BIOLOGICAL AND PSYCHOSOCIAL CORRELATES OF GENDER-VARIANT AND GENDER-TYPICAL IDENTITIES

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ABSTRACT

The aim of this thesis is examine biological and psychosocial factors that contribute to the development of gender-variant or gender-typical identities. Blanchard's autogynephilia theory (Blanchard, 1989b) suggests that these factors are different in birth-assigned males with different sexual orientations. Previous research has found that genetics, prenatal hormone exposure, neuroanatomy, handedness, dermatoglyphics, fraternal birth order, and abuse are related to gender identity. While a number of investigators have studied these variables individually, this is the first known study to have examined the inter-relationships of these variables in one sample and to include participants with a wide range of gender identities. Data were collected from a convenience sample of 2,277 online-recruited participants with gender-variant and gender-typical identities using an online questionnaire. Participants were mainly white/Caucasian (92%) adults living in the USA (54%) and New Zealand (19%). From the results, reported family concordance for gender-variance and a systematic review of case reports of twins with gender-variant identities indicated genetic determinants of gender identities. Finger-length ratio, systemising, and a systematic review of case-reports of gender identity outcomes for adults with intersex and related conditions indicated prenatal hormone determinants of gender identities. Further evidence for biological factors came from elevated levels of non-right handedness among birth-assigned females with gender-variant identities. Structural equation modelling showed that the positive relationship between abuse experience and degree of adult gender-variance was partially mediated by recalled childhood gender-variance. This suggests abuse may be a cause as well as a result of gender-variance. Contrary to Blanchard's theory, there were no differences in biological and psychosocial factors between birth-assigned male participants of different sexual orientations. This was the first research to find evidence that biological and psychosocial factors are the same for transsexuals as for persons with other gender-variant identities. Overall, these findings add support for a biological predisposition for gender-variant and gender-typical identities. Psychosocial determinants are likely to be complex and work in interaction with biological factors.

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LIST OF ABBREVIATIONS

17β-HSD	17β hydroxysteriod dehydrogenase
5α-RD	5α reductase deficiency
2D:4D	ratio between the length of the second and fourth fingers
BIDR	balanced inventory of desirable responding
BSTc	central subdivision of the bed nucleus of the stria terminalis
CAH	congenital adrenal hyperplasia
CI	confidence intervals
DZ	dizygotic
FM	female-to-male
INAH-3	interstitial nucleus of the anterior hypothalamus nuclei 3
MF	male-to-female
MGD	mixed gonadal dysgenesis
MZ	monozygotic
OGV	other gender-variant identity
PAIS	partial androgen insensitivity syndrome
PCOS	polycystic ovary syndrome
SE	standard error
SEM	structural equation modelling

SECTION I - INTRODUCTION

CHAPTER 1 - INTRODUCTION

1.1 Rationale

This thesis examines biological and psychosocial variables relevant to the development of gender-variant and gender-typical identities. Previous research has found that genetics, prenatal hormone exposure, neuroanatomy, handedness and dermatoglyphics (proposed to be related to susceptibility to developmental disturbances), fraternal birth order, and abuse are related to gender identity. While a number of investigators have studied these variables individually, the present study is the first known research to examine the inter-relationships of these variables. Including multiple variables in one study is important because causal relationships of biological and psychosocial variables on gender identities may be hidden or suppressed by the relationships among these variables (Cohen, Cohen, West, & Aiken, 2003). Most of the past research has been conducted on homogenous groups (either transsexuals or cross-dressers). In contrast, this research includes participants from a broad range of gender-variant identities. In this way it makes a theoretical and empirical contribution to the growing body of psychological literature on the development of gender identities.

A deeper understanding of the biological and psychosocial factors associated with gender identities may lead to less discrimination and prejudice toward people with gender-variant identities. Depending on how broadly one defines a gender-variant identity, as many as 3% of the population could be part of this group (Langstrom & Zucker, 2005; Lawrence, 2009). Persons with gender-variant identities are a significantly marginalised group. They have an increased likelihood of facing discrimination, violence, mental health difficulties, suicide, sex working, and contracting sexually transmitted infections (e.g. Clements-Nolle, Marx, & Katz, 2006; Lombardi, Wilchins, Priesing, & Malouf, 2001; Operario, Soma, & Underhill, 2008). Expanding scientific knowledge about gender-variant identities is likely to improve the lives of people with gender-variant identities across a range of social indicators where discrimination impacts on their wellbeing. In particular, these findings will be relevant to medicine and health-related fields, where increased understanding of the development of gender identities may lead to better treatment of people with gender-variant identities.

1.2 Terminology

A *gender-variant identity* is defined as a subjective sense of not belonging completely to the gender of one's birth-assigned sex (derived from Docter 1988, p. 201). The term *gender-variance* is used to refer to the behavioural expression of this identity which could range from occasionally dressing as one's identified gender to living full-time in this gender. A *gender-typical identity* is defined as a subjective sense of belonging to one's birth-assigned sex. *Gender dysphoria* is defined as feelings of discontent or discomfort with the sex one was assigned at birth (derived from Baumbach & Turner, 1993, p. 110).

A *transsexual* is defined as a person who has a sustained gender identity that is the opposite of their birth-assigned sex along with a desire to alter their bodily appearance towards that of the opposite sex (Buhrich & McConaghy, 1978b). In this study, participants are classed as transsexual if they identify as one.

Cross-dressers/*transvestites* are defined as persons who dress in clothing of the opposite sex for identity expression, emotional relief, and/or sexual arousal (Docter, 1988). They are usually heterosexual or bisexual. Although they may experience a gender identity that is at variance with their birth-assigned sex, this identity is not strong or persistent enough to occupy the individual's entire gender identity (Buhrich & McConaghy, 1979; Docter, 1988). Although the term cross-dresser is preferred, the term transvestite is used when reviewing previous research that uses this terminology.

The term *drag artist* will refer to those, usually homosexual persons who dress in *drag* as the opposite sex for the purposes of performing.

When referring to sexuality in this thesis, the term *androphilia* is used to refer to those who are sexually attracted to adult males, and *gynephilia* is used to refer to those who are attracted to adult females (Blanchard, 1988). This terminology is preferred to the more commonly known heterosexual and homosexual, because it does not necessitate knowledge of a person's gender. This can sometimes be a hindrance when describing persons with gender-variant identities. The term *bisexual* is used to describe those who are sexually attracted to both males and females.

1.3 Outline

The following section reviews literature on the development of gender-variant identities. Chapter 2 considers theories of gender-variant identity development. Theories of the development of gender-variant identities inform the way that biological and

psychosocial variables can be tested. Conversely, the findings of this thesis have significant theoretical implications, because the finding of a number of biological and psychosocial variables adds weight to the growing understanding of gender-variant identities as causally complex. In Chapter 3, previous research on biological and psychosocial correlates of gender-variant identity is reviewed. Aims and hypotheses are outlined in Chapter 4 and methods are outlined in Chapter 5. In the first chapter of the results section, Chapter 6, confirmatory factor analysis and invariance testing is conducted on latent variables used in this thesis. In Chapter 7, results of testing the hypotheses are presented, and these are discussed in Chapter 8. Finally, strengths, limitations, and implications of the findings are discussed in Chapter 9.

All findings reported in the literature reviews in this thesis were statistically significant, unless reported otherwise. All *p* values are reported for two-tailed tests, given to three decimal places for precision. Because a number of analyses are conducted throughout the thesis, the criterion for statistical significance in this thesis is $p < .01$, to reduce the likelihood of Type-I errors.

This chapter sets the foundations for this thesis by describing the rationale, defining the terminology, and outlining the structure of remainder of this thesis. The focus of the thesis turns next to a review of the literature.

SECTION II - LITERATURE REVIEW

CHAPTER 2 - THEORIES OF GENDER-VARIANT IDENTITY DEVELOPMENT

The focus of this thesis is on biological and psychosocial factors that contribute to the development of gender-variant or gender-typical identities. This chapter outlines different theoretical conceptions of gender-variant identity development. These theories differently attribute biological and psychosocial factors to the development of gender-variant identities. The first section considers and outlines early views of gender-variant identity development. The next section introduces Blanchard's (1998b) theory of autogynephilia as a means of accounting for the development of two forms of gender-variant identity development among birth-assigned males.

2.1 Early views of gender-variant identity development

An overview of the historical development of theories of gender-variant identity within psychology shows that a conception of different forms of transsexualism emerged during the 1970s and became an ongoing feature of how psychologists classified transsexuals. The vast majority of theories of gender-variant identity development were designed to explain its occurrence in people assigned male at birth. It was common until the 1970s for medical professionals to hold the view that a transsexual's desire to have sex with persons assigned the same sex at birth as them was an intrinsic part of their desire for sex reassignment. Thus, sexual attraction to people of the opposite birth-assigned sex was seen as contradictory to the desire for sex reassignment surgery (Benjamin, 1966; Stoller, 1971). This compulsory heterosexuality probably arose from the negative and pathologising views of homosexuality held by clinicians at the time—they did not want to be seen "creating" homosexuals as they thought they would be if they allowed a person with sexual attractions to the opposite birth-assigned sex to change their sex (Tobin, 2003).

Clinical reports of transsexual sexuality in the 1970s started to report sexual arousal associated with cross-dressing among male-to-female (MF) transsexuals. For example, Money and Gaskin (1970) distinguished between transsexualism as related to effeminate androphilia, where birth-assigned males who were sexually attracted to males enacted feminine behaviours since childhood; or as related to non-androphilic transvestism. Money and Gaskin cautioned that these are not always distinct; they saw cases as occurring on a continuum as opposed to a typology. Another example is

Bentler (1976), who studied 42 MF postoperative transsexuals using three groupings: androphilic, asexual, and gynephilic. He found that androphilic transsexuals received sex reassignment surgery on average about 4 years earlier than the asexual transsexuals and about 10 years earlier than the gynephilic transsexuals. He also reported that 50% of gynephilic, 18% of asexual, and 23% of androphilic participants reported that cross-dressing was sexually arousing prior to surgery.

Person and Ovesey (1974a, 1974b) believed that, along with what everyone considered to be the "classic" effeminate androphilic MF transsexual archetype, there existed another group of birth-assigned males seeking sex reassignment who had a tendency to be attracted to females or asexual. Person and Ovesey (1974a) noted that of the 10 non-androphilic transsexuals in their study sample, nine showed no evidence of femininity in childhood: they participated in rough-and-tumble behaviour as required and did not engage in girls' activities any more than the other boys in their peer group. Each of these participants admitted to being envious of girls and fantasised of being a girl. Person and Ovesey (1974a) noted that these persons appear more like transvestites, as they do not show significant femininity in childhood and often make an attempt to live in the male role in adulthood. They labelled this group "secondary transsexuals". In the second part of the study, Person and Ovesey (1974b) reported that the androphilic transsexuals they studied resembled the then-perceived stereotypical transsexual. These birth-assigned males were effeminate from earliest childhood; as children they preferred girls as playmates, and avoided boyish pursuits. Person and Ovesey labelled this group "primary transsexuals".

Buhrich and McConaghy (1977) outlined another typology of gender-variant identities in birth-assigned males. They differentiated between (1) *nuclear transsexuals*, who have never experienced sexual arousal with cross-dressing, and are likely to be significantly younger than the other groups; (2) *fetishistic transsexuals*, who have experienced sexual arousal with cross-dressing and who are significantly more likely to be married to women, and to experience gynephilic attraction; (3) *marginal transvestites*, who as well as experiencing sexual arousal with cross-dressing desire feminisation by way of hormones and surgical intervention; and (4) *nuclear transvestites*, who experience cross-gender sexual arousal but do not desire to feminise their body. Buhrich and McConaghy found that self-identified fetishistic transsexuals showed significantly more sexual interest in males and felt like women when naked than self-identified marginal transvestites.

In summary, early views of gender-variant identity development focused on MF transsexualism. Early research seemed to expect that to be truly transsexual, the person had to be sexually attracted to males. Reports of MF transsexuals with sexual attractions to females and cross-gender eroticism started to emerge from the 1970s. Distinctions between these different "types" of transsexuals also started to emerge. It wasn't until the 1980s that more comprehensive theories of the reasons for these different manifestations in birth-assigned males were developed. The most prominent of these, by Ray Blanchard, is outlined in the next section.

2.2 Blanchard's theory of autogynephilic and androphilic male-to-female transsexualism

Ray Blanchard (1989b) introduced the concept of *autogynephilia*, which he used to refer to "a male's propensity to be sexually aroused by the thought of himself as a female" (p. 616). This concept underlies Blanchard's hypothesis that there are two distinctive manifestations of MF transsexualism: *homosexual* and *autogynephilic*. According to Blanchard, gender dysphoria among those birth-assigned males who are not homosexual relative to their birth-assigned sex occurs as the result of autogynephilia. Blanchard's theory proposed that sexuality plays a key role in the development of both types of MF transsexualism.

These two types of MF transsexuals can be distinguished in that homosexual MF transsexuals (androphilics) express marked gender-variance in childhood and are sexually attracted exclusively to males. In comparison, autogynephilic transsexuals do not display such marked gender-variance in childhood, have a history of sexual attractions to women and autogynephilic arousal (Blanchard, 1989b, 1993, 2005).

2.2.1 Androphilic transsexualism

Blanchard's writing gave little detail about what motivates androphilic MF transsexuals to transition. However, Bailey (2003) has expanded on this theory and asserted that these androphilic MF transsexuals develop femininity that is the same as that of homosexual males. However this femininity is more marked than amongst homosexual males who do not transition (Bailey, 2003). It has been noted that these individuals often have a difficult time as very effeminate homosexual males "socially, romantically, and sexually, and their transition appears to be largely motivated by a desire to improve their lives in these domains" (Bailey & Triea, 2007, p. 524; see also

Bailey, 2003). Similarly, Lawrence (2009) conceptualised androphilic MF transsexuals as “the most feminine of gay men, persons who are so naturally feminine that it is easier and more satisfying for them to live in the world as women than as men” (p. 199). Thus, the decision to transition and live as a woman is seen as a “rational choice” (Bailey, 2003, p. 183) for those MF transsexuals with exclusive sexual attractions to males. In accordance with this proposal, one study found that androphilic MF transsexuals were subjectively evaluated to have a physical appearance that more closely matched their gender identity than those who were not exclusively androphilic (Smith, van Goozen, Kuiper, & Cohen-Kettenis, 2005b).

