought have suggested that women are most attracted to men with strong masculine scents and features when they are at their most fertile phase of their mestrual cycle, ovulation, which suggests that men with higher levels of T are preferred as fathers (Gangestad, Thornhill, & Garver-Apgar, 2005; Thornhill & Gangestad, 1999; Gangestad, 2000; Grammer, 1993; Thornhill, et al., 2000; Pillsworth, Haselton, & Buss, 2004; Penton-Voak, et al., 1999). Although these studies have aided in understanding the psychology and mechanisms which stimulate attraction, mate choice and sex in heterosexual individuals operating in accordance with prescribed biological norms regarding reproductive potential, very little research has investigated the mechanisms and psychology behind attraction, sex and mate choice in homosexual individuals (Bailey, Gaulin, Agyei, & Gladue, 1994). Therefore, the primary aim of this study was to assess whether SO affected individuals response to putative pheromones and if so how, and furthermore assessing whether the response of homosexual individuals is similar to that of heterosexual same sex or opposite sex individuals, both or neither.

T-shirts were used as the pheromonal (scent) stimuli, the rationale for this was based on previous research which used the same method. It is assumed from these studies that pheromones are secreted via sweat, and therefore will be transferred onto the t-shirts that the participants wear (Thornhill & Gangestad, 1999; Thornhill, et al., 2003). The primary aim was to compare the rankings that both men and women and homosexual and heterosexual individuals gave the t-shirts in terms of both attractiveness and masculinity.

It is suspected that men and women will adopt social behaviours that fall somewhere on a continuum of masculinity and femininity regardless of orientation (Bem, 1974). Therefore, it was important to include a measure of androgyny to ascertain the level of traditional femininity or masculinity individuals adopt as this may influence what they may find attractive. It was predicted that individuals, male or female, who exhibit more female like traits may rank the male faces similarly as well as individuals who exhibit more male traits. Therefore, the personality attributes questionnaire (PAQ) (Spence & Helmreich, 1978) was included in the judges' questionnaire as a measure of androgyny.

This study was conducted in the fulfilment of a Masters in social science dissertation.

3.2. Research Questions, Hypotheses and Rationale

3.2.1. Objective 1:

To establish whether, as previous literature suggests, there is an association between the attractiveness and masculinity of men, and furthermore that these associations are distinguishable from scent as well as visual stimuli.

Question 1:

<u>Are male attractiveness and perceived masculinity judged similarly?</u>

The comparison of faces and scents was made on two dimensions, masculinity and attractiveness. The rationale for choosing two descriptors or constructs on which to rank the stimuli, both masculine and attractive, was because previous literature has suggested that women who were ovulating found a very masculine scent as well as very masculine features more attractive than when they were not ovulating (Feinberg, et al., 2006; Gangestad, et al., 2005; Jones., et al., 2005; Little & Hancock, 2002; Penton-Voak, et al., 2001; Penton-Voak, et al., 1999; Peters, Simmons, & Rhodes, 2009; et al., 2004). Furthermore, for women who were not ovulating very masculine scents were considered somewhat unpleasant (Grammer, 1993). Therefore, it was obligatory to this study to differentiate between the two descriptors as what is considered masculine may sometimes, but not always be considered attractive.

Furthermore, according to Huoviala and Rantala (2013), the scent of the male pheromone androstadienone produces cooperative behaviour in other men. This suggests that men are able to distinguish the smell of highly masculine men (men with high T) from those less masculine, indicating men are able to judge masculinity independantly of attraction, as they might consider another man very masculine depending on his secretion of androstadienone, although not necessarily attractive.

Null Hypothesis: There is no significant association between rankings of attractiveness and masculinity for both the stimuli.

Alternate Hypothesis: There is a significant association between the rankings of attractiveness and masculinity for both the stimuli.

Question 2

<u>Do the rankings of attractiveness/masculinity of scent correspond with the rankings of the photographs?</u>

It is assumed from previous studies, that men who secrete very masculine, or very attractive pheromones will also have very masculine or attractive visual features (Thornhill & Gangestad, 1999; Cornwell, et al., 2004; Kovacs, et al., 2004). Thus it was important to include both visual and pheromonal stimuli to ascertain whether indidividuals respond to both stimuli similarly.

In a study conducted by Kovacs et al., (2004) it was indicated that exposure to sex specific pheromones influenced men's perception of faces. Kovacs et al. (2004) found that when male participants smelled androgen like pheromones they perceived faces to look more masculine, however, when they smelled oestrogen based pheromones they perceived faces to be more feminine; thus, indicating a clear link between perceptions of visual and pheromone stimuli. This finding reiterates the notion proposed by Kohl (2008), that responses to visual stimuli, including perception, are conditioned by the exposure to pheromones.

Studies conducted by Cornwell, et al. (2004) and Thornhill and Gangestad (1999), suggest there is a definite link between visual and pheromonal sexually dimorphic cues which are said to indicate both attractiveness and conformity to ones sex. Cornwell et al. (2004) compared ratings of pheromone preference to that of visual face shape and found a correlation. Cornwell et al. (2004) concluded "that putative sex pheromones and sexually dimorphic facial characteristics convey common information about the quality of potential mates" (p.635). Similarly, Thornhill and Gangestad (1999) conducted a study in which they compared attractiveness judgements of visual stimuli from photographs with pheromone stimuli from worn t-shirts (much like the current study). Their results proved in support of the argument "that facial attractiveness (as judged from photos) appears to predict body scent attractiveness to the opposite sex" (Thornhill & Gangestad, 1999, p. 175).

It is predicted here that participants will rank their preference of photograph concordantly to the scent of the t-shirts. That is that participants will rank the t-shirt worn by a particular

stimuli participant in the same or similar position as they rank that stimuli participant's photograph for both constructs of masculinity and attractiveness.

Null Hypothesis: There is no significant association between the ranking of t-shirts and of photographs

Alternate Hypothesis: There is a significant association between the ranking of t-shirts and photographs

3.2.2. Objective 2

Question 3

<u>Does the sex of an individual determine how attractive or masculine they find certain male faces and body odours?</u>

Regardless of SO, this question aimed to assess whether men and women regard the attractiveness and masculinity of male with concordance on both visual and scent criteria. According to conclusions surmised by Cornwell et al., (2004) sexually dimorphic sex pheromones illicit sex specific preferences, in that, males tend to prefer female pheromones and females, male pheromones. According to Savic, Berglund, Gulyas and Roland (2001), men and women differ in their brain activation when exposed to sex specific pheromones, thus suggesting "a potential physiological substrate for a sex-differentiated behavioural response in humans" (p.661).

Although the male chemo-signal AND is considered by many as a sex pheromone specifically eliciting attraction in women it does also produce cooperative behaviour in other males (Huoviala & Rantala, 2013). This may suggest that men are likely to be more accurate and concordant in their rankings of scent in terms of masculinity and perhaps more arbitrary in their rankings of scent in terms of attractiveness, whereas women are likely to be concordant on both dimensions: masculinity and attractiveness. The use of these ranking criteria will be discussed in more detail in chapter 3.6.

The ovluatory cycle of women as mentioned before does affect percieved attractiveness of men, thus the estimation of ovulation included in the questionnaire for the female judging participants, would help to ascertain whether or not this did affect female rankings of the

stimuli in this study. According to research conducted by Grammer (1993) women who were in their ovulatory phase were more positively responsive to the scent of male pheromones than at any other time in their menstrual cycle. Furthermore, according to Levin (2004) women are much more influenced by scent than men are, it is said that men are swayed more by "looks" than smell when it come to selecting a partner.

Therefore, it is predicted that women, particularly those who are ovulating will be more congruent in their rankings of attractiveness and masculinity in terms of scent preference. Furthermore, it is predicted that within the concordance of rankings males and females will show differences in preference.

Table 2: Predicted concordance among males and females		
Sex	Attractiveness	Masculinity
Females	High	High
Males	Low	High

Null Hypothesis: There is no significant difference in the rankings of attractiveness or masculinity for the VS and the SS between men and women.

Alternate Hypothesis: Men differ significantly from women in terms of how they rank the attractiveness and masculinity of the VS and the SS.

Question 4

<u>Does the SO of an individual determine how attractive or masculine they find certain male faces and body odours?</u>

Lippa (2007) and Jankowiak et al. (1992), argued based on evidence produced in their studies, that sex, more so than SO, affected the attractiveness judgements of others, however, these studies did not consider the influence of SS as a criterion on which to base judgements. Lippa (2007) and Jankowiak et al. (1992), rather focused their study on visual physical attributes such as age, "good looks", and height as well as social attributes as a measure on which to rate attractiveness. Therefore, in terms of VS, it would appear that society has a larger impact on how attraction should be perceived than one's own biological preference. Berglund et al. (2006), and Savic et al. (2005) alternatively showed that hypothalamic activation differed between SOs when exposed to SS, thus resulting in differing autonomic

arousal and attraction that was influenced by both sex and SO. Therefore, suggesting that the less tangible and societally advertised smell of natural BO may show a truer indication of subjective preference, and furthermore emphasize that SO is in fact a biologically determined state, as it causes a specific biological response different from heterosexual individuals.

From the results of these previous studies, it is predicted that for VS, both SOs will be concordant in their rankings, however, in terms of SS, homosexual individuals will consider the rankings differently. A combination of sex and SO will be more accurate in indicating concordance and thus question five was introduced into the analysis.

> Null Hypothesis: There is no significant difference in the rankings of attractiveness and masculinity for the VS and the SS between SOs.

> Alternate Hypothesis: SOs differ significantly in their rankings of attractiveness and masculinity for both VS and SS.

Question 5

<u>How does sex and sexual orientation interact in the judgement of male visual features and body odour in terms of attractiveness and masculinity?</u>

According to many studies conducted recently there does appear to be a difference in pheromone attraction between differing SOs however, this is always intrinsically linked to sex (Berglund, Lindstrom, & Savic, 2006; Savic, Berglund, & Lindstrom, 2005; Savic & Lindstrom, 2008). Therefore, an analysis of how sex and SO combined affected the rankings of VS and SS was necessary.

Berglund, Lindstrom and Savic (2006) found that the brain processes responsible for processing pheromones was not only sexually dimorphic but also differed regarding SO. They found similar brain activation between lesbian women and heterosexual men when exposed to oestrogen based chemical compounds. Furthermore, in a similar related study conducted by Savic, Berglund and Lindstrom (2005) it was found that gay men much like heterosexual women showed hypothalamic activation when exposed to androstadienone (AND). Similarly, Lubke, Hoenen and Pause (2012) individuals regardless of SO respond similarly when exposed to the scent of their preferred sexual partner (male or female). Trouton et al. (2012) replicated a "T-shirt study" in which they included SO as well as sex as factors in the measure of female SA. They included t-shirts worn by women at both ovulatory

and non-ovulatory phases of their menstrual cycle. The results produced indicated that heterosexual men and lesbian women considered the t-shirts, regardless of menstrual phase with the same attraction and enthusiasm, however, only heterosexual men rated the ovulatory phase t-shirts as more pleasant than any other group. Furthermore, Martins et al. (2005) showed that individuals are able to discriminate somewhat between the scents of different SOs and sexes.

As indicated by the previous studies discussed, it is clear that sex and SO are indeed connected and it is predicted that homosexual individuals will show preferences that are concordant with the opposite sex heterosexual individuals.

Table 3: Predicted concordance between sex by sexual orientation groups

	HeW	HoW
HeM	Low	High
HoM	High	Low

Null Hypothesis: There is no significant relationship between sex and SO, when ranking the attractiveness and masculinity of the pheromonal stimuli

Alternate Hypothesis: There is a significant relationship between sex and SO when ranking the attractiveness and masculinity of the pheromonal stimuli.

3.3. Research Design

According to Durrheim (2006) good research must address concerns regarding both validity and design coherence. The validity of a study is concerned with accuracy of the findings in terms of cause and effect, whereas design coherance involves ensuring that the research is conducted logically and systematically (Durrheim, 2006). In terms of design coherence, the research questions of this study neccesitate a quantitative design as quantifiable differences in responses rather than subjective experience is required, furthermore, as this study was informed by evolutionary theory, which defends the notion of objective truth, a positivist ontology was used. The study made use of a quasi-experimental design as randomisation was not possible and because the comparative goups naturally exist, (i.e. sex and SO), a cross-sectional differential research design was specified (Gravetter & Forzano, 2009).

This study made use of a questionnaire in which participants were asked to rank order a series of stimuli. However, all participants were asked to rank all of the stimuli thus introducing threats to internal validity normally associated with a within-subjects design such as order or testing effects and instrumentation (Gravetter & Forzano, 2009). Order or testing effects according to Gravetter and Forzano occur when participant responses are affected not by the treatment itself but rather by the order of treatments or experience of previous treatments. A discussion of the effect of order effects and how it was reduced can be found in chapter 3.6.

Instrumentation occurs when the instrument of measurement is altered or decayed during the course of data collection (Gravetter & Forzano, 2009). This was of particular consideration in this study as the t-shirts were highly vulnerable to scent decay and contamination over time and use. This will also be discussed further in chapter 3.6.

3.4. Sampling, Recruitment and Data Collection

To collect the data needed to address the research questions, it was first necessary to collect the stimuli required for the experiment, therefore this section will be divided into sampling and recruitment, materials and procedure firstly for the collection of the stimuli and secondly for the main experiment itself.

3.4.1. The Stimuli

Sampling and Recruitment

A convenience and purposive sampling method was used in this study. According to Henry (1998) convenience sampling is a type of nonprobability sampling which impedes the generalizability of a study as participants are recruited from subpopulations most readily available to the researcher and not randomly selected from the general population. The use of non-probability convenience sampling methods does introduce sample bias as the sample readily available (i.e. the student population) belongs to a specific subgroup of the population which may differ from the general population on some characteristic attributes (Henry, 1998). The stimuli sample in this research was recruited from the undergraduate male population of the Pietermaritzburg UKZN campus. The research conducted required that only androgen based chemo-signals be utilised as to minimise the complexity of the study, therefore, only adult men were required to constitute the stimulus. Furthermore, only two race groups were recruited for this sample as Van Beek (1992) suggests that race and culture are intrinsically

linked and food often has cultural significance which would affect BO. Thus, because sex and race were criteria on which recruitment was based, the sampling was purposive.

The stimuli participants were approached whilst at leisure on the main campus lawns, these individuals were given a brief explanation of the purpose of the study and asked if willing to attend an appointment at the most convenient time for them the following day. Of the approximate 40 individuals who were approached, 29 attended their appointment. Of those 29 participants, six individuals dropped out, leaving 23 participants who completed the study adequately. Of the 23, six were selected for the stimuli, based on race matching (i.e. three Black and three White males) and obvious adherence to the required rules. Participants were offered a free t-shirt as an incentive for their participation. Participants who did not adhere to the rules were not disadvantaged in any way regarding the incentive. The stimulus t-shirts were kept in a freezer until the main phase of data collection. After the initial collection of main data, the t-shirts had begun to lose their scent. Hence, the t-shirts were washed without detergent and re-worn by the same participants who were contacted via sms and offered a further incentive of R20.00.

Materials

The stimuli sample in this study was made up of a pheromone scent stimulus (SS) as well as a visual stimulus (VS), both of which needed to come from the male population specifically. For the pheromone stimulus worn t-shirts were used. Previous studies have used a similar technique for obtaining the chemo-signal found in sweat (Gangestad, et al., 2005; Miller & Maner, 2010; Singh & Bronstad, 2001).

All stimuli participants were given an information sheet explaining the aspect of the study they were participating in, as well as a consent form which required consent for participation in each area of the study considered challenging or sensitive, such as wearing a t-shirt for two consecutive nights, having their photograph taken and supplying their contact information. Each stimuli participant was also given a short questionnaire in which the participants indicated their race, sex and age, as well as contact information in case reminders to return the t-shirts were necessary. A copy of the information sheet and consent form can be found in appendix C. The short questionnaire filled out by the stimuli sample appeared as follows.

```
┌────────────────────────────────────────────────────────┐
│  STIMULUS PARTICIPANTS                                  │
│                                                        │
│  Name: _____               │
│                                                        │
│  Age: _____                             │
│                                                        │
│  Ethnicity: Black_____     White_____              │
│                                                        │
│  Contact Number_____            │
│                                                        │
│  Email Address_____  │
│                                                        │
│                                                        │
│                                                        │
└────────────────────────────────────────────────────────┘
```

Figure 4: Example of stimuli participant questionnaire

To create the pheromone stimulus, 30 identical white cotton t-shirts were used, all the t-shirts were same size (XL) to reduce size bias in the second phase of data collection. Each of the t-shirts was sealed with a bar of unscented soap in a large reseal-able Ziploc® bag. Participants were explained a list of rules on how to wear the t-shirts without contaminating them with other odours. This was to minimise the risk of extraneous odours from modifying the scent that would thus influence respondent's rankings of preference in the second phase of data collection.

Instructions for wearing the t-shirts:

1. Please sleep in the given t-shirts for the next two consecutive nights.

2. Please do not wash the t-shirts.

3. Please will you wash your bed linen on the day prior to participating

4. Please wash with unscented soap before wearing the t-shirts

5. Please do not wear any deodorant, perfume or scented talc powder before wearing the t-shirts.

6. Please do not eat any of the following strong foods on the nights you are given to wear the t-shirts: garlic, chilli, cabbage, cheese, onion, and asparagus.

7. Please do not drink any alcohol before or whilst wearing the t-shirt

8. Please do not smoke any tobacco products whilst wearing the t-shirt

9. Please do not use any recreational drugs before or whilst wearing the t-shirt

10. Please do not engage in any sexual activity whilst wearing the t-shirt

11. Please refrain from sleeping in the same bed as another person whilst wearing the t-shirt

12. Please will you place the t-shirt in the Ziploc® bag after wearing it on each night and seal the bag.

13. Please will you return the t-shirt in the sealed Ziploc® bag to the psychology masters room by 10:00am on the day following the second night.

As an incentive, all the t-shirt wearers were given a black t-shirt to keep. A R20 incentive was offered to those selected students who were later asked to re-wear the t-shirts. The t-shirts once returned were kept in an empty freezer.

A photograph of each of the participants' faces was taken using a Canon EOS M camera. Each t-shirt had a unique four-digit numeric code written in black permanent marker on the inside collar, which corresponded to another unique three-digit code given to each photograph. This was saved in a password-protected database to ensure the confidentiality of the participants and to ensure the obscurity of the scent and image connection. All six of the selected stimuli participants were heterosexual.

Procedure

Once the male stimuli participants were recruited and given an appointment time they arrived at the psychology lab (room 25) in the psychology building at the UKZN Pietermaritzburg campus the following day. Interestingly none of the participants arrived at their allotted time and a few non-recruited participants turned up, these individuals had been told about the study from their friends. Once informed consent was obtained from each participant, they were asked to fill out a brief questionnaire (Appendix D) indicating demographic information and then were taken one at a time into a connecting room to pose individually for the photograph. All photographs were taken with the same camera and background and at the same distance from the participant. All the participants were asked to look straight ahead without smiling, as smiling tends to affect attractiveness judgments (Otta, Abrosio, &

Hoshino, 1996). Photographs were taken of the participants faces from the top of the shoulders. The photographs were also all taken in greyscale to reduce the effects that skin tone and condition may have on attractiveness judgements (Penton-Voak, et al., 1999). Furthermore, the photographs were taken in the same room, in artificial light, thus eliminating any confounding variables that time of day might have had. Participants were all given identical white cotton t-shirts and a fragrance-free bar of soap in a sealed Ziploc® bag and asked to return just the t-shirt in the Ziploc® bag in two consecutive days' time to the masters' room in the psychology building at the Pietermaritzburg campus. Exactly 23 of the t-shirts were returned and all those participants were given a black t-shirt as a thank-you gift for their participation. From the 23 t-shirts collected, six were chosen for the final phase of data collection. Those shirts that were noticeably contaminated by other smells, such as cigarette smoke, deodorant or soap other than the one given or food, were eliminated from the pool.

After the initial second phase of data collection, deterioration of the SS had occurred as the scent on the t-shirts had been altered (Gravetter & Forzano, 2009). Therefore, it was necessary to re-acquire the scent of BO from the stimuli participants. The t-shirts were washed, without detergent and then given back to those six participants to re-wear. The participants were contacted via sms and email using the contact details that they had provided. All of the six participants agreed verbally to participate further in the study. The participants were once again explained the purpose and rules of the study and verbally agreed to participate again. The participants collected the t-shirts from the masters' room and returned them two days later. For their further participation, these individuals received an incentive of R20.00.

All researchers involved were knowledgeable of the study procedure and could answer any questions that participants may have had.

3.4.2. The Judges

Sampling and recruitment

The sample sizes from the various "t-shirt" studies conducted over the years differ quite significantly:

- Wedekind et al. (1995), 294 participants
- Thornhill et al. (2003), 142 participants
- Singh and Bronstad (2001) 52 participants
- Miller and Maner (2010) 37 participants
- Trouton et al. (2012) 53 participants

Based on previous similar studies, a minimum of 37 participants and a maximum of 200 was the estimated requirement sample for this study. Participants were recruited from the undergraduate population at the UKZN as well as members of staff from the Gay and Lesbian Network (GLN), based in Pietermaritzburg. It was vitally important to this study that a sufficient homosexual population was targeted in order to compare to a heterosexual population on which most sexual selection theory is normed. Therefore, because the initial recruitment did not yield a sufficient number of homosexual individuals, who were expected to naturally occur in the university population, it was necessary to seek participants from the GLN as the institution was most convenient and obliging in fulfilling the necessary requirement for homosexual participants, the sampling method was thus again convenience and purposive. Due to limited time for data collection unavoidable by the instrumentation of the scent on the t-shirts, only a small sample was obtained. The entire sample consisted of 52 individuals of mixed race, sex and SO; however, only 31 of those participants correctly completed the questionnaire. Of those who adequately completed the questionnaire ten were male and 21 were female, furthermore, of those 21 females 17 indicated they were heterosexual and 4 indicated they were either lesbian or bisexual. Of the ten males, six indicated they were heterosexual and the remaining four homosexual. Of those 21 females 12 stated that they were not ovulating. Although, the homosexual sample sizes are significantly smaller than the heterosexual sample sizes they are demographically over-represented, as according to Kunzig, (2008) at maximum only approximately 10% of the global population is homosexual although the exact prevalence of homosexuality is difficult to pinpoint especially in conservative and developing countries.

Participants from the UKZN were approached by a secondary researcher at the Golf road campus and invited voluntarily to partake in the study. Students were given directions to the classroom in the Psychology building where the main phase of data collection was to take place. In recruiting members from the GLN, the director of the institution was contacted via email and an appointment to discuss the study and study requirements was established. The researcher was invited to attend the institution's weekly meeting and hence recruited gay and lesbian participants.

Materials

For the main phase of data collection, several items were needed. Firstly, the stimuli made up of six identical white cotton t-shirts were needed. The t-shirts each corresponded to a photograph of a male face. Each of the t-shirts and photographs included a unique numeric code. In addition to the stimuli items a traditional paper and pencil questionnaire was also used.

The first few items on the questionnaire required disclosure of demographic information. This included age, sex, ethnicity and SO as well as an approximation of last menstruation for females (to estimate ovulation); this was in the form of forced choice response format. The next section of the questionnaire was a scale measuring androgyny; this was important in the assumptions of homosexuality and aided in assessing whether gender role conformity has any sway in SO as well as attractiveness and masculinity ratings. For this section the personal attributes questionnaire (PAQ) developed by Spence, Helmreich and Stapp (1973) was used. This scale comprises of 24 Likert-type scale items where "A" indicates a very close identification with the trait on the left and "E" a very close identification with the trait on the right. A copy of this scale can be found in Appendix F. Each item in the scale is indicated to be either extremely masculine (M), extremely feminine (F), a masculine to feminine polarisation (M-F), or undifferentiated (Spence & Helmreich, 1978).

```
Example of scale items
F-M     Not at all aggressive    A.......B.......C.......D.......E    Very aggressive
M       Not at all independent   A.......B.......C.......D.......E    Very independent
F       Not at all emotional     A.......B.......C.......D.......E    Very emotional
```

Figure 5: Example of PAQ items

Lastly included in the judges' questionnaire was a section in which participants were required to indicate their rankings of preference for both the photographs and T-shirts. Included in the questionnaire were four blank tables consisting of six numbered rows. Participants were asked to write the code for the t-shirt or photograph in the row corresponding to their perceived ranking of attractiveness or masculinity. The tables were designated as follows:

Please place the code on the back of the photographs in the block corresponding to the ranking of attractiveness.

1.	
2.	
3.	
4.	
5.	
6.	

Figure 6: Example of ranking scheme

Procedure

Once students had been recruited from the UKZN, they were shown to an empty room in the psychology building. Informed consent was obtained by explaining the aim and procedure of

the study and asking participants to sign a consent form, agreeing to answer the paper and pencil questionnaire as well as sniff and rank t-shirts and observe and rank photographs. Participants were asked to complete the questionnaire individually, and were given privacy when sniffing and ranking the t-shirts in order to avoid social desirability bias and peer influence. Completion of the entire questionnaire took approximately 15 minutes. The T-shirts and photographs were randomised between each participant in order to compensate for order and testing effects. The same procedure was used at the GLN. All of the researchers administering the questionnaire were aware of the procedure requirements and could answer all questions relating to the research.

3.5. Ethical Considerations

In any research where human participation is necessary, it is vital that the utmost care is taken to protect those individuals from any harm and ensure that consideration of their contribution to the construction of knowledge is acknowledged at each stage of the research design (Wassenaar, 2006). Thus, it is vital that an independent party review the ethical consideration of all research conducted with the intent to use human participants, to ascertain that no significant harm will come to them (Wassenaar, 2006). For this study, ethical clearance was obtained from University of KwaZulu-Natal, Humanities and Social Sciences Research Ethics Committee, reference code HSS/0720/013M (see appendix A).

3.5.1. Informed Consent and Respect for Autonomy

According to Wassenaar (2006) informed consent has often been an axiom of ethical research. Informed consent respects and protects the autonomy and confidentiality of the individual participant and typically comprises of four objectives:

1. Adequate information regarding the study be given

2. Participants' are competent and able to understand the information given

3. Participation must be voluntary and allow for participants to withdraw from participation

4. Explicit and official consent must be obtained before participation commences

This current study fulfilled these four objectives as follows.