Because childhood gender-variance is a component of Blanchard’s androphilic transsexualism, theories of childhood gender-variance development are relevant to the etiology of this type of transsexualism. Susan Coates and colleagues suggested that childhood gender-variance in boys occurs because of a complex interaction of psychosocial and psychological factors. These included the boy having a sensitive and anxious temperament, trauma in early childhood—such as a death in the family, a mother that prevents the child from developing a sense of autonomy, and a father who is physically or emotionally withdrawn (Coates, Friedman, & Wolfe, 1991). Coates et al. proposed that this results in gender-variant expression occurring as a defence against separation anxiety.

Zucker and Bradley (1995) also proposed a theory of the development of childhood gender-variance in boys and girls which involved biological and psychodynamic factors. Similar to Coates et al. (1991), Zucker and Bradley proposed that these children are more likely to have a sensitive and anxious temperament. They proposed that mothers of gender-variant boys tend to unconsciously encourage female-typical behaviour. Gender-variant girls are considered more likely to have mothers with depression who feel inadequate as parents and fathers with a low opinion of women. Gender-variant girls are also more likely to experience parental marital discord which leads them to feel they need to stand up for their mother. Zucker and Bradley also proposed that parents of gender-nonconforming children are more likely to have difficulty with regulating their negative affect. This difficulty means that they are not able to set limits on the child’s gender-variant behaviour. Bradley (2003) described the regulation of this negative affect as the ability of an individual to “respond flexibly to the demands of their environment” (pp. 28-29). In essence, Zucker and Bradley

suggested that childhood gender-variance is a response to insufficient parental guidance in either promoting positive gendered modelling or managing environmental stressors.

It is worth noting here that prospective studies have shown that significant childhood gender-variance does not necessarily persist into adulthood (Cohen-Kettenis, 2001; Drummond, Bradley, Peterson-Badali, & Zucker, 2008; R. Green, 1979, 1987; Wallien & Cohen-Kettenis, 2008; Zucker & Bradley, 1995). Nevertheless, one study found that those expressing a more extreme gender-variance in childhood are more likely to develop a gender-variant identity in adulthood (Drummond et al., 2008).

2.2.2 Autogynephilic transsexualism

According to Blanchard, autogynephilic transsexuals are birth-assigned males who develop an error in "erotic target localisation" (Freund & Blanchard, 1993, p. 558). This means that they displace their sexual attraction towards women onto their own bodies, such that they experience sexual arousal from wearing women's clothing or imagining themselves as women. Blanchard believed this displaced desire is the result of a failure of some developmental process that keeps "normal" heterosexual learning on target (Blanchard, 1991). This proposed process biases sexual arousal to stimuli external to a person's self, and if this were to fail then instead the erotic target becomes stimuli internal to a person's self. Blanchard did not speculate what causes the hypothetical error in erotic target localisation. When this development process fails, a person acquires sexual fantasies of themselves having some or all attributes of the desired object. In the case of transvestites, individuals become attracted to particular garments rather the parts of the female body that the garment is worn over. In the case of autogynephilia the desired object is the female physique, and the individual in some way locates this on their own body (Blanchard, 1991). Blanchard (1989b) believed that there is much commonality between autogynephilic transsexuals and transvestites. His autogynephilia concept, however, is broader than transvestism—it also includes sexual fantasies in which the wearing of women's apparel is less important or even absent altogether. For example, Blanchard (1993) claimed that the preferred fantasy of many autogynephilic transsexuals is simply the mental image of themselves with a nude female body.

Blanchard stated that sexual arousal to autogynephilic fantasy may diminish or even disappear due to age, hormone treatment, and genital surgery; and yet the desire to live as a woman does not diminish and often grows stronger. He saw this as a likeness

to human pair bonding: after years of marriage, sexual excitement with a partner tends to decrease, but one continues to be just as attached to that person. Similarly, the desire to have a female body can continue in some permanent "love-bond" (Blanchard, 1991).

As well as studies cited in Section 2.1, a number of studies by Blanchard and others since have reported the existence of autogynephilic sexual arousal among MF transsexuals (Blanchard, 1985a, 1988, 1989b; Docter & Fleming, 2001; Doorn, Poortinga, & Verschoor, 1994; Johnson & Hunt, 1990; Lawrence, 2003, 2005; Smith et al., 2005b; Veale, Clarke, & Lomax, 2008; Walworth, 1997). Among MF transsexuals, Johnson and Hunt found gynephilia was positively correlated with sexual arousal to cross-gender fantasy, and negatively correlated with childhood gender-variance. Doorn and colleagues found that those transsexuals who reported autogynephilic sexual arousal recalled less feminine childhood play and toy preferences and a lower degree of adult gender-variance than those who reported they had not experienced autogynephilic sexual arousal. From a sample of MF transsexuals who had undergone surgery from a single US surgeon, Lawrence (2005) found that 87% of 100 gynephilic, 93% of 89 bisexual, 80% of 10 asexual, and 40% of 15 androphilic MF transsexuals reported a history of autogynephilic sexual arousal. Two studies have found that MF transsexuals who were sexually attracted to males reported being more feminine as a child and less likely to report sexual arousal when cross-dressing (Lawrence, 2005; Smith et al., 2005b). From an online sample, Veale et al. found a subgroup of MF transsexuals reported a greater amount of autogynephilia than a comparison group of birth-assigned females with gender-typical identities. As expected, autogynephilia was positively correlated with gynephilia in Veale et al.'s study, but contrary to Blanchard's theory it was unrelated to recalled childhood gender-variance.

Blanchard (1989a) proposed that an equivalent of autogynephilia—first termed by Dickey and Stephens (1995) as *autoandrophilia*—does not occur among birth-assigned females. This is because Blanchard believed that a type of transsexualism analogous to autogynephilic transsexualism does not occur in birth-assigned females.

In this thesis, the term *cross-gender eroticism* is used in place of *autogynephilia* because the eroticism is not always directed at the self. This is evidenced by the erotic pleasure derived from reading erotic narratives containing cross-gender experiences of other fictional characters (Docter, 1988). Also, the term is gender neutral, which fits the purposes of this thesis better as this phenomenon is assessed in birth-assigned females.

2.2.3 Disagreement with Blanchard's theory and associated perceptions of social desirability

A significant number of transsexuals have voiced disagreement with Blanchard's theory (Dreger, 2008; Lawrence, 2007a; Veale, Clarke, & Lomax, 2009). Veale et al. gave MF transsexuals the opportunity to comment on Blanchard's theory, and found the majority of their comments were negative. The most common response was that the theory is too narrow, and participants had observed experiences of gender-variance within themselves or others that do not fit neatly into one of Blanchard's two subtypes. There is evidence for average differences in relevant gender-variance experience dimensions between subtypes of MF transsexuals in the direction predicted by Blanchard's theory. That is, average differences in sexual orientation, autogynephilia, and recalled childhood gender-variance (Blanchard, 1985b, 1988, 1989b; Doorn et al., 1994; Freund, Steiner, & Chan, 1982; Johnson & Hunt, 1990; Smith et al., 2005b; Veale et al., 2008). However, some MF transsexuals still report experiencing their gender-variance in a way that does not completely fit into one of Blanchard's two categories, suggesting that Blanchard's two subtypes do not completely encompass the diversity of gender-variance experiences. This occurrence is supported by research by Veale et al. (2008) that found a subgroup of MF transsexuals of varying sexual orientations were almost indistinguishable from a comparison group of birth-assigned females with no gender-variant identity on a number of sexuality variables, including autogynephilia. These transsexuals with a history of sexual attraction to females would not fit into one of Blanchard's two subtypes if they did not report autogynephilia at greater levels than this comparison birth-assigned female group.

The existence of these reported experiences has also been observed by supporters of Blanchard's theory. Bailey (2003) purported that those who feel like they don't fit into either category are generally those of the autogynephilic subtype, who are consciously or unconsciously denying that they have some of the components of autogynephilic transsexualism. There is evidence for this claim from two studies. Blanchard, Racansky, and Steiner (1986) reported that autogynephilic birth-assigned males with gender-variant identities reacted with penile tumescence to narratives of fantasies of male-to-female cross-dressing even if they refuted any history of sexual arousal in relation to cross-dressing. Blanchard, Clemmensen, and Steiner (1985) found significant correlations between socially desirable responding and portraying oneself in the more "classical" direction on quantitative measures of feminine gender identity

among non-androphilic MF transsexuals. This included greater adult and recalled childhood female gender identity, sexual orientation towards males, and less cross-gender eroticism. By comparison, they found androphilic MF transsexuals did not show significant correlations between these measures and socially desirable responding. Lawrence (2007a) claimed that non-androphilic transsexuals do not feel like they fit into Blanchard's theory is because their autogynephilia expresses itself in ways more akin to romantic love than sexual eroticism.

2.2.4 Summary

Blanchard's theory proposes that among birth-assigned males there is a different sequence of biological and psychosocial events that cause gender identity development in those who are androphilic and those who are non-androphilic. Androphilic MF transsexuals engaged in feminine behaviours from childhood, and a gender-variant identity develops as the result of a "rational choice" in response to the femininity that develops in homosexual males. In those who are non-androphilic, a developmental variation of unspecified cause interacts with their sexual attraction to females, causing them to localise their erotic/romantic target onto their own bodies. This initial sexual arousal can give way, but an enduring "love-bond" to the idea of oneself as a woman remains. This accounts for the pattern of transitioning to female gender during adulthood rather than displaying feminine behaviours in childhood. In birth-assigned females with gender-variant identities, this latter developmental pathway does not occur.

2.3 Docter's theory of gender-variant identity development.

At around the same time as Blanchard, Richard Docter proposed another theory of gender-variant identity development among birth-assigned males. Docter (1988) distinguished a typology of MF transsexualism comparable to Blanchard's. Using Person and Ovesey's terminology (1974b, 1974a), Docter's *primary* transsexualism was basically equivalent to Blanchard's androphilic transsexualism and his *secondary* transsexualism was basically equivalent to Blanchard's autogynephilic transsexualism.

Docter (1988) provided a developmental theory accounting for transvestism and secondary MF transsexualism. He proposed three antecedent developmental factors that predispose a birth-assigned male to develop transvestism and secondary transsexualism. Firstly, young males are given strict boundaries in terms of gender-appropriate

behaviour and clothing, which can lead to a curiosity and fascination with the forbidden, and result in an erotic component. Secondly, g*ender envy* might also develop as a result of the stresses of growing up as a boy and perceiving girls as having things much easier, being beautiful, and receiving more love and security. Finally, Docter saw inhibitions about sexual relationships with girls during adolescence as a precursor to fetishism. Docter noted that once transvestism develops, the sexual arousal experienced in adolescence is extremely reinforcing, even without orgasm. The "relaxing" and "calming" effect reported by transvestites when cross-dressed may also be reinforcing. Docter's theory states that once independence from parental supervision occurs, a gender-variant identity develops. An example of this is the development of a feminine name. This identity is either integrated into the primary (male) self-system when persons are content with a dual identity as is the case with cross-dressers or causes an upheaval of the primary self to become the dominant identity as is the case with secondary transsexuals. Only some of those who Docter defined as transvestites/cross-dressers become secondary transsexuals if they have a more pervasive gender-variant identity.

Docter (1988) proposed a continuum of gender-variant identities. Persons with gender-typical identities and transsexuals are at either end of this continuum. Docter believed persons with other gender-variant identities, such as cross-dressers and drag artists, are at intermediary points on this continuum.

2.4 Summary and implications for biological and psychosocial variables

This chapter outlined the way early psychological ideas about of gender-variant identities introduced the concept of different types of MF transsexualism organised by sexual orientation. It introduced Blanchard's theory on the significance of autogynephilia to gender-variant identity development. That is, that there are two distinct types of gender-variance that are related to sexual orientation that can develop in people assigned male at birth. If Blanchard's theory were correct, then it would be expected that the biological and psychosocial factors that cause a gender-variant identity to develop would be different in these two sexual orientation groups. This chapter also introduced Docter's developmental theory of gender-variant identities. Docter's theory proposes that a gender-variant identity needs to reach a certain level to become the dominant identity as occurs in transsexuals. If Docter's theory were correct then it would be expected that the biological and psychosocial factors that cause a gender-

variant identity would not differ between transsexuals and those with other gender-variant identities.

The next chapter outlines past research evidence for biological and psychosocial correlates of gender-variant and gender-typical identities. Studies that have assessed whether these variables differ in persons with different sexual orientations will also be identified and their results will also be reviewed.

CHAPTER 3 - REVIEW OF RESEARCH ON BIOLOGICAL AND PSYCHOSOCIAL CORRELATES

This chapter reviews previous studies of correlates of biological and psychosocial factors that are relevant to the development of gender-variant and gender-typical identities. Evidence for differences in these variables between sexual orientation groups among birth-assigned males is also outlined where this is available.

3.1 Biological factors

Biological correlates of gender identities fall under five headings: genetics, prenatal hormones, neuroanatomical, handedness and dermatoglyphics, and familial.

3.1.1 Genetics

3.1.1.1 Twins

Monozygotic (MZ) twins share essentially all of the same genes, whereas dizygotic (DZ) twins share only half of the genes that humans differ on. Because rearing environment generally does not differ between types of twins, genetic factors can be modelled as the amount of greater concordance of transsexualism among MZ twins than DZ twins. A search for academic sources that have reported twins with at least one transsexual was conducted. Academic books and articles were identified through searches for keywords “twin” or “transsexual” in Scopus and Google Scholar, and through searches of articles citing or cited by all the other articles that had already been obtained. Table 3.1 outlines all twin pairs concordant and discordant for transsexualism that could be found reported in the academic literature. From this table it can be seen that MZ twins are more likely to be concordant for transsexualism than DZ twins, $\chi^2(4, N = 83) = 15.05$, $p = .005$.

It is notable that this analysis drew 41% of cases from one conference paper that has not been peer-reviewed (Diamond & Hawk, 2004). When these cases are removed from this analysis it is no longer statistically significant $\chi^2(4, n = 49) = 7.88$, $p = .096$.