For the stimuli participants, an information sheet (Appendix C) was given and a verbal explanation of the study aims and requirements. Participants were told verbally and in writing that their participation was entirely voluntary and that if they were uncomfortable with any aspect of the study or at any point during the study, they were free to end their participation without any discrimination from the researcher. Furthermore, the participants were told their role in the study as well as the rules that they were required to adhere to and why they were of importance. Participants were also given the contact details of the researcher and supervising researcher and told to contact these individuals if they had any queries, grievances or comments with the conducted research. The participants were also informed of the incentives of the study. Once participants were completely informed, they were asked to

sign a consent form (Appendix C), giving their consent to firstly wearing the t-shirt for two consecutive nights, and adhering to the rules, giving their contact details, to having their photograph taken and lastly to receiving the incentive. The identity, image and t-shirt connection as well as the contact details of the participants were stored in a password-protected database. The questionnaires were also locked away in a cupboard to ensure the confidentiality of the participants.

For the main judging sample of participants, individuals were given an information sheet and a verbal explanation of the study and study requirements. The judging participants were also told that their participation was confidential and voluntary and that they could withdraw their participation from the study at any time if they felt uncomfortable, and they would not be discriminated against. Identifying information was not required from the judging participants therefore ensuring their anonymity in the study. However, participants were asked if they would like to receive information regarding the outcomes of the research and were asked to provide contact details if so. These contact details were written on a separate sheet of paper and therefore not at all connected to the responses, thus protecting their anonymity. Furthermore, answered questionnaires were locked away in a cupboard after data collection, thus safeguarding confidentiality. The judging participants were also given the contact details of the researcher and supervising researcher if they were to have any queries, grievances or comments.

3.5.2. Non-Maleficence

Non-maleficence as a principle of ethical practice entails minimising any potential harm that could disturb the participant regarding the conduct of the research (Wassenaar, 2006). It was of particular importance during this research that at all phases of data collection and research that participants were treated with the utmost care and respect. None of the requirements of the study directly harmed any of the participants. However, the stimuli participants may have found participation time consuming and demanding, as they were required to follow a set of rules that limited possible daily routines for two days and they were asked to wear an item of clothing that was not theirs. However, as compensation for their efforts, they were offered an extra free t-shirt and were informed that they were free to withdraw their participation if it made them at all uncomfortable. These participants were treated with respect and in a courteous manner. Participants who were asked to judge the scent of these t-shirts may have also been embarrassed or offended by being asked to smell the t-shirts and were given the

opportunity to withdraw if they felt uncomfortable in anyway. Participants were also given privacy during the ranking phase of the questionnaire minimising any social discomfort or embarrassment that t-shirt sniffing may elicit. Furthermore, all participant's details and identifiable information was kept confidential and where possible anonymous. Absolute anonymity was not possible for the stimuli participants as their photographs were used in the study, however, this was explained to all the stimuli participants verbally and in writing before consent was given. No deception was necessary in this study therefore minimising any potential emotional harm to participants.

3.5.3. Beneficence

Beneficence according to Wassenaar (2006) is the ethical responsibility to provide some benefit for the research participant. For the stimuli participants, this was accomplished by providing an incentive of firstly a t-shirt and secondly a monetary gift of R20.00. Participants were also asked to sign a receipt of incentive. There were no other direct benefits for either the stimuli sample or the judging sample, and the participants were informed of this prior to signing the consent form. Participants were asked however, whether they would like to be informed of the anonymised outcomes of the study as a form of indirect benefit. Most participants indicated a positive response. For this reason, contact details were collected and stored securely and separately from questionnaire responses. After a period of five years from the completion of this research all electronic information regarding the participants will be deleted and any hard copy information including consent forms and completed questionnaires will be shredded.

3.5.4. Justice

Justice in research ethics is the fair and equitable treatment of research participants and the assurance that there is a favourable risk to benefit ratio for the participants (Wassenaar, 2006). In this study justice was applied by ensuring that all the individuals in the convenient population had an equal chance of being selected to participate. Furthermore, treatment of all the research participants was standardised, to ensure fairness and equity and to eliminate any discrimination or bias. Participants were all well informed of the study aims and requirements and participated voluntarily and without coercion.

3.6. Validity and Reliability

According to Loewenthal (2001), validity refers to how accurately the test or investigation is at measuring what is thought to be true whereas reliability refers to the consistency of the test at producing a particular outcome. Consequently, a test may be reliable, that is, it may be consistent, but not valid or accurate in its measure. In this section, the validity and reliability of the instrument of measurement (the questionnaire) will firstly be discussed, followed by a discussion of the threats to the internal and external validity of the study and how these were controlled.

3.6.1. The Questionnaire

The PAQ

For the scale PAQ scale developed by Spence, Helmreich and Stapp in 1973, Helmreich, Spence and Wilhelm (1981) conducted a psychometric analysis on three independent samples. Each of the three samples consisted of separate populations differing in age. The first sample was drawn from the population of New England high school students and consisted of 674 females and 509 male respondents. The second sample was recruited from the University of Texas and consisted of 1585 female and 1251 male respondents. The last sample used to assess the psychometric properties of the PAQ was taken from the general parental population recruited via a postal survey; of these respondents, 1028 were mothers and 926 were fathers. A factor analysis was conducted for each of the three populations sampled using only the F and M subscales (16 items) the MF scale was left out as it produced low internal consistency. According to the results produced by Helmreich et al. in 1981, the items indicated for the M scale had an average loading on the M factor of 0.51, and the F scale items had an average loading on the F factor of 0.53. F scale items did not load significantly on the M factor and neither did M scale items on the F factor.

The internal consistencies for each of the three samples were reported as "satisfactory and quite consistent across samples" (Helmreich, Spence, & Wilhelm, 1981, p. 1106) and are indicated in the table 4 below.

Table 4: Cronbach's alpha for F and M PAQ subscales from the psychometric analysis conducted by Helmreich et al. (1981)

PAQ subscales	High school respondents		University Students		Parents	
	Males	Females	Males	Females	Males	Females
M	.67	.71	.76	.73	.78	.77
F	.72	.73	.76	.73	.80	.79

Furthermore, Helmreich et al. (1981) showed that the PAQ had good criterion and predictive validity in a discriminant analysis as gender classification was 80% correct for high school students, 77% for university students and 81% for parents, furthermore the chi-squared values were all significant at the level of α=0.001. The PAQ is comparable to another measure of gender conformity, Bem's sex role inventory, as it was similarly able to correctly classify gender, therefore indicating the concurrent validity of the PAQ. According to Loewenthal (2001) concurrent validity refers to how different scales claiming to measure the same thing compare.

Although the psychometric analyses conducted in 1981 were "satisfactory and consistent", these analyses were conducted more than twenty years ago. Therefore, it is reasonable to assume that gender roles and norms may have changed somewhat. For this reason, estimates of internal consistency were calculated for both sexes for the M and F subscales for this study. The Cronbach's alpha for each sex on each subscale is reported in table 5 below.

Table 5: Cronbach's alpha for males and females for both the M and F PAQ subscales

PAQ subscale	Males	Females
M	.840	.262
F	.880	.644

From the internal consistencies reported above it would appear that the sample of women in this study were less consistent in their responses to the items regarding the M subscale. However, men were more consistent in their responses to both M and F subscales in comparison to the psychometrics reported by Helmreich et al. (1981). The internal consistency of female responses regarding the F subscale was moderately satisfactory however not as impressive as male consistency. This may suggest that since the development

and testing of the psychometric properties of the PAQ in 1981, women, more so than men have changed their perception of gender roles in particular to the conformity of masculine gender roles. However, the values of internal consistency for the PAQ for this study were calculated from small sample sizes and therefore may be inaccurate in their estimation of criterion and predictive validity. Larger samples would need to be obtained for greater accuracy.

A chi-square analysis was conducted comparing sex, SO and groups of sex by SO to further assess the association of the PAQ with sexuality and gender role conformity, the results of this analysis are reported in chapter 4.

Ranking scale

In this study as compared to previous t-shirt studies (Singh & Bronstad, 2001; Thornhill & Gangestad, 1999; Thornhill, et al., 2003; Trouton, et al., 2012; Wedekind, et al., 1995), participants were asked to rank stimuli items in order of attractivness. Previous studies used Likert scales or rating scales as a measure for participants to indicate the attractiveness of the scent and or visual stimuli. However, the researcher expected that response bias may lead the judges in this study to consistently rate the scent of the t-shirts negatively because of the unfavourable connotations associated with BO. Therefore, by asking participants to rank the stimuli, it forced respondents to indicate their preference, and minimises the influence of response bias or consistent "nay saying". To assess the inter-rater-reliability and consistency of the rankings a Kendall's coefficient of concordance $\widetilde{W}$ was used. The statistic $\widetilde{W}$ was also used in the main analysis as a measure of effect size for the Friedman's test as well as to assess pairwise comparisons, therefore the reliability statistics of this scale will not be presented here, but will be presented and discussed in chapter 4.

The criterion validity of this the ranking scale was influenced by previous studies although not entirely dictated by them. In this study the criteria or measures for ranking the visual and scent stimuli were attractiveness and masculinity. In previous t-shirt studies, the criteria for rating the stimuli were often threefold and included ratings of pleasantness, sexiness and or intensity (Trouton, et al., 2012; Wedekind, et al., 1995; Singh & Bronstad, 2001; Thornhill & Gangestad, 1999). However, Wedekind et al. (1995) found that using both pleasantness and sexiness was redundant as they correlated very highly, therefore only the measure of pleasantness was reported on. It was deemed by the researcher of this current study that

"attractiveness" was a cumulative term for both pleasantness and sexiness. In addition, the term "attractiveness" is defined as how attractive one individual or object seems to another, whereas, the term pleasantness and sexiness both may not necessarily imply attraction specifically.

It was also necessary to establish whether masculinity as a construct was judged similarly to what previous research suggests. According to Thornhill and Gangestad (1999) masculinity is precipitated by a pronounced jaw, facial hair and a heavier set brow, which would be evident in the photographs. Measures of reliability such as $\widetilde{W}$ would indicate whether the features that are deemed masculine in the literature are validated by the consensus of the sample. Furthermore, whether individuals consider visual masculinity (VM) similarly to scent masculinity (SM) and how these rankings of masculinity fared against rankings of attractiveness, especially for women. Therefore, it was necessary to include both measures of attractiveness and masculinity to provide criterion validity to the study.

3.6.2. Threats to Internal and External Validity

According to Tredoux and Smith, (2006) a study has internal validity if the conclusions drawn from the research can be logically deduced from the design and methods employed for assessing the hypotheses. External validity, alternatively, refers to the extent to which the results of the study can be accurately applied to the other contexts or populations and how relevant the conclusions are to the world in general (Tredoux & Smith, 2006). According to Tredoux and Smith (2006), there are three dimensions of research design, the first is descriptive, the second relational, and the third is comparative. This research is comparative as it uses a quasi-experimental design. The study is condsidered quasi-experimental as true randomisation was not possible as the experimental groups are pre-existent, (sex and SO). Furthermore, due to the time sensitive nature of the data collection period because of the risk of instrument decay, matched samples of adequate size were not possible to obtain, and therefore, randomization rather than matching was used in the recruitment of participants to the experimental groups. Furthermore, for those experimental group samples that were severly unbalanced, procedures of oversampling with replacement were incorporated into the analysis to establish balance and decrease the potential for smaller samples to be underrepresented. However, the method of oversampling may introduce pitfalls of its own as the variance within the oversampled group may be reduced.

Extraneous and confounding variables

Tredoux and Smith (2006) state that confounding variables are any extraneous elements that may inadvertantly affect the outcome of a study and thus subvert the internal validity of the research. Therefore it was vital that the researcher aimed to control for as many confounding variables as was possible, as the validity of the conclusions drawn depended upon it. In this study, a number of possible extraneous variables were considered as potential threats to the internal validity of the research. Firstly the demographics of the participants both for the stimuli and judges was considered to be potentially confounding.

For the stimuli participants, age, race and SO was controlled for. Firstly as there were only six stimuli participants any significant variation in the age of the participants may affect how they appear visually and affect the degree of T that they produced and consequently how attractive or masculine they presented. Therefore the age range of the stimuli participants was limited between 19 and 25 years. The race of the stimuli participants was also considered a threat to the internal validity as mentioned previously, as it is intrinsically linked to culture and subsequently diet which would affect BO (van Beek, 1992). Therefore only two race groups were used to create the stimulus, black and white and were matched accordingly. Furthermore, according to the biological theories described in chapter 2 regarding SO, hormonal differences often occur in differing SOs, which would affect the pheromones secreted. Therefore, all of the stimuli items used in the study were produced by participants reported to be heterosexual. Additionally the stimuli participants were asked to follow a set of guidelines as used by Thornhill and Gangestad (1999) which, if followed would eliminate the potential for confounding scents to contaminate the t-shirts. These guidelines included an avoidance of smoking, and recreational drug and alcohol use whilst wearing the t-shirts, the avoidance of sexual encounters whilst wearing the t-shirts as well as the avoidance of particular foods. Participants were also asked to refrain from using any fragranced cosmetic products whilst wearing the t-shirts and were given a fragrance free soap to wash with, thus ensuring that only the natural BO was left on the t-shirt. Participants were reminded not to wash the t-shirts. All of the T-shirts given to the participants were identical in size and colour, thus eliminating any confounding effect that size or colour preference may have. Furthermore, the use of only six male stimuli participants may have limited the range of represented attractive and masculine men in terms of the stimuli target population. A larger stimulus range may have been necessary to obtain adequate variation amongst the stimuli. Any other extraneous variables that could potentially threaten the internal validity of the

study were either impractical or unethical to measure, such as disease or hormonal imbalance and therefore were not accounted for.

For the judging participants, confounding variables such as menstrual phase, race and age were also considered to potentially confound the results. Therefore an estimation of menstruation for female participants was included in the questionnaire and ovulation estimated from that. This however, is not the most accurate measure of detecting ovulation as women may not be accurate in their estimations and furthermore, the assumption that all the female participants have regular menstrual cycles was made. A more precise indication of ovulation would have required the implementation of ovualtion tests, which would have been infeasable and potentially unethical. Therefore the basic estimation of ovulation was used. Additionally in the creation of the questionnaire, the potentially confounding affects that hormonal contraceptives used by women could have, was overlooked and therefore questions regarding hormonal contraceptive usage was not included. This may be a confounding factor in the study (Wedekind, et al., 1995; Singh & Bronstad, 2001). For the judging participants, all races were included, as race was only an important consideration in the production of BO. However, additional analyses were still conducted to assess whether race did signicantly predict the way any of the individuals ranked the visual and scent stimuli, although this was not expected. Age was also included in additional analyses as a potential confounding variable. Previous literature suggests, that men regardless of age prefer younger partners and women generally prefer older partners (Geary, Vigil, & Byrd-Craven, 2004). This, however, is predominently shown in heterosexual populations, additional analyses were conducted assessing whether age and SO were associated with regard to preference rankings.

Campbell's Schema

In 1957, Campbell proposed a schema for assessing the internal and external validity specifically in experimental research. Campbell (1957) identified six potential threats to the internal validity of a study design which include the threat of covarying events, maturation, testing effects, instrument decay, statistical regression to the mean and subject mortality. For this study Campbell's schema for identifying threats was quite useful, although not all the threats were applicable.

The first threat identified using Campbell's schema, was the threat of covarying events. According to Campbell (1957), this is the potential for outside, extraneous events occuring that would affect the attitudes or behaviours of the repondents. Because the sampled

population of this study included students from UKZN, threats of this nature may have included disruptive conduct in and around the UKZN campus (i.e. protest action), or prior commitments such as lectures which may have rushed respondents in there completion of the ranking process. Therefore, all respondents were asked before being recruited if they were available and then shown to a private room, whereby no other individuals or distractions were present and participants were able to complete the entire procedure without the influence of covarying events.

Order effects were of significant consideration with regard to the threat of testing effects as the research made use of a repeated measures design, where each subject was asked to rank multiple stimuli (treatment conditions). Order effects may threaten the internal validity of a study as the dependant variable or in this case the rankings may be determined by the order in which stimuli are presented rather than the independent variable (Gravetter & Forzano, 2009). Although no randomisation steps were implemented to order the presentation of the stimuli to the participants, they were allowed to look at each VS and smell each t-shirt more than once and in any order. It was therefore unlikely that the order in which participants viewed and smelled each stimulus was the same for any participant.

This study was also vulnerable to the threat of instrument decay. According to Campbell (1957), the threat that instrument decay may have on the internal validity of a study occurs when a change in the instrument of measurement influences the outcome of the dependant variable. In this study instrument decay occurred in two ways. Firstly, Campbell (1957) suggests, particularly in the social sciences, that the instrument of measurement can often be human subjects, which is the case in this study as particpants are asked to be judges by providing rankings. Instrument decay in this case would occur due to olfactory fatigue as participants were asked to smell a number of t-shirts, and their ability to discriminate between smells, especially when they are subtle as in the t-shirt, would be affected. For this reason, participants were asked to smell a lemon between each t-shirt in order to refresh their olfactory senses. The second way in which instrumnet decay occurred, and which was most problematic to the recruitment of adequate sample sizes, was the decay of the t-shirts. That is that the t-shirts began to lose their scent and became contaminated by other scents. It was therefore necessary to wash the t-shirts without detergent, to reduce the effect that detergent may have on scent and ask the stimuli participants to rewear the t-shirts. Fortunately all six of the original participants agreed to further participate in the study and received a further incentive of R20.00.

Threats to External Validity

External validity refers to sample selection and whether conclusions drawn from a study would be relevant and applicable to other samples or populations (Tredoux & Smith, 2006). In this study, purposive and convenience sampling was used to recruit participants. The judging participants were selected from the student population at the local UKZN campus as well as the local GLN. Furthermore, sample sizes were small which would convey an underrepresentation of the actual population. Therefore the external validity concerning the generalisability of the results to other populations is unfortunately biased, and conclusions drawn from that data may only be generalised to the specific population it was drawn from.

3.7. Data Analysis

In order to answer the research questions satisfactorily, a series of stages were implemented in the analytical approach. The data consisted of multiple factors, including SO, sex, stimuli (photograph or t-shirt), and measure of ranking (masculine or attractive) as well as psychometric data obtained from the PAQ androgyny scores. The dependant variable was the final rankings of preference given to the stimuli across both measures, attractiveness and masculinity. All information used in the data analysis was obtained from the questionnaires. Data analysis was conducted using Microsoft (MS) Excel and the statistical package for the social sciences (SPSS). Firstly, the data were cleaned and coded into MS Excel and then transferred into SPSS. Frequency tables and pie charts were created to establish the count of male, female, homosexual, and heterosexual individuals as well as response rates and missing data. Only those individuals who answered all of the questions satisfactorily were included in the final analysis. Due to the small dataset (N=31) and relatively smaller sample sizes for the individual groups as well as the outcome variable being ordinal in nature, non-parametric tests were used in the analysis.

Nonparametric tests are uniquely advantageous to this particular study and dataset as according to Siegel (1956) nonparametric tests:

- Do not make assumptions about the distribution of a population
- Apply particularly to ranked data and not necessarily exact numerical scores
- They are relatively simple to calculate
- They are appropriate for use with small sample sizes.

Therefore, for each phase of the data analysis the most appropriate nonparametric test was selected to address each of the objectives. Additionally, as respondents were asked to repeat the ranking process for each stimulus and measure, nonparametric related samples tests were used namely, the Friedman's two-way analysis of variance test. Furthermore, a measure of concordance was necessary to obtain a measure of agreement between rankings or intra-judge reliability and therefore Kendall's coefficient of concordance was used.

3.7.1. Friedman's Two-way Analysis of Variance by Ranks

The Friedman's test is a non-parametric measure of analysis used for testing ranked and ordinal data for k number of samples. Friedman's test produces a chi-squared estimate which can be used with chi-square distribution table to ascertain significance. According to Siegel (1956) the power efficiency of the Friedman's test is comparable to that of the F-test and therefore is the preferred non-parametric test for comparing k related samples of ordinal data. According to Sheskin (2007), the Kendall's coefficient of concordance is a reliable measure of effect size for within subjects design such as Friedman's two-way ANOVA.

The hypotheses for the Friedman's two-way ANOVA test are as follows:

Null hypothesis: H_0: $\theta_1 = \theta_2 = \theta_n$: That all sample medians are equal across ranked groups

Alternate hypothesis: $H_1 \neq H_0$: That there is at least one difference between k ranked sample medians

	Stimulus 1	Stimulus 2	Stimulus 3	Stimulus 4	Stimulus 5	Stimulus 6
Heterosexual men	6	4.5	4.5	3	1	2
Homosexual men	1.5	3.5	6	5	3.5	1.5
Heterosexual women	4.5	2	2	2	6	4.5
Homosexual women	4	2	4	4	6	1
$\sum R_j$	16	12	16.5	14	16.5	9
$\sum R_{j^2}$	256	144	272.25	196	272.25	81

Figure 7: Example of layout for Friedman's two-way ANOVA

The Friedman's test identifies differences between the items or objects being ranked, if a difference occurs, it indicates that overall each of the items was given a similar rank by each of the judges or set of judges. However, if there is no difference between the ranked objects, it suggests that each of the judges or set of judges considered the items differently, so the sum of the ranks for each item would produce similar scores as seen in figure 7, which illustrates how a Friedman's test would be set up. The columns indicate the items that are ranked and the rows indicate the judges and the sum of ranks ($\sum R_j$) row indicates that there is very little difference between the sums of the ranks for each item. Therefore, indicating that each item would have a wide range of rankings from the sets of judges, indicating that the judges would have differences of opinion.

Equation 1: Friedman's two-way analysis of variance by ranks

$$x_r^2 = \frac{12}{Nk(k+1)} \sum_{j=1}^{k} (Rj)^2 - 3N(k+1)$$

N = number of rows or judges

k = number of columns or items being ranked

R$_j$ = sum of ranks for each ranked item

3.7.2. Kendall's Coefficient of Concordance ($\widetilde{W}$)

Kendall's $\widetilde{W}$ estimates concordance or association indicating whether the individuals within a group agree in terms of the order of ranking. The $\widetilde{W}$ statistic will always fall between 0 and one, where zero indicates no agreement and one, perfect agreement in how a set of stimuli should be ordered. According to Siegel (1956) $\widetilde{W}$ indicates overall agreement between k sets of rankings. Therefore, $\widetilde{W}$ is often referred to as a measure of inter-judge reliability (Sheskin, 2007). For the analysis of data concerned in this study, $\widetilde{W}$ will serve three roles, firstly as a measure of inter-judge reliability and secondly as Sheskin (2007) suggests as a measure of effect size for the Friedman's two-way ANOVA and thirdly as a post hoc test to show individual comparisons of association. The hypotheses for $\widetilde{W}$ are as follows:

Null hypothesis: H₀: W=0: that there is no significant correlation or agreement between k sets of rankings

Alternate hypothesis: H₁: W≠0: That there is significant agreement amongst k sets of rankings

Equation 2: Kendall's coefficient of concordance:

$$\widetilde{W} = \frac{12S}{k^2(n^3 - n) - kT}$$

Where

       k= number of judges

       n=number of ranked objects

       T= number of ties

S= sum of squares of observed differences from the mean of R_j:

$S = \sum \left(R_j - \frac{\sum R_j}{N} \right)^2$, R_j= sum of the ranks applied to each object being judged

Kendall's $\widetilde{W}$ was calculated for groups of: men, women, heterosexual and homosexual individuals, highly masculine, feminine, and androgynous individuals indicated by the PAQ, race groups, and lastly, HeM, HoM, HeF, and HoF groups. Kendall's coefficient of concordance was calculated using MS Excel.

3.7.3. Bootstrapping

Due to the small sample sizes, it was suspected that the power of the study would be compromised and the chance of a type two error occurring would increase. According to Lachenicht (2002) a type two error occurs when one does not reject a false null hypothesis. In the analysis of the study the majority of the tests proved insignificant, this could therefore be attributed to a high beta score and low power produced by the small sample size. Therefore, a bootstrapping procedure was applied to the calculations of all the statistics. A traditional nonparametric bootstrapping procedure was applied to the data . Bootstrapping allows one to create an estimated distribution of the population from a smaller resampled distribution of data (Chernick, 2008). This procedure involves resampling the original sample with replacement, and then recalculating a test statistic for each iteration of the resampled sample for m permutations thus providing a parameter estimate (Chernick, 2008). According to Winston (2004) bootstrapping can be performed in MS Excel by using a number of functions. Firstly, the sample or subsample that is to be bootstrapped is indexed. This index then provides the range for which randomised resampling with replacement can be performed (Winston, 2004). This means that an original sample of n subjects may reproduce a resampled sample of n subjects however, with some subjects repeated and some subjects unrepresented (Sprent, 1989). Winston (2004), then suggests using the *VLOOKUP* function in MS Excel to find the corresponding data scores from the original data sample that matched each indexed subject in the resampled sample. The test statistic of interest is then calculated for the resampled sample for each of m permutations of the resampling process (in this study all original samples were resampled $m=10000$ times). The distribution of the bootstrapped test statistics are then presented in a data table in MS Excel and parameter estimates regarding the test statistic can be calculated from this (Winston, 2004; Chernick, 2008; Sprent, 1989). Figure 8 below illustrates how data is bootstrapped in MS Excel.