Table 3.1 *Reports of twins at least one case of transsexualism in the academic literature*

Zygocity and birth-assignment	Number concordant	References	Number discordant	References	Total
MZ Male	16 (10.5)	(Anchersen, 1956; Diamond & Hawk, 2004 [7]; Gooren, 1984, Gooren et al., 1989, and Latour, 1997, as cited in M. Diamond & Hawk, 2004; Hyde & Kenna, 1977; R. Green, 2000b [2]; Tsur, Borenstein, & Seidman, 1991; Zucker & Bradley, 1995)	15 (20.5)	(Diamond & Hawk, 2004 [8]; Chazen, 1995, Gooren et al., 1989 [3], and Stoller, 1976, as cited in M. Diamond & Hawk, 2004; Hepp, Milos, & Braun-Scharm, 2004; Zucker & Bradley, 1995)	31
DZ Male	1 (4.7)	(Gooren et al., 1989, as cited in Diamond & Hawk, 2004)	13 (9.3)	(Diamond & Hawk, 2004 [6]; Gooren, 1984 [2], Gooren et al., 1989 [3], and Maghazji, 1985, as cited in M. Daimond & Hawk, 2004; Vujovic, Popovic, Sbutega-Milosovec, Djordevic, & Gooren, 2009)	14

Zygocity and birth-assignment	Number concordant	References	Number discordant	References	Total
MZ Female	11 (9.1)	(Benjamin, 1971 [2]; Diamond & Hawk, 2004 [2]; de Vaal, 1975, Harima, 2003, and Hewitt & Warren, 1996, as cited in M. Diamond & Hawk, 2004; R. Green, 2000b; Broadbent, 1996, as cited in R. Green 2000b; Knoblauch, Busjahn, & Wegener, 2007; Sadeghi & Fakhrai, 2000)	16 (17.9)	(Diamond & Hawk, 2004 [5]; Gooren, 1984 [2], Hammond, 1995, and Stoller, 1976, as cited in M. Diamond & Hawk, 2004; Garden & Rothery, 1992; R. Green & Stoller, 1971; Martin, 1981, as cited in Freund, 1985; Segal, 2006 [2]; Hewitt, 1995 and Hutchinson, 2000, as cited in Segal, 2006)	27
DZ Female	0 (1.7)		5 (3.3)	(Diamond & Hawk, 2004 [4]; Vujovic et al., 2009)	5
DZ Male and Female	0 (2.0)		6 (4.0)	(Diamond & Hawk, 2004 [2]; de Vaal, 1975 [3] and Gooren, 1984, as cited in M. Diamond & Hawk, 2004)	6
Total	28		55		83

Note. Figures in parentheses are the expected value if concordance for transsexualism was equally split between MZ and DZ twins (the null hypothesis). Figures in square brackets refer to the number of cases observed in this reference—references without a figure observed one case.

It is also notable that there is no check on the equal environments assumption in this analysis. This is the assumption that MZ twins are not treated more similarly than DZ twins in ways that might affect their gender identity. However, Bailey, Dunne, and Martin (2000) were able to test a large representative sample of Australian twins and found that twins who were more similar on adult gender identity were not more likely to report a more similar environment than those that were less similar. (There was a tendency for MZ female twins to report a more similar environment, but Bailey et al. noted that this was a small relationship, accounting for no more than 2% of the variance.) Bailey et al. also did not test any environmental factors that may be specifically relevant to gender identity development. Their study estimated that 31% (95% confidence intervals 0%-44%) of the variance of adult gender identity was accounted for by genetic factors, 69% (53%-85%) was accounted for by non-shared environmental factors, and 0% (0%-30%) was accounted for by shared environmental factors among males. Among females the corresponding percentages were 24% (0%-42%), 67% (56%-79%), and 9% (0%-35%). However, because this study was not likely to include many participants with gender-variant identities, the reader should be cautious in extrapolating these findings to this population.

In all cases of twins reported to be concordant for transsexualism, sexual orientation was also reported to be concordant where this information was given. However, this should be expected to a certain degree, as a significant concordance of sexual orientation among twins with gender-typical identities has also been reported (Bailey et al., 2000; Kendler, Thornton, Gilman, & Kessler, 2000; Langstrom, Rahman, Carlström, & Lichtenstein, 2010).

In summary, reports of twins with transsexualism show a greater concordance of gender identity among MZ than DZ twins. This suggests a genetic effect for gender identity. No twin studies on persons with gender-variant identities other than transsexualism have been published.

3.1.1.2 Other within-family concordance

There are a number of case reports of within-family concordance of gender-variance. Ball (1981) reported three probably androphilic MF transsexual siblings in one family (who also had an exclusively homosexual brother). Sabalis, Frances, Appenzeller, and Moseley (1974) also described three such siblings in one family. Hore, Nicolle, and Calnan (1973) and Stoller and Baker (1973) both reported the occurrence

of two androphilic MF transsexual siblings in one family. Hastings (1974, as cited in Freund, 1985) described two MF transsexuals who were half-siblings. Joyce and Ding (1985) reported a pair of sibling FM transsexuals. Edelstein (1960, as cited in Freund, 1985) described a transvestite patient with a transvestic older brother, Liakos (1967) described two sons sharing their transvestism with their father. There are three case reports of fathers and sons concordant for transvestism (Kasantikul & Roback, 1978; Krueger, 1978; Zucker & Blanchard, 1997).

Because they are only individual case reports, these give little insight as to whether gender-variant person's family member is more likely to also be gender-variant than persons in the general population. Fortunately, six additional reports have examined within family concordance among large samples of gender-variant individuals. Results of these studies are summarised in Table 3.2. Overall, these studies indicate the prevalence of transsexuality in the relatives of transsexuals appears to be higher than population prevalence estimates. The most liberal population estimates for transsexualism have been 1:2,900 MF and 1:8,300 FM in Singapore (Tsoi, 1988), and 1:4,470 MF and 1:26,818 among New Zealanders (Veale, 2008). (See De Cuypere et al., 2007 for a review of transsexualism prevalence estimates.) However, given transvestism has been estimated to occur among 2%-6% of the male population (see Lawrence, 2009 for a review), there is no evidence for elevated familial co-occurrence of transvestism.

Arguing a case for a genetic component for transsexuality, R. Green (2000b) noted that social learning could not have been a factor in the parent-child cases in his sample because in all of the cases the child did not know about their parent's gender-variance before they were aware of their own cross-gender feelings. However, it is possible that children would be able to notice subtle differences in their parent's gender expression. This parent, being a role model, may have had an impact on their child's gender identity development through social learning effects[1]. Further research is required to test R. Green's argument.

[1] I acknowledge the thesis examiner, Dr. Tarryn Witten for alerting me to this point.

Table 3.2 *Summary of studies of within-family concordance of gender-variance*

Reference	Sample	Within-family concordance
Randell (1971)	340 transvestic clinical patients	Three "familial cases" (3%)
Buhrich (1978)	70 male members of cross-dressing clubs	Three (4%) had a first degree relative that cross-dressed—one father, one brother, and one sister
Croughan, Saghir, Cohen, and Robins (1981)	70 male members of cross-dressing clubs	One (1%) father, two (3%) brothers, and one (1%) sister cross-dressed
R. Green (2000b)	Clinic sample of 1500 transsexuals	Four MF transsexual sibling sets[1]; one MF transsexual with a gender-dysphoric birth-assigned female sibling; one FM transsexual siblings set; one MF transsexual with a gender dysphoric father[2]; one MF transsexual with a transvestite son[2]; one transvestite father with a gender dysphoric, gynephilic son; one transvestite father with a FM transsexual offspring.
Gómez-Gil et al. (2010)	Clinic sample of 677 MF transsexuals and 318 FM transsexuals	Eleven MF transsexuals (2%) had a transsexual sibling (nine MF siblings and two FM siblings) and one FM transsexual (.003%) had a FM sibling.

Note. [1]Sexual orientation not given for these pairs although one of these pairs had both been married. [2]Both probands reported a history of gynephilic sexual attraction.

3.1.1.3 Genetic linkage studies

There is some evidence that three genes that have been associated with sexual differentiation of brain structures correlate with transsexualism. These genes have been associated with the androgen receptor, aromatase, and the estrogen receptor. Henningson et al. (2005) found 29 MF transsexuals scored differently from 229 males with gender-typical identities on the estrogen receptor gene, although most transsexuals' scores were still within normal range. Henningson et al. suggested that specific combinations of androgen receptor, aromatase, and estrogen receptor genes may be more relevant to the development of transsexualism. They found evidence for this with an interaction effect for these three genes in predicting transsexuality using a regression analysis. This study was replicated by L. Hare and colleagues (2009) among a larger

sample of 112 MF transsexuals and 258 gender-typical males. While their results did not to replicate the estrogen receptor finding, they did find that MF transsexuals differed on the androgen receptor gene, suggesting a greater likelihood of reduced sensitivity to androgens among transsexuals.

Hengstschläger et al. (2003) found no detectable genetic abnormalities among 30 MF or 31 FM transsexuals at the chromosomal level, at the molecular level on gene locus Xq12 (associated with androgen receptor), or the SRY gene (sex determining region). Another study found no genetic differences between transsexuals (MF or FM) and persons with gender-typical identities of the same birth-assigned sex in the steroid 5α-reductase gene which is involved with androgen metabolism (Bentz et al., 2007). The same research team also found that a variant of the CYP17 gene which influences the metabolism of sex hormones and leads to above average tissue concentrations of both estrogens and androgens was carried by more FM transsexuals (44%) than females with gender-typical identities (31%); however, MF transsexuals did not differ from gender-typical males (Bentz et al., 2008). Data on sexual orientation of MF transsexuals were not collected in any of these genetic studies.

Care is needed in interpreting the findings of these genetic studies. Although the differences are statistically significant, there is still large proportion of the population who have these gene patterns yet are not transsexuals and a large proportion of transsexuals who do not have these gene patterns. The strongest conclusion these genetic studies allow to be drawn is that genetic determinants of hormones play a small role in increasing the likelihood of transsexualism.

3.1.2 Prenatal hormones

Almost all of the evidence for sex-atypical prenatal hormone levels among persons with gender-variant identities has been of androgen levels. Androgen levels are much higher in men than women and these hormones play a role in masculinity development at both pre- and post-natal stages of development (Nelson, 2005).

3.1.2.1 Persons with intersex and related conditions

The most compelling evidence for the effects of prenatal androgens on adult gender identity in humans comes from studies of the gender identity of persons with intersex and related conditions. Persons with intersex conditions have discordance between their sexual genotype (sex chromosomes) and phenotype (genital appearance)

(Mazur, Colsman, & Sandberg, 2007). These individuals are often exposed to prenatal androgen levels that are intermediary between male-typical and female-typical levels. This can lead to genitalia development that is intermediary between male-typical and female-typical formations. These individuals are given a male or female assignment at birth and often given early surgery to make their genitals conform to their assigned gender. Other individuals experience male-typical prenatal androgen levels but not male-typical genitalia due to cloacal exstrophy or penile agenesis, or if the penis is accidently ablated (Meyer-Bahlburg, 2005). While these individuals do not fit the definition of intersex above, because many are given a female gender assignment at birth they are relevant to studies looking the effects of prenatal androgens on gender identity development.

There are a number of different intersex conditions. Information on the adult gender identity of persons with the following conditions is available in the academic literature:

Congenital adrenal hyperplasia (CAH) is a genetic disorder in which due to a defect in the adrenal glands, individuals receive a high level of androgen exposure prenatally (and sometimes postnatally). This often results in the appearance of ambiguous genitalia at birth in genetic females (Dessens, Slijper, & Drop, 2005).

Persons with androgen insensitivity syndrome have a male genotype but have fewer androgen receptors in their cells, so they are insensitive to androgen and its masculinising effects. Persons with complete androgen insensitivity syndrome develop externally-appearing female genitals at birth, but do not develop a uterus or ovaries, and have undescended testes. Almost all of these persons are raised as girls, do not reject the female gender identity, and the majority are androphilic (Wisniewski et al., 2000). More common is partial androgen insensitivity syndrome (PAIS), in which the genetically male fetus utilises androgens at a lower rate than is typical of genetic males. In these individuals, ambiguous genitalia are usually formed at birth (Mazur, 2005).

Gonadal dysgenesis is a genetic defect which causes abnormal gonad development, often including streaks of connective tissue in the place of the gonad. Individuals with mixed gonadal dysgenesis (MGD) have female internal sex organs and varying degrees of masculinisation of external sex organs (Szarras-Czapnik, Lew-Starowicz, & Zucker, 2007).

Micropenis is the development of a fully formed penis that is markedly smaller that would be expected. This usually occurs as a result of the hypothalamus or (less

commonly) pituitary gland inadequately regulating hormone production (Tuladhar, Davis, Batch, & Doyle, 1998).

Persons with 5α reductase deficiency (5α-RD) and 17β hydroxysteriod dehydrogenase deficiency (17β-HDD) are genetically male, but due to a lack of dihydrotestosterone—responsible of masculinising the genitalia—they develop female-typical or ambiguous genitalia (Cohen-Kettenis, 2005).

Penile agenesis is a developmental anomaly where the penis fails to develop, but the testes and scrotum are often unaffected. Persons with cloacal exstrophy have their abdominal organs exposed and intermingled, and the genitalia are often split. Penile ablation refers to traumatic loss of the penis, which can occur for a variety of reasons, including circumcision accidents, dog bites, or deliberate mutilation (Meyer-Bahlburg, 2005).

Recent reviews have shown that individuals with these conditions are much more likely to change from the gender they were assigned at birth than persons without these conditions (Cohen-Kettenis, 2005; Dessens et al., 2005; Mazur, 2005; Meyer-Bahlburg, 2005). Using these reviews and other academic sources, a summary of all the cases of intersex and related conditions reported in the academic literature in which there is information about their adult gender identity is given here. Academic books and articles were identified through searches for keywords “intersex” or “disorders of sex development” in Pub Med and Google Scholar, and through searches of articles citing or cited by all the other articles that had already been obtained. A list of these articles is given in Table 3.3 along with the diagnosis and number of persons they reported the gender identity of in adulthood.