Original sample

index	Stimulus 1	Stimulus 2	Stimulus 3	Stimulus 4	Stimulus 5	Stimulus 6
1	6	4	5	2	3	1
2	3	1	6	5	2	4
3	2	4	1	5	3	6
4	3	4	6	2	5	1
5	3	4	6	2	5	1
6	2	5	6	4	3	1
7	2	6	1	4	3	5
8	1	5	3	4	2	6
9	3	2	1	5	4	6
10	3	4	6	2	5	1

	28	39	41	35	35	32	210
	-7	4	6	0	0	-3	
	49	16	36	0	0	9	110

Kendall's W	0.062857

Resample with replacement

index	Stimulus 1	Stimulus 2	Stimulus 3	Stimulus 4	Stimulus 5	Stimulus 6
4	3	4	6	2	5	1
6	2	5	6	4	3	1
2	3	1	6	5	2	4
6	2	5	6	4	3	1
10	3	4	6	2	5	1
7	2	6	1	4	3	5
5	3	4	6	2	5	1
5	3	4	6	2	5	1
6	2	5	6	4	3	1
8	1	5	3	4	2	6

	24	43	52	33	36	22	210
	-11	8	17	-2	1	-13	
	121	64	289	4	1	169	648

Kendall's W	0.370286

Resampled with replacement from the original data

Each entry in the data table is a recalculation of the test statistic (Kendall's W) from the sample resampled $m=10000$ times

Data Table

0.3703
0.0870
0.0676
0.0383
0.0816
0.0751
0.1005
0.0712
0.1194
0.0512
0.0049
0.0536
0.0764
0.0764
0.1088
0.1145
0.1337
0.0287
0.1272
0.1052

cont to m^{th} permutation

Figure 8: Illustration of bootstrapping method used

The estimation of the bootstrapped statistic is often referred to as theta (θ). A distribution fitting procedure can be applied using MS Excel to estimate how closely the bootstrapped distribution would fit to a normal distribution given the mean and standard deviation of the bootstrapped data. When the bootstrapped data is not normally distributed it is suggested that the percentile method rather than the central limit theorum for calculating confidence limits is preferred. The percentile method defines the confidence interval as the range of the θ distribution that excludes any scores below or above the the level of confidence the researcher has set at correctly rejecting the null hypothesis (i.e. α) (Chernick, 2008). Although the percentile method with a correction for bias would be most appropriate as the data did not always produce a Gaussian distribution, it requires complex calculations that without the necessary sophisticated computer software would be impractical for the amount of bootstrapped statistics in this study (Chernick, 2008). Therefore, for all bootstrapped measures, conclusions drawn must be done so with caution as parameter estimates may be biased. The calculation of the confidence limits for a 95% confidence interval required finding the 2.5th percentile for the lower limit and the 97.5th percentile for the upper limit. Furthermore one can approximate with caution whether the test would produce a significant result from bootstrapped data given the confidence intervals.

3.7.4. Objective 1

For both question one and two the level of agreement between respondents was calculated using $\widetilde{W}$. It was firstly necessary to evaluate the level of agreement amongst all respondents for each measure and stimulus, that is overall agreement for rankings of: visual attractiveness (VA), visual masculinity (VM), scent attractiveness (SA) and scent masculinity (SM). In all four stimuli measurement groups the number of judges (k) remained constant at 31, and the number of items being ranked (n) was always six (photographs and t-shirts). A bootstrapping method was applied to this calculation as the small sample size may have produced a biased estimate of the population.

Question one:

Is male attractiveness and perceived masculinity judged similarly?

In order to address the first question, $\widetilde{W}$ was calculated to ascertain the level of agreement between the ranks of attractiveness and masculinity for both the photograph and the t-shirt. In this instance k=62, as each of the 31 respondents gave rankings for both measures of attractiveness and masculinity for each stimulus. A Friedman's two-way ANOVA was then used to assess whether respondents ranked stimuli on the measure of attractiveness differently to the measure of masculinity

The median of the rankings for each stimulus item for all 31 respondents was calculated within each of the four groups explored in objective one and two, i.e., rankings of photograph attractiveness, photograph masculinity, t-shirt attractiveness and t-shirt masculinity. For objective one, all comparisons made were between the measures of attractiveness and masculinity, with the type of stimulus held constant in each comparison. For example, the median average ranks of photograph attractiveness were compared to the median average ranks of photograph masculinity and the same was applied to the t-shirt stimulus measures using a Friedman's two-way ANOVA test. A bootstrapping procedure was applied to the calculation of Friedman's two-way ANOVA using the median ranking of each stimulus for all 31 subjects resampled 10000 times. The data was set out as follows:

Table 6: Friedman's two-way ANOVA by ranks comparison across attractiveness and masculinity

	VA median average rank[a]	VM median average rank[a]	SA median average rank[b]	SM median average rank[b]
stim1	3	2	5.5	2.5
stim2	3	4.5	3	5
stim3	6	2	5.5	2.5
stim4	5	2	3	2.5
stim5	3	4.5	1	6
stim6	1	6	3	2.5

Superscript letters denote between which groups tests were conducted

In order to ascertain whether ovulating women did indeed find more masculine looking and smelling men more attractive during ovulation, two Friedman's tests were run. In the first Friedman's test rankings of VA and VM for both ovulating and non-ovulating women were compared. Both Friedman's tests were bootstrapped, which meant that each block in Figure 9 below contained the average rank for the set of medians for each of the stimuli items for each group, with the group resampled with replacement for 10000 iterations.

Friedman's two-way analysis of variance comparing rankings across menstrual phase and mode of ranking							
Menstrual phase	Stimulus	1	2	3	4	5	6
Luteal phase	Photo attractiveness						
	Photo masculinity						
Follicular phase	Photo attractiveness						
	Photo masculinity						
R_j							
R_j^2							

Figure 9: Diagrammatic representation of how the Friedman's two-way ANOVA by ranks was conducted comparing the ranks by menstrual phase

The data was set out similarly in the second of the Friedman's tests, however, for the scent stimuli (t-shirts).

After the Friedman's tests, a series of $\widetilde{W}$ tests were run to assess the concordance between attractiveness and masculinity rankings of the VS, and then the scent stimulus (SS) between women who were estimated to be firstly in the follicular (non- ovulating) phase of their cycle, and then secondly for women in the luteal (ovulating) phase of their cycle. Kendall's $\widetilde{W}$ was also used to assess whether there was concordance amongst the individual groups of ovulating and non-ovulating women. Due to the small sample sizes in these comparisons, a bootstrapping procedure was conducted on the calculations of $\widetilde{W}$, using a sampling with replacement method as used with the Friedman's analysis.

Question two:

<u>Do the rankings of attractiveness and masculinity of the t-shirts correspond with the criteria rankings of the photographs?</u>

To address the question in objective two, a similar process of analysis to objective one was applied. Firstly $\widetilde{W}$ was calculated, however, in this case comparing rankings between stimuli (i.e. the photograph and t-shirt) with the measure of attractiveness or masculinity held constant. Subsequently, a Friedman's two-way ANOVA test was applied in a similar fashion to the first objective. Firstly, the average rank of the medians for each of the six stimuli items for each of the four measures was calculated; however, in this case the test assessed for differences between stimulus groups with the measure of attractiveness and masculinity matched.

Table 7: Friedman's two-way ANOVA by ranks comparison across visual stimuli and scent stimuli

	VA median average rank[a]	SA median average rank[a]	PM median average rank[b]	SM median average rank[b]
stim1	3	5.5	2	2.5
stim2	3	3	4.5	5
stim3	6	5.5	2	2.5
stim4	5	3	2	2.5
stim5	3	1	4.5	6
stim6	1	3	6	2.5

Superscript denotes across which groups the test was conducted

3.7.4. Objective 2:

Question 3

<u>Does the sex of an individual determine how attractive or masculine they find certain faces and male body odours?</u>

In order to evaluate whether sex does indeed determine how individuals rank the attractiveness and masculinity of faces and BOs, a Friedman's test was run. The Friedman's test compared the average median ranks from each sex group, matched on each of the four ranking criteria: attractiveness and masculinity for the VS as well as the SS. The Friedman's calculations comparing sex were then bootstrapped using the traditional method in order to estimate a population approximation.

Of the 31 participants who acted as judges, 21 of them were female and only 10 were male, this meant that the sample sizes between the sexes was unbalanced which may have affected the measures of $\widetilde{W}$, causing the smaller group to be underrepresented in combined measures of $\widetilde{W}$ (Imbalanced data- Finding Waldo, 2016). According to the webpage, Imbalanced Data-Finding Waldo (2016), there are a number of ways in which the problem of unbalanced data can be resolved. To even out the sample sizes of the sex groups, it was suggested that an over-sampling with replacement method be used for the smaller of the two groups, thus, producing two groups with equal sample sizes, In the case of this study, women would retain their sample size n=21 and men would be oversampled with replacement to match that of the women's sample size. This method however, does reduce the variance within the resampled samples. Below is an example of how this would be conducted in MS Excel.

Original male sample

Index	Stimulus 1	Stimulus 2	Stimulus 3	Stimulus 4	Stimulus 5	Stimulus 6
1	6	1	5	3	4	2
2	2	5	1	4	3	6
3	1	3	2	4	5	6
4	2	5	3	1	4	6
5	3	1	5	2	6	4
6	4	2	1	6	3	5
7	3	6	4	2	6	5
8	4	6	2	1	3	5
9	1	5	4	6	3	2
10	2	6	1	3	4	5

Male sample, oversampled with replacement

Index	Stimulus 1	Stimulus 2	Stimulus 3	Stimulus 4	Stimulus 5	Stimulus 6
5	3	1	5	2	6	4
1	6	1	5	3	4	2
5	3	1	5	2	6	4
5	3	1	5	2	6	4
9	1	5	4	6	3	2
1	6	1	5	3	4	2
2	2	5	1	4	3	6
3	1	3	2	4	5	6
10	2	6	1	3	4	5
1	6	1	5	3	4	2
8	4	6	2	1	3	5
6	4	2	1	6	3	5
1	6	1	5	3	4	2
5	3	1	5	2	6	4
4	2	5	3	1	4	6
6	4	2	1	6	3	5
3	1	3	2	4	5	6
8	4	6	2	1	3	5
8	4	6	2	1	3	5
7	3	6	4	2	6	5
9	1	5	4	6	3	2

Each row from the original sample is randomly drawn and replaced n=21 times

Figure 10: Example of oversampling with replacement to equate unequal sample sizes

It is suggested that oversampling is a better method for equating the sample sizes than under-sampling, i.e. randomly omitting cases from the larger sample to equate the unbalanced samples, as potentially important data is lost although this may lead to a reduction in variance (Imbalanced data- Finding Waldo, 2016). Equating the sample sizes was not necessary for calculations regarding the Friedman's test as the test required only median average rankings to calculate the statistic. The $\widetilde{W}$ statistic however, required that the sum of the ranks for each group be calculated, which would be biased by unbalanced sample sizes. The $\widetilde{W}$ statistic was calculated for women, men (resampled with replacement to match the sample size of the women), and for women and men combined, although, with sample sizes matched unlike in previous all round calculation of $\widetilde{W}$. This was conducted for all the ranking criteria. Kendall's $\widetilde{W}$ was then bootstrapped to estimate test parameters and to ascertain to what degree the sexes agreed, if the Friedman's test proved no differences existed and furthermore, to show whether the sexes individually were concordant in their rankings.

Question 4

Does the sexual orientation of an individual determine how attractive or masculine they find certain male body odours?

Firstly, a Friedman's test was used to assess whether any differences in rankings between the SOs occurred for each of the two measures and stimuli. These measures were further bootstrapped as sample sizes were small and a population estimate would be more accurate from the bootstrapped data. The sample sizes for the differing SOs was severely unbalanced, for heterosexual individuals n=23 and for homosexual individuals n= 8, therefore a similar procedure to addressing objective three was applied to evaluating objective four. Firstly, the smaller of the sample sizes was matched to the larger sample size for each of the SOs using a resampling method in MS Excel then $\widetilde{W}$ was calculated for the SOs together, and individually. Kendall's $\widetilde{W}$ served as a measure of effect size for the Friedman's calculation as well as a measure of inter-judge reliability.

Question 5

Do the groups defined by both sex and sexual orientation determine how attractive or masculine they find a visual and scent stimulus?

To evaluate whether the interaction of sex and SO affected the rankings of the stimuli for both ranking criteria a Friedman's two-way ANOVA by ranks was calculated to assess whether there was at least one significant difference between the groups. This statistic was further bootstrapped. Following the test of significance, a series of $\widetilde{W}$ tests were run for each of the four sexual groups. It was predicted that HeM, HoM, HeF and HoF groups, would have good and significant concordance amongst themselves, as it was expected that these individuals would regard the attractiveness and masculinity of visual and scent stimuli similarly being of the same sex and SO. Kendall's $\widetilde{W}$ was also calculated to assess the agreeableness between pairwise sex groups with group sample sizes matched on sex by SO, for example heterosexual women were the largest group (n=17), therefore the sample for underrepresented groups was oversampled with replacement to n=17. Kendall's $\widetilde{W}$ was also calculated for agreement between sex by SOs of opposite sex and SO, i.e. agreement amongst HeW and HoM, however with sample sizes matched. The $\widetilde{W}$ statistics were bootstrapped on all accounts.

3.7.5. Additional Analyses

Personal attributes questionnaire

SPSS was used to analyse the PAQ data. For the PAQ, items for each participant were coded as 1, 2, 3, 4, or 5, depending on how the participant agreed with the item statements on a Likert style format: a selection of 1 indicated strong disagreement, 3, unsureness or indifference and 5 strong agreement. All the items in the sample correlated with either a masculine, feminine, or an androgynous construct. The scores for each participant were tallied for the items for each of the three constructs to give and overall score of masculinity, femininity and androgyny, for each participant. The masculinity and femininity scores were then compared to give an overall gender identification classification for each participant. This was completed in accordance with the instructions given by Weiten, Dunn, and Hammer (2012) where participants were catagorised as shown in table 9.

Table 8: Indication of androgyny categorization

		Femininity Score	
		High (24-32)	Low (0-23)
Masculinity	High (24-32)	Androgynous (coded as 4)	Masculine (coded as 3)
Score	Low (0-23)	Feminine (coded as 2)	Undifferentiated (coded as 1)

The items from the PAQ that indicated how androgynous an individual was were then coded as a dummy variable, with a score of one indicating conformity or identification with androgynous traits and zero indicating non-conformity. However, there was only one individual who identified with the androgynous traits and thus that construct was left out of further analysis and only the androgyny scores collated from the masculine and feminine scores were used in the final analysis. It was also suggested by Weiten et al., (2012) that only the masculinity and femininity scores be used in the calculation of classifications.

A crosstabulation and chi squared analysis was run comparing the PAQ classifications with sex, SO and the sex by SO groups to determine whether any significant associations existed between the groups. Any significant associations between the groups would indicate that sex, SO and or the sex by SO groups are related to specific personality traits. According to Spence and Helmreich (1978), the creators of the PAQ, the traits measured by certain items in this

scale are aligned with gender norms. Therefore, any significant associations in the crosstabulation and chi squared analysis would indicate that a particular sex, SO and or sex by SO group conforms to either masculine or feminine traits or niether, or in the case of androgyny to both masculine and feminine traits. This result will give a tentative indication of social conformity

$\widetilde{W}$ calculations were conducted to ascertain whether there was any significant concordance between the PAQ groups and sex by SO groups that showed any signifcant specific associations as determined by the residuals. Any specific association regarding the PAQ masculine score however was ignored as only one individual in the entire sample was classified as PAQ masculine. This finding may suggest either a biased sample which is confounded by the use of a convenience sampling method, or, that the PAQ test is outdated and the notion of 'masculinity', has changed since the production of the test.

Additional analyses regarding other demographics: race and age

Kendall's $\widetilde{W}$ was calculated for each race and age groups, with smaller samples matched to the largest group sample, to counteract bias caused by the unbalanced samples. Understandably, race and age are potentially confounding variables which could significantly affect the results. However, with non-parametric statistical procedures as is used in this study, it is very difficult to control confounding variables as factorial non-parametric designs are complex and require specialised computer software.

Chapter 4: Results

4.1. Demographic and Descriptive Statistics

Table 9 is a frequency table and shows the variation of respondents across sex, SO, race and age groups. The largest group was black non-ovulating women in the age range of 18-25 which made up 16.12 % of the sample; the next largest group was Indian ovulating women aged between 18-25 years which contributed to 12.9% of the sample. A number of specific groups contain no respondents or a very limited number. Therefore, due to a lack of matching and a distinct under-representation of some groups it was vital to heed caution when analysing and interpreting results. Severely under-represented groups were dropped from the analysis

Table 9: Sample sizes according to sex, sexual orientation, age, and race

	Heterosexual				Homosexual				Grand Total
	Black	White	Indian	Mixed race	Black	White	Indian	Mixed race	
Men	3	2		1	2	1		1	10
18-25yrs	3	2		1					6
26-30yrs					2			1	3
30+yrs						1			1
Women	8	1	6	2	2		2		21
Ovulating	3		4				2		9
18-25yrs	1		4				2		7
26-30yrs	2								2
not ovulating	5	1	2	2	2				12
18-25yrs	5	1	2	2	2				12
Grand Total	11	3	6	3	4	1	2	1	31

Of the 31 participants that were used in the questionnaire, 81% were between the ages of 18-25, 16% were between the ages of 26-30 and only 3% were over the age of 31 years. The demographics collected from the questionnaire indicate that the majority of respondents were female (67%) whilst only 33% were male. The ages for females ranged between 19 and 30 ($\bar{x}$ = 21.76, s = 2.91) and for males between 18 and 47 ($\bar{x}$ = 24.9, s = 8.56). There was no significant difference in age between male and female participants. In addition, 74% of the respondents were heterosexual and 26% were homosexual, this discrepancy in sample size

between SO groups was likely to affect the results and therefore methods for equating the groups were applied in later analyses although conclusions must still be regarded tenuously. The ages for heterosexual individuals ranged between 18 and 30 ($\bar{x}$ = 21.3; s = 2.82) and between 20 and 47 for homosexual individuals ($\bar{x}$ = 27; s = 8.68). There was no significant difference in age between heterosexual and homosexual individuals.
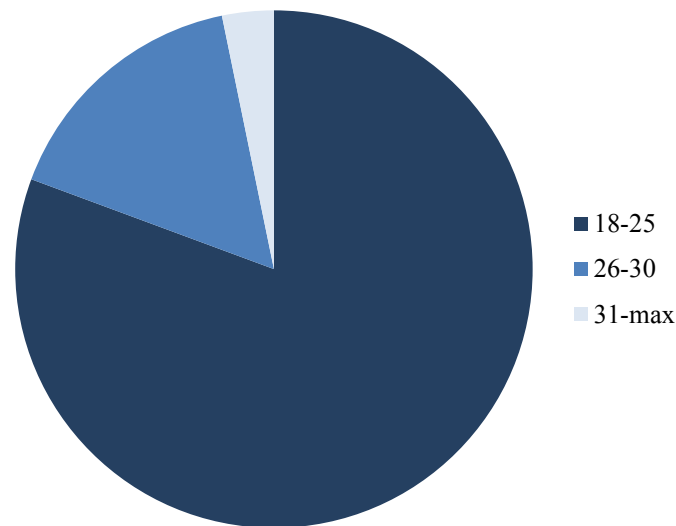
Figure 11: Pie chart indicating proportions divided by age

For the groups divided across SO and sex, ages for heterosexual males ranged between 18 and 21 years ($\bar{x}$ = 20; s = 1.26), for heterosexual females from 19 to 30 ($\bar{x}$ = 21.76; s = 3.09), and for homosexual females from 20 to 25 ($\bar{x}$ = 21.75; s = 2.36). Homosexual males were significantly older than the other groups with an age range of 27 to 47 years ($\bar{x}$ = 32.25; s = 9.84; p≤0.001 across all post hoc comparisons). The pie chart (Figure 12) below indicates the proportions of sex by SO groups for the total sample. As is visible in the chart heterosexual women make up most the sample with 55%, and both homosexual groups of men and women comprise 13% each of the total sample. Heterosexual men make up the remaining proportion with 19%.
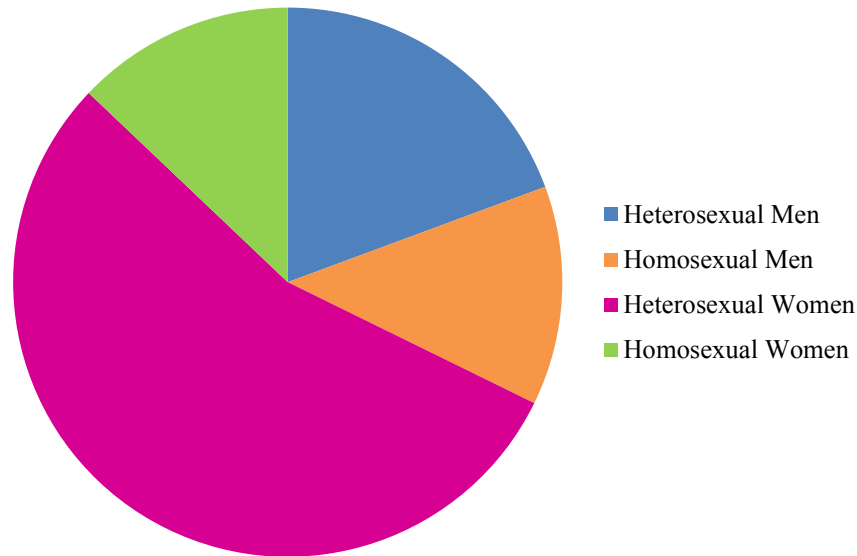
Figure 12: Pie Chart indicating group proportions of sex by sexual orientation

The next demographic considered was race, from the 31 participants who completed the questionnaire 48.4% indicated that they were Black, 25.8% that they were Indian, and both White and Coloured responses each comprised 12.9% of the total sample. These demographics can be seen graphically in figure 13.
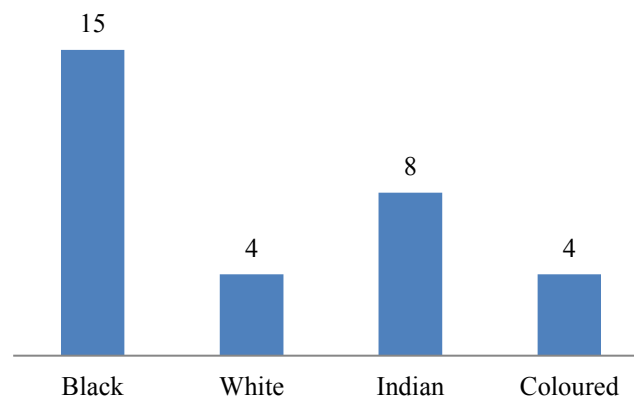
Figure 13: Bar chart indicating proportions divided by race

Three crosstabulations with chi-square calculations were conducted, comparing SO with sex, SO with race and sex with race. None of the comparisons yielded any significant associations (χ^2_{SO*sex}=1.553, df=3, p=0.213; $\chi^2_{SO*race}$=0.011, df=3, p=1; $\chi^2_{sex*race}$=7.738, df=3, p=0.052). However, the standardised residuals for sex and race revealed specific differences. It appears

that there were significantly more White males as compared to females than expected (d=2) and that there were significantly less Indian males (d=-2.3) than Indian females.

4.1.1. Response Rate

The response rate for the questionnaire was calculated by dividing those questionnaires that were answered satisfactorily (N=31) by all those questionnaires that were distributed (N=52), therefore the response rate was 59.62%. The poor response rate may be due to instrument effects in that, participants sense of smell became fatigued and they consequently could not adequately rank the t-shirts and so left out some of the questionnaire, or perhaps found the procedure uncomfortable and so chose non-response as a form of participation withdrawal.

4.2. Objective One:

Table 10 below describes the mean, standard deviation, median and average rank of the median. The median is an important statistic when using non-parametric tests, which traditionally compare the distribution of the median rather than the mean as in parametric tests. The average median ranks for each ranking measure appear to be distinctively different at a glance, however, closer inspecting in the form of a Kendall's coefficient of concordance ($\widetilde{W}$) will indicate whether there is significant agreement between the groups, and the Friedman's two-way analysis of variance by ranks will indicate whether a significant difference occurs between the ranked objects and thus no difference between the judges.

Table 10: Descriptive statistics for each stimulus items, for both attractiveness and masculinity

Stimulus item	VA			VM			SA			SM		
	$\bar{x}$ (s)	median rank	Md	$\bar{x}$ (s)	median rank	Md	$\bar{x}$ (s)	median rank	Md	$\bar{x}$ (s)	median rank	Md
1	3.39 (1.407)	3	3	3.23 (1.564)	2	3	3.52 (1.768)	5.5	4	3.74 (1.692)	2.5	3
2	2.9 (1.513)	3	3	3.68 (1.681)	4.5	4	3.45 (1.748)	3	3	3.42 (1.728)	5	4
3	4.97 (1.923)	6	6	3.32 (1.777)	2	3	3.84 (1.864)	5.5	4	3.42 (1.669)	2.5	3
4	3.42 (1.259)	5	4	2.81 (1.457)	2	3	3.55 (1.662)	3	3	3.23 (1.564)	2.5	3
5	3.55 (1.338)	3	3	3.9 (1.165)	4.5	4	3.06 (2.032)	1	2	4.06 (1.931)	6	5
6	2.71 (1.901)	1	2	4.19 (2.024)	6	5	3.68 (1.376)	3	3	3.13 (1.628)	2.5	3

For objective one the aim of the analysis was to investigate whether the measure of attractiveness and masculinity across stimuli was concordant as previous literature has suggested. According to Penton-Voak et al., (2001) and Thornhill and Gangestad (1999) masculine features produced by high T levels which are also indicated through the smell of sweat are associated with a man's level of attractiveness, particularly if women are judging. The next phase of objective one was to investigate whether visual stimuli corresponded with scent stimuli which in theory would advertise male pheromones as suggested by Kohl (2008) and Cornwell, et al. (2004). In order to assess these hypotheses, it was first necessary to assess the level of agreement using $\widetilde{W}$ for the of ranking of each stimulus. The calculations used to obtain the original results were then bootstrapped using a resampling with replacement method in order to provide a better populating estimate. Below is table 11 representing both the original and bootstrapped $\widetilde{W}$ statistics.

Table 11: Bootstrap of $\widetilde{W}$ calculated for each ranking measure on for each construct

Measure	$\widetilde{W}$	χ^2	Sig	$\theta_{\widetilde{W}}$	Std Error	Sig	95% confidence limits	
							Lower bound	Upper bound
VA	0.180	27.952	<.001	0.207	0.088	<.001	0.062	0.394
VM	0.072	11.160	0.05	0.102	0.05	0.01	0.027	0.218
SA	0.019	3.005	0.7	0.051	0.035	0.2	0.008	0.140
SM	0.034	5.341	0.5	0.066	0.036	0.1	0.014	0.153
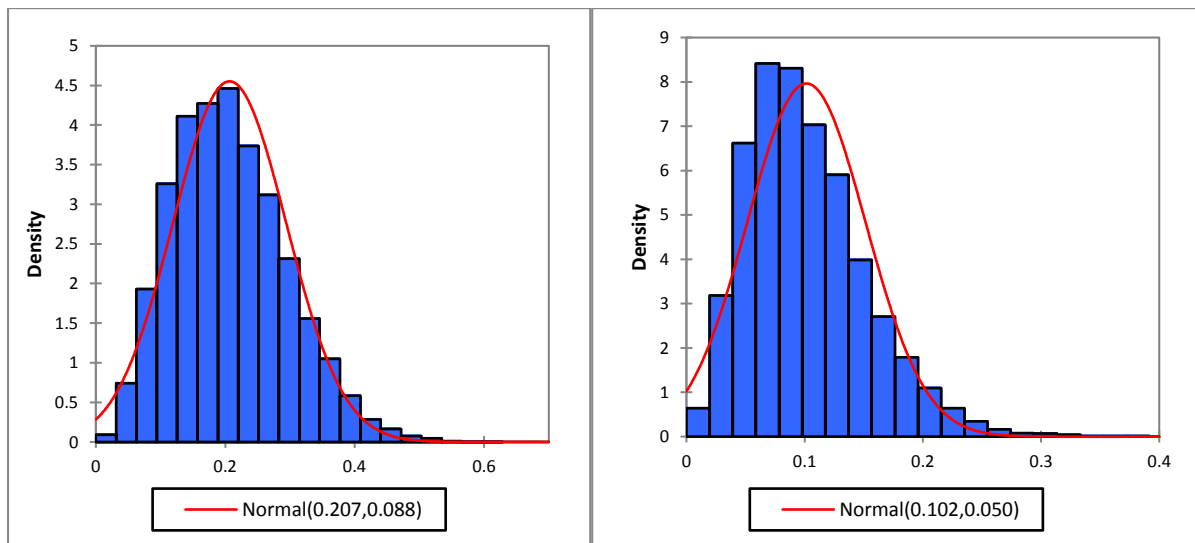
Figure 14: Histograms showing the bootstrapped distribution of θ_W̃ for VA (left) and VM (right)

From the results reported in the table 12 above it appears that only rankings regarding the VS were concordant in both the original calculations and the bootstrapped measures of concordance, whereas there was very little agreement regarding the rankings of the SS. The confidence intervals calculated using the percentile method, indicate that the real world $\widetilde{W}$ value estimated by $\theta_{\widetilde{W}}$ falls between 0.062 and 0.394 with 95% certainty for rankings of attractiveness on visual stimuli and between 0.027 and 0.218 for rankings of masculinity on visual stimuli. The bootstrap indicated an increase in the $\widetilde{W}$ coefficient for both VA and VM measures, indicating that it provides a more powerful estimate of the test. The original $\widetilde{W}$ coefficient falls within the confidence interval estimated by the bootstrap for both measures of attractiveness and masculinity for the VS; therefore, we can conclude that the sample statistic falls within the 95% confidence range. The two histograms above indicate the degree of fit of the bootstrap statistics to a normal distribution given the mean of the bootstrapped

statistic and the standard error. Only histograms of the results that were significant are reported here. In both cases the distribution of the bootstrap statistics are positively skewed although only slightly, indicating the estimated majority of the population would have a level of concordance closer to the lower bound confidence limit. Due to the skewed data and lack of fit to a normal distribution in the histograms, the significant concordance indicated by the results must be interpreted cautiously.

4.2.1. Question 1

<u>'Are male attractiveness and perceived masculinity judged similarly?'</u>

Table 12 below indicates measures of concordance amongst ranking measurements of attractiveness and masculinity for both the VS and SS. The results indicate that attractiveness and masculinity judgements were significantly concordant amongst the VS, although this was not the case for the SS. Although, the test of concordance was significant, the $\widetilde{W}$ statistic indicates only a small degree of agreement between the judges. These results mirror previous finding in this study whereby visual stimuli are more concordant than scent stimuli.

Table 12: $\widetilde{W}$ between attractiveness and masculinity rankings

	$\widetilde{W}$	χ^2	Sig	Decision
VS	0.040038	12.41167	0.05	Reject H0
SS	0.00362	1.12212	0.98	Fail to reject H0

A Friedman's two-way ANOVA was used to estimate the difference between measures of attractiveness and masculinity for stimuli using overall median ranks from each group. The original chi-square values for comparisons between attractiveness and masculinity for the VS (χ^2=0.786, df=5, NS) and the SS (χ^2=1.071, df=5, NS) were both not significant and when bootstrapping was applied, the χ^2 value increased for both the VS ($\theta_{\chi^2} = 2.29, df = 5, NS$), and the SS ($\theta_{\chi^2} = 4.5, df = 5, NS$) although still not significantly. Both the original and bootstrapped χ^2 values fall within the confidence interval for the VS (LC=0.571: UC=6.) and the SS (LC=0.571: UC=6.857) suggesting that the sample statistics are within the 95% confidence range for the estimated population statistic. The lack of significance leads to a failure to reject the null hypothesis that there is no significant difference between the rankings of the stimuli items and therefore the researcher assumes that attractiveness and masculinity

for both the visual and scent stimuli are ranked significantly differently by the judges as is suggested by the Friedman's test.

According to Penton-Voak, et al., (2001) and Pillsworth and Haselton, (2006) women are most receptive to and influenced by the association between attractiveness and masculinity. It is stated that the association between attractiveness and masculinity will either be positively correlated during the follicular phase of a women's menstrual cycle or negatively correlated or uncorrelated at any other time of her cycle. It was also noted previously that men may be receptive to T and therefore concordant in their rankings of masculinity as according to Gabrielson (2013) and Eisenegger, Haushofer, and Fehr, (2011) men are able to detect and tend to behave differently when exposed to highly masculine men, or more correctly men with higher levels of testsosterone. This hypothesis will be explored in more depth in the investigation of objective two.

To explore the hypothesis that women at their most fertile ovulatory phase will find masculine men more attractive than at the least fertile phase of their menstrual cycle, a Friedman's two-way analysis of variance was conducted and bootstrapping was applied. The chi square bootstrap statistic for the VS (θ_{x^2}=9.37, df=5, NS) is much greater than the original chi-square statistic (χ^2=5.607, df=5, NS) calculated with the Friedman's test for the VS. The confidence interval calculated using the bootstrapped data suggests that with 95% confidence it is predicted that the mean chi-square statistic of the estimated population will fall between LC= 4.571 and UC=16.571. In addition, both the original and bootstrapped chi-square statistics are not significant at the level of for α=0.05. Therefore the null hyothesis that there is no significant difference between the objects being ranked, is not rejected this suggests that perhaps the women at their luteal phase ranked the attractiveness of the VS differently to the women at their follicular phase.

The same outcome was illustrated by the results of Friedman's test for the SS. However, in this case the chi-square statistic is slightly decreased by the bootstrap. For the Friedman's two way ANOVA, the chi-square statistics from both the original (χ^2=3.286, df= 5, NS) and bootstrap (θ_{x^2}=3.177, df=5, NS) data were not significant and therefore the null hypothesis that there are no differences between the stimuli rankings was not rejected. It may therefore, be assumed that luteal and follicular phase women rank the stimuli differently. The

confidence interal (LC=0.571:UC=7.607) estimated by the bootstrapped Friedman's suggests that the real world statistic fall with 95% confidence within that interval.

Kendall's coefficient of concordance was calculated for each measure of attractiveness and masculinity for each of the stimuli, for women in general, at the lutel phase of their cycle and women estimated to be at the follicular phase of their menstrual cycle. All calculations were bootstrapped and are reported in table 13. For women in general, the original calculations showed that there was significant agreement in rankings of VA, as well as rankings of VA and masculinity combined. With bootstrapping applied the $\widetilde{W}$ statistic increased in all of the measures for women in general. Once bootstrapped not only were the rankings of VA and VA and VM combined, significantly concordant, but the measure of VM as well as SA. In all the measures regarding women in general the original $\widetilde{W}$ statistic fell within the 95% confidence intervals as represented in table 13 below. Thus, the sample can be assumed to represent the population estimated from the bootstrap.

For women in the follicular phase of their cycle (ovulation), VA, SA as well as VA and VM combined were all shown to be significantly concordant before the bootstrap was applied (table 13). Thus, indicating that women at their most fertile phase of their menstrual cycle agreed significantly more about the attractiveness of both the stimuli and, most importantly to this hypothesis, there was significant concordance in the rankings of VA and VM combined. The $\widetilde{W}$ statistic for VA indicates a moderate to high degree of agreement meaning that women at ovulation agree highly on the VA of men. Although there was agreement about the concordance of attractiveness and masculinity rankings combined for the VS, there was no significant concordance for the same measure of the SS. This is incongruent with the expected alternate hypothesis that there would be significant agreement amongst ovulating women regarding the attractiveness and masculinity of male scent. Furthermore, although the bootstrap of these calculations did increase the mean estimate of the $\widetilde{W}$ statistic, it did not change any of the outcomes to reject the null hypothesis. In all the measures calculated for follicular phase women the original sample statistic fell within the confidence interval of the estimated population and therefore, it can be assumed that the original sample falls within the population parameter estimates.

For women at the luteal phase of their menstrual cycle rankings of VA were the only measure with significant concordance before the bootstrap. Before the bootstrap there were no other significant outcomes regarding concordance. This was expected as previous literature suggests that non-ovulating women would be less attracted to masculine men and furthermore non-ovulating women more anosmic, (less likely to detect scents) (Pillsworth, Haselton, & Buss, 2004). The bootstrap of the measurements for women in their luteal phase indicated that the mean $\widetilde{W}$ for rankings combining VA and VM was significant. It was not expected that the bootstrapped real world estimate of concordance would be significant for luteal phase women. Please refer to table 13 for a summary of the $\widetilde{W}$ test statistics.

Table 13: Summary of bootstrapped $\widetilde{W}$ statistics for women at different phases of their menstrual cycle

		$\widetilde{W}$	Sig	$\theta_{\widetilde{W}}$	SE	Sig	95% confidence limits Lower bound	Upper bound	decision
Women in general	VA	0.33	<0.001	0.36	0.121	0.01	0.145	0.609	reject
	VM	0.065	NS	0.109	0.056	0.05	0.028	0.249	reject
	VA and VM	0.09	0.01	0.113	0.05	0.01	0.035	0.23	reject
	SA	0.086	NS	0.128	0.056	0.05	0.032	0.244	reject
	SM	0.043	NS	0.088	0.044	NS	0.023	0.194	fail to reject
	SA and SM	0.008	NS	0.032	0.019	NS	0.006	0.079	fail to reject
Follicular phase	VA	0.636	<0.001	0.678	0.105	0.01	0.479	0.88	reject
	VM	0.086	NS	0.185	0.115	NS	0.032	0.486	fail to reject
	VA and VM	0.147	0.05	0.183	0.102	0.01	0.036	0.422	reject
	SA	0.253	0.05	0.336	0.104	0.01	0.179	0.58	reject
	SM	0.074	NS	0.177	0.087	NS	0.043	0.382	fail to reject
	SA and SM	0.054	NS	0.102	0.054	NS	0.022	0.229	fail to reject
Luteal phase	VA	0.213	0.05	0.279	0.129	0.01	0.07	0.549	reject
	VM	0.056	NS	0.132	0.077	NS	0.022	0.321	fail to reject
	VA and VM	0.068	NS	0.103	0.048	0.05	0.031	0.215	reject
	SA	0.065	NS	0.144	0.039	NS	0.022	0.37	fail to reject
	SM	0.06	NS	0.138	0.075	NS	0.03	0.318	fail to reject
	SA and SM	0.025	NS	0.063	0.093	NS	0.01	0.156	fail to reject

4.2.2. Question 2

<u>Do the rankings of attractiveness and masculinity of the t-shirts correspond with the rankings of the photographs?</u>

Table 14 indicates the level of agreement amongst the two stimuli, visual and scent, for both measures of attractiveness and masculinity. The $\widetilde{W}$ statistic represented in table 14 shows that the stimuli were only significantly concordant for rankings of attractiveness and not so for rankings of masculinity. This indicates that respondents agreed that the photographs and t-shirts produced by the same stimuli participant were alike in attractiveness but respondents disagreed regarding masculinity. However, as indicated in table 14 the degree of concordance amongst participants regarding attractiveness is very small.

Table 14: $\widetilde{W}$ between visual and scent stimuli

Measure	$\widetilde{W}$	χ^2	Sig	Decision
Attractiveness	0.06	18.67	0.01	Reject H0
Masculinity	0.03	9.08	0.2	Fail to reject H0

For the Friedman's test comparing the rankings of visual and scent stimuli for overall attractiveness rankings (χ^2=7.57, df=5, NS) and overall masculinity rankings (χ^2=5.64, df=5, NS) there was no significant result. Furthermore, once bootstrapped the mean χ^2 decreased slightly, suggesting that the sample calculations overestimated, although not significantly, the differences between the stimuli item rankings for both measures of attractiveness (θ_{χ^2}=5.72, df=5 NS) and masculinity (θ_{χ^2}=4.08, df=5, NS). The failure to reject the null hypothesis for the comparisons of rankings between stimuli for both attractiveness and masculinity, suggests that judges ranked VS significantly differently to SS regardless of whether the criteria for rankings was attractiveness or masculinity. The original calculated χ^2 values fell within the confidence intervals for both measures of attractiveness (LC=3.071: UC=7.929) and masculinity (LC=1.286: UC=6.857) suggesting with 95% confidence that the sample was drawn from the population estimated at by the bootstrap.

4.3. Objective 2

For objective two a Friedman's two-way ANOVA was calculated and the calculation bootstrapped for each measure of ranking for each stimulus. After which a $\widetilde{W}$ was run and bootstrapped for each independent variable for each measure and stimulus.

4.3.1. Question 3

<u>Does the sex of an individual determine how attractive or masculine they find certain male faces and body odours?</u>

Visual Stimulus Attractiveness

The Friedman's two-way ANOVA comparing rankings of stimuli items between the sexes was not significant both before a bootstrap was applied ($\chi^2= 7$, df =5, NS) as well as after (θ_{χ^2}=5.37, df=5, NS). Therefore, the null hypothesis was not rejected and the conclusion that there was no significant difference between the ranked stimuli items, drawn. However, as there were no significant differences between the ranked items it can be assumed that men and women ranked the items differently.

Although the Friedman's test implies a difference between the average rank of the medians between men and women, a $\widetilde{W}$ test indicates significant agreement both before and after a bootstrap for both the sexes combined. However, although the agreement is significant it is small, and furthermore the $\widetilde{W}$ statistic decreases after the bootstrap. In addition, the maximum agreement estimated by the upper confidence limit suggests that we can be 95% certain that the $\widetilde{W}$ population will not be greater than 0.286, which indicates a small yet significant window of agreement. Men in the initial sample did not significantly agree on which of the VS they considered visually attractive, however after a bootstrap was applied the men showed small but significant agreement. Women showed moderate significant concordance regarding the VS. This result may support the Friedman's test. However, after a bootstrap was applied with the sample size of the sexes equated both men and women, independent of each other, showed agreement in their rankings of VA. However, in this instance women still showed more agreement regarding rankings of VA. Please see table 15 for a summary of the $\widetilde{W}$ findings.

Table 15: Summary of bootstrapped (B=10000) $\widetilde{W}$ for rankings of visual attractiveness for the sexes

Sex	$\widetilde{W}$	P	$\theta_{\widetilde{W}}$	P	SE	Lower confidence limit	Upper confidence limit	Decision
Both sexes combined	0.18	<0.001	0.143	<0.001	0.062	0.045	0.284	Reject
Women	0.33	<0.001	0.362	<0.001	0.116	0.142	0.597	Reject
Men	0.063	NS	0.107	0.05	0.062	0.026	0.266	Reject

The histograms below indicate the distributions of $\theta_{\widetilde{W}}$ for all significant aggreements in rankings of VA. The first histogram indicates the distribution of $\theta_{\widetilde{W}}$ statistics for both sexes combined, as is evident in the graph the distribution is slightly skewed and the confidence limits are quite narrow as indicated by the graph and table 15 above. Due to the slight skewness and narrow confidence limits interpretations must be regarded tenuously. The second histogram represents the distribution of $\theta_{\widetilde{W}}$ for women. As is visible in the graph, the distribution of scores is almost normal and the confidence interval is much wider, therefore, inferences regarding the female sample may be made with more rigour as the population estimation deduced from the bootstrap is normally distributed. The histogram regarding male rankings of VA is quite skewed and the confidence interval quite narrow, this may however be due to the reduction in variance caused by the oversampling procedure and thus must be interpreted cautiously.
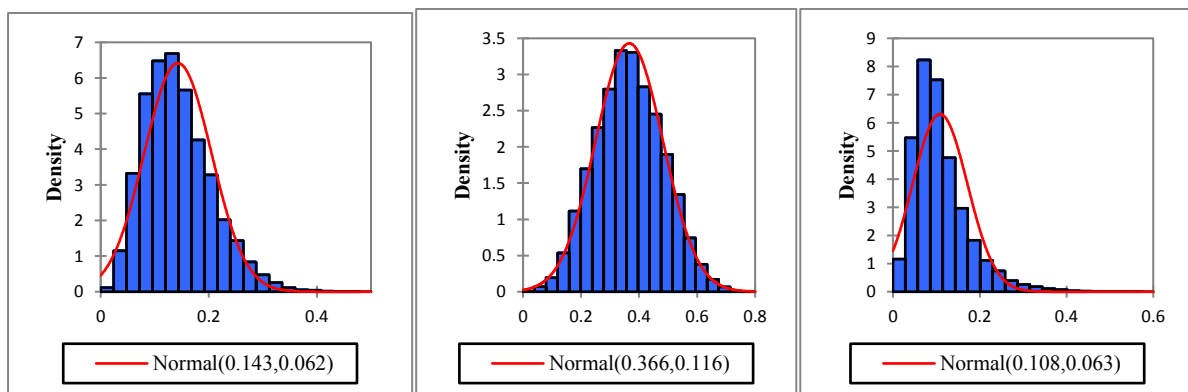
Figure 15: Histograms representing the distribution of bootstrapped θ_$\widetilde{W}$ VA scores for both sexes combined (left), women (centre), and men (right)

Visual Stimulus Masculinity

A Friedman's test indicated no significant difference between the ranked stimulus items when contrasting the sexes (χ^2=6.86, df=5, NS), this was also not significant after bootstrapping was applied (θ_{χ^2}= 6.02, df=5, NS). Therefore, the null hypothesis that there is no significant difference between the ranked items was not rejected, and the conclusion that men and women may rank the items differently was drawn.

As before, the Friedman's result is not congruent with the measures of $\widetilde{W}$ as agreement between the sexes was indicated to be significant although this agreement was very small and only just significant (see table 16). Subsequently, although men and women combined may have indicated significant agreement, men and women independently, did not show significant concordance before the bootstrap was applied. However, once bootstrapped, $\theta_{\widetilde{W}}$ for both sexes independently and both sexes combined indicated significant concordance. The bootstrap increased the degree of agreement amongst all the groups. Men showed greater agreement with regards to VM, sustaining predictions made earlier.

Table 16:Summary of bootstrapped (B=10000) $\widetilde{W}$ for rankings of visual masculinity for the sexes

Sex	$\widetilde{W}$	P	$\theta_{\widetilde{W}}$	P	SE	Lower confidence limit	Upper confidence limit	Decision
Men and women combined	0.072	0.05	0.107	0.001	0.047	0.034	0.213	Reject
Women	0.065	NS	0.108	0.05	0.055	0.026	0.237	Reject
Men	0.163	NS	0.201	0.001	0.089	0.057	0.4	Reject

The histograms indicating the distributions for $\theta_{\widetilde{W}}$ for VM for both sexes combined and independent are slightly positively skewed, therefore conclusions must be drawn tentatively regarding all the results. The confidence intervals for both sexes combined and women are slightly narrower than the confidence interval for the male sample, indicating a wider 95% confidence interval for the estimation of the real world $\theta_{\widetilde{W}}$ statistic for men.
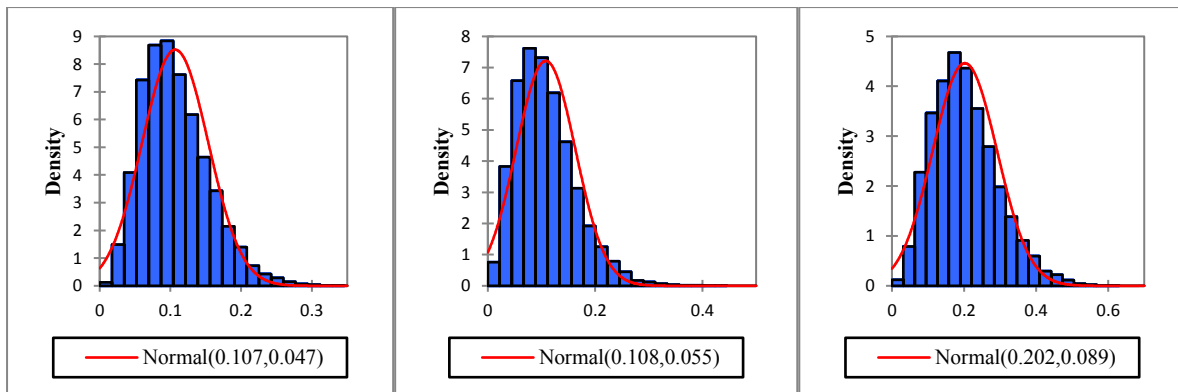
Figure 16: Histograms representing the distribution of bootstrapped θ_W̃ VM scores for both sexes combined (left), women (centre), and men (right)

Scent Stimulus Attractiveness

In comparing the sexes for a difference in the rankings of stimulus items a Friedman's test found no significant difference both before the bootstrap (χ^2= 0.21, df=5, NS) and after (θ_{x^2}=3.4, df=5, NS). Thus, indicating that the null hypothesis should fail to be rejected and that there is no significant difference between the SA ranked items and thus, possibly a difference between the sexes.

This result is supported by the $\widetilde{W}$ statistics reported in table 17. Per these results, men and women do not rank the attractiveness of scent concordantly and this result is sustained after the application of bootstrapping. Furthermore, before the bootstrap, both men and women independently were not concordant in their rankings of scent attraction, however, once bootstrapped, significant agreement was indicated, although the degree of agreement for both men and women was small.

Table 17: Summary of bootstrapped (B=10000) $\widetilde{W}$ for rankings of scent attractiveness for the sexes

Sex	$\widetilde{W}$	P	$\theta_{\widetilde{W}}$	P	SE	Lower confidence limit	Upper confidence limit	Decision
Men and women combined	0.019	NS	0.029	NS	0.020	0.005	0.081	fail to reject
Women	0.086	NS	0.129	0.02	0.056	0.038	0.254	Reject
Men	0.061	NS	0.106	0.05	0.066	0.022	0.280	Reject

The histograms in figure 17 below, represent the distribution of $\theta_{\widetilde{W}}$ for women and men. For women, the distribution is positively skewed, although, much less skewed than the distribution for men. The confidence interval however is somewhat narrower than the confidence interval for men, as indicated in table 18. For men, the distribution is quite skewed with most of the distribution falling at the lower end of the confidence interval. These resultant distributions estimated to represent the population by the bootstrap are not normally distributed indicating that the results should be compared tenuously given the assumption that the population is normally distributed.
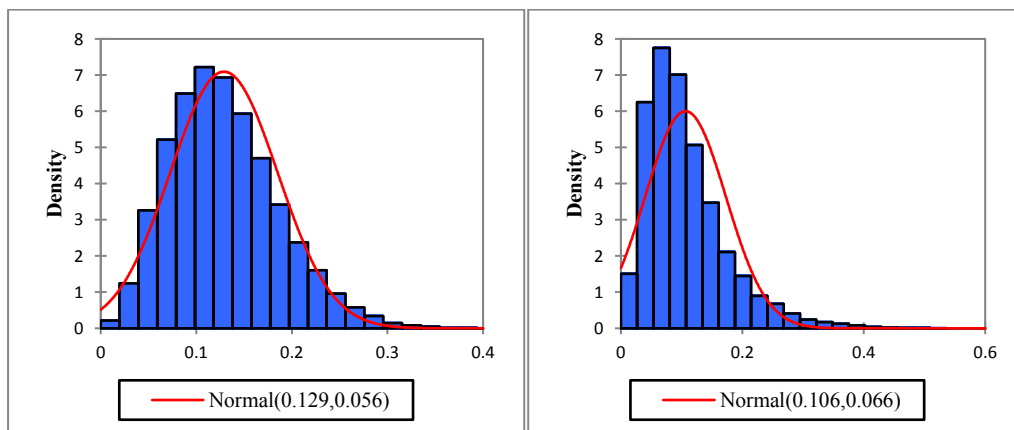
Figure 17: Histograms representing the distribution of bootstrapped θ_W̃ SA scores women (left), and men (right)

Scent Stimulus Masculinity

The Friedman's test for the masculinity of scent between stimulus items for the sexes indicated that both before bootstrapping (χ^2=4.71, df=5, NS) and after bootstrapping (θ_{χ^2}=5.133, df=5, NS) the distribution of stimulus items were not significantly different, therefore a conclusion can be tenuously drawn that men and women ranked the masculinity of the scent differently.

According to the summary of $\widetilde{W}$ statistics for the agreement between the sexes regarding the masculinity of scent, there was no significant agreement amongst sexes combined, men or women. Furthermore, the only original outcome that was not sustained by the bootstrap was concordance amongst men and women combined which increased with the bootstrap and is only just significant with a very small degree of agreement.

Table 18: Summary of bootstrapped (B=10000) $\widetilde{W}$ for rankings of scent masculinity for the sexes

Sex	$\widetilde{W}$	P	$\theta_{\widetilde{W}}$	P	SE	Lower confidence limit	Upper confidence limit	Decision
Both sexes combined	0.034	NS	0.056	0.05	0.032	0.011	0.130	Reject
Women	0.043	NS	0.089	NS	0.045	0.022	0.194	fail to reject
Men	0.036	NS	0.083	NS	0.056	0.013	0.225	fail to reject

The distribution of $\theta_{\widetilde{W}}$ regarding masculinity rankings for both sexes combined is illustrated in figure 18 adjacent, indicates a slight positively skewed distribution. This indicates that most estimated $\theta_{\widetilde{W}}$ statistics lie below the mean and closer to the lower confidence limit. A skewed distribution violates the assumption of normality and therefore any conclusions drawn cannot be substantially indicative of the real-world population. Furthermore, the confidence interval is quite narrow providing a small window for which to be 95% certain of a real-world estimate.
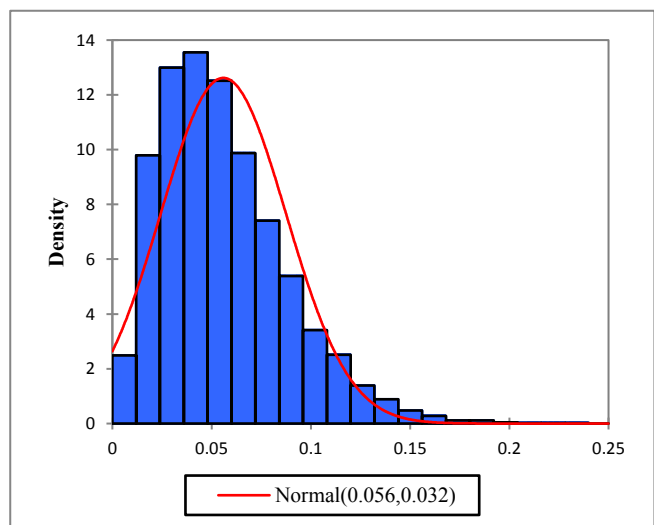
Figure 18: Histograms representing the distribution of bootstrapped θ_W̃ SM for both sexes combined

4.3.2. Question 4

Does the sexual orientation of an individual determine how attractive or masculine they find certain male faces and body odours?