Table 3.3 *Reference, clinical diagnosis, and assigned gender details for cases used in the analysis*

Reference	Cases included
Dessens et al. (2005)[1]	CAH 60AF, 13AM
Mazur (2005)[1]	PAIS 34AF, 12AM; micropenis 6AF 60AM
Cohen-Kettenis (2005)[1]	5α-RD 79AF; 17β-HDD 27AF
Meyer-Bahlburg (2005)[1]	Penile agenesis 4AF; penile ablation 4AF; cloacal exstrophy 10AF

Reference	Cases included
L. E. Newman and Stoller (1968)	CAH 1AF
Crawford (1970), see also Money (1991)	PAIS 1AM
Price et al. (1984)	PAIS 2AM
Meyer et al. (1986)	CAH 1AF; MGD 1AM
Reilly and Woodhouse (1989)	MGD 3AM; micropenis 9AM
Money (1991)	CAH 2AF, 1AM; PAIS 4AF, 1AM; micropenis 1AM
Reiner (1996)	MGD 1AF
Costa et al. (1997)	CAH 3AF; 5α-RD 2AF
Minto, Liao, Woodhouse, Ransley, and Creighton (2003)	CAH 22AF; MGD 2AF, 1AM; 5α-RD 2AF; 17β-HDD 2AF
Warne et al. (2005)	CAH 16AF; PAIS 3AF, 1AM; MGD 1AF, 1AM; 17β-HDD 2AF
Bin-Abbas, Sakati, and Al-Ashwal (2006)	CAH 1AM
Meyer-Bahlburg, Dolezal, Baker, Ehrhardt, and New (2006)	CAH 61AF
Nihoul-Fékété, Thibaud, Lortat-Jacob, and Josso (2006)	PAIS 5AF, 3AM; 5α-RD 5AF
Brinkmann, Schuetzmann, and Richter-Appelt (2007)	CAH 11AF; PAIS 3AF, 3AM, MGD 1AF; 5α-RD 3AF; 17β-HDD 2AF
Mukherjee, McCauley, Hanford, Aalsma, and Anderson (2007)	Cloacal exstrophy 3AF
Schweizer, Brinkmann, and Richter-Appelt (2007)	CAH 1AM
Szarras-Czapnik, Lew-Starowicz, and Zucker (2007)	MGD 7AF, 10AM
Baldinotti et al. (2008)	5α-RD 1AF
Jorge, Echeverri, Medina, and Acevedo (2008)	CAH 1AF
Liakopoulou, Keramydas, Dracopoulou, and Dacou-Voutetakis (2009)	17β-HDD 1AF

Note. [1]review article. AF = assigned female. AM = assigned male.

A summary of each of the cases identified, delineated by condition type, is given in Table 3.4. The percentage of cases that had later reassigned their gender is reported as a gender-variant identity outcome. In addition to this, sometimes the case was reported to have dysphoria about their gender, but had not taken steps to reassign their gender. These cases are reported as gender dysphoric.

Table 3.4 *Frequency and percentage of clinical diagnosis and gender-variant identity outcomes for cases used in this study.*

Condition	Prenatal androgen level	Gender assignment at birth (% of total)	Gender-variant identity outcomes
CAH	Intermediary	178 female (34%)	5% male plus 5% gender dysphoric
		16 male (3%)	25% female
PAIS	Intermediary	52 female (10%)	10% male
		20 male (4%)	35% female
Micropenis	Intermediary	6 female (1%)	None
		70 male (14%)	3% gender dysphoric
MGD	Intermediary	13 female (3%)	15% male plus 15% gender dysphoric
		15 male (3%)	7% female
5α-RDD	Male-typical	92 female (18%)	66% male
17β-HDD	Male-typical	34 female (7%)	47% male plus 3% gender dysphoric
Cloacal exstrophy	Male-typical	13 female (3%)	31% male plus 15% gender dysphoric
Penile agenesis	Male-typical	4 female (1%)	25% male
Penile ablation	Male-typical	4 Female (1%)	50% male plus 25% gender dysphoric

Three conclusions can be drawn from this table. Firstly, it appears that persons with intersex and related conditions that are reported in the academic literature are much more likely to have gender dysphoria or to reassign their sex than the general population (see Tsoi, 1988; and Veale, 2008 for estimates of the prevalence of transsexualism in the general population). Secondly, gender dysphoria and gender reassignment appears to be more common among those persons who were assigned female with a male-typical prenatal environment than those who were assigned female with an intermediary level of prenatal androgen exposure. This suggests that when the prenatal androgen

environment is more dissimilar to the gender of assignment at birth, the more likely a gender-variant identity outcome is to occur. This *dosage effect* of prenatal androgen has also been reached in studies of persons with CAH (Meyer-Bahlburg et al., 2006). Thirdly, this review also supports a strong contribution for psychosocial factors determining adult gender identity development. The majority of cases in this review did not have a gender-variant identity despite having a prenatal environment that was not gender-typical.

However, there are a number of limitations that are likely to have impacted on these conclusions. Firstly, it is possible that this sample is biased. Zucker argued that cases of gender reassignment are more likely to be reported in the academic literature because they are "deemed newsworthy" (2002, p. 272). If this is the true, then the majority of cases of gender reassignment in this review would be expected to be reported in articles only reporting these types of cases. However, this wasn't the case—66% of the cases used in this review that reported gender reassignment or gender dysphoria were taken from articles that also reported cases that had no gender change or dysphoria. In comparison, only 54% of cases that reported no gender change or dysphoria were taken from articles that also reported cases with gender change or dysphoria. Secondly, individuals with these intersex/related conditions may have different experiences that are relevant to their adult gender identity formation than individuals without these intersex/related conditions. For example, genital appearance, childhood genital surgery, and spontaneous virilisation in puberty are all experiences common to persons with these intersex/related conditions but not common to persons without these conditions. Furthermore, two of these conditions, 5α-RD and 17β-HDD, are more likely to occur in non-Western cultures that sometimes have recognition of their occurrence as a kind of late developing male (S. B. Green, Akey, Fleming, Hershberger, & Marquis, 1997; Lozano, García-Cueto, & Muñiz, 2008).

Therefore, care is needed in extrapolating findings of change of sex in persons with intersex conditions with those who do not have these conditions. Meyer-Bahlburg et al. (1996) argued that there are differences in the manifestation of gender-variance between transsexuals and intersex persons. Transsexuals experience more gender dysphoria (discomfort or upset) whilst intersex persons experience more gender confusion or uncertainty, and that the gender-variant identity formation appears to develop later in intersex persons than those with early-onset transsexualism.

Further evidence for prenatal androgen exposure impact on gender identity comes from direct and indirect measures of prenatal androgens.

3.1.2.2 Direct measures of prenatal androgens

Only one study has directly tested the relationship between prenatal androgen levels and adult gender-variance. This study found that higher prenatal androgen levels measured by maternal blood samples were related to more masculine adult gender *role* behaviour among females (Udry, Morris, & Kovenock, 1995). No research has specifically examined the relationship between gender *identity* and direct measures of prenatal androgens

3.1.2.3 Indirect measures of prenatal androgens

Associations have also been made between a number of less direct measures of prenatal androgen exposure and gender-variance. The ratio between the length of the second and fourth fingers (2D:4D) is widely believed to be an indicator of prenatal sex hormone levels (W. M. Brown, Hines, Fane, & Breedlove, 2002; Cattrall, Vollenhoven, & Weston, 2005; Lutchmaya, Baron-Cohen, Raggatt, Knickmeyer, & Manning, 2004; Manning, Bundred, Newton, & Flanagan, 2003; Okten, Kalyoncu, & Yaris, 2002). A number of studies have shown that females have greater 2D:4D ratios than males on average (Manning et al., 2000; Manning, Churchill, & Peters, 2007; Manning, Scutt, Wilson, & Lewis-Jones, 1998) and most studies have found that this effect is greater on the right hand than the left hand (W. M. Brown, Finn, Cooke, & Breedlove, 2002; Lippa, 2003; Manning et al., 2007; Manning et al., 1998; Williams et al., 2000). Studies of 2D:4D using samples of persons with gender-variant identities are outlined in Table 3.5. These studies have only assessed transsexuals. Generally, these studies have either found transsexuals do not differ from persons with gender-typical identities of the same birth-assigned gender, or there are differences in the expected direction. This provides some further evidence that prenatal androgens play a role in gender-variant identity development. All of these studies used experimenter measurement from photocopies to measure 2D:4D.

Table 3.5 *Summary of studies of 2D:4D among persons with gender-variant identities*

Reference	Sample	Findings[1]
Schneider, Pickel, and Stalla (2006)	63 MF and 43 FM transsexuals; 58 males and 65 females with gender-typical identities	MF transsexuals differed from gender-typical males on right hand but not left hand; no differences between FM transsexuals and gender-typical females
Wallien, Zucker, Steensma, and Cohen-Kettenis (2008)[2]	96 MF and 51 FM transsexuals; 90 males and 112 females with gender-typical identities	No differences between MF transsexuals and gender-typical males; FM transsexuals differed from gender-typical females on both right and left hands
Kraemer et al. (2009)	39 MF and 17 FM transsexuals; 176 males and 190 females with gender-typical identities	MF transsexuals differed from gender-typical males on right hand but not left and no effect of sexual orientation on this; right handed FM transsexuals had hyper-feminised 2D:4D compared to gender-typical females

Note. [1]All findings in the expected direction (i.e. a lower 2D:4D signalling a more feminine gender identity and a higher 2D:4D signalling a more masculine gender identity) unless otherwise noted. [2]This study also did not find differences between children diagnosed with gender identity disorder and gender-typical children of the same birth-assigned gender.

Anticonvulsants have been demonstrated to alter prenatal hormone levels (DiStefano, 2002). One study found 3 transsexuals (one MF and two FM) out of a group of 243 Dutch persons who had been exposed to anticonvulsants prenatally (Dessens et al., 1999). This is a much higher prevalence than expected due to chance.

Another study has found that those persons who experienced prenatal exposure to the Dutch famine were no more likely to report a gender-variant identity (de Rooij, Painter, Swaab, & Roseboom, 2008). Underfeeding has been associated with lower prenatal androgen levels in studies of animals (de Rooij et al., 2008).

Women with polycystic ovary syndrome (PCOS) experience elevated levels of androgen exposure postnatally and possibly prenatally (Xita & Tsatsoulis, 2006). Some

studies have shown elevated rates of PCOS among FM transsexuals who have not yet begun cross-sex hormone treatment (reviewed in Table 3.6). Many of the earlier studies lacked a consistent definition of PCOS, so the newer Rotterdam criteria (Rotterdam ESHRE/ASRM-Sponsored PCOS Consensus Workshop Group, 2004) was applied to these. In sum, the total prevalence of 29% of 294 FM transsexuals (Wald 95% confidence intervals for a proportion: 24%-35% was greater than the most liberal population estimates of PCOS in females with gender-typical identities, 13% (Mueller et al., 2008).

Table 3.6 *Summary of studies of PCOS among FM transsexuals*

Reference	Sample	Findings
Futterweit, Weiss, and Fagerstrom (1986)	40 FM transsexuals	Eleven (28%) met Rotterdam[1] criteria for PCOS
Spinder, Spijkstra, Gooren, and Burger (1989)	16 FM transsexuals	None met Rotterdam criteria for PCOS, but ultrasound was not measured
Balen, Schachter, Montgomery, Reid, & Jacobs (1993)	16 FM transsexuals	Seven (44%) met Rotterdam criteria for PCOS
Bosinski et al. (1997)	16 FM transsexuals	Eight (50%) met Rotterdam criteria for PCOS
Baba et al. (2007)	69 FM transsexuals	40 (58%) met Rotterdam criteria for PCOS
Mueller et al. (2008)	61 FM transsexuals and 94 gender-typical females	Nine (15%) met Rotterdam criteria for PCOS, however this was not more than gender-typical females (13%)
Vujovic, Popovic, Sbutega-Milosovec, Djordevic, and Gooren (2009)	76 FM transsexuals	Eleven (14%) met Rotterdam criteria for PCOS
Total	294 FM transsexuals	86 (29%) met Rotterdam criteria for PCOS

Note. [1]To meet this criteria, study participants must have two of: clinical (hirsutism) and/or bio-chemical (hormone levels) signs of androgen excess, oligo-amenohhrea (nine or fewer menstrual cycles per year), or ultrasound evidence of polycystic ovaries.

3.1.3 Neuroanatomical differences

Neuroanatomical differences have been observed among transsexuals. One research team has found a sex differentiation in the neuron volume of the central subdivision of the bed nucleus of the stria terminalis (BSTc) of the hypothalamus and in post-mortem examinations of transsexuals' brains found that their BSTc neuron volume matched that of their opposite birth-assigned sex (Zhou, Hofman, Gooren, & Swaab, 1995; Kruijver et al., 2000). Their sample included six MF transsexuals and one FM transsexual, and all had received hormone treatment for a significant period of time. These MF transsexuals were all non-androphilic (Garcia-Falgueras & Swaab, 2008). Kruijver et al. (2000) also included a birth-assigned male who "had very strong cross-gender identity feelings" (p. 2039) but never received hormone treatment in their sample. They found a BSTc neuron volume within the female range for this person. Both studies also included six "sex hormone disorder" cases of persons with gender-typical identities who had atypical hormone levels and came to the conclusion that the BSTc differences were not associated with hormone treatment in either the transsexuals or persons with gender-typical identities. Given their findings, Zhou et al. and Kruijver et al. proposed a neurobiological basis as an explanation of transsexualism.

However, more recent research has found that sex differences in BSTc volume do not develop until well into adulthood (Chung, De Vries, & Swaab, 2002) and yet the majority of transsexuals report that their transsexual feelings began before adulthood (Lawrence, 2003). Lawrence (2007b) also critiqued these BSTc studies, arguing that there is insufficient evidence that these brain differences were not the effect of hormone treatment. To illustrate this, Lawrence noted research that found hormone treatment for MF transsexuals decreased overall brain volume, and another study showed that in FM transsexuals both hypothalamic and overall brain volume increased with hormone treatment (Hulshoff Pol et al., 2006). There is also evidence from experimental studies of animals and correlational studies of humans that childhood stress (including abuse) has an impact on brain structure, including the hypothalamus (Kaufman, Plotsky, Nemeroff, & Charney, 2000; Teicher, Tomoda, & Andersen, 2006). Further independent research using larger samples is needed to assess BSTc as a proposed basis of a neurobiological explanation of transsexualism.

The interstitial nucleus of the anterior hypothalamus nuclei 3 (INAH-3) has previously been shown to be sexually dimorphic and it has been reported that

homosexual males with a gender-typical identity also have a female-typical INAH-3 size (Byne et al., 2001; LeVay, 1991). Garcia-Falgueras and Swaab (2008) found 11 MF transsexuals had an INAH-3 that was on average a smaller, female-typical size. The group differed from 14 males with gender-typical identities but not from 11 females with gender-typical identities. They also reported the INAH-3 size of one FM transsexual was within the male range. Given that most of the MF transsexuals in this research were non-androphilic this finding has interesting implications for the relationship between sexual orientation and gender identity. However, Garcia-Falgueras and Swaab found that INAH-3 size of five castrated males was intermediary between males and females with gender-typical identities, suggesting that androgen level changes in adulthood may have an effect on INAH-3 size.