Visual Attractiveness

On the measure of VA, a Friedman's two-way ANOVA found no significant differences between the ranked stimuli items when SO groups were compared both in the original calculation (χ^2=7.357, df=5, NS) and once a bootstrap had been applied (θ_{χ^2}=6.341, df=5,

NS). In fact, the bootstrap showed a decrease in the χ^2 value. This result indicates that the null hypothesis that there is no significant difference between the sums of items being ranked should not be rejected and the conclusion it can be tentatively assumed that the SOs ranked the items differently.

The conclusion drawn by the Friedman's test was not significantly supported by the $\widetilde{W}$ calculations as agreement amongst both SOs combined was significant however the degree of agreement was small (<0.2) before the bootstrap and decreased after the bootstrap was calculated suggesting that when the sample sizes were equated and an estimation of the population calculated, there was less agreement between the SOs, although $\theta_{\widetilde{W}}$ was still significant. This may support the result of the Friedman's test. Before the application of bootstrapping, heterosexual respondents ranked VA significantly concordantly, and their degree of agreement increased with the bootstrap. Homosexual respondents, however, were not concordant in the attraction to visual stimuli, before the application of the bootstrap, however, they were significantly concordant when oversampled and bootstrapped, although the degree of agreement increased only slightly.

Table 19: Summary of bootstrapped (B=10000) $\widetilde{W}$ for rankings of visual attractiveness for sexual orientation

Sex	$\widetilde{W}$	P	$\theta_{\widetilde{W}}$	P	SE	Lower confidence limit	Upper confidence limit	Decision
Both sexual orientations combined	0.18	<0.001	0.152	<0.001	0.063	0.051	0.0.295	Reject
Heterosexual	0.252	<0.001	0.287	<0.001	0.109	0.096	0.513	Reject
Homosexual	0.109	NS	0.147	0.01	0.070	0.054	0.322	Reject

The histograms represented in figure 19, indicate the distribution of $\theta_{\widetilde{W}}$ scores for both SOs combined, with the sample sizes equated using an oversampling method, the distribution of $\theta_{\widetilde{W}}$ for heterosexual respondents and the distribution for homosexual respondents. As is visible from the graphs the $\theta_{\widetilde{W}}$ distributions for both SOs combined and heterosexual respondents are approximately normal, with SOs combined being only slightly positively skewed. This indicates that the bootstrap is a good estimate of a normally distributed population. The distribution of $\theta_{\widetilde{W}}$ for homosexual respondents however, is quite positively

skewed indicating that the majority of $\theta_{\widetilde{W}}$ values lie below the mean $\theta_{\widetilde{W}}$ value indicating that most respondents would lie closer to the lower confidence limit.
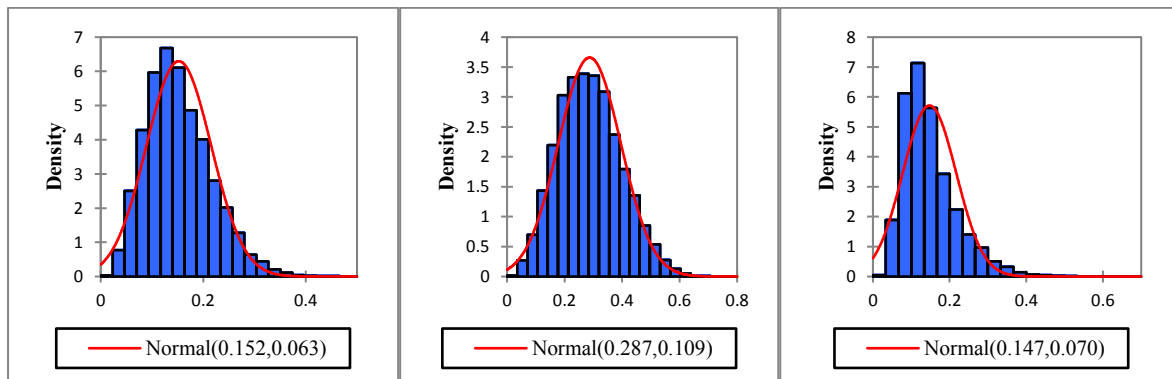
Figure 19: Histograms representing the distribution of bootstrapped θ_W̃ VA scores for both SOs combined (left), heterosexual respondents (centre), and homosexual respondents (right)

Visual Masculinity

When investigating whether SO influenced the rankings of stimuli items for the measure of VM, a Friedman's test found no significant differences between the ranked items both before (χ^2=3.714, df =5, NS), and after (θ_{χ^2}=4.000, df=5, NS) a bootstrap was applied, although the bootstrap did increase the likelihood of significance somewhat. Therefore, the null hypothesis was not rejected and there was no significant difference found between the sums of the ranked items, suggesting that heterosexual and homosexual respondents ranked the stimuli items differently.

Table 20 below, indicates a summary of $\widetilde{W}$ statistics shows that both before and after the application of the bootstrap, the agreement between both SOs and heterosexual respondents was significant. Although, and especially for SOs combined, this significance was only just, and the degree of concordance for both SOs combined was minimal in the original calculation (<0.1) and even less for $\theta_{\widetilde{W}}$. Concordance increased, although only slightly for heterosexual respondents after bootstrapping, indicating that the sample may be underestimating population concordance. These results contrast with those for homosexual individuals who were not concordant in their rankings both before and after the application of the bootstrap, indicating that perhaps the notion of VM may be ambiguously judged by homosexual individuals.

Table 20: Summary of bootstrapped (B=10000) $\widetilde{W}$ for rankings of visual masculinity for sexual orientation

Sex	$\widetilde{W}$	P	$\theta_{\widetilde{W}}$	P	SE	Lower confidence limit	Upper confidence limit	Decision
Both sexual orientations combined	0.072	0.05	0.055	0.05	0.029	0.012	0.126	Reject
Heterosexual	0.139	0.02	0.175	0.001	0.074	0.059	0.342	Reject
Homosexual	0.041	NS	0.083	NS	0.053	0.017	0.218	fail to reject
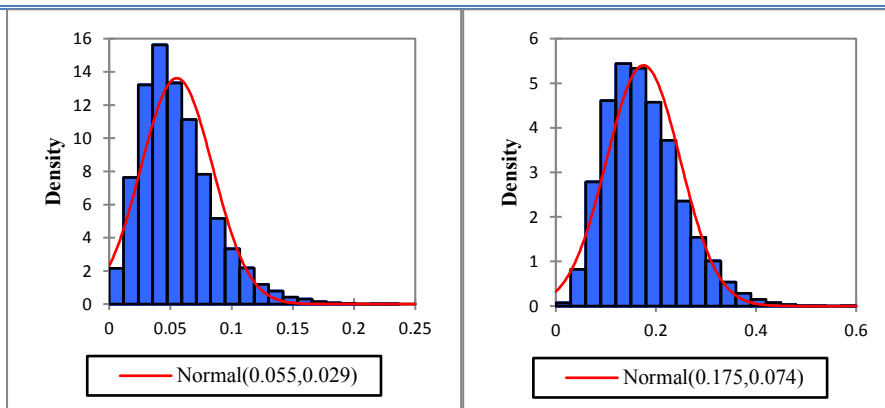
Figure 20: Histograms representing the distribution of bootstrapped θ_W̃ VM scores for both SOs combined (left), heterosexual respondents (right)

Figure 20 above indicates the distribution of $\theta_{\widetilde{W}}$ for both SOs combined and heterosexual respondents. The distribution for homosexual respondents was not included as no significant concordance was indicated for this group. Figure 20 illustrates a somewhat skewed distribution of $\theta_{\widetilde{W}}$ for both SOs combined, and furthermore the 95% confidence interval depicted in the histogram and reported in table 20 is quite narrow, thus suggesting a narrower distribution for which to base population estimations on. Therefore, the conclusion must be accepted tentatively. The distribution of $\theta_{\widetilde{W}}$ score for heterosexual respondents is somewhat more normally distributed and the 95% confidence interval is wider, therefore, although this conclusion must still be made with caution, this distribution provides a better estimate of its target population.

Scent Attractiveness

A Friedman's analysis found that no significant differences existed between the sum of the ranks for scent stimuli items when ranked by differing SOs both before a bootstrap (χ^2=0.643, df=5, NS) and after (θ_{χ^2}=1.975, df=5, NS). This result suggests that the different SO regard the attractiveness of a scent differently.

The results of the $\widetilde{W}$ calculation support the failure to reject the Friedman's null hypothesis as $\widetilde{W}$ and $\theta_{\widetilde{W}}$ for both SOs combined were not significant, indicating a lack of agreement between the groups. However, heterosexual individuals were concordant in their rankings of SA in the original calculation of $\widetilde{W}$ and both heterosexual and homosexual individuals showed significant concordance after a bootstrap was applied to the calculation. In both SO groups the $\widetilde{W}$ statistic was improved in the bootstrap, indicating an estimate of greater concordance in the population.

Table 21: Summary of bootstrapped (B=10000) $\widetilde{W}$ for rankings of scent attractiveness for sexual orientation

Sex	$\widetilde{W}$	P	$\theta_{\widetilde{W}}$	P	SE	Lower confidence limit	Upper confidence limit	Decision
Both sexual orientations combined	0.019	NS	0.026	NS	0.016	0.005	0.068	fail to reject
Heterosexual	0.106	0.05	0.144	0.01	0.068	0.037	0.297	Reject
Homosexual	0.196	NS	0.231	<0.001	0.075	0.115	0.404	Reject

The histograms illustrated in figure 21 indicate the distribution of $\theta_{\widetilde{W}}$ rankings of SA for firstly heterosexual individuals (left) and homosexual individuals (right) as these groups indicated significant concordance. Both groups show a slightly positively skewed $\theta_{\widetilde{W}}$ distribution, although homosexual individuals are somewhat more peaked. The skewness indicates that the majority of the $\theta_{\widetilde{W}}$ estimated population would have a mode that is somewhat closer to the lower confidence limit than the mean, suggesting that agreement in the target population is estimated with 95% confidence to be predominantly on the lower end of the spectrum with regards SA for both heterosexual and homosexual individuals.
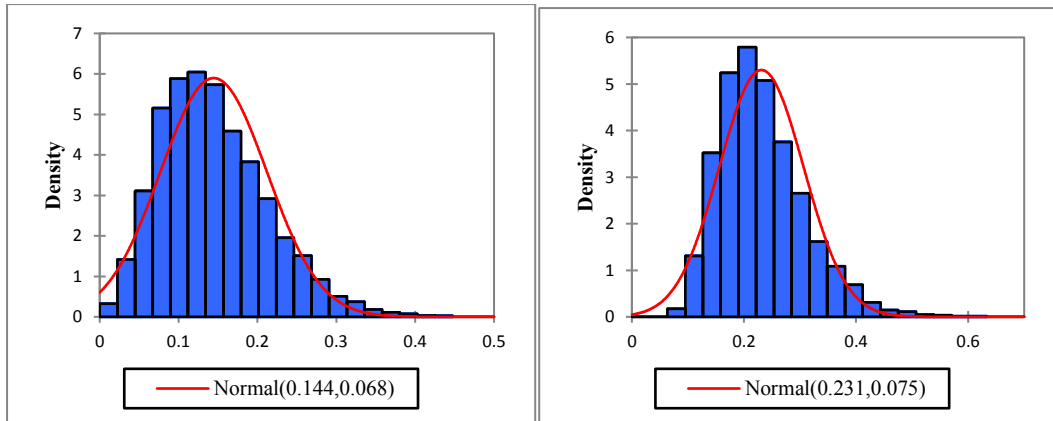
Figure 21: Histograms representing the distribution of bootstrapped θ_W̃ SA for heterosexual respondents (left), and homosexual respondents (right)

Scent Masculinity

For the measure of SM, the Friedman's test indicated that there was no significant difference between the sums of the ranked items before bootstrapping ($\chi^2=0.929$, df=5, NS) and after ($\theta_{\chi^2}=3.232$, df=5, NS), however, bootstrapping did improve this measure. This result leads to a failure to reject the null hypothesis that there is no significant difference between the items and suggests that the judges ranked the items differently.

This result is supported by the $\widetilde{W}$ statistic both before and after bootstrapping as SOs combined showed no significant agreement in their rankings. Furthermore, heterosexual and homosexual individuals were not significantly concordant in their rankings of SM in the calculation of $\widetilde{W}$. However, $\theta_{\widetilde{W}}$ was significant for heterosexual individuals, although only just. The results suggested here confirm previous indications that masculinity may be an ambiguous and subjective criterion for homosexual individuals to base judgements on.

Table 22: Summary of bootstrapped (B=10000) $\widetilde{W}$ for rankings of scent masculinity for sexual orientation

Sex	$\widetilde{W}$	P	$\theta_{\widetilde{W}}$	P	SE	Lower confidence limit	Upper confidence limit	Decision
Both sexual orientations combined	0.034	NS	0.039	NS	0.024	0.007	0.100	fail to reject
Heterosexual	0.074	NS	0.113	0.05	0.048	0.036	0.224	Reject
Homosexual	0.052	NS	0.093	NS	0.053	0.017	0.217	fail to reject

The histogram in figure 22 adjacent indicates that the distribution of $\theta_{\widetilde{W}}$ for heterosexual respondents is somewhat positively skewed, although not drastically. This suggests that in the bootstrapped estimation of the population, agreement amongst heterosexual individuals will be biased toward the lower confidence limit. Furthermore, the 95% confidence interval is quite narrow, and suggests that the degree of agreement amongst the estimated population of heterosexual individuals will not exceed 0.224.

Figure 22: Histogram representing the distribution of bootstrapped $\theta\_\widetilde{W}$ SM for heterosexual respondents
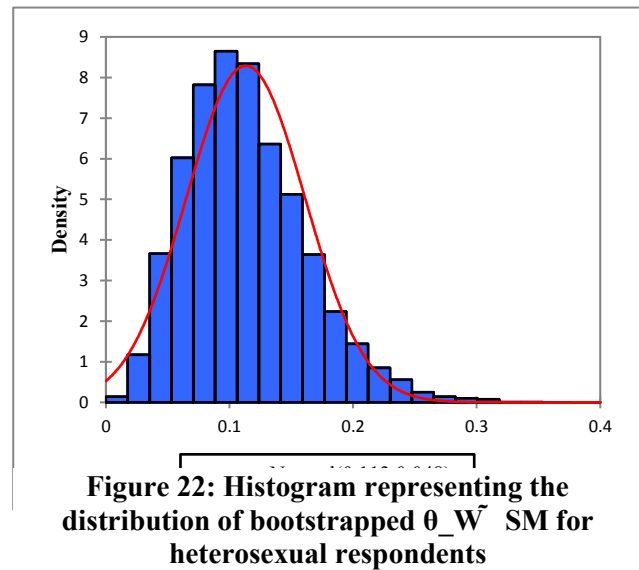
4.3.3. Question 5

Do the groups defined by both sex and sexual orientation determine how attractive or masculine they find a visual and scent stimulus?

To answer this question a Friedman's two-way ANOVA was conducted comparing the sex by SO groups for each of the measures and stimuli. Furthermore, $\widetilde{W}$ statistics were calculated for each of the four sex by SO groups as well as four pairwise comparisons between groups.

Visual attractiveness

In the Friedman's analysis, the difference between the stimulus items for the four sex by SO groups were not significant both before a bootstrap was applied (χ^2=5.107, df=5, NS) or after (θ_{χ^2}=7.270, df=5, NS) and therefore the null hypothesis was not rejected. This further suggests that the judges made up of the sex by SO groups had different average median rankings.

According to the $\widetilde{W}$ presented in table 23 HeM were not significantly concordant in their rankings of VA before the bootstrap, however, this may be due to the small sample size. HoM were also not significantly concordant in their preference for VA. The result that both heterosexual and homosexual men were not agreeable in their rankings of VA is reiterative of the result found in question three, that men in general did not show significant concordance before the bootstrap was applied. Although HeM were not in significant agreement in the

original $\widetilde{W}$ calculation, they did show an improvement in agreement once bootstrapped. Figure 23 illustrates the distribution of $\theta_{\widetilde{W}}$ for HeM, as is visible in the graph the distribution is slightly positively skewed, indicating that the majority or mode of $\theta_{\widetilde{W}}$ scores fell below the mean, this indicates that the majority of the estimated population lean toward the lower confidence limit. The confidence interval however, is quite wide indicating that with 95% confidence the true population parameter will within this interval (see table 23) .
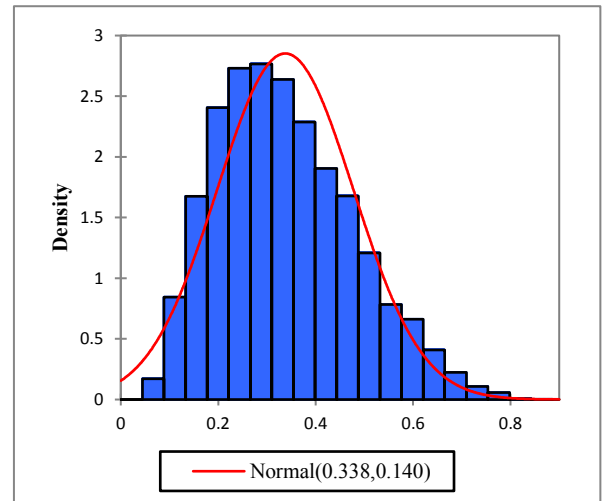
Figure 23: Histograms representing the distribution of bootstrapped θ_W̃ VA scores for HeM

Agreement in terms of the order in which respondents ranked the VA of the six stimuli for both HeW and HoW was significant both before and after a bootstrap, this complements the result found in the analysis of question three which showed a significant concordance amongst women both before and after the bootstrap. The histograms in figure 24 below depict the distribution of $\theta_{\widetilde{W}}$ for HeW and HoW respectively. Both distributions are somewhat skewed, however HeW indicates a wider confidence interval than HoW, which indicates that $\theta_{\widetilde{W}}$ for HeW is perhaps a better estimate of its target population parameter than the $\theta_{\widetilde{W}}$ of HoW.
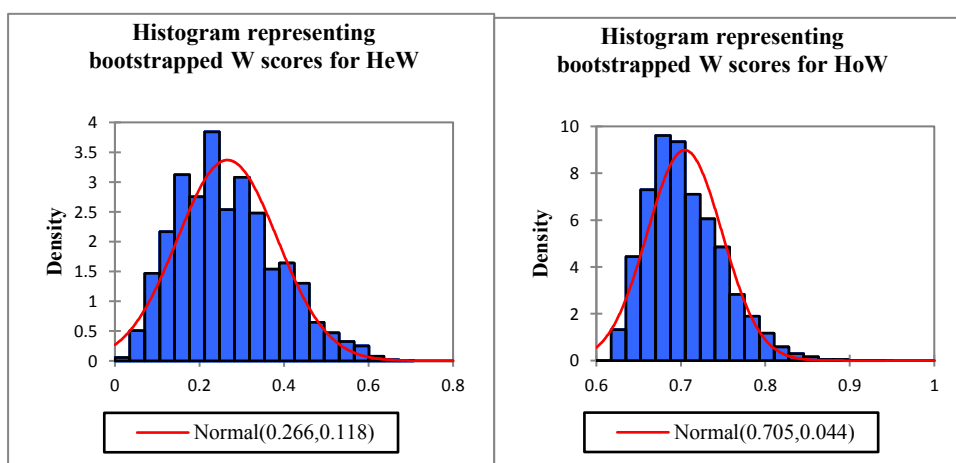
Figure 24: Histograms representing the distribution of bootstrapped θ_W̃ VA for HeW (left) and HoW (right)

Table 23: Summary of bootstrapped (B=10000) $\widetilde{W}$ for rankings of visual attractiveness for sex by sexual orientation

Sex by sexual orientation group	$\widetilde{W}$	P	$\theta_{\widetilde{W}}$	P	SE	Lower confidence limit	Upper confidence limit	Decision
HeM	0.216	NS	0.338	<0.001	0.14	0.113	0.645	Reject
HoM	0.214	NS	0.127	NS	0.098	0.011	0.382	fail to reject
HeW	0.299	<0.001	0.266	<0.001	0.118	0.077	0.529	Reject
HoW	0.736	0.02	0.705	<0.001	0.044	0.635	0.809	Reject

Table 24 below indicates how concordantly sex by SO groups ranked with each other, in terms of VA. According to the data in table 24 all group comparisons were significantly concordant. The measure of agreement between the sexes for heterosexual individuals matched on sample size was significantly concordant, however, the degree of concordance small, and furthermore, once bootstrapped the upper confidence limit indicated a degree of agreement of only 0.284. Concordance amongst homosexual men and women was also significant and the degree of agreement was substantial. Furthermore, the $\theta_{\widetilde{W}}$ value estimated that the population of homosexual individuals of different sexes will be highly concordant in their regard for VA. The results of the $\widetilde{W}$ calculations also indicated that there was significant agreement amongst HoM and HeW both before and after the bootstrap. However, the bootstrap did decrease the degree of agreement, suggesting that perhaps the greater degree of agreement in the original calculation came from the larger sample of the HeW overshadowing the lack of agreement from the smaller sample of HoM. Thus, when the samples were matched on sample size, agreement decreased, although not significantly. Concordance between HeM and HoW was also significant both before and after the application of a bootstrap and the degree of agreement was moderate, indicating that HeM and HoW agree about VA.

Table 24: Summary of bootstrapped (B=10000) $\widetilde{W}$ for rankings of visual attractiveness for sex by sexual orientation pairwise comparisons

Group comparison	$\widetilde{W}$	P	$\theta_{\widetilde{W}}$	P	SE	Lower confidence limit	Upper confidence limit	Decision
HeM*HeW	0.18	<0.001	0.143	<0.001	0.062	0.045	0.284	Reject
HoM*HoW	0.18	<0.001	0.796	<0.001	0.088	0.632	0.975	Reject
HoM*HeW	0.131	0.02	0.074	0.05	0.038	0.02	0.163	Reject
HeM*HoW	0.417	0.01	0.471	<0.001	0.086	0.306	0.64	Reject

Visual masculinity

The Friedman's analysis showed that the sum of the ranks of stimuli items were not significantly different for rankings of VM before a bootstrap was applied (χ^2=6.643, df=5, NS) or after (θ_{χ^2}=6.032, df=5, NS) and therefore the null hypothesis was not rejected. This suggests that the judges may have considered and ranked the stimuli items in terms of VM differently.

In the original calculations of $\widetilde{W}$ represented in table 25 only HeM were significantly concordant, with a moderate degree of agreement. However, once bootstrapped HoM was the only group to not have significant concordance. The histograms presented in figure 25 indicate the distribution of $\theta_{\widetilde{W}}$ for rankings of VA. Both the left-hand and centre figure indicate that the distribution of $\theta_{\widetilde{W}}$ for HeM and HeW is slightly skewed although normally peaked. The histogram that illustrates the distribution of $\theta_{\widetilde{W}}$ for HoW severely violates any assumptions about the normality of a distribution. Therefore, any results regarding the rankings of VM for HoW must be interpreted with caution.
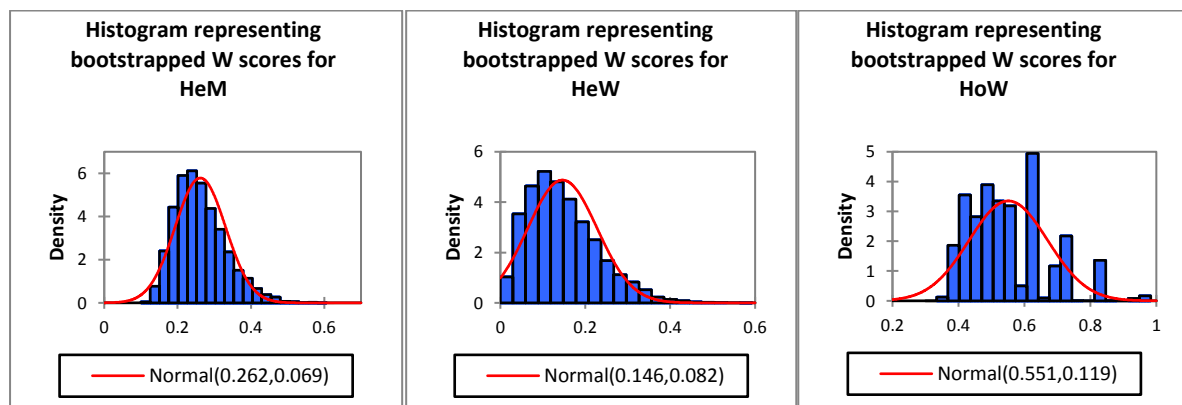
Figure 25: Histograms representing the distribution of bootstrapped θ_W̃ VM for HeM (left), HeW (centre) and HoW (right)

Table 25:Summary of bootstrapped (B=10000) $\widetilde{W}$ for rankings of visual masculinity for sex by sexual orientation

Sex by sexual orientation group	$\widetilde{W}$	P	$\theta_{\widetilde{W}}$	P	SE	Lower confidence limit	Upper confidence limit	Decision
HeM	0.471	0.02	0.262	<0.001	0.069	0.155	0.423	Reject
HoM	0.136	NS	0.126	NS	0.069	0.037	0.298	fail to reject
HeW	0.07	NS	0.146	0.05	0.081	0.027	0.334	Reject
HoW	0.386	NS	0.551	<0.001	0.119	0.388	0.826	Reject

Regarding the concordance of rankings for pairwise comparisons shown in table 26, the bootstrap indicated that all sex by SO groups were significantly concordant. This contrasts with the original $\widetilde{W}$ calculations, which indicated that only heterosexual sex groups and homosexual sex groups were significantly concordant; and $\widetilde{W}$ calculations for opposite sex by SO groups combined indicated non-significance. In addition, for initial $\widetilde{W}$ calculations the degree of agreement never exceeded 0.1, which implies a minimal effect size. The mean $\theta_{\widetilde{W}}$ statistic for each group comparison never exceeded 0.2, indicating that after bootstrapping the degree of agreement remained small. This may be due to the limited range of stimuli.