More recently, studies using neuroimaging technology have examined transsexuals' brains. Research using MRI scans has found that 22 MF and 28 FM transsexuals have corpus collosum midsaggital plane shapes on average more typical of those of the gender they identify as when compared to persons with gender-typical identities (Yokota, Kawamura, & Kameya, 2005). Also, a recent study has found that non-androphilic MF transsexuals who had not been taking cross-sex hormones showed a female-typical hypothalamus activation pattern when smelling odorous steroids known to activate the hypothalamus (Berglund, Lindstrom, Dhejne-Helmy, & Savic, 2009). Another study found that 6 androphilic and 18 gynephilic MF transsexuals who had not commenced hormone therapy had gray matter variation that was more similar to gender-typical males than gender-typical females, although transsexuals of both sexual orientations had a female-typical volume of grey matter in the left putamen (Luders et al., 2009).

Underlying differences in neuroanatomic structure can also be manifested in cognitive test performance. Studies of cognitive abilities of persons with gender-variant identities are outlined in Table 3.7. Almost all of this research has been conducted on transsexuals. Overall, these results are mixed, with some studies showing no differences between transsexuals and persons with gender-typical identities of the same birth-assigned sex and some showing transsexuals' cognitive test performance in line with their gender identity. It also appears that transsexuals' hormone treatment does not have much effect on the results (e.g. Haraldsen, Egeland, Haug, Finset, & Opjordsmoen, 2005). The most likely reason for these mixed findings is the small sample sizes of both transsexuals and persons with gender-typical identities in most of the studies. It also

seems that studies that included more transsexuals who were sexually attracted to the same birth-assigned sex (Collaer, Reimers, & Manning, 2007; Peters, Manning, & Reimers, 2007) were more likely to report differences between transsexuals and persons with gender-typical identities of the same birth-assigned sex because sexual orientation has also been associated with sex-atypical results on these cognitive tests. For example, an internet study of 255,100 participants found heterosexual males performed better on a three-dimensional mental rotation task than homosexual males, with bisexual males scoring intermediately. This study also found heterosexual females scored lower than homosexual and bisexual women who did not differ from each other (Peters et al., 2007).

3.1.4 Handedness and dermatoglyphics

Research into the handedness of gender-variant persons is outlined in Table 3.8. All of this research has been conducted on transsexuals. A consistently high proportion of non-right handedness has been found among transsexuals in all of the controlled and non-controlled studies outlined. One study has also found have elevated rates of left-handedness among boys diagnosed with childhood gender identity disorder (Zucker, Beaulieu, Bradley, Grimshaw, & Wilcox, 2001). Two studies have shown elevated levels of non-right handedness occurs independently of sexual orientation in MF transsexuals (R. Green & Young, 2001; Watson & Coren, 1992). Herman-Jeglinska, Dulko, and Grabowska (1997) found that the elevated levels of non-right handedness was more pronounced in those transsexuals who did not have an immediate relative who was non-right handed compared to gender-typical persons who also did not have an immediate relative who was non-right handed. They suggested this is a reflection of a non-genetic determinant of the relationship between transsexuality and non-right handedness. Herman-Jeglinska et al. also noted a greater prevalence of extreme-right handedness among transsexuals, which they operationally defined as scoring the maximum possible for right-handedness on a continuous scale.

Table 3.7 *Summary of studies of cognitive tests among gender-variant persons*

Reference	Sample	Findings
La Torre, Gossmann, and Piper (1976)	8 MF transsexuals, 12 gender-typical males and 14 gender-typical females	MF transsexuals differed from gender-typical males but not gender-typical females on an embedded figures test
Hunt, Carr, and Hampson (1981)	17 MF and 5 FM transsexuals	Wechsler scores were all typical of that birth-assigned gender
Cohen-Kettenis et al. (1998)	44 MF and 34 FM transsexuals pre hormone treatment, 51 gender-typical males and 29 gender-typical females	Transsexuals scored atypically of the same birth-assigned sex on a verbal memory test but not on a two-dimensional test of spatial ability
van Goozen, Slabbekoorn, Gooren, Sanders, & Cohen-Kettenis (2002)	22 MF and 19 FM transsexuals pre hormone treatment, 20 gender-typical males and 23 gender-typical females	No differences between groups on a two dimensional mental rotation task and verbal reasoning test; MF and FM transsexuals scored intermediary between gender-typical groups on judgement of line orientation, three-dimensional mental rotation, and targeted throwing
Haraldsen et al., (2003)	22 MF and 30 FM transsexuals pre hormone treatment, 14 gender-typical males and 15 gender-typical females	No effect of gender identity on two-dimensional rotation, visualization, perception, verbalization, logic, or artithmetic tests.
Menaged (2004)	20 MF transsexuals not taking hormone treatment, 20 gender-typical males and 20 gender-typical females	Transsexuals and gender-typical females did not differ from each other but scored lower than gender-typical males on a three-dimensional mental rotation task.
Wisniewski, Prendeville, and Dobs (2005)	27 hormone treated MF transsexuals and 16 gender-typical males	These groups did not differ on perceptual speed, map memory, and three-dimensional mental rotation tests

Table 3.8 *Summary of studies of handedness among gender-variant persons*

Reference	Sample	Findings
Orlebeke, Boomsma, Gooren, and Verschoor (1992)	93 MF and 44 FM transsexuals	Both transsexual groups were almost twice as likely to be left handed than estimates of the general population
Watson and Coren (1992)	45 MF transsexuals of varying sexual orientations and 225 age-matched gender-typical males	Transsexuals were more than three times more likely to be left handed than age-matched males
Herman-Jeglinska et al. (1997)	12 MF and 70 FM transsexuals; 148 gender-typical males and 331 gender-typical females	FM transsexuals more likely to be non-right handed than gender-typical females; a non-significant trend towards non-right handedness among MF transsexuals
Cohen-Kettenis van Goozen, Doorn, and Gooren (1998)	46 MF and 47 FM transsexuals	3 MF (7%) and 13 (28%) transsexuals were non-right handed
Slabbekoorn et al. (2000)	184 MF and 110 FM transsexuals; 158 gender-typical males and 164 gender-typical females	Both transsexual groups more likely to be non-right handed than persons with gender-typical identities
R. Green and Young (2001)	443 MF and 93 FM transsexuals; 144 gender-typical males and 140 gender-typical females	Both transsexual groups more likely to be non-right handed than persons with gender-typical identities

The causes of non-right handedness are not completely understood. There is evidence that the cause of at least some non-right handedness is genetic (e.g. Klar, 2003). However, two other explanations for non-right handedness are more likely to have relevance to gender-variant identities: elevated prenatal androgens and developmental instability. There is evidence that non-right handedness is associated with increased prenatal androgen levels from a studies of females with CAH (Helleday, Siwers, Ritzen, & Hugdahl, 1994; Kelso, Nicholls, Warne, & Zacharin, 2000; Nass et

al., 1987) and another study showing a link between handedness and genes associated with the androgen receptor (Medland et al., 2005). Whilst this explanation of elevated prenatal androgen levels causing non-right handedness is consistent with theory and research of prenatal hormones (outlined in Section 3.1.2) among gender-variant birth-assigned females, lower levels of non-right handedness would be expected among gender-variant birth-assigned males within whom theory and research has aligned with lower than usual prenatal hormone levels.

A second causal explanation of non-right handedness that can account for gender-variant identities among persons of both birth-assigned sexes is *developmental instability*. This term has been used refers to a persons' susceptibility to developmental disturbances; such disturbances could be environmental (e.g. exposure to pathogens) or genetic (e.g. gene mutations) during early development. These result in reduced reproductive fitness and increased likelihood of developing neurodevelopment disorders such as autism and schizophrenia. According to this theory, non-right handedness is an indicator of developmental instability and the finding of elevated levels of non-right handedness among transsexuals suggests that such developmental disturbances also have a role in the cause of transsexualism (see Lalumiere, Blanchard, & Zucker, 2000 for a review of the theory of developmental instability and its application to sexual orientation development).

Another morphological phenomenon relevant to prenatal androgens and developmental instability is dermatoglyphics (fingerprints). It has been proposed that total finger ridge count is positively associated with prenatal androgen levels and finger ridge fluctuating asymmetry is associated with developmental instability. Two studies have assessed dermatoglyphics among transsexuals. Slabbekoorn, van Goozen, Sanders, Gooren, and Cohen-Kettenis (2000) did not find any differences between transsexuals (FM or MF) and persons with gender-typical identities of the same birth-assigned sex on total finger ridge count or fluctuating asymmetry. R. Green and Young (2000) also found no differences between total ridge count between transsexuals and persons with gender-typical identities but found a difference between androphilic and non-androphilic MF transsexuals and persons with gender-typical identities on fluctuating asymmetry. This scarcity of significant results using dermatoglyphics has also been found in studies of sexual orientation (see Mustanski, Bailey, & Kaspar, 2002 for a review).

3.1.5 Familial variables

Fraternal birth order sibling sex ratio has been linked to homosexuality in males with gender-typical identities (Blanchard, 2004; Blanchard & Lippa, 2007; Bogaert, 1998, 2000, 2003, 2005a, 2005b; Camperio-Ciani, Corna, & Capiluppi, 2004; King et al., 2005; Purcell, Blanchard, & Zucker, 2000; Williams et al., 2000). Studies of birth order and sibling sex ratio in persons with gender-variant identities are included here as biological correlates because of convincing evidence that this has a biological origin among homosexual males. Using a population-based sample, Bogaert (2000) found no evidence that the fraternal birth order effect occurs as result of same-sex sexual influence such as mutual sex play or activity from older brothers. Bogaert (2006) found that this fraternal birth order effect occurs independently of whether the older brothers lived in the same household. Furthermore, Bogaert (2006) also found that older stepbrothers and adoptive brothers did not have this effect on sexual orientation regardless of how long they had spent living in the same household. These findings favour biological, rather than psychosocial explanations of this effect. The most promising of these biological explanations was given by Blanchard and Klassen (1997), who proposed that with every male baby a mother has, there is progressive immunisation of H-Y antigens for the following male foetus which feminises the sex differentiation in the brain. However, more research is required to clarify the mechanism of this effect.

Differences in birth order have also been found among transsexuals. Tsoi, Kok, and Long (1977) examined 43 androphilic MF transsexuals from Singapore and found them to have a later than expected birth order. However, they did not employ a comparison group. Blanchard and Sheridan (1992) found that 193 androphilic MF transsexuals had more siblings than 204 FM transsexuals, who also had more siblings than 273 non-androphilic MF transsexuals. The androphilic MF transsexuals had a sibling sex ratio of 131 brothers per 100 sisters, which was higher than the 106 males per 100 females found in the general population. The non-androphilic MF transsexuals and FM transsexuals' sibling sex ratios did not differ from the population as a whole. The androphilic MF transsexuals also had a later birth order than the non-androphilic MF transsexuals. The FM transsexuals had an intermediary birth order that did not differ from either MF transsexual group. Blanchard, Zucker, Cohen-Kettenis, Gooren, and Bailey (1996) also found 83 androphilic MF transsexuals had a later birth-order and higher sibling sex ratio than 56 non-androphilic MF transsexuals. In a separate study,

Blanchard et al. found that 21 adolescent androphilic MF transsexuals had a later birth order than 21 psychiatric controls matched for age and sibship size. R. Green (2000a) found that 106 androphilic MF transsexuals had a later birth-order and higher number of older brothers than 336 non-androphilic MF transsexuals. R. Green also found that 100 FM transsexuals did not differ from expected birth-order. In summary, these studies have tended to find an elevated fraternal birth order effect in only androphilic MF transsexuals.

Two studies found that transvestites have shown the opposite birth order effect—a tendency to be more likely to be the oldest birth-assigned male or only child (Prince & Bentler, 1972; Schott, 1995). However, these studies did not include comparison groups and this finding has not been replicated in another study (V. L. Bullough, Bullough, & Smith, 1983).

R. Green and Keverne (2000) found MF transsexuals, regardless of sexual orientation, had a greater number of maternal aunts than maternal uncles. No differences from the expected equality were found among FM transsexuals or on the paternal side of MF transsexuals. R. Green and Keverne interpreted this as evidence for genes on the X chromosome contributing to the development of MF transsexualism. No disparate maternal (or paternal) aunt:uncle ratio was found in one study of homosexual males (McKnight & Malcolm, 2000).

This section has highlighted the biological factors that are related to gender-variant and gender-typical identities. These include genetic factors through genetic linkage studies and twin and other within-family concordance; prenatal hormones through follow-up of people with intersex and related conditions and direct and indirect measures of prenatal hormone exposure; neuroanatomical differences though brain studies and cognitive test performance; handedness; and fraternal birth order. Psychosocial factors that are related to a gender-variant or gender-typical identity are reviewed in the next section.

3.2 Psychosocial factors

3.2.1 Parental factors

The majority of research into parental factors has examined the relationship between parents and a child who develops a gender-variant identity. A less warm, more emotionally distant, controlling or rejecting father has been associated with transsexualism in two studies with gender-typical comparison groups (Cohen-Kettenis

& Arrindell, 1990; Parker & Barr, 1982). However, two studies have found that androphilic MF transsexuals reported being no less close to their father than homosexual males (Buhrich & McConaghy, 1978a; Freund, Langevin, Zajac, Steiner, & Zajac, 1974). There is also evidence from studies of participants with gender-typical identities that this poor relationship is associated with the child's feminine expression rather than later sexual orientation (Freund & Blanchard, 1983). Buhrich and McConaghy (1978a) found that 34 birth-assigned male transvestites and 29 MF transsexuals were more likely than 30 medical patients to report that their mother had wished for a girl before birth. They also reported higher mothers' involvement and lower fathers' involvement in their upbringing than gender-typical persons. However, the authors reported no evidence of "abnormal relationships" with the participants' mothers. Hogan-Finlay (1995) reported that 101 gender-typical males were less likely to report feeling that their parents wished for a girl when they were born than 27 MF transsexuals and 64 transvestites which did not differ from each other. Two studies have found that transvestites viewed their fathers as more dependent and affiliative than gender-typical males (Newcomb, 1985; Schott, 1995). Schott found that 68% of his sample of 85 transvestites reported a neutral or negative relationship with their father, compared to only 41% of a comparison group of 44 males with gender-typical identities.

Some further studies have examined separation from parents. One study found that gender clinic patients were more likely than psychiatric patients to report parent death—especially fathers and during adolescence and early adulthood (S. M. Bernstein, Steiner, Glaister, & Muir, 1981). Among a population sample of 1,279, Langstrom and Zucker (2005) found an increased likelihood of separation from parents during childhood among males reporting transvestic fetishism. However, Hogan-Finlay (1995) found that MF transsexuals, transvestites, and gender-typical males did not differ in their reported parent relations to each other or likelihood of living with both parents during their childhood. Also, studies of gender-typical populations have not found any evidence for an absent father having an effect on gender development (Stevens, Golombok, Beveridge, & ALSPAC Study Team, 2002; Stevenson & Black, 1988).

There are four studies that have looked at familial encouragement of childhood gender-variance. Schott (1995) reported that 22% of his sample had had their cross-dressing initiated, and openly encouraged by a female family member during their formative years. Prince and Bentler (1972) reported that 4% of their sample of 504

transvestites were “made to wear dresses as punishment” and 6% were “kept in curls till longer than other boys” (p. 912). However, neither of these studies employed comparison groups. Hogan-Finlay (1995) found that MF transsexuals were more likely to report being dressed as a girl in childhood than transvestites who in turn were more likely to report this than gender-typical males. However, Talamini (1982) reported that few of his male transvestite research participants remembered being treated like a girl during childhood.

Two studies have assessed parental age of persons with gender-variant identities. Blanchard and Sheridan (1992) found no difference in maternal age at participants’ birth among FM and MF transsexuals (which were also grouped as androphilic and non-androphilic). Buhrich and McConaghy (1978a) also found no differences in parental age between gender-typical birth-assigned male heterosexuals, homosexuals, transvestites, and transsexuals.

3.2.2 Abuse

Studies of the prevalence of emotional, physical, and sexual abuse among gender-variant persons are outlined in Table 3.9. Many of these studies have small samples and/or lack adequate comparison groups. In the studies that include comparisons there is evidence that persons with gender-variant identities are more likely to have experienced abuse than persons with gender-typical identities.

Whether this abuse is a cause or effect of transsexualism is not clear. Reflecting on interviews with FM transsexuals, Devor stated “I have speculated, as have some of the participants themselves, that, in some cases, transsexualism may be an adaptive extreme dissociative survival response to severe child abuse” (1994, p. 49). On the other hand Gehring and Knudson (2005) believed that children with gender-variance are more of a target to abusers. They stated that their findings “do not support any notion that childhood trauma is associated with…the formation of transsexualism…but rather has more to do with society’s prejudices about being transsexual” (p. 29).

Two studies have also found increased levels of gender-nonconforming behaviour and identity in girls who had been sexually abused. In one study the girls were followed up in middle childhood (Cosentino, Meyer-Bahlburg, Alpert, & Gaines, 1993), in the other they were followed up in adolescence (Aiosa-Karpas, Karpas, Pelcovitz, & Kaplan, 1991).

Table 3.9 *Summary of studies of abuse among gender-variant persons*

Reference	Sample	Emotional abuse	Physical abuse	Sexual abuse
Pauly (1974)	80 FM transsexuals	Not assessed	24 (30%)	23 (29%)
Lothstein (1983)	53 FM transsexuals	Not assessed	26 (49%)	12 (23%)
Devor (1994)[1]	45 FM transsexuals	13 (29%)	17 (38%)	14 (31%)
Hogan-Finlay (1995)	27 MF transsexuals, 64 transvestites, 101 gender-typical males	Gender-variant groups scored higher	No differences between groups	No differences between groups
B. Bullough and Bullough (1997a)	41 MF transsexuals, 331 transvestites	Not assessed	Not assessed	37 (10%)
Kersting et al. (2003)	29 MF and 12 FM transsexuals, 56 male and 59 female psychiatric patients	Transsexuals scored higher	No differences between groups	Transsexuals scored lower
Gehring and Knudson (2005)	34 MF and 8 FM transsexuals	50-80%	20-30%	23 (55%) unwanted sexual event
Langstrom and Zucker (2005)	36 persons who reported sexual arousal from cross-dressing from a population sample of 2,450	Not assessed	Not assessed	Increased likelihood among those reporting transvestism
Grossman, D'Augelli, and Salter (2006)[2]	31 young MF transsexuals who used a drop-in centre	27 (87%) reported “verbal abuse”	11 (35%)	5 (16%)
Wharton (2007)	Online-recruited persons with gender-variant identities; birth-assignment 132 female, 163 male	Not assessed	63 (48%) birth-assigned females and 53 (33%) birth-assigned males reported physical or sexual abuse	

Note. [1]A total of 60% of this sample reported at least one of these forms of abuse.
[2]Those who had been more gender atypical in childhood (i.e. reported being called a sissy) were more likely to report experiencing verbal and physical abuse.

3.3 Summary and implications

3.3.1 Summary

This chapter outlined evidence for biological and psychosocial variables related to gender-variant and gender-typical identities. There is evidence that biological factors—genetics, prenatal androgen exposure, neuroanatomical differences, handedness, and fraternal birth-order—play a significant role in the etiology of gender-variant and gender-typical identities. While there is evidence for a number of biological correlates, this does not necessarily imply that more than one biological factor plays a role—it is possible that they are related and share a common precursor. For instance, it is plausible that there is a causal pathway from genes causing atypical prenatal hormones levels causing neuroanatomical differences causing adult gender identity.

Studies of individuals with intersex and related conditions have shown that it is not uncommon for an individual to have a male-typical prenatal environment (including androgen levels), to be assigned a female sex at birth, and to develop a female gender identity. Therefore, psychosocial factors also have a role to play in the etiology of gender identities. There is evidence that a poor or absent parental relationship, childhood abuse, and parental encouragement of gender-variance are more common amongst samples of persons with gender-variant identities. It is unclear whether some of these factors are a cause or effect of gender-variance. It is possible that any psychosocial variables that play a causative role in the development of gender-variant or gender-typical identities are complex and work in interaction with biological variables.

3.3.2 Implications for theories of gender-variant identity development

Although in his journal articles Blanchard did not give specific details about the etiological factors that determine the different types of gender-variance experience, from the research he conducted it can be seen that he proposed that androphilic gender-variance had its etiological roots in the causes of homosexuality and non-androphilic gender-variance in the causes of heterosexuality (Blanchard, Dickey, & Jones, 1995; Blanchard & Sheridan, 1992). Therefore, Blanchard's theory proposes that differences in the etiological factors for both these groups would be expected.

Some research outlined in this chapter has examined whether biological and psychosocial factors differ between sexual orientations as Blanchard proposed. These findings are summarised here. Firstly, in most cases of twin and within-family

concordance for gender-variance, sexual orientation was also reported to be the same among the two family members with gender-variant identities where this information was given (reviewed in Section 3.1.1). This is in line with Blanchard's theory—if there is a distinct genetic component for each type of gender-variance then it would be expected that the two types would separately co-occur amongst family members. Three studies have found that androphilic MF transsexuals have a later fraternal birth order and higher ratio of brothers to sisters than non-androphilic MF transsexuals (Blanchard & Sheridan, 1992; Blanchard et al., 1996; R. Green, 2000a). On the other hand, there are a number of studies that have found the same biological variable predicts gender-variant identity development among those of both sexual orientations. R. Green and Young (2001) found elevated levels of non-right-handedness among MF transsexuals of both sexual orientations. R. Green and Keverne (2000) found MF transsexuals of both sexual orientations had a significantly greater number of maternal aunts than maternal uncles. Luders et al. (2009) found MF transsexuals of both sexual orientations had a female-typical left putamen grey matter volume. There is also evidence that non-androphilic MF transsexuals have an INAH-3 (part of the hypothalamus) of similar size to that typical of homosexual males, rather than heterosexual males as Blanchard's theory would predict (Garcia-Falgueras & Swaab, 2008).

Overall, these findings give little support to Blanchard's theory's hypothesis that biological and psychosocial factors causing a gender-variant identity are different in birth-assigned males with different sexual orientations. Research that has tested this has shown mixed findings, with greater evidence that these factors are the same. Research presented in this thesis will test this among a large number of factors. Specific aims and hypotheses of this research are outlined in the next chapter.

CHAPTER 4 - AIMS AND HYPOTHESES

The overall aim of this thesis is to broaden the scientific understanding of the factors that are related to the development of gender-variant or gender-typical identities. This was achieved by modelling biological and psychosocial variables predicting adult gender identities and accounting for social desirability response bias. Where these variables are latent (unobserved), the factor structure of their measurement was incorporated into the model to test the validity of measurement and incorporate measurement error.

4.1 Aim 1: To model biological and psychosocial variables predicting gender-variant and gender-typical identities

As outlined in the previous chapter, number of studies have reported evidence for a variety of biological and psychosocial factors in the development of gender-variant and gender-typical identities. These include number of older brothers, within-family concordance of gender-variance, handedness, maternal aunt:uncle ratio, abuse, finger length ratios (2D:4D), mental rotation, and maternal age.

These studies are limited in that they have generally only assessed a single biological or psychosocial variable. This is problematic because in isolation it is not possible to assess the “true” relationship between a biological psychosocial factors and gender identity. The present study will be the first to examine a number of these biological and psychosocial variables in one sample to give a more accurate estimate of the true relationship between biological and psychosocial variables and gender identities in adulthood.

This study will also examine some biological and psychosocial variables that have not previously been assessed in persons with gender-variant identities—systemising and parental cohabitation. These additional variables were chosen because of their theoretical significance and links with related biological factors. Systemising is the propensity of the individual to understand and construct systems (Baron-Cohen, 2002). It is hypothetically connected to the development of gender-variant identities because it is thought to be related to prenatal androgen exposure. More detail of this mechanism is provided in Section 8.1.8. Parental cohabitation (the amount of time living with parents) was found to be related to sexual orientation in one study (Frisch & Hviid, 2006) and parental absence has been proposed as a psychosocial factor related to the development of gender-variant identities (see Section 2.2.1).

Furthermore, most of the past research has been conducted on specific groups of persons with gender-variant identities. This has usually been clinical samples of transsexuals. The few research studies been conducted on persons with gender-variant identities other than transsexualism have been conducted on samples of birth-assigned male cross-dressers recruited from support groups. The present study is one of the first studies to include transsexuals as well as participants with other gender-variant identities in the same sample and also include participants of both birth-assigned genders.

Consistent with previous research outlined in the previous chapter, it is hypothesised that:

Hypothesis 1: Biological and psychosocial factors will predict adult gender-variant identity. These factors are number of older brothers, within-family concordance of gender-variance, handedness, maternal aunt:uncle ratio, abuse, finger length ratios (2D:4D), mental rotation, maternal age, systemising, and parental cohabitation.

This hypothesis is illustrated in Figure 4.1.

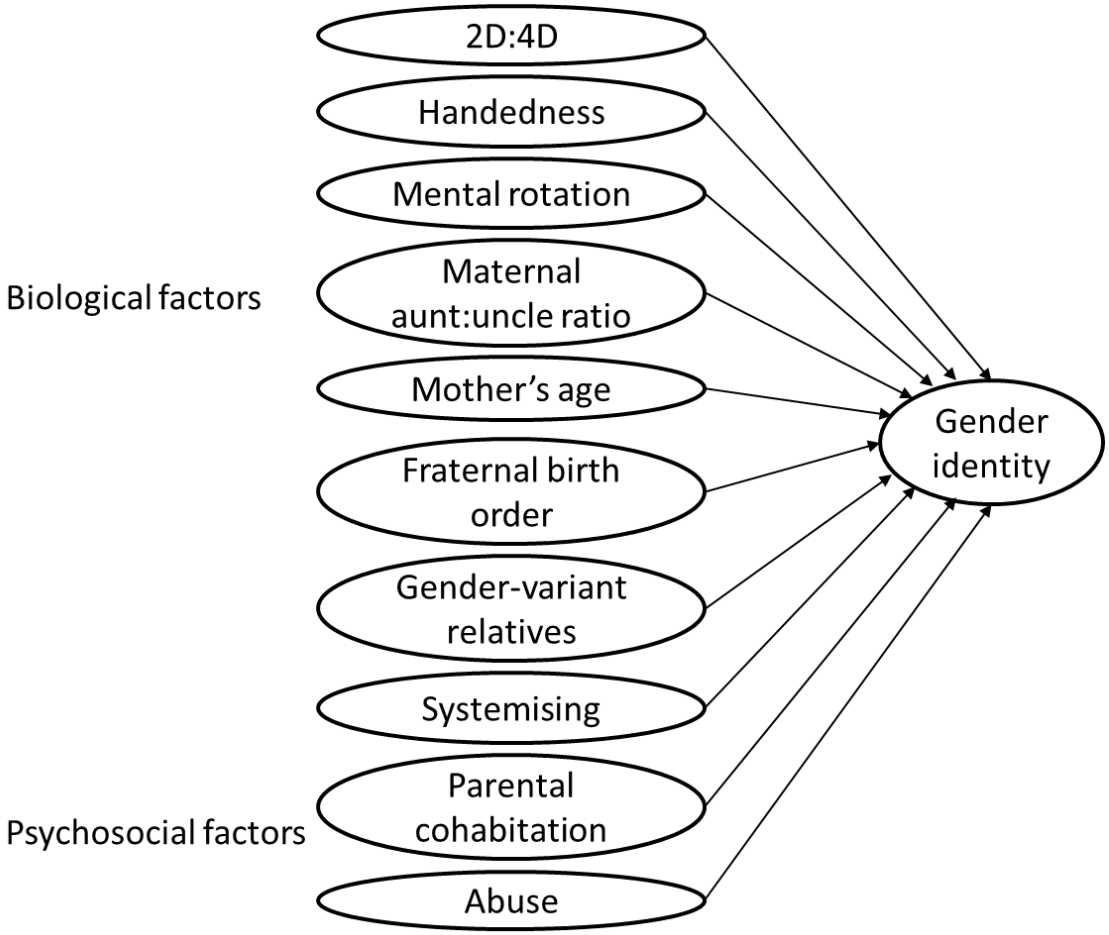

Figure 4.1 *Illustration of Hypothesis 1—biological and psychosocial variables predicting adult gender identity*

Note. Correlations among the predictor variables are not depicted in this figure.