Table 26: Summary of bootstrapped (B=10000) $\widetilde{W}$ for rankings of visual masculinity for sex by sexual orientation pairwise comparisons

Group comparison	$\widetilde{W}$	P	$\theta_{\widetilde{W}}$	P	SE	Lower confidence limit	Upper confidence limit	Decision
HeM*HeW	0.072	0.05	0.107	<0.001	0.047	0.034	0.213	Reject
HoM*HoW	0.072	0.05	0.055	0.05	0.029	0.012	0.126	Reject
HoM*HeW	0.078	NS	0.090	0.01	0.048	0.022	0.210	Reject
HeM*HoW	0.098	NS	0.137	<0.001	0.039	0.080	0.229	Reject

Scent attractiveness

According to the results of the Friedman's test, the sum of the ranks of the stimuli were not significantly different when considering SA rankings between sex by SO groups either before a bootstrap was applied (χ^2=3.250, df=5, NS) or after (θ_{χ^2}=4.136, df=5, NS). Therefore, the null hypothesis that the stimuli items are not significantly different in rankings is not rejected and the conclusion drawn that the judges may have ranked the stimuli items in terms of SA differently.

The table 27 below indicates a summary of $\widetilde{W}$ calculations, including original and bootstrapped calculations for rankings of SA. In the original calculations, only HoM were significantly concordant and the degree with which these respondents agreed was high, indicating a good effect size. Once bootstrapped however, the degree of agreement decreased, but, remained significant. The $\theta_{\widetilde{W}}$ statistic for HeM, and HoW groups showed an improvement as concordance for these groups were significant. The degree of agreement amongst all of the groups after bootstrapping except for HeW was small to moderate. The histograms depicted in figure 26 represent the distributions of significant $\theta_{\widetilde{W}}$ statistics. The distribution for HeM is relatively normal although slightly positively skewed, however, both distributions for HoM and HoW are highly skewed and therefore the significant results

obtained from the bootstrap must be interpreted cautiously as they do not represent a normally distributed population.
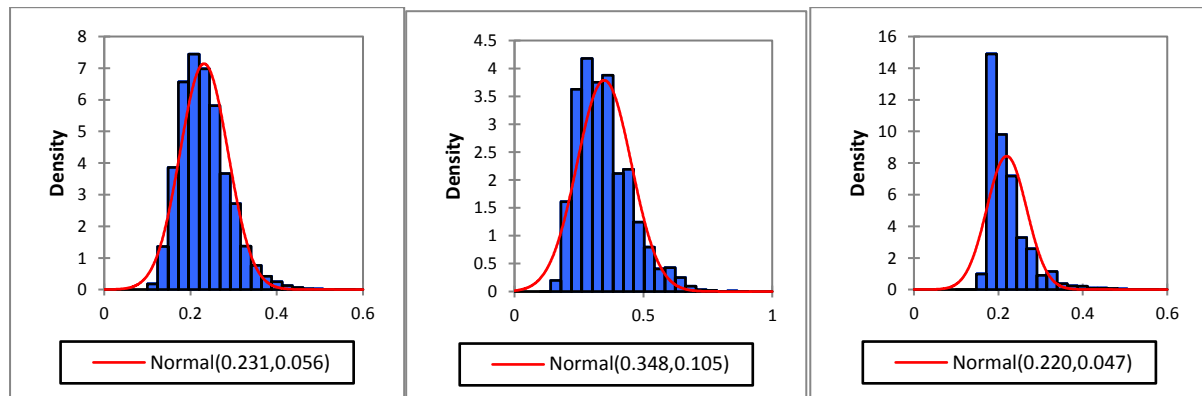
Figure 26: Histograms representing the distribution of bootstrapped θ_W̃ SA for HeM (left), HoM (centre) and HoW (right)

Table 27: Summary of bootstrapped (B=10000) $\widetilde{W}$ for rankings of Scent attractiveness for sex by sexual orientation

Sex by sexual orientation group	$\widetilde{W}$	P	$\theta_{\widetilde{W}}$	P	SE	Lower confidence limit	Upper confidence limit	Decision
HeM	0.149	NS	0.231	0.01	0.056	0.143	0.359	Reject
HoM	0.871	0.01	0.348	<0.001	0.105	0.193	0.598	Reject
HeW	0.112	NS	0.090	NS	0.066	0.011	0.263	fail to reject
HoW	0.229	NS	0.22	0.01	0.047	0.173	0.343	Reject

As is evident in table 28 none of the pairwise concordance calculations were initially significant indicating that none of the sex by SO groups agreed on the attractiveness of scent. However, in the initial calculations, the sample sizes were significantly unbalanced and small, therefore, the bootstrap, which included an oversampling method for equating the sample sizes, was a better estimate of true concordance. According to the $\theta_{\widetilde{W}}$ values, HoM and HeW ranked the attractiveness of scent significantly concordantly, although the degree of agreement was small (<0.1). Furthermore, the $\theta_{\widetilde{W}}$ value for HeM and HoW was also significantly concordant in rankings of SA, with a degree of agreement somewhat better than HoM and HeW, although still not large. Heterosexual sex groups and homosexual sex groups were not significantly concordant.

Table 28: Summary of bootstrapped (B=10000) $\widetilde{W}$ for rankings of scent attractiveness for sex by sexual orientation pairwise comparisons

Group comparison	$\widetilde{W}$	P	$\theta_{\widetilde{W}}$	P	SE	Lower confidence limit	Upper confidence limit	Decision
HeM*HeW	0.019	NS	0.029	NS	0.020	0.005	0.081	fail to reject
HoM*HoW	0.019	NS	0.026	NS	0.016	0.005	0.068	fail to reject
HoM*HeW	0.006	NS	0.066	0.05	0.033	0.018	0.145	Reject
HeM*HoW	0.106	NS	0.126	<0.001	0.041	0.058	0.218	Reject

Scent masculinity

A Friedman's test indicated that the sum of the ranks of stimuli items for rankings of SM before (χ^2=3.250, df=5, NS) and after (θ_{x^2}=4.823, df=5, NS) bootstrapping were not significantly different with sex by SO groups. Therefore, the null hypothesis that the stimuli items are not significantly different is not rejected and the conclusion that the judges ranked the stimuli items in terms of SM potentially differently is drawn.

Table 29 demonstrates the $\widetilde{W}$ statistics before and after bootstrapping. The initial calculations of $\widetilde{W}$ indicate that none of the sex by SO groupsagreed significantly on the masculinity of the scents they were asked to rank. However, once a bootstrap was applied HoM, HoW and both homosexual groups combined ranked the masculinity of the scent stimuli concordantly, furthermore the degree of agreement amongst the HoM group and the HoW group was moderate, this is in comparison to the HeM and HeW groups which were not significantly concordant. The distribution of $\theta_{\widetilde{W}}$ as indicated by the histograms in figure 27 below show that both the distribution HoM and HoW $\theta_{\widetilde{W}}$ is slightly skewed, more so in the distribution of HoW, therefore interpretations regarding the target population drawn from the bootstrapped sample must be done so with prudence.

Table 30 below displays the concordance values between pairs of sex by SO groups. Initially $\widetilde{W}$ was not significant amongst any of the paired groups, however due to the small and unequal sample sizes it was assumed results would be biased. Therefore, a bootstrap was applied with the samples equated. The results indicate that only the homosexual sex group combination was not significantly concordant. All other groups matched pairwise showed significant agreement. The degree of agreement between heterosexual sex groups, although significant, was quite small (<0.1).
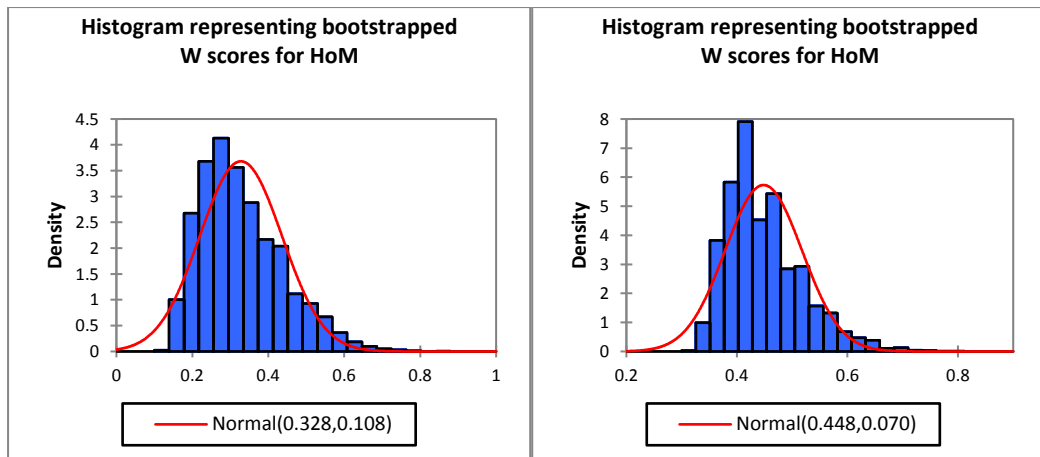
Figure 27: Histograms representing the distribution of bootstrapped θ_W̃ SM for HoM (left) and HoW (right)

Table 29: Summary of bootstrapped (B=10000) $\widetilde{W}$ for rankings of SM for sex by sexual orientation

Sex by sexual orientation group	$\widetilde{W}$	P	$\theta_{\widetilde{W}}$	P	SE	Lower confidence limit	Upper confidence limit	Decision
HeM	0.036	NS	0.104	NS	0.063	0.028	0.264	fail to reject
HoM	0.193	NS	0.328	<0.001	0.108	0.17	0.577	Reject
HeW	0.37	NS	0.112	NS	0.061	0.023	0.256	fail to reject
HoW	0.5	NS	0.448	<0.001	0.07	0.351	0.613	Reject

Table 30: Summary of bootstrapped (B=10000) $\widetilde{W}$ for rankings of scent masculinity for sex by sexual orientation pairwise comparisons

Group comparison	$\widetilde{W}$	P	$\theta_{\widetilde{W}}$	P	SE	Lower confidence limit	Upper confidence limit	Decision
HeM*HeW	0.034	NS	0.056	0.05	0.032	0.011	0.130	Reject
HoM*HoW	0.034	NS	0.039	NS	0.024	0.007	0.100	fail to reject
HoM*HeW	0.031	NS	0.164	<0.001	0.056	0.071	0.286	Reject
HeM*HoW	0.102	NS	0.157	<0.001	0.031	0.110	0.234	Reject

4.4. Additional Analyses

4.4.1. PAQ Results

The frequencies of the PAQ classification groups, undifferentiated, feminine, masculine and androgynous, were calculated ($\bar{x}$ = 2.29, s = 1.216). Of the 31 respondents, 32.26% were scored as undifferentiated, 35% as feminine, 3.22% as masculine, and 29.03% as androgynous. The very small masculine proportion of the sample may indicate an unrepresentative sample or indicate that the idea of what is considered masculine has changed since the creation of the PAQ. A crosstabulation and chi squared test of the PAQ groups and sex yielded no significant associations all round (χ^2 =2.253, NS). However, a crosstabulation of PAQ groups with SO did yield a significant association (χ^2 = 7.998, p = .046, Φ_c = .508) (see table 31). Cramer's V (.508) shows a moderate strength of association. Looking at specific subgroup associations as indicated by the adjusted residuals, both SO groups were significantly associated the undifferentiated and androgynous PAQ groups (d_{hetero} =-2.4, d_{homo} =2.4, α= 0.05). There were significantly more heterosexual undifferentiated respondents than expected (d =2.3> z_{crit} 1.96) with significantly fewer homosexual undifferentiated respondents than expected (d =-2.3< z_{crit} =-1.96). Furthermore, there were significantly less heterosexual androgynous respondents than expected (d=-2.4< z_{crit} =-1.96) and significantly more homosexual androgynous respondents (d =2.4> z_{crit} 1.96). These results suggest that heterosexual individuals are not likely not conform or align with either of the gender norms defined by the PAQ; and homosexual individuals are likely to conform or align with traits from both genders. The other two categories of the PAQ groups did not yield any significant differences between SOs. This interpretation is made with caution as the sample size was small and potentially unrepresentative. Furthermore, one of the assumptions regarding the chi-square test is that the expected count for each cell should be more than five in the majority of the cells in the table, however, as there are zeros in some of the cells the assumption is violated.

Table 31: Crosstabulation of PAQ groups and Sexual Orientation

Sexual Orientation	PAQ Groups				χ^2	Φ_c
	Undifferentiated	Feminine	Masculine	Androgynous		
Heterosexual	10_a (2.3)	$8_{a, b}$ (-0.1)	$1_{a, b}$ (0.6)	4_b (-2.4)	7.998 (p=0.046)	0.508
Homosexual	0_a (-2.3)	$3_{a, b}$ (0.1)	$0_{a, b}$ (-0.6)	5_b (2.4)		

Adjusted residuals indicated by parentheses

Subscript denotes differences between column proportions at significance level α=0.05

Another crosstabulation and chi squared analysis was conducted investigating the association between PAQ groups and sex by SO groups. The chi squared analysis did not reveal an overall significant association; however, the adjusted residuals presented in the crosstabulation did indicate two significant isolated associations between PAQ groups and sex by SO groups. Firstly, there were significantly more heterosexual men in the masculine PAQ group than expected (d= 2.1 > z_{crit} =1.96), and secondly there were significantly more homosexual men in the androgynous PAQ group than expected (d= 2.2> z_{crit} =1.96). Furthermore, according to the denoted subscript in table 32, there is a significant difference between masculine and androgynous heterosexual men, with only heterosexual men being classed as masculine, and furthermore, no heterosexual men being classed as androgynous.

Table 32: Crosstabulation of PAQ groups and Sex by Sexual Orientation groups

Sex by Sexual Orientation	PAQ Groups				χ^2	Φ_c
	Undifferentiated	Feminine	Masculine	Androgynous		
Heterosexual Men	$3_{a, b}$ (1)	$2_{a, b}$ (-1)	1_b (2.1)	0_a (-1.7)	13.558 (NS)	0.661 (NS)
Homosexual Men	0_a (-1.5)	1_a (-.5)	0_a (-.4)	3_a (2.2)		
Heterosexual Women	7_a (1.2)	6_a (.0)	0_a (-1.1)	4_a (-.7)		
Homosexual Women	0_a (-1.5)	2_a (0.7)	0_a (-0.4)	2_a (1)		

Adjusted residuals indicated by parentheses
Subscript denotes differences between column proportions at significance level α=0.05

Kendall's $\widetilde{W}$ was calculated for those PAQ groups that showed a significant specific association with SO and sex by SO groups in the chi-squared analysis above. The first set of

$\widetilde{W}$ calculations were for associations between heterosexual individuals and the PAQ undifferentiated group. According to the results there was significant concordance amongst rankings of VA for both the initial calculations ($\widetilde{W}$=0.2, df=5, p<α=0.001) and the bootstrapped calculations ($\theta_{\widetilde{W}}$=0.197, SE=0.067, p<α=0.001). The 95% confidence limits for bootstrapped VA data are as follows: LC=0.086 and UC= 0.34. For rankings of VM, concordance was also significant before ($\widetilde{W}$=0,111, df=5, p<α=0.001) and after bootstrapping ($\theta_{\widetilde{W}}$=0.116, SE=0.043, p<α=0.001) with a confidence interval of LC=0.048: UC=0.214. The rankings of SA were significantly concordant both before bootstrapping ($\widetilde{W}$=0.094, df=5, p<α=0.001) and after ($\theta_{\widetilde{W}}$=0.108, SE=0.047, p<α=0.001), with LC limit of 0.033 and an UC limit of 0.212. Finally, SM was also found to be significantly concordant both before ($\widetilde{W}$=0.093, df=5, p<α=0.001) and after bootstrapping ($\theta_{\widetilde{W}}$=0.127, SE=0.044, p<α=0.001), with an LC limit of 0.49 and a UC limit of 0.223. All these results indicate that regardless of the measure and stimulus, heterosexual and PAQ undifferentiated individuals had significantly similar rankings, however the $\widetilde{W}$ and $\theta_{\widetilde{W}}$ statistics indicate that although significant, the degrees of agreement were small.

In the chi squared analysis above, a significant association between the PAQ androgynous group and homosexuality was found. Therefore $\widetilde{W}$ was calculated to verify whether, the rankings for stimuli attractiveness and masculinity were similar between respondents classified as PAQ androgynous and homosexual respondents. These calculations were further bootstrapped due to small and unequal sample sizes. For rankings of VA androgynous respondents and homosexual respondents were significantly concordant in their rankings both before ($\widetilde{W}$=0.144, p=0.05) and after bootstrapping ($\theta_{\widetilde{W}}$=0.189, SE=0.117, p=0.01), this indicates that the bootstrap increased the degree of agreement between respondents although the degree of agreement is still below 0.2. This means that the respondents who expressed they were homosexual were significantly concordant with those who were classed as androgynous in terms of which male face they found attractive. The 95% LC limit for the $\theta_{\widetilde{W}}$ distribution was 0.0252 and the UC limit was 0.465. Androgynous and homosexual individuals were not significantly concordant in their rankings of VM or SA either before (VS: $\widetilde{W}$=0.076, NS; SA: $\widetilde{W}$=0.009, NS) or after bootstrapping (VS: $\theta_{\widetilde{W}}$=0.129, SE 0.076, NS; SA: $\theta_{\widetilde{W}}$=0.058, SE 0.039, NS). However, androgynous and homosexual individuals were significantly concordant in their rankings of SM after the application of a bootstrap ($\theta_{\widetilde{W}}$=0.141, SE 0.059, p≤α=0.05), although not in the original calculation ($\widetilde{W}$=0.091, NS).

The 95% confidence interval for the $\theta_{\widetilde{W}}$ distribution (LC=0.049: UC=0.275) indicates a somewhat narrower interval than the distribution of $\theta_{\widetilde{W}}$ for VA rankings, which indicates a smaller range from which we can estimate the real-world concordance statistic to fall.

In the chi-squared analysis regarding sex by SO groups and PAQ classifications, the adjusted residuals indicated that there was a specific association between androgyny and HoM in particular. Therefore, a test of $\widetilde{W}$ was run to assess whether rankings of stimuli items were similar between androgynous and HoM respondents. The only significant agreement in rankings between androgynous and HoM was found after the application of a bootstrap and for rankings of SA specifically ($\theta_{\widetilde{W}}$=0.14, SE 0.058, p≤α=0.05) with a 95% confidence interval for the distribution of $\theta_{\widetilde{W}}$ at LC=0.054: UC=0.275. Furthermore, the mean degree of association for the bootstrapped data indicated by $\theta_{\widetilde{W}}$ was small (<0.2). All other measures of concordance from both original and bootstrapped calculations were not significant.

4.4.2. Age

In order to assess whether age was associated with the rankings of stimuli on measures of attractiveness and masculinity a measure $\widetilde{W}$ was calculated and bootstrapped. Age was first recoded into three categories, the first category consisted of all participants ranging from the youngest (18yrs.) to age 25, and the second category included participants ranging from 26-30 yrs. The last category included participants older than 30 yrs. Only one participant exceeded 30 yrs. and so, this category was left out of the analysis.

Participants aged between 18 and 25 were all significantly concordant in their rankings of VA and VM both before and after a bootstrap was applied. However, SA and SM were only significantly concordance once the calculation was bootstrapped. The relevant statistics are shown in table 33 below. The $\theta_{\widetilde{W}}$ statistic is significant for all ranking conditions, and the degree of agreement improved for all conditions once bootstrapping was applied, suggesting that the real-world parameter estimated at by $\theta_{\widetilde{W}}$ is more likely to be significant.

Table 33: Summary of bootstrapped (B=10000) $\widetilde{W}$ for rankings by participants aged between 18 and 25 years

Ranking condition	$\widetilde{W}$	P	$\theta_{\widetilde{W}}$	P	SE	Lower confidence limit	Upper confidence limit	H0 Decision
VA	0.298	0.001	0.327	<0.001	0.109	0.127	0.549	Reject
VM	0.116	0.05	0.15	0.1	0.062	0.051	0.294	Reject
SA	0.081	NS	0.12	0.1	0.06	0.032	0.257	Reject
SM	0.079	NS	0.117	0.05	0.046	0.043	0.221	Reject

According to the statistics presented in table 34 below, before bootstrapping was applied participants aged between 25 and thirty did not significantly rank the stimuli items concordantly for any of the ranking conditions. However, once bootstrapped the mean $\theta_{\widetilde{W}}$ shows a significant improvement in concordance for all ranking conditions, thus agreement is improved by resampling. Although the $\theta_{\widetilde{W}}$ is significant in all conditions the degree of agreement is generally small for all ranking conditions.

Table 34: Summary of bootstrapped (B=10000) $\widetilde{W}$ for rankings by participants aged between 25 and 30 years

Ranking condition	$\widetilde{W}$	P	$\theta_{\widetilde{W}}$	P	SE	Lower confidence limit	Upper confidence limit	H0 Decision
VA	0.109	NS	0.144	0.01	0.04	0.097	0.254	Reject
VM	0.054	NS	0.09	0.05	0.053	0.017	0.221	Reject
SA	0.246	NS	0.276	<0.001	0.082	0.165	0.477	Reject
SM	0.145	NS	0.18	<0.001	0.042	0.128	0.284	Reject

4.4.3. Race

According to table 35 below, Black respondents who made up the majority of the sample did not rank either of the stimuli objects for either of the ranking conditions with any significant concordance, this was sustained even after the application of a bootstrap.

Table 35: Summary of bootstrapped (B=10000) $\widetilde{W}$ for rankings by African participants

Ranking condition	$\widetilde{W}$	P	$\theta_{\widetilde{W}}$	P	SE	Lower confidence limit	Upper confidence limit	H0 Decision
VA	0.081	NS	0.14	NS	0.087	0.025	0.36	Fail to reject
VM	0.061	NS	0.123	NS	0.068	0.024	0.282	Fail to reject
SA	0.022	NS	0.088	NS	0.054	0.017	0.226	Fail to reject
SM	0.07	NS	0.132	NS	0.073	0.027	0.306	Fail to reject

In the original calculations of $\widetilde{W}$ for White individuals, no significant concordance was found for any of the ranking conditions as is indicated in table 36 below. This lack of significance may however, be related to the small and unequal sample sizes between race groups. Therefore, a bootstrap was applied to the calculation of $\widetilde{W}$ and the sample size oversampled to match the largest race sample (Black). The mean bootstrap statistic $\theta_{\widetilde{W}}$ indicated that White participants were significantly concordant in their rankings of VS and that the mean degree of agreement once bootstrapped was improved from the original calculation, and was small to moderate for both VA and VM. However, the bootstrap failed to improve the agreement regarding SA and SM significantly.

Table 36: Summary of bootstrapped (B=10000) $\widetilde{W}$ for rankings by White participants

Ranking condition	$\widetilde{W}$	P	$\theta_{\widetilde{W}}$	P	SE	Lower confidence limit	Upper confidence limit	H0 Decision
VA	0.171	NS	0.226	0.01	0.083	0.122	0.448	Reject
VM	0.182	NS	0.233	0.01	0.065	0.153	0.4	Reject
SA	0.079	NS	0.139	NS	0.104	0.022	0.404	Fail to reject
SM	0.057	NS	0.121	NS	0.064	0.039	0.281	Fail to reject

When estimating agreement amongst rankings for the Indian sample of respondents, only the VA ranking condition was significantly concordant before the application of the bootstrap. Furthermore, the degree of agreement for VA amongst Indian respondents was quite high (>0.7) and this degree of agreement increased after a bootstrap was applied. Furthermore, the bootstrap also improved concordance significantly for rankings of VM and SA, although the

degree of agreement was a low moderate in both cases. Rankings for SM were not significant both in the initial calculation of $\widetilde{W}$ and in the calculation of $\theta_{\widetilde{W}}$. Thus, the estimation of the population attained by bootstrapping would suggest that the Indian population would be highly concordant in their preference for VA, and somewhat concordant in their perception of VM and SA.

Table 37: Summary of bootstrapped (B=10000) $\widetilde{W}$ for rankings by Indian participants

Ranking condition	$\widetilde{W}$	P	$\theta_{\widetilde{W}}$	P	SE	Lower confidence limit	Upper confidence limit	H0 Decision
VA	0.765	<0.001	0.782	<0.001	0.035	0.719	0.855	Reject
VM	0.18	NS	0.235	0.01	0.098	0.087	0.469	Reject
SA	0.225	NS	0.278	<0.001	0.07	0.182	0.452	Reject
SM	0.064	NS	0.126	NS	0.057	0.041	0.265	Fail to reject

The initial calculation of $\widetilde{W}$ for Coloured respondents was not significant for any of the ranking conditions as is indicated in table 38 below. However, this may have been due to the small sample size and therefore, bootstrapping with the sample size matched to the Black sample size was applied. According to the results presented in table 38, this improved concordance for all ranking conditions significantly and the decision to reject the null hypothesis was reached for all ranking conditions. The improvement in significance demonstrated by the bootstrap suggests that the Coloured target population is estimated to be concordant in their rankings of VA, VM, SA and SM, although this is purely an estimation and not an exact assumption about the population.

Table 38: Summary of bootstrapped (B=10000) Kendall's coefficient of concordance for rankings by Coloured participants

Ranking condition	$\widetilde{W}$	P	$\theta_{\widetilde{W}}$	P	SE	Lower confidence limit	Upper confidence limit	H0 Decision
VA	0.536	NS	0.566	<0.001	0.062	0.462	0.705	Reject
VM	0.314	NS	0.362	<0.001	0.109	0.177	0.608	Reject
SA	0.143	NS	0.2	0.01	0.125	0.043	0.484	Reject
SM	0.421	NS	0.459	<0.001	0.065	0.374	0.616	Reject

Chapter 5: Discussion, Limitations, and Conclusion

5.1. Discussion of Results

This discussion will be a synthesis of the results and further provide evidence either in support or contradiction of previous studies regarding sexual selection, pheromones and or sexual orientation. However, any conclusions drawn here are done so with the acknowledgement that they are tentative. This is due to the lack of adequate representation of the population from the very small sample sizes. Therefore, this study may be vulnerable to bias as sample sizes between comparable groups were unequal and furthermore not adequately matched on all demographic characteristics as is indicated in the demographic descriptive data in the results section. With the acknowledgement of the limitations of this study and its vulnerability to threats of both internal and external validity, the results will hereby be discussed with tentative expectations.

In this study, the objectives for analysing the data were threefold. The first objective was to assess whether the conditions which required judgement (VA, VM, SA, and SM) were correlated. The second objective aimed to assess whether sex, sexual orientation and a combination of both were associated with the rankings of the four conditions and the third objective was to assess whether other demographics such as androgyny PAQ scores, age and race affected rankings.

5.1.1. Masculinity and Attractiveness

This objective aimed at analysing the stimuli. The stimuli, as mentioned before, consisted of six photographs and six t-shirts which were considered to have the presence of male BO. These two variants of stimuli were supplied by the same six male participants. The smallness of stimuli sample may have under-represented the population of males as the population was not exhausted in the recruitment of stimuli participants. This may have reduced the range of attractiveness and masculine characteristics in the stimuli sample, which would have potentially reduced the variation amongst stimuli consequently limiting the possibility of concordance in rankings amongst groups. For example, the first finding of interest to report on here is firstly that the VS tended to have more concordant rankings in general than the SS suggesting that perhaps the variation of scents present on the t-shirts were too similar or perhaps contaminated with other smells. Secondly rankings of attractiveness were, in general, found to be more concordant than rankings of masculinity, suggesting perhaps that the stimuli

sample did not provide enough variation in masculine traits to discern an objective order of masculinity.

The analysis of objective one included the entire sample and did not incorporate sex or sexual orientation as covariables, except regarding women in question one because of the hypothesized correlation that female peak fertility may have on rankings. When "eyeballing" the descriptive statistics consisting of the mean, median and average median rank for each stimuli item determined from the entire sample, it would appear that all of the medians and average median ranks were quite different between ranking conditions (see table 10). For both VS and SS, the average median ranks for attractiveness appear to negatively correlate with average median ranks of masculinity. The average median rank for stimulus six is one for VA and six for VM. The highest average median rank for VA corresponds with the lowest tied median rank of the VM condition. This result was similarly demonstrated regarding the scent stimuli. These observed results suggest that without taking demographic information into account; the respondents ordered the six stimuli quite differently regarding how attractive and masculine they perceived them to be. This tentative result based on mere inspection of the descriptive statistics may however be biased because of the over-representations of some groups (i.e. females as compared to males). Furthermore, female judgment according to Penton-Voak et al. (2001) and Grammer (1993) is often affected by hormonal fluctuations associated with the risk of conception.

The Friedman's analysis comparing the VS and the SS rankings for each item showed that there was a difference between VS and SS regarding both attractiveness and masculine rankings, furthermore, a difference between attractiveness and masculinity was found for both the VS and SS. This was unexpected as according to both Kohl (2008) and Cornwell et al. (2004), the preference for scent or pheromones is conditioned to associate with visual preferences. This unexpected finding may be due to the reduced variation or range in the stimuli sample. However, despite these differences one of the most frequent findings drawn from the results is that VS, regardless of the condition on which the stimuli were ranked, tended to be concordant in general as is indicated in table 11 and 12.

One possible explanation for this is that the VS are a much more overt sensory input than the SS. The effects of T on masculine features are more consciously distinguishable in the observable facial characteristics of the individuals in the photographs than in the smell of the t-shirts. Furthermore, sight is not as significantly influenced by the fluctuation of sex

hormones in women; however, the hypothalamic reception of olfactory sensory input is (Grammer, 1993; Pause, et al., 1999; Savic, et al., 2001; Kovacs, et al., 2004; Shepherd, 2006; Hoover, 2011). This may be further compounded the by the threat to internal validity of instrument decay regarding the BO of the male stimuli participants that was present on the t-shirts. The scent that was present on the SS used in this study had the propensity to fade quickly even though all appropriate measures to preserve scent were implemented: for example the SS were kept in sealed ziploc bags and cooled to reduce scent loss. During the data collection phase however, scent loss was very difficult to control as judging participants were required to open the bags to smell the SS, thus exposing the SS to air and increasing the liklihood that external smells such as fragrance or food would contaminate the t-shirts and that the original smell created from the BO of the stimulus participants would be reduced. To reduce the the degree of scent loss and contamination participants were asked not to touch or remove the t-shirts from the ziploc bag, but instead, simply hold the open bag up to their noses. Despite this attempt to reduce instrument decay, it was still impossible to completely control. The VS alternatively were obviously much less vulnerable to instrument decay as the image presented in the photograph is not likely to change and furthermore, if any of the photographs were damaged during data collection, they could easily be reprinted, unlike the SS, which would require further participation from the stimulus participants and further ethical enquiry.

Additionally, it has been suggested by many authors that hormone changes that occur during the menstrual cycle of women affect their olfactory abilities, which would compromise the concordance in rankings of SS amongst women in general (Gangestad, et al., 2005; Grammer, 1993; Kohl, 2008). Furthermore, as the sample of women in this study outnumber men by just over double, the possible inconsistency expected from female rankings in general may overwhelm any condordance amongst men, when $\widetilde{W}$ for the entire sample was calculated.

It is for this reason that tests regarding the ovulatory cycle of women were conducted with regard to how rankings of VA,VM, and SA, SM differed and correlated. Firstly Friedman's tests were conducted. This test showed that ovulating women ranked the VS items differently to non-ovulating women indicating that women at peak fertility considered the order of the six photographs differently in terms of attractiveness and masculinity depending on their phase of menses. This result was also shown for the rankings of SS items. This is an expected result as previous literature suggessts that ovulation alters women's perceptions of both male

faces and male scents (Gangestad, et al., 2005; Grammer, 1993; Pillsworth, et al., 2004; Penton-Voak, et al., 1999; Peters, Simmons, & Rhodes, 2009). In addition, $\widetilde{W}$ calculations for women at each estimated phase their cycle were calculated, for measures of VA, VM, VA*VM, SA, SM, and SA*SM, where the "*" denotes that these rankings were combined for the calculation of $\widetilde{W}$ (see table 13). The results obtained support previous findings that VS are generally ranked with more concordance, regardless of whether the rankings came from ovulating women, non-ovulating women, or women in general. It was predicted that women at their follicular phase would be more concordant in their VA*VM rankings and SA*SM rankings than women at their luteal phase, as women are more likely to find characteristics associated with high T levels most attractive when ovulating (Gangestad, 2000; Gangestad, et al., 2005; Pillsworth & Haselton, 2006; Pillsworth, et al., 2004).

For women in general, regardless of menstrual phase, all of the VS conditions were concordant, including VA*VM, however, women were only concordant in their rankings of SA, with regard to SS, and failed to agree significantly in their rankings of SM and SA*SM. These results echo the previous findings that rankings of VS are generally much more concordant. It was assumed that this result was due to the discrepency in mentrual phases amongst the women which would have affected how they percieved both the attractiveness and masculinity of SS. Therfore $\widetilde{W}$ statistics were interpreted for both women estimated to be at their follicular and luteal phases.

It was predicted that women at their follicular phase would be significantly more concordant in their rankings of stimuli all round as olfactory abilities are said to be heightened at this phase (Gangestad, et al., 2005; Pillsworth, et al., 2004; Grammer, 1993), and furthermore, women are said to find masculine men more attractive at this phase (Gangestad & Simpson, 2000; Penton-Voak, et al., 1999; Pillsworth & Haselton, 2006). However, in contrast to the expected outcome, the results from this study indicated that for women estimated to be at their follicular phase, only rankings ragarding, VA, VA*VM, and SA, were concordant. A possible reason for why this outcome did not adequately sustain the prediction for follicular phase women, could be due to the method for estimating ovulation. To estimate ovulation, women were asked to report the starting date of their last mentruation on the questionnaire. From this, the follicular phase of each female participants' cycle was estimated as being approximately 14 days after menstruation. This method of estimation however, does not always accurately predict ovulation, as it assumes that all women have regular 28 day

menstrual cycles. For a more accurate estimation of ovulation, urine tests could have be used, or a method of tracking the menstrual cycle of women for a month as Miller and Maner (2010) did in their study. Both these options however, were either impractical, unfeasible, or would have required special ethical approval (i.e. urine ovulation tests).

Another potential reason for the discrepancey or lack of concordance for VM, SM, and SA*SM conditions could be that sexual orientation amongst women was not included as a covarying factor in this analysis. If the hormone theory explained by Ellis and Ames (1987) is true, then the way in which HoW percieve male VS and SS may be different to how HeW percieve them. According to the hormone theory, maternal T may cross the placental barrier at the critical period of gestation when SO and sex type behaviour are determined which would affect the sexual differentiation of the brain (Ellis & Ames, 1987). This masculinisation of the female foetal brain that is said to lead to homosexuality in women would mean that for HoW perceptions and neuronal responses of VS and SS would be similar to that of HeM due to the slight masculinisation of the brain. This hypothesis has been confirmed by Berglund, et al. (2006) in a study investigating hypothalamic activation in lesbian women when exposed to putative pheromones; the study showed that HoW had similar brain responses to HeM when exposed to both male and female chemo-signals. The reason why SO was not included as a covarying factor in this analysis was because the sample size of HoW was too small (n=4) to allow for the division of the sample by menstrual phases as sample sizes less than three would have invalidated the $\widetilde{W}$ calculations.

Although follicular phase women did not sustain all the predictions made ragarding attractiveness and masculinity, they were significantly concordant in measures of VA, VA*VM, and SA whereas, only VA and VA*VM were significantly concordant amongst luteal phase women. Furthermore, the degree of agreement in conditions indicated to be significant for all of the groups (women in general, follicular phase and luteal phase), was much greater in follicular phase women. For example VA for women in general had a moderate degree of concordance was ($\theta_{\widetilde{W}}$ =0.36), for luteal phase women the degree of concordance was small to moderate ($\theta_{\widetilde{W}}$ =0.277), whereas for follicular phase women concordance was moderate to large ($\theta_{\widetilde{W}}$ =0.679). This was also shown in for rankings regarding VA*VM. The ranking condition of SA was significantly concordant for follicular, but not luteal phase women, suggesting that the SA is somehow correlated with peak fertility which does give credence to hypotheses suggested in literature (Grammer, 1993; Hoover,

2011), especially since the degree of association amongst women at this phase was moderate ($\theta_{\widetilde{W}}$=0.337) and much larger than women at their luteal phase ($\theta_{\widetilde{W}}$=0.064).

For follicular phase women rankings of masculinity for both the VS and SS were not concordant. This was unexpected, particularly for the rankings of VS for follicular phase women, as previous literature suggests that masculine features, such as a strong jawline and prominent brow would be most attractive during ovulation as these are indicative of high T levels and without the presence of severe FA, would indicate excellent heritable genetic fitness (Gangestad, 2000). However, aattractiveness rankings did appear to be more concordant than masculinity rankings overall and not just for women. This is seen in the $\widetilde{W}$ calculations for question two as indicated in table 13, although the degree of concordance for attractiveness amongst the whole sample as was small (<0.1).

This finding suggests that perhaps the construct of masculinity as a condition for ranking was ambiguous. In the original t-shirt studies, most authors asked participants to rank the stimuli on measures of pleasantness, sexiness and intensity, and not masculinity. Furthermore, in studies conductd by Penton-Voak, et al. (1999) and Cornwell, et al. (2004), judgements of VM were based on manipulated digtial images of male faces to make them appear physically more masculine or feminine. However, in this study particpants were asked to rank the VS and SS in the order of how masculine they percieved the items to be. Therefore, it is possible that the judging participants perhaps considered the term "masculinity" with subjective bias. It was assumed by the researcher that participants would base their rankings of masculinity on the biological markers indicative of T, however, the notion of masculinity as a social ideal was not considered. According to Geary et al. (2004) and Palmer and Palmer (2002), cultural success can be associated with masculinity, especially in traditional patriarchal societies where men are the "breadwinners". Cultural success in men in patriarchal societies, is an indication of raised social and financial status and dominance within family and community groups and is consequently associated with machismo (Geary, et al., 2004). As cultural success is a socially rather than biologically acquired correlate of masculinity, it can be assumed that judging participants may have based their rankings of the stimuli on the assumption of social rather than biological indications of masculinity. For example, in the creation of the VS, photographs only included the shoulders and face of male stimulus participants and were printed in greyscale to reduce the affect that skin tone may have had on rankings. These photographs however, did still indicate hair style and what participants were wearing at shoulder level. These factors may subtely suggest social status and thus depending

on how the individual judging participant discerned the term masculinity, may have affected how they ranked VM. Furthermore, as cultural success is associated with status and subsequently grooming and cleanliness, the intensity of some of the BO on the SS may have been construed as a lack of cleanliness and thus t-shirts with more subtle scents were ranked as more masculine, as they may have smelled "cleaner" to some women. This however, is merely an hypothesis and should not be construed as a difinitive explanation.

The lack of concordance regarding masculinity, however, may also be due to ambiguity in the masculinity of the stimuli sample itself. The stimuli sample was small therefore the masculine features of the six items for both the VS and SS may not have varied adequately to obtain significant and efficacious results.

5.1.2. Sex and Sexual Orientation

The aim of objective two was to assess whether the sexes, sexual orientations, and an interaction of both would affect how individuals ranked the stimuli. It was predicted that there would be a significant difference between the sexes. This prediction was supported by the Friedman's test results which found that regardless of the ranking condition there was never a significant difference between the sum of rankings for each stimulus item when comparing men and women, homosexual and heterosexual individuals, and the four groups, thus suggesting that the groups ordered the six VS items differently from each other. This result however was contradicted by the significant concordance that many of the combined groups demonstrated for example for rankings of VA for both sexes, and both SOs. This indicates that groups showed significant agreement in how the VS should be ranked. This result was demonstrated for rankings of VM as well. The contradiction shown by the Friedman's and Kendall's tests could be indicative of the reduced variance in the stimuli sample.

Sex and sexual orientation as independent variables

The Friedman's test results for both question three and four showed that there was a difference between the sexes as well as between the SOs. What is confounding however, it that the $\widetilde{W}$ shows concordance between both sexes as well as both SOs. This is unusual as if there were a significant difference between the groups as is suggested by the Friedman's outcome, then it would be expected that a lack of concordance amongst groups would be found. This may be explained by the degree of concordance between the groups that although

was significant, was generally small. This however, is still unexpected as according to previous literature (Saxton, et al., 2008; Bao & Swaab, 2011; Savic, et al., 2001), men and women should percieve male attractiveness differently. The findings in this study do suggest concordance between men and women, however, this concordance is only applicable to VS. This finding was mirrored by analysis of the SO groups, as both heterosexual and homosexual individuals were concordant in their rankings of VA, and furthermore, both sexual orientations combined with sample sizes equated were concordant, although, this does not fit with Friedman's test findings as indicated earlier. Therefore, it is possible that the criteria with which both men and women, and heterosexual and homosexual individuals based their judgements of VA on, were socially constructed criteria likely concerning factors such as the appearance of social status (indicated visually through clothing and hair style) and masculine features. From this perspective, it is likely that most respondents regardless of sex or SO based their visual rankings of male features on what they percieved was attractive by societal standards and not their own interpretation of biological masculinity (Lippa, 2007). Societal suggestions of what is attractive and masculine would influence the judgment of VS for all individuals exposed to societal pressures, thus explaining how perhaps both men and women, and heterosexual and homosexual individuals could be concordant in their VA rankings. This may also explain why SS rankings amongst individuals were less concordant as scent without the influence of fragrance is not discriminantly advertised socially.

It was interesting to note that homosexual individuals, although signifcantly concordant in their rankings of VA were not concordant in their rankings of VM and SM. Again this may be attributed to the ambiguous masculinity of the stimuli and masculinity as a construct, especially in gay communities, where gender conformity is highly correlated with SO and thus notions of traditional masculinity may often be contested as a form of social rebellion (Lippa, 2007). This understanding of SO and gender conformity as a correlate for influencing the perception of masculinity was expanded upon in the additional anlysis of the PAQ and how it was associated with sex, SO and sex by SO. Furthermore, as homosexuality in this analysis did not differentiate between lesbian women and gay men, sex may have also been a confounding factor in how masculinity was interpreted, although in the next phase of analysis the interacting variables of sex and SO were investigated. Interestingly both heterosexual and homosexual individuals were concordant amongst themeselves with regard to the rankings of SA, however, were not concordant when the SOs were combined, suggesting as the Friedman's test did, that there is a difference between how homosexual and heterosexual

individuals percieve the attractiveness of BO. This finding is confirmed by studies conducted by Berglund et al., (2006), Lubke, et al., (2012) and Savic and Lindstrom (2008), all of which found that brain response to sexually dimorphic SS was dependant not only on the sex but SO as well. A discussion of how sex and SO combined and correlated will be discussed in question five.

In the analysis of the data regarding sex, women were more concordant than men about in their rankings of VA, and men were more concordant than women in their rankings of VM, although both groups were significantly concordant in both conditions. This finding somewhat sustains the predictions made earlier, that men would be receptive to the masculinity of other men in terms of indications of T levels. However, this prediction was made concerning the SS, as evidence from the studies conducted by Gabrielson, (2013) and Huoviala and Rantala (2013), indicated that men were more generous toward other men with higher T level pheromones. Yet, neither women nor men were significantly concordant in their ranking of SM, although with regard to rankings of SA, women were more concordant than men. This result does not support the hypothesis inferred from Gabrielson's (2013) study. Perhaps a reason why the expected SS results were tranferred to the VS results could be due to what Kohl (2008) suggests in his OPM model. In this model, Kohl (2008) suggests that visual preferences or identification of features related to hormones are conditioned by pheromonal preferences and physical identifiers also related to those same hormones. It could be stated thus that male judging participants could detect and discrimnate the VM features on a biological level as they have been conditioned to associate visual features with the presence of secreted 16-androstenes, however, due to the ambiguity of the term "masculinity" and the subtelty of smell on the SS, confounded together, men may have been unable to adequately and accurately percieve SM.

The predictiction that women would be more congruent in their rankings of attractiveness for both the VS and SS were sustained by the results. An explanation of these expected results can be found in the study conducted by Savic et al. (2001), who showed that the recepton of sexual dimorphic cues does activate different areas of the hypothalamus in men and women. Furthermore, the study conducted by Savic et al. (2001) was primarily concerned with how pheromones affected the hypothalmus in humans, which would support the findings in this study regarding SA rankings. For rankings of SA, men independent of women ranked significantly concordantly and vice versa, however the degeree of agreement amongst women was higher than men. Futhermore, there was no significant concordance amongst SA

rankings of men and women combined. Thus indicating that women regard the attractiveness of scent differently to men, although both sexes regard SA similarly amongst themeselves. This finding confirms the finding of Savic et al. (2001) that sexual brain differentiation affects SA.

Interactions between sex and sexual orientation

The main aim of question five, was to investigate if SO and sex did indeed show have any interactive significant effect on the rankings and perceptions of both the VS and SS. Firstly the Friedman's tests showed that regardless of ranking condition, the sex by SO groups, always indicated that the groups ranked the stimulus items differently. In addition to the Friedman's analysis several $\widetilde{W}$ tests were run to determine firstly, how concordant each group was amongst themselves and secondly, to assess whether the predictions made in chapter 3.1 were accurate. The first set of $\widetilde{W}$ analyses conducted assessed whether there was concordance within each of the four groups (HeM, HoM, HeW, and HoW) for each ranking condition. Interestingly, only HoM individuals were not significantly concordant when ranking the VS. The VS, as mentioned previously, has generally been more concordant then the SS for reasons regarding instrument decay. Therefore, it was unusual and thus worth examining that HoM, in particular, would regard the VS with less concordance than the other groups.

One possible explanation of why HoM were not concordant in their VS rankings is that the homosexual population is not so swayed by social norms and typically reject stereotyping (Lippa, 2007). Furthermore, as the respondents are HoM and are asked to select and rank individuals who they would potentially select as sexual partners, they may have been "pickier" than the other groups. Confounding these two notions may result in a varied preference for visual features in HoM.

Perhaps a better explanation for the lack of concordance amongst HoM comes from the technical application of the tests and the division of sex and SO to produce the four separate groups. The division of sex and SO into the four groups yielded a diminished sample size which would thus affect the results of the test even after bootstrapping, as the re-sampled results are drawn from an already small and unrepresentative sample (n=4). Furthermore, in the previous analysis of VA rankings amongst SOs, the $\widetilde{W}$ statistics were initially not significant, it was only once bootstrapping was applied that concordance amongst SOs

became significant. In addition, rankings of VM were not significant at all, both before and after bootstrapping. Men in general were also not significantly concordant in their rankings of VA and VM before the application of bootstrapping. Therefore, as the initial concordance amongst both men and homosexual individuals in general, was not initially significant and given that the HoM sample was drawn from sex and SO groups, it would be reasonable to assume that significant concordance from the interaction of these groups would not occur.

All other sex by SO groups were significantly concordant in their rankings of VS, suggesting that the they regard visual facial features with similarity within their groups. Interestingly, HoW had the highest degree of concordance in their rankings of VA. This high degree of ranking may have overwhelmed the degree of concordance amongst HoM in the analysis of question four, where homosexual individuals in general were significantly concordant in their rankings of VA.

For rankings of SS, HeW appeared to be the least concordant in their rankings. This result is unusual as it was expected that women would be most congruent regarding scent discrimination. There are three possible explanations as to why HeW were not congruent with regard to the SS. Firstly, the menstrual phase of women in general was not included as a factor in this analysis as it would have reduced the sample sizes further, making the analysis impractical. The ovulatory status as mentioned and shown before in this study, does affect how women perceive the attractiveness of male BO. As previously shown, women regardless of SO, were most congruent in their rankings of SA at the follicular phase, and least congruent at the luteal phase of their menstrual cycle, giving credence to the studies conducted by Thornhill et al. (2003) and Gangestad et al. (2005) This may be one possible reason why HeW were not concordant in their SS rankings as they were at different phases of their menstrual cycle.

Secondly, the MHC hypothesis may be another explanation for the lack of agreement amongst HeW and not HoW for rankings of SS. The reason for this is that because MHC has as its premise that genetic fitness is inheritable, immune fitness for potential offspring would then be irrelevant to HoW. According to Wedekind et al. (1995) and Thornhill et al. (2003), MHC is advertised via sweat and indicates immune system compatibility. The hypothesis is that individuals will prefer sexual partners who "smell" unlike their own MHC, as this would produce heterozygosity and improved immune efficiency in offspring and prevent the occurrence of deleterious mutations and vulnerability to co-evolving bacteria and pathogens

(Wedekind, et al., 1995; Thornhill, et al., 2003). In previous studies concerning the MHC, researchers were required to take blood samples from participants to type their MHC (Wedekind, et al., 1995; Thornhill, et al., 2003). In this study, the researcher did not have the medical skills set, access to adequate medical facilities or ethical clearance to take blood samples and conduct blood tests. Therefore, MHC typing was not possible and may have been a confounding variable in how HeW ranked the SS.

The third possible explanation for the lack of concordance amongst HeW may be due to the fact that knowledge of hormonal contraceptive use amongst women was not obtained. According to Wedekind et al. (1995), women using hormonal birth control (the pill), varied in their rankings of SS to those women who did not take the pill. This may be a confounding variable that again may only affect HeW and not HoW. This is because the primary function of the pill is to reduce the risk of conception caused by heterosexual sex. Therefore, the pill used for its primary function would not necessarily be used by HoW as the risk of conception is not possible when sexual intercourse is between individuals of the same sex.

Regarding rankings of SM, HeM were not concordant, although it was predicted that they would be. Therefore, this result was highly unexpected, as according to Eisenegger, et al. (2011), Gabrielson (2013) and Huoviala & Rantala (2013), the scent of very masculine men is discernible by other men and even promotes specific social interactions and behaviours such as co-operation and status seeking. The lack of concordance in rankings regarding SM in this study could be related to the small sample size of HeM; although this is unlikely as HoM were concordant and had a smaller sample size. The concordance in SM rankings amongst HoM was also unexpected. Perhaps the reason why HoM were more concordant than HeM in SM rankings is because it is said that HoM brains are wired much like HeW brains to receive pheromones indicative of masculinity (Savic et al., 2005); although HeW in this study were not significantly concordant for the aforementioned reasons. Despite the lack of concordance amongst HeW, HoM may still be similar to women as they lack those confounding variables that may contribute to non-concordance. Firstly, HoM are not influenced by hormone fluctuations related to the menstrual cycle. Secondly, HoM are not consciously "looking" for MHCs that could benefit offspring as they do not reproduce with their chosen sexual partners, and lastly, HoM are not likely to take the pill as a form of birth control. Therefore, HoM could, as Savic et al. (2005) suggest, have similar preferences and can discriminate between SM similarly to HeW, however, HoM are less affected by the presence of extraneous variables.

According to previous research, it has been stated that regarding SS, HeM would be most alike to HoW in their preference and response (Lubke, et al., 2012; Berglund, et al., 2006) and that HoM would be most alike to HeW (Savic et al., 2005). The outcomes of this study give credence to the findings produced by those aforementioned studies, as rankings of SA were significantly concordant between HoM and HeW as well as HeM and HoW, this result was also found in rankings of SM suggesting that these groups ranked the attractiveness and masculinity of the six t-shirts similarly.

For measures relating to VS all combinations of sex by SO groups were significantly concordant. This may be due to, as mentioned previously, societal mores of visual attractiveness and masculinity.

5.1.3. Additional Analysis

PAQ

Due to the expected association between gender and sex, SO, and sex by SO, a crosstabulation and chi-squared analysis was conducted to investigate whether these associations existed in this study. The PAQ classifications were compared firstly with sex and no significant associations were found. This result was unexpected as previous psychometric studies regarding the PAQ found that it could correctly discriminate between the sexes more than 75% of the time (Helmreich, et al., 1981). It was expected that women would be significantly associated with the F sub-scales and that men would associate with the M sub-scales, however, this was not the case in this study. A possible reason for the lack of association with sex in the PAQ may be that the test is outdated and gender roles have changed since its development in the 1970's or perhaps that the small sample used was unrepresentative.