Evidence for the theoretical proposal of sexual orientation differences in biological and psychosocial variables in birth-assigned males is mixed. An aim of this thesis is to further clarify this effect. As outlined in Chapter 2, Blanchard's theory of gender-variant identity development predicts that the biological and psychosocial variables related to the etiology of gender identities will differ between birth-assigned males with different sexual orientations. Chapter 3 reviewed studies of the biological and psychosocial variables linked to the development of gender-variant and gender-typical identities. Few of these studies examined whether these variables differ between birth-assigned males who have different sexual orientations. As discussed in Section 3.3.2, the results have been mixed in those studies that have assessed this difference, but there is more evidence from these studies that there is no difference in biological and psychosocial variables in persons with gender-variant identities with different sexual orientations. Therefore, it is hypothesised that:

Hypothesis 2: There will be no difference between homosexual and non-homosexual (relative to birth-assigned gender) participants in the biological and psychosocial factors that predict adult gender-variance.

An illustration of this hypothesis is given in Figure 4.2 below.

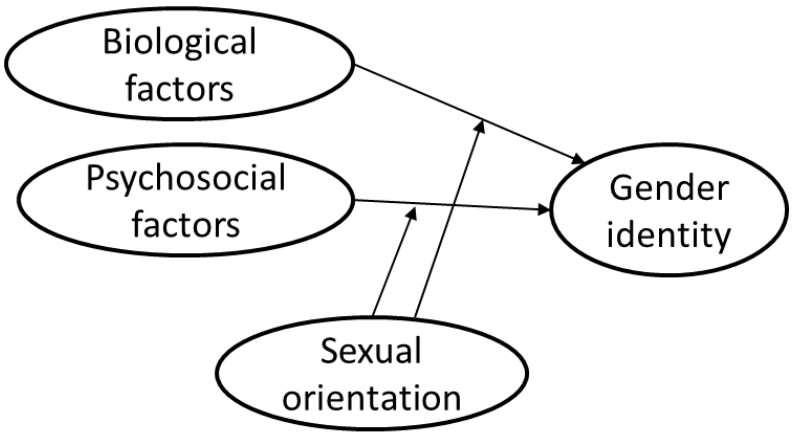

Figure 4.2 *Modelling to test Hypothesis 2—sexual orientation influencing the relationship between biological/psychosocial factors and adult gender identity in birth-assigned males*

As outlined in Chapter 2, it has been theorised that gender-variant identities occur on a continuum. The continuum ranges from those with a gender-typical identity to those with a transsexual identity. If this were the case, it would be expected that the same biological and psychosocial variables would be related to transsexualism as those related to other gender-variant identities, and there would be a less strong effect for the latter group. Although this has never been empirically tested, the theoretical underpinning suggests:

Hypothesis 3: Participants with gender-variant identities other than transsexual will score intermediary between transsexual participants and participants with no gender-variant identity on the biological and psychosocial variables measured in this study.

As outlined in Section 3.2.2, a number of studies have reported a relationship between abuse experience and adult gender-variance. It is unclear whether abuse experience is a cause or an effect of a gender-variant identity. By using modelling that accounts for childhood gender-variance, another aim of this thesis is to further clarify

the causal effect of abuse experience on adult gender-variance. This is illustrated in Figure 4.3 below: as well as abuse causing adult gender identity, it may also be caused by gender-variant expression in childhood making a person more of a target for abuse. This childhood gender-variant expression is related to adult gender identity.

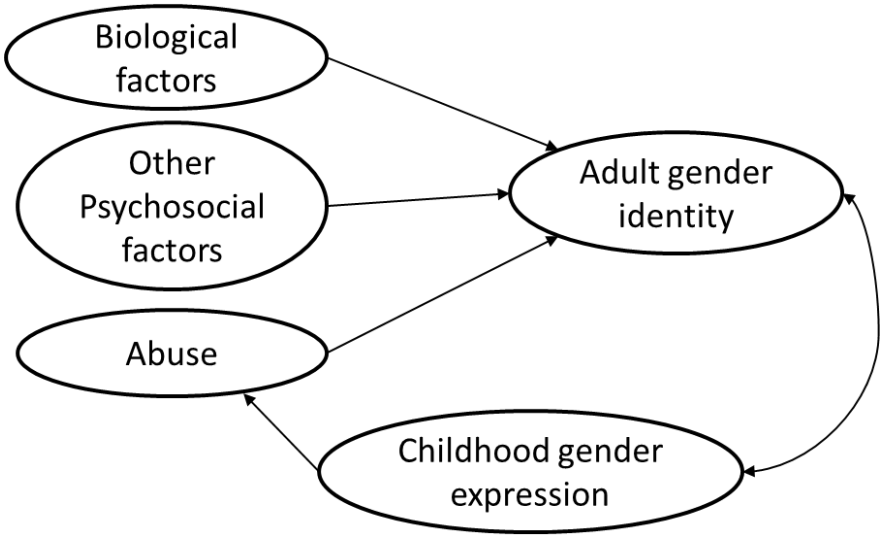

Figure 4.3 *Proposed modeling to incorporate the relationship between childhood gender expression, abuse, and adult gender identity*

4.2 Aim 2: To examine the structure of latent variables associated with gender-variant and gender-typical identities

An aim of this research is to strengthen the findings of this thesis by including assessment and modelling of latent (unobserved) variables using confirmatory factor analysis and structural equation modelling (SEM). Testing the factor structure of latent variables using confirmatory factor analysis provides additional evidence for their reliability and validity. In addition, between-group invariance testing was conducted to assess whether any findings of group differences (such as those proposed in Hypothesis 2) could be explained by differences in how latent variables are measured in these groups.

Conducting analyses in this framework allows testing whether the proposed measurement models fit the data. It also allows for the incorporation of measurement error as part of the model. This provides greater accuracy in estimating the relationships between variables and allow for a more accurate measure of the proportion of adult gender-variance accounted for by the biological and psychosocial predictor variables measured in this thesis.

This is illustrated in Figure 4.4 below. In this figure, the measurement model for the latent variables is incorporated in the model. This is depicted as the small rectangles, each representing a single indicator item. Each indicator item is a question that participants responded to. The number of indicator items varied for different latent variables. Each of the latent variables in Figure 4.4 below are given three indicator items for simplicity.

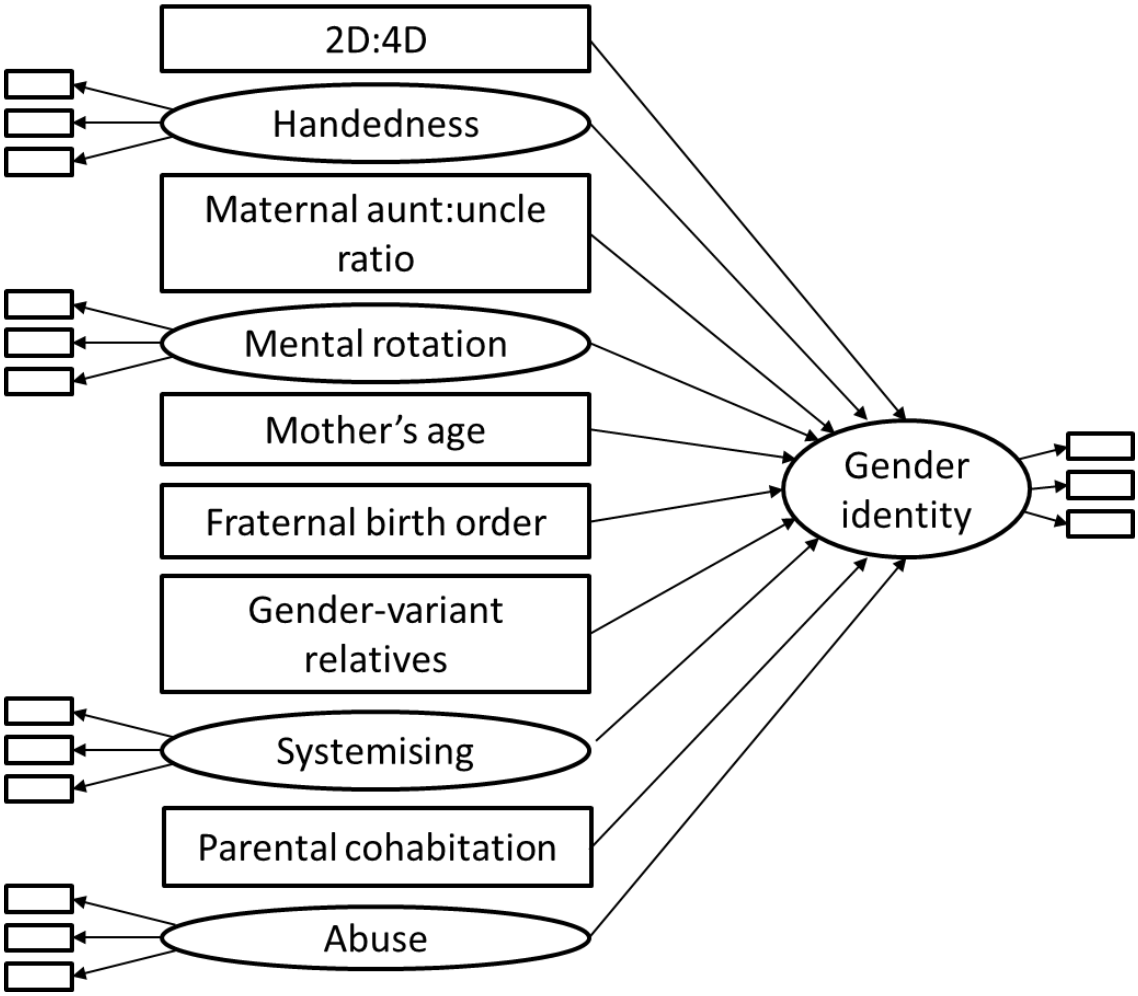

Figure 4.4 *Illustration of inclusion of measurement models into model of biological and psychosocial factors predicting gender identity*

4.3 Aim 3: To examine the influence of social desirability response bias in the study of gender identity development

Past research on the development of gender-variant identities has found it to be susceptible to social desirability response bias. Blanchard, et al. (1985) found that socially desirable responding was related to portraying oneself as having a more classical gender-variance experience among non-androphilic MF transsexuals. It is

conceivable that socially desirable responding may impact on participants' responding in an assessment of biological and psychosocial variables. Therefore, another aim of this study is to account for socially desirable responding in these analyses. This will be achieved by measuring this construct among study participants and including it as a covariate in analyses. This is illustrated in Figure 4.5 below.

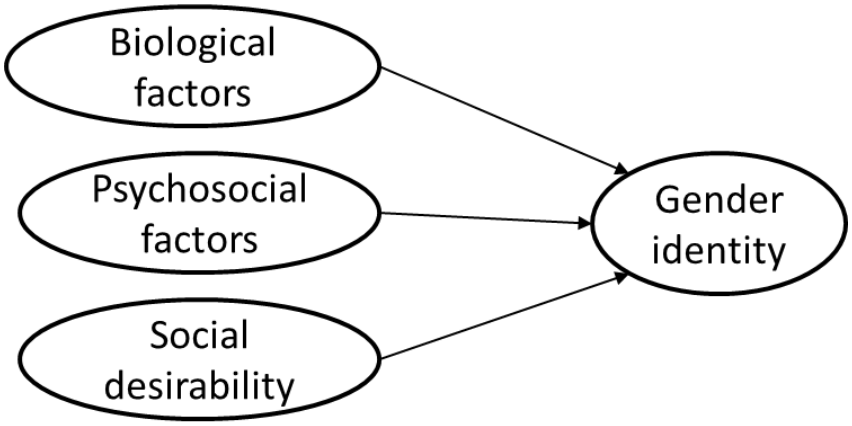

Figure 4.5 *Illustration of aim to incorporate social desiribility as a covariate into the model*

4.4 Summary

The aims of the present study are to build on the scientific evidence for biological and psychosocial factors that are related to the development of gender-variant and gender-typical identities. The breadth of variables considered allows for a complex consideration of the relationship between variables. The study aims to establish whether these variables differ in birth-assigned males of different sexual orientations. This finding would support Blanchard's theory of two distinct types of gender-variance. Furthermore, this study aims to assess whether these variables are the same in transsexuals as participants with other gender-variant identities. This finding would support Docter's theory of gender-variant identities occurring on a continuum. The findings of this thesis will be strengthened by incorporating latent variable structure and accounting for social desirability. Details of the methodology for this research are given in the next chapter.

SECTION III - METHODS

CHAPTER 5 - METHODS

5.1 Design

The design of this research is cross-sectional. The relationships between variables collected at a single time point were analysed with no manipulation of any variables. The hypotheses were tested using SEM analysis with each of the models outlined in the previous chapter. While there are limitations to the causal conclusions that can be made in a study using this design (Goodwin, 2010), this design meets the aims of the research outlined in the previous chapter and it would be impractical or unethical to study this topic using longitudinal or experimental designs.

5.2 Participants

Participants were recruited for an internet-based survey described as investigating the development of gender and sexuality. This was conducted through Google advertising to web sites and search pages that had keywords such as "transsexual", "transgender", "sexuality", and from contacting international gay-, lesbian-, bisexual-, and/or transgender-related online groups and organisations that had a web site asking if they would distribute a call for participants among their members. The call for participants included a brief outline of the aims of the research, what would be involved for participation, and a link for potential participants to access to participate. This is reproduced in Appendix A on page 159. A press release was also released through Massey University Communications and this generated some media attention that is likely to have attracted a significant proportion of the participants with gender-typical identities.

There were a total of 2,709 responses to the questionnaire. Of these, 195 responses (7%) could not be used as they did not complete any further than the demographics section at the beginning of the questionnaire. In accordance with the procedure suggested by Bowen, Daniel, Williams, and Baird (2008), duplicates were identified due to having the same demographic data. In total, 236 responses were deleted because they were duplicates, and the more complete response of a duplicate was retained. This left a sample of 2,278. In all of the duplicate cases the questionnaire was less complete in the first instance of the duplicate. This meant it was likely that the participant had started the survey but had not been able to finish it, but returned later to compete the questionnaire further.