Alternatively, the PAQ did show a significant association with SO. The specific associations in the crosstabulations indicated that homosexual individuals and HoM were significantly more androgynous than heterosexual individuals, who were significantly associated with the undifferentiated classification of the PAQ. The association between homosexual individuals and androgyny indicates that they may endorse traits typically related to both sexes. If this is considered from a biological perspective, the androgyny argument for homosexuals would appear logical. Homosexual individuals have sex specific organs, thus making them biologically a particular sex. Sex organs typically produce sexually dimorphic hormones,

such as T in men (Bao & Swaab, 2011). However, if the neuro-hormonal hypothesis is correct, then brain differentiation of homosexual individuals would be similar to heterosexual opposite sex individuals. Therefore, behaviours in homosexual individuals may be induced by both sexually dimorphic hormones specific to sex and brain differentiation similar to heterosexual opposite sex individuals, thus exhibiting traits typical of both sexes.

Heterosexual individuals on the other hand, are associated with the undifferentiated classification of the PAQ, and thus endorse traits typical of neither sex. This may perhaps be due to the change in gender roles, which has been discussed previously, for example the introduction of feminism and post-modernism. This result may also perhaps be due to the considerable cultural variations in the South African context from which the sample was drawn, which may differ regarding gender norms as the sample included individuals from multiple cultural backgrounds. According to Helman and Ratele (2016), who conducted a study investigating the construction of gender norms in various South African families, norms of gender inequality are largely influenced by culture, socio-economic status and religion. They noted that a majority of families produced a somewhat patriarchal discourse when interviewed, however, the different social classes in terms of culture and socio-economic status did show a difference in their construction of patriarchal norms. Therefore, "the South African context should…be viewed as 'a patchwork quilt of patriarchies' in which equitable gender relations extend beyond the social categories of race, class and culture" (Helman & Ratele, 2016, p.2). Helman and Ratele (2016) found that gender constructions in a South African context, although predominantly patriarchal, have the propensity to be fluid. The researchers suggested that rather than defining families as either egalitarian or traditional, that they fall somewhere on a continuum of these ideals (Helman & Ratele, 2016).

Race and Age

Although this study did not aim to investigate whether age or race affected judgements of attraction or masculinity, $\widetilde{W}$ tests were run to investigate whether age and race were concordant as these are recognised as potential extraneous variables.

It has been suggested that race is associated with culture and culture with food, thus affecting the smell of BO produced by individuals (van Beek, 1992). Therefore, to reduce the effect of culturally dependant BO, only two race groups (Black and White) were recruited to produce the stimulus. However, all races were included as judges. This additional analyss aimed to

assess whether any of the races were more concordant. According to the results produced. Black individuals showed no significant agreement for any of the ranking conditions, suggesting that this race would not have been a confounding variable in any of the other analyses and that the stimuli were not concordant among the Black population. White individuals were only concordant regarding the VS. This may be explained by a social bias as blatant indications of status are visible in the images of the male stimulus participants, thus suggesting that White individuals are more biased by social mores when judging VS.

Indian participants were concordant in all ranking conditions except for SM and Coloured individuals showed significant concordance for all ranking conditions. This suggests that perhaps Indian and Coloured individuals may have confounded the analyses. Interestingly, the race groups that could potentially have produced the greatest confounding effect (Indian and Coloured) were not included in the recruitment of the stimuli participants. This leaves scope for future studies investigating whether different race groups can discern other races through smell.

According to Jankowiak et al. (1992), attractiveness judgements are commonly influenced by the age of the individual being judged. It is for this reason that all the male stimuli participants were within a similar age range. Furthermore, according to Lippa (2007) both HeM and HoM regard age as a factor which influences attractiveness. Therefore, it was important in this study, to ascertain whether there was concordance amongst the ages. Both younger age categories were concordant in their rankings regardless of the ranking condition. The first of the two younger age categories consisted of respondents between the ages of 18 and 25, and the other group ranged from 26 to 30 years of age. The oldest age group however, was left out of the analysis as there was only one individual older than 30 years. As all the age categories were significant regardless of ranking condition, age may be considered a confounding variable as is suggested by Lippa (2007) and Jankowiak et al. (1992).

A comment on the quantitative procedures used

In addition to the discussion of the results it is also pertinent to discuss the uniqueness of the analytical approach taken in this study, as statistical procedures such as Kendall's $\widetilde{W}$ and bootstrapping are not commonly implemented in social science research designs. However, they do provide a valuable alternative to the more traditional parametric statistics used when assumptions are violated and sample sizes small. Kendall's $\widetilde{W}$ provides a measure of inter-

judge reliability that covers a wider range of judgments than means or medians (Siegel, 1956). This measure provides a simple and time efficient way of calculating over-all agreement amongst k sets of rankings (Siegel, 1956). According to Sheskin (2007), $\widetilde{W}$ provides a measure for "data that are rank-ordered by more than two judges" (p.1388), alternatively one could use Spearman's rho as "$\widetilde{W}$ for [k] sets of ranks is linearly related to the average value of Spearman's rho which can be computed for all possible pairs of ranks" (p.1387). Computing multiple calculations for all possible pairs of rankings to find the average agreement amongst a large sample of k judges, however would be time consuming and likely increase the family-wise error rate (Siegel, 1956). Therefore, $\widetilde{W}$ was a more suitable measure to find agreement amongst the ranks given by the judging participants. Furthermore, as the data collection procedure required participants to rank order the stimuli, a parametric factorial method would not have been appropriate. Bootstrapping, provides another unique empirical method for analysing the data, which enables the researchers to predict and estimate population parameters, without making parametric assumptions (Chernick, 2008;Winston, 2004; Sprent, 1989). Furthermore, with bootstrapping, one can estimate population confidence intervals using the percentile method which although could be refined with the use of a bias corrected model with an acceleration constant, does provide good approximations of the 95% confidence interval parameter.

5.2. Limitations, Recommendations and Conclusions

5.2.1. Limitations and Recommendations

The first and most profound limitation of this study was the minimal sample sizes and under-representation of specific groups. According to Lachenicht (2002) a small sample size may affect the power of a study and consequently increase the chance of making a type two error which is incorrectly failing to reject the null hypothesis. It was, very difficult to increase the sample size for this study as instrument decay in the t-shirts placed time constraints on the data collection from the judging sample. Therefore, non-parametric measures were used in the analysis, as they are more robust when assumptions about the normality of a population are violated, and furthermore, bootstrapping methods with oversampling to equate the unbalanced small sample sizes were implemented, however, with the acknowledgment that this would restrict the variance of the sample. Furthermore, the six stimulus participants may also have limited the study as they may not have supplied an adequate array of variation in terms of attractiveness and masculinity. In future studies it is recommended that larger

sample sizes be obtained for both the stimuli sample and the judging sample, and methods for the reduction of scent loss be implemented.

Instrument decay in the form of scent loss and contamination were a great limitation to this study as this affected the sample size, which subsequently affected the power of the study. The instrument decay affected sample size as not enough judging participants were able to be recruited before the t-shirts lost their scent and became contaminated by other scents. In an attempt to try and recruit more judging participants, stimuli participants were asked to rewear the t-shirts after a detergent free wash, to reduce scent contamination. The scent, however, did last long enough to recruit a sufficient number of participants. In future studies, it is reccommended that the method used by Singh and Bronstad (2001) to reduce scent loss and contamination be used. That is that the SS are placed in a box with a triangular hole cut into it, judging participants can then smell the SS from where the hole is cut out. This method reduces the amount of contact that the judging participants have with the t-shirts thus reducing scent contamination and scent loss.

Another limitation that may have affected this study was the use of the term "masculinity", as from the results it appears to have produced the least concordant results. The lack of concordance with regard to masculinity rankings may be due to the ambiguity of how the word is defined in either social or biological terms. It was assumed that participants would judge and rank the stimuli in terms of how they percieved masculinity biologically. However, this may not have been the case, as social status is also associated with masculinity, and this would have been indicated in the photographs through hair style and visible clothing, which may have swayed participants from ranking the male faces on the presence of biological markers of masculinity. In future studies, it is reccommened that stimulus participants wear identical clothing whilst posing for the photographs to reduce potential bias from social status. Digitally manipulated photographs showing the same face with both masculinised and feminised features could also be used to assess masculinity preference (Cornwell, et al., 2004). In addition perhaps the measures for which participants made judgements in previous studies should have been used, i.e. pleasantness, sexiness and intensity (Gangestad, et al., 2005; Singh & Bronstad, 2001; Thornhill & Gangestad, 1999).

The additional analyses regarding age and race showed that these factors could potentially be confounding variables, as the age categories showed significant concordance across all ranking categories, which suggests that the different age groups considered the stimuli

similarly. Furthermore, only the judges who were the same race as the stimulus partcipants did not show significant concordance amongst rankings, however, for those participants who were not of the same race did show significant concordance in their rankings, suggesting that race may possible be a confounding variable. In future studies, it may be advantageous to limit age for judging participants as well as race to match the race of the stimuli participants. Alternatively, to add more validity to the study, adequate and matched sample sizes should be used.

A further limitation of this study is that it did not consider the potential for hormonal contraceptive use amongst women, which may have confounded the rankings given by women. In future studies, it is recommended that this information be obtained from female participants. Furthermore, the measure for predicted ovulation may not have been entirely accurate and therefore there is scope for improvement in future studies, either by gaining ethical clearance and finances to buy and administer urine ovulation tests, or by tracking the female participants' menstrual cycle over a monthly period.

In this study, it was also necessary to use multiple separate tests such as Kendall's coefficient of concordance for many separate subgroups. Performing multiple tests is known to increase the likelihood of family-wise error to occur which may lead to inaccurately rejecting the null hypothesis (Tredoux & Durrheim, 2002). However, per a study conducted by Nichols and Hayasaka, (2003), the bootstrap test offers a flexible model that reduces the prevalence of familywise error in its estimation of population parameters

A last recommendation for this study is that a meta-analysis be conducted comparing effect sizes between all of the t-shirt and pheromone studies. According to Shanks and Vadillo (2015) publication bias and p-hacking is often a concern particularly with replicated studies, such as this one. According to Shanks and Vadillo (2015), publication bias, refers to the the tendency to only publish results which are significant, and p-hacking refers to the tendency to alter data in order to achieve significance, this could be in the form of sampling until significance is reached or removing outliers after testing. Shanks and Vadillo (2015) suggest that due to publication bias and p-hacking, published literature may not always be an accurate measure of the real world. A meta-analysis of the previous literature as well as this study may explain why some of the data here did not prove significant as expected from previous studies.

5.2.2. Concluding Remarks

From the interpretation of the results of this study it appears that some of the findings, in particular, those regarding scent and attractiveness sustained the predictions made by the researcher. However, some of the findings were not as expected, and this may be due to the limitations and threats to internal validity present in the study design. In sum, the findings regarding the rankings of VS and attractiveness were in general more concordant than rankings regarding SS and masculinity throughout the study.

The analysis regarding ovulatory cycle did exhibit both predicted and unexpected findings. As predicted, women at their follicular phase were more concordant in their rankings of attractiveness and VA and VM rankings combined, than luteal phase women. This was particularly important for SA, as previous literature has said that women have improved olfactory abilities during ovulation and are more positively inclined toward masculine BO (Pause, et al., 1999; Grammer, 1993; Gangestad & Simpson, 2000; Gangestad, et al., 2005; Pillsworth & Haselton, 2006). However neither, follicular or luteal phase women were concordant in the rankings regarding masculinity or the combination of rankings for SA and SM which was unexpected for follicular phase women.

When considering rankings amongst the sex by SO groups specifically, all were concordant except for HoM with regard to rankings of VS, and HeW with regard to rankings of SA. All other sex by SO groups were however concordant regarding all other ranking conditions.

The main aim of this study was, as mentioned previously, to assess whether homosexual individuals can and do respond to putative pheromones and to assess whether SO affects how individuals respond to putative human pheromones and if this response is similar to that of heterosexual same sex or opposite sex individuals. The findings of this study indicated that neither the sexes nor the SOs differed significantly in their rankings of the VS as both the different sexes and different SOs were significantly concordant in their rankings when combined. This result was unexpected, as it was predicted that men and women, and homosexual and heterosexual individuals would regard the attractiveness of visual features differently, based on how masculinised they appeared (Penton-Voak, et al., 2001). The SS rankings however did provide findings that were predicted as although men and women, and heterosexual and homosexual respondents were independently concordant, when the rankings amongst the sexes and similarly amongst the SOs were combined, no significant concordance was found. This gives endorsement to the predictions based on the studies conducted by

Lubke et al. (2012), Berglund et al. (2006), Savic & Lindstrom (2008), Savic, et al., (2005) and Savic, et al., (2001), that have shown that sex and SO are predictive of specific hypothalamic activativation and brain responses when exposed to putative human pheromones. Furthermore, the results from this study showed that HeM and HoW, as well as HoM and HeW, were significantly concordant when combined in all ranking conditions, suggesting that HeM and HoW, and HoM and HeW regard the attractiveness and masculinity of the VS and SS similarly. This lends support to the findings made by Savic et al. (2005) and Berglund et al. (2006).

Due to issues of data collection and sample size this study would greatly benefit from future research in this area, and leaves scope for an expansion of the topic. In future studies, it is recommended that precautions be taken to minimise scent loss and contamination of the t-shirts so that a larger sample size may be recuited. This may reduce the neccessity for complicated bootstrapping procedures. Furthermore, other confounding variables can be controlled for better in future studies by including a question for women regarding hormonal contraceptive use as well as a more accurate method for detecting ovulation. It is also recommended that the discourse for the construct being measured is also more precisely defined, for example instead of the term "masculinity", a more difinitive term which elicits responses regarding explicit masculine features should be used.

In future studies about the influence of pheromones on sexual selection it may also be prudent to include assessments of how different SOs may be affected by the BO of women, and how the BO of differing SOs are percieved by others. This will aid in elucidating the social and biological interactions between the sexes as well as provide inclusional sexual selection theories regarding the different SOs. This study has aided in answering some of those questions surrounding the issue of the applicability of sexual selection theories to different SOs, however, has left scope for future studies.

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Appendix A: Ethical Approval

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

13 February 2014

Ms A Wilkinson 209522203
School of Applied Human Sciences – Psychology
Pietermaritzburg Campus

Protocol reference number: HSS/0720/013M
Project title: Is pheromone detection in sexual selection applicable to everyone? Homosexual pheromone attraction to masculine features

Dear Ms Wilkinson,

Full approval notification – Committee reviewed protocol

With regards to your response to our letter dated 03 September 2013, this letter serves to notify you that your application in connection with the above study has now been granted full approval.

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach/Methods must be reviewed and approved through an amendment/modification prior to its implementation. In case you have further queries, please quote the above reference number. PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.

This ethical clearance certificate is only valid for a period of 3 years from the date of issue. Thereafter Recertification must be applied for annually.

Best wishes for the successful completion of your research protocol

Yours faithfully

Dr Shenuka Singh (Chair)

/ms

cc Supervisor: Professor Lance Lachenicht
cc Academic Leader Research: Professor D McCracken
cc School Administrator: Mr S Duma

Humanities & Social Sciences Research Ethics Committee
Dr Shenuka Singh (Chair)
Westville Campus, Govan Mbeki Building
Postal Address: Private Bag X54001, Durban 4000
Telephone: +27 (0) 31 260 3587/8350/4557 Facsimile: +27 (0) 31 260 4609 Email: ximbap@ukzn.ac.za / snymanm@ukzn.ac.za / mohunp@ukzn.ac.za
Website: www.ukzn.ac.za

1910 - 2010
100 YEARS OF ACADEMIC EXCELLENCE
Founding Campuses   Edgewood   Howard College   Medical School   Pietermaritzburg   Westville

Appendix B: Gatekeeper's Permission

UNIVERSITY OF ™
KWAZULU-NATAL
INYUVESI
YAKWAZULU-NATALI

26 August 2013

Ms Abigail Wilkinson
School of Psychology
Pietermaritzburg Campus
UKZN
Email: 209522203@stu.ukzn.ac.za

Dear Ms Wilkinson

RE: PERMISSION TO CONDUCT RESEARCH

Gatekeeper's permission is hereby granted for you to conduct research at the University of KwaZulu-Natal towards your postgraduate studies, provided Ethical clearance has been obtained. We note the title of your research project is:

"Is pheromone detection in sexual selection applicable to everyone? Homosexual pheromone attraction to masculine features".

It is noted that you will be constituting your sample by randomly approaching male students (black and white) from the Pietermaritzburg Campus of UKZN who are willing to participate in performing two tasks viz having their faces photographed and wearing a t-shirt for two nights.

Data collected must be treated with due confidentiality and anonymity.

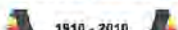Yours sincerely

Professor J J Meyerowitz
REGISTRAR

Office of the Registrar
Postal Address: Private Bag X54001, Durban, South Africa
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Website: www.ukzn.ac.za

1910 - 2010
100 YEARS OF ACADEMIC EXCELLENCE
Founding Campuses ■ Edgewood ■ Howard College ■ Medical School ■ Pietermaritzburg ■ Westville

Appendix C: Information and Consent form for Stimuli Participants

INFORMATION SHEET AND CONSENT FORM

IS PHEROMONE DETECTION IN SEXUAL SELECTION APPLICABLE TO EVERYONE? HOMOSEXUAL PHEROMONE ATTRACTION TO MASCULINE FEATURES

Stimuli Participant

Hello, I am Abigail Wilkinson; I am master's student at the school of psychology. I am conducting research on sexual selection theory and pheromones and its impact on attraction for different sexual orientations. I am conducting a study to compare the ratings of visual attractiveness and masculinity and pheromone attractiveness and masculinity.

I am asking you whether you will participate in an experiment where you will be asked to pose for a photograph and wear a t-shirt for a period of two consecutive nights. If you agree to participate, I will ask you to provide some personal details about yourself and follow some instructions for the course of the nights that you agree to wear the t-shirts.

Please understand that **your participation is voluntary** and you are not being forced to take part in this study. The choice of whether to participate or not, is yours alone. If you choose not to take part, you will not be affected in any way whatsoever. If you agree to participate, you may stop participating in the research at any time and tell me that you don't want to go continue. If you do this, there will be no penalties and you will not be prejudiced in any way.

Some identifying information will be asked of you; however, your details will be kept very securely in a locked cabinet. Any reference of you will linked to fictitious codes in order to hide your identity and your details will not be connected to either the photograph or the t-shirt.

At the present time, we do not see any risk of harm from your participation. There are no immediate benefits to you from participating in this study. However, this study will be extremely helpful to us in that we hope will promote understanding of attraction and sexual orientation. If you would like to receive feedback on our study, we will record your phone number on a separate sheet of paper and can send you the results of the study when it is completed sometime after.

If you have concerns or questions about the research you may call the project leader, Abigail Wilkinson, cell phone- 084 3320294, email- gindahouse-1@hotmail.com

CONSENT

I hereby agree to participate in this research project. I understand that I am participating freely and without being forced in any way to do so. I also understand that I can stop participating at any point should I not want to continue and that this decision will not in any way affect me negatively. I understand that this is a research project whose purpose is not necessarily to benefit me personally in the immediate or short term. I understand that my participation will remain confidential.

I hereby agree to have my photograph taken.

I hereby agree to wear a t-shirt for two nights.

I hereby agree to follow the given instructions for two nights.

I understand that the information that I provide will be stored electronically and will be used for research purposes now or at a later stage.

…………………………..

Signature of participant   **Date**:…………………..

I wish to be informed of the results of the research

………………………………   **Date**:……………………..

Signature of participant

Contact details for dissemination of results

Tel:...

Email:………………………….

Appendix D: Questionnaire for Stimuli Participants

STIMULUS PARTICIPANTS

Name: _____

Age: _____

Ethnicity: Black_____   White_____

Contact Number_____

Email Address_____

Appendix E: Information and Consent Form for Judging Participants

INFORMATION SHEET AND CONSENT FORM

IS PHEROMONE DETECTION IN SEXUAL SELECTION APPLICABLE TO EVERYONE? HOMOSEXUAL PHEROMONE ATTRACTION TO MASCULINE FEATURES

Judges

Hello, I am Abigail Wilkinson; I am masters student at the school of psychology. I am conducting research on sexual selection theory and pheromones and its impact on attraction for different sexual orientations. I am conducting a study to compare the ratings of visual attractiveness and masculinity and pheromone attractiveness and masculinity.

I am asking you whether you will participate in an experiment where you will be asked to view several photographs and smell several t-shirts and rank them in order of attractiveness and masculinity If you agree, I will ask you to fill out a survey with your details. The study will take approximately 15-20 minutes.

Please understand that **your participation is voluntary** and you are not being forced to take part in this study. The choice of whether to participate or not, is yours alone. If you choose not to take part, you will not be affected in any way whatsoever. If you agree to participate, you may stop participating in the research at any time and tell me that you don't want to go continue. If you do this, there will be no penalties and you will not be prejudiced in any way.

No identifying information will be asked of you and your questionnaires will be kept in a locked file cabinet, will not be available to others, and will be kept confidential to the extent possible by law. The records from your participation may be reviewed by people responsible for making sure that research is done properly, including members of the ethics committee at the Human Sciences Research Council. (All of these people are required to keep your identity confidential.) Otherwise, records that identify you will be available only to people working on the study, unless you give permission for other people to see the records.

I will not record your name anywhere that can be viewed by others and no one will be able to connect you to the answers you give. Your answers will be linked to a fictitious code number and I will refer to you in this way in the data, any publication, report or other research output. The risks associated with participation in this study are no greater than those encountered in daily life are. Your answers will be stored electronically in a secure environment and used for research or academic purposes now or at a later date in ways that will not reveal who you are. All future use of the stored data will be subject to further Research Ethics Committee review and approval.

There are no immediate benefits to you from participating in this study. However, this study will be extremely helpful to us in that we hope will promote understanding of attraction and sexual orientation.

If you would like to receive feedback on our study, we will record your phone number on a separate sheet of paper and can send you the results of the study when it is completed sometime after.

If you have concerns or questions about the research you may call the project leader, Abigail Wilkinson, cell phone- 084 3320294, email- gindahouse-1@hotmail.com

---

CONSENT

I hereby agree to participate in research on the rating of scents. I understand that I am participating freely and without being forced in any way to do so. I also understand that I can stop participating at any point should I not want to continue and that this decision will not in any way affect me negatively. I understand that this is a research project whose purpose is not necessarily to benefit me personally in the immediate or short term. I understand that my participation will remain confidential.

I hereby agree to rank the attractiveness and masculinity of photographs and scent

I understand that the information that I provide will be stored electronically and will be used for research purposes now or at a later stage.

…………………………..

Signature of participant   **Date**:…………………..

I wish to be informed of the results of the research

………………………………   **Date**:……………………..

Signature of participant

Contact details for dissemination of results

Tel:... Email:…………………….

Appendix F: Questionnaire for Judging Participants

JUDGES QUESTIONNAIRE

FOR ALL PARTICIPANTS

Age: _____

Sex: Male_____ Female_____

Ethnicity: Black_____ White_____ Indian_____ Coloured_____

 Other (please indicate)_____

Sexual orientation: Heterosexual_____ Homosexual_____ Bisexual_____

The items below inquire about what kind of person you think you are. Each item consists of a PAIR of characteristics, with the letters A-E in between. For example,

Not at all artistic A......B......C......D......E Very artistic

Each pair describes contradictory characteristics - that is, you cannot be both at the same time, such as very artistic and not at all artistic.

The letters form a scale between the two extremes. You are to choose a letter which describes where YOU fall on the scale. For example, if you think that you have no artistic ability, you would choose A. If you think that you are pretty good, you might choose D. If you are only medium, you might choose C, and so forth.

1	Not at all aggressive	A……B……C……D……E	Very aggressive*
2	Not at all independent	A……B……C……D……E	Very independent*
3	Not at all emotional	A……B……C……D……E	Very emotional*
4	Very submissive	A……B……C……D……E	Very dominant*
5	Not at all excitable in a major crisis*	A……B……C……D……E	Very excitable in a major crisis
6	Very passive	A……B……C……D……E	Very active*
7	Not at all able to devote self completely to others	A……B……C……D……E	Able to devote self completely to others*

8	Very rough	A……B……C……D……E	Very gentle
9	Not at all helpful to others	A……B……C……D……E	Very helpful to others*
10	Not at all competitive	A……B……C……D……E	Very competitive*
11	Very home oriented	A……B……C……D……E	Very worldly
12	Not at all kind	A……B……C……D……E	Very kind*
13	Indifferent to others approval*	A……B……C……D……E	Highly needful of others' approval
14	Feelings not easily hurt*	A……B……C……D……E	Feelings easily hurt
15	Not at all aware of feelings of others	A……B……C……D……E	Very aware of feelings of others*
16	Can make decisions easily*	A……B……C……D……E	Has difficulty making decisions
17	Gives up very easily	A……B……C……D……E	Never gives up easily*
18	Never cries*	A……B……C……D……E	Cries very easily
19	Not at all self-confident	A……B……C……D……E	Very self-confident*
20	Feels very inferior	A……B……C……D……E	Feels very superior*
21	Not at all understanding of others	A……B……C……D……E	Very understanding of others*
22	Very cold in relations with others	A……B……C……D……E	Very warm in relations with others*
23	Very little need for security*	A……B……C……D……E	Very strong need for security
24	Goes to pieces under pressure	A……B……C……D……E	Stands up well under pressure*

FOR FEMALES ONLY

Estimated date of last menstruation_____

FOR ALL PARTICIPANTS

Please place the code on the back of the photographs in the block corresponding to the ranking of attractiveness.

1.
2.
3.
4.
5.
6.

Please place the code on the back of the photographs in the block corresponding to the ranking of masculinity

1.
2.
3.
4.
5.
6.

Please place the code on the tag of the t-shirts in the block corresponding to the ranking of attractiveness.

1.
2.
3.
4.
5.
6.

Please place the code on the tag of the t-shirts in the block corresponding to the ranking of masculinity.

1.	
2.	
3.	
4.	
5.	
6.	

Appendix G: Turnitin Report

MASTERS RESEARCH CW THES…   Thesis - DUE 31-Dec-2016

Originality   GradeMark   PeerMark   **Dissertation**   turnitin   **6%**
                                                          BY ABIGAIL WILKINSON   SIMILAR

Submission Info

SUBMISSION ID	659354413
SUBMISSION DATE	19-Jun-2016 07:55PM
SUBMISSION COUNT	2
FILE NAME	Abigail_Wilkinson_Master's Thesis…
FILE SIZE	3.78M
CHARACTER COUNT	319220
WORD COUNT	58641
PAGE COUNT	169

ORIGINALITY

OVERALL	6%
INTERNET	5%
PUBLICATIONS	2%
STUDENT PAPERS	1%