Testing for multivariate outliers was conducted by assessing Mahalanobis distance D^2 values for each participant. This value refers to the distance of the observed values from the centroid cluster of cases in multivariate space (Byrne, 2010; Tabachnick & Fidell, 2007). Byrne suggested removing participants who have Mahalanobis D^2 values distinctly higher than all other D^2 values as multivariate outliers. Mahalanobis D^2 values for the ten cases farthest from the centroid are presented in Table 5.2. There was a notable gap between observation 2630 which was farthest from the centroid and the remainder of the cases. Therefore, this observation was deleted from remaining analyses, leaving a sample of 2,277.

Table 5.1 *Mahalanobis distance for the ten cases farthest from the centroid.*

Observation number	Mahalanobis D^2 score
2630	140.26
2097	129.65
2756	128.24
2686	127.86
1221	125.65
1728	124.11
2782	121.43
2526	120.13
1787	119.53

Table 5.2 outlines data on participants' gender identity, ethnicity, country, level of education, and age. Participants could select as many of the ethnicity categories as they identified as. Because numbers of participants in the ethnicity categories other than White/Caucasian were small, it was not possible to break down any analyses by ethnicity. Male gender assignment at birth was reported by 1,500 participants (66%) and female gender assignment was reported by 777 (34%). Transsexual participants were those who identified as such. Participants categorised as having an "other" gender-variant identity were those who did not identify as transsexual, but identified as at least one of the other possible gender-variant identities: transvestite, gender queer, drag artist, cross-dresser, androgygne, or bi-, third-, omni-, or non-gendered. Participants categorised as gender-typical did not identify with any of these gender-variant identities.

Table 5.2 *Gender identity, education, ethnicity, country, and age of participants grouped by birth-assigned gender*

		Total		Birth-assigned males		Birth-assigned females		$\chi^2(1)$	*p*
		n	%	*n*	%	*n*	%		
Gender identity	Transsexual	755	33	609	41	146	19	72.33	< .001
	Other gender-variant	899	40	640	43	259	33	10.79	.001
	Gender-typical	623	27	251	17	372	48	183.53	< .001
Ethnicity	White/Caucasian	2,081	92	1,387	93	694	89	0.39	.531
	East Asian	67	3	31	2	36	5	11.62	.001
	Hispanic/Latino	66	3	40	3	26	3	0.86	.355
	American Indian	64	3	39	3	25	3	0.73	.393
	Black/African	42	2	19	1	23	3	8.07	.005
	South/other Asian	37	2	25	2	12	2	0.04	.841
	Maori	24	1	7	1	17	2	14.51	< .001
	Other	42	2	14	1	28	4	19.97	< .001
Country of residence	USA	1,221	54	906	60	315	41	36.60	< .001
	New Zealand	427	19	181	12	246	32	106.08	< .001
	Great Britain	183	8	119	8	64	8	0.08	.781
	Canada	148	7	91	6	57	7	1.34	.246
	Australia	95	4	65	4	30	4	0.25	.618
	Other	203	9	138	9	65	8	0.36	.551
Education	3 years of high school	159	7	97	7	62	8	1.67	.196
	4 years of high school	233	11	168	12	65	9	4.03	.045
	5 years of high school	246	11	147	10	99	13	4.09	.043
	Diploma	449	21	332	23	117	16	13.01	< .001
	Bachelor’s degree	676	31	423	30	253	34	3.27	.071
	Master’s degree	311	14	188	13	123	16	4.06	.044
	Doctoral degree	115	5	79	6	36	5	0.41	.523
Age	Mean	37.37		41.50		29.45			
	Standard deviation	14.48		14.26		11.25			

Between-gender differences were tested for in these demographic variables. Results of these χ^2 tests (with one degree of freedom) are given in the right hand column of Table 5.2. Because a large number of univariate tests were conducted here, Bonferonni adjustment was conducted to mitigate chances of making a Type-1 error. With Bonferroni adjustment for 24 tests, *p* values less than .001 were required for statistical significance at the .01 level. Birth-assigned males were significantly overrepresented among participants with gender-variant identities and significantly underrepresented among participants with gender-typical identities. Maori and "other ethnic identity" participants were more likely to be birth-assigned female. Participants from the USA were more likely to be birth-assigned male and participants from New Zealand were more likely to be birth-assigned female. Birth-assigned male participants were also significantly more likely to report holding a diploma as their highest qualification, and birth-assigned males were significantly older than birth-assigned females, $t(2275) = 20.48$, $p < .001$.

5.3 Questionnaire

Questionnaire items and scales were selected to test the hypotheses outlined in Chapter 4. This section describes these items and scales.

This questionnaire had two versions. The first version collected data from the first 681 respondents. The questionnaire was upgraded to a second version for the remaining 1,596 responses. Alterations were made to upgrade the handedness question from a single question of hand preference to the Edinburgh handedness inventory, to include childhood family variables that were found to be related to sexual orientation (Frisch & Hviid, 2006), and to include the systemising quotient which was proposed to be related to prenatal androgen exposure (see Section 8.1.8). It is unlikely that having responded to these questions would result in participants responding differently to later questions, causing potential differences between participants who had responded to different versions of the questionnaire. Nevertheless, these childhood family variables and the systemising quotient were added near to the end of the questionnaire to mitigate any potential effect of this. The only scale to follow these additions was the adult gender-variance scale. Data from the questions that were only included in the second version of the questionnaire were treated as missing if a participant completed the first version of the questionnaire.

The questionnaire also contained items that were not analysed as part of this thesis. These were scales examining sexual intimidation from women (presented to birth-assigned male participants reporting sexual attraction to females), coping and defence styles, recalled childhood personality, environmental acceptance of gender-variance, and cross-gender eroticism. There was also a specific question that asked about self-identification with classical/non-classical gender-variance, and at the end of the questionnaire participants were given an explanation of the identity-defence theory (Veale, Lomax, & Clarke, 2010) and asked to rate how feasible they thought the theory is. The entire questionnaire and related instructions are produced in Appendix B (pp. 160-183). The questions and scales used in this research are outlined in the remainder of this section. These are given in the order that they were presented to participants.

5.3.1 Demographics

The first section of the questionnaire collected demographic information including gender identity, gender of assignment at birth, whether participants identify as a gender-variant identity (e.g. transsexual, cross-dresser etc.), age, ethnicity, country, and level of education. Gender-variant identity categories were created using the author's personal knowledge of common identities. Participants could select as many gender-variant identity categories as they identified as, as well as an "other, please specify" option with a text box to type this in. Ethnicity categories were taken from the United States, United Kingdom, and New Zealand censuses. Participants could select as many ethnicity categories as they identified as, as well as an "other, please specify" option.

5.3.2 Family history

This section asked participants their number of older/younger brothers and sisters, and maternal/paternal aunts and uncles. Participants were also asked to report the number of their biological relatives who are/were homosexual/bisexual, transsexual, or and/or another gender-variant identity. This number was converted into a proportion of relatives.

Participants who completed the second version of the questionnaire were also asked whether the identity of their biological mother and father were known, their parents' age, number of years up to age 18 of living with either or both biological parents, biological parents deaths before age 18, and biological parents' marital

situation. Only participants age 18 or over completed this section of family history. These questions were added to the end of the questionnaire

5.3.3 Hand variables

Handedness was measured using the Edinburgh Handedness Inventory (Oldfield, 1971) using the response scales suggested by Bogaert (2007). Response options were “Always right”, “Usually right”, “Both equally”, “Usually left”, and “Always left”. Lower scores on this measure represent a greater tendency towards non-right-handedness. From a confirmatory factor analysis of the Edinburgh Handedness Inventory, Dragovic (2004) suggested that the “drawing” item be excluded due to collinearity with the writing item and the “broom” and “lid opening” be excluded due to a large proportion of measurement error. These modifications resulted in a 7-item scale, which had good internal reliability and factorial validity in Dragovic’s study.

Lengths of participants’ second and fourth fingers on the right hand were also collected. The specific instructions given to participants were taken from the BBC Internet Study (Reimers, 2007) and these are reproduced in Appendix B (p. 163). Participants were also given the option of using an “online ruler” which was the image of a ruler in a pop-up browser window. This ruler could not accurately measure finger lengths because the size of the picture and thus the scale of the ruler vary depending on the size and resolution of the computer screen. However, provided both fingers are measured on the same ruler, 2D:4D—a ratio between the lengths of the second and fourth fingers—can be measured accurately. An assessment of reliability of the online ruler is conducted in Appendix C (p. 186). Caswell and Manning (2009) and Manning, Churchill, and Peters (2007) excluded 2D:4D scores greater than 1.2 or less than 0.8 because these scores were so statistically improbable that they would be only achieved as a result of the participant reporting incorrect results. This procedure was also followed, and six participants’ 2D:4D scores were removed due to not meeting this exclusion criterion.

Because of this self-measurement, it can be assumed that this variable has some degree of measurement error. In the analyses in this thesis, it is assumed that the proportion of measurement error for 2D:4D is .61. This is calculated based on the variance of 2D:4D in this study, the amount of variance of 2D:4D in other studies that have assessed this among transsexuals, and inter-experimenter reliability in

experimenter-measured studies using similar samples. These calculations are given in Appendix F (p. 197).

5.3.4 Sexual orientation

Sexual orientation was measured using participants' self-rating on six-item Kinsey scales for sexual fantasies and behaviours (taken from Bailey, 1989). These questions ask participants' attraction to and history of sexual behaviours with males versus females. Bailey et al. (2000) found internal consistency reliability for the sexual fantasy measure to be $\alpha = .92$ for males and $\alpha = .67$ for females. This notable gender difference in reliability could be explained by females responding less consistently than males because of the gender difference in plasticity of sexual orientation (e.g. Baumeister, 2000).

Sexual orientation categories were chosen in accordance with Blanchard's (1989b) theory. Birth-assigned male participants were categorised as androphilic if they reported Kinsey scores of 6 or 7 for both fantasies and experience; otherwise they were categorised as non-androphilic. There were 35 (7%) MF transsexuals, 42 (8%) birth-assigned males with other-gender variant identities, and 81 (42%) males with gender-typical identities classified as androphilic.

5.3.5 Social desirability

The balanced inventory of desirable responding (BIDR; Paulhus, 1988)—short form (Stober, Dette, & Musch, 2002) was included to measure social desirability. This 16-item scale has been proposed to include two factors: self-deception (10 items) and impression management (6 items) to which participants responded on 7-point Likert scales from "Not true at all" to "Very true". An example self-deception question is "I never regret my decisions", and an example impression management question is "I sometimes tell lies if I have to". Stober et al. reported internal consistency reliability scores of $\alpha = .66$ for self-deception and $\alpha = .67$ for impression management. A number of studies have reported evidence for convergent validity, with the BIDR correlating highly with other measures of social desirability (Kroner & Weekes, 1996; Lanyon & Carle, 2007; Paulhus, 1988; Stober et al., 2002). Using a confirmatory factor analysis with a forensic population, Kroner and Weekes found a three factor structure provided the best fit for their data. These factors were labelled impression management, denial of negative, and over-confident rigidity.

5.3.6 Abuse

Emotional abuse was measured using the 5-item emotional abuse subscale of the childhood trauma questionnaire—short form (D. P. Bernstein et al., 2003). Each item begins with the phrase “When I was growing up” and response options were a 7-point Likert scale from “Not true at all” to “Very true”. Using a longer form of this scale, D. P. Bernstein et al. (1994) reported internal consistency of $\alpha = .95$ and test-retest reliability over a 2- to 6-month interval of .88 for the entire scale, as well as convergent evidence for validity with a structured trauma interview ($r = .42$) and discriminant validity with measures of social desirability and verbal intelligence among a sample of adult substance abusers. Using the short form, D. P. Bernstein et al. (2003) reported an internal reliability coefficient of $\alpha = .87$ among a normative sample of 579 American adults. D. P. Bernstein et al.’s (2003) study also found evidence for validity using exploratory and confirmatory factor analyses. In this process, significant error covariance between two items (“People in my family called me things like ‘stupid,’ ‘lazy,’ or ‘ugly,’” and “People in my family said hurtful or insulting things to me”) was included in the model. D. P. Bernstein et al. (2003) also reported evidence for criterion-related validity with a correlation of $r = .48$ between the scale and therapist observations of emotional abuse among a sample of adolescent inpatients. Confirmatory factor analyses have also supported the construct validity of the emotional abuse subscale among adolescent psychiatric inpatients, adult substance abusers, and female health maintenance organisation members (D. P. Bernstein, Ahluvalia, Pogge, & Handelsman, 1997; D. P. Bernstein et al., 1994; D. P. Bernstein et al., 2003).

Physical abuse was measured using one item of the child abuse and trauma scale that was shown to be an accurate screener for physical abuse with reasonable sensitivity (70%) and specificity (94%; Thombs, Bernstein, Ziegelstein, Bennett, & Walker, 2007). The full physical abuse subscale of the child abuse and trauma scale measures this construct at $\alpha = .85$ internal consistency reliability (D. P. Bernstein et al., 1994). Because this is the most accurate estimate that can be made of the proportion of true variance and error variance, this proportion of error variance is included in models that incorporate the physical abuse variable.

Sexual abuse was measured using a single questionnaire item designed by one of this thesis project’s supervisors. This item asked participants to select which of the following statements best applied to their experience: “I know I was not sexually

abused"; "I think I might have been sexually abused"; "It is probable that I was sexually abused"; "I know for sure that I was sexually abused somewhat"; "I know for sure that I was sexually abused for an extended period"; and "My mind goes blank when I try to think about this". No evaluation of the psychometric properties of this item has been previously undertaken. Based on past studies of similar questions, the best estimate of the amount of internal reliability in measures of sexual abuse is .93 (D. P. Bernstein et al., 1994). This proportion will be used in models that include the sexual abuse variable.

5.3.7 Spatial ability

Spatial ability was measured using the mental rotation test (adapted from Vandenberg & Kuse, 1978). In this 34-item timed test participants were required to view two three-dimensional cuboids and decide whether they are the same (only rotated) or different objects. Participants were given two minutes to give as many correct answers as possible. Participants would gain one point for every correct answer and lose one point for every incorrect answer. This test has consistently outperformed other measures in differentiating sex and sexual orientation, and is thought to measure underlying gender-based neuroanatomy structural differences (see Rahman & Wilson, 2003a for a review).

For the purposes of confirmatory factor analysis and later SEM in this thesis, the 34 items are "parcelled" into three scaled items, each being the sum of every third item. This step was necessary because given the timed nature of the test, modelling of all 34 items is not possible because participants have different finishing places on the test, meaning the later items had high proportions of missing data. Because all of the items in the test are of the same format—mentally rotating cuboids—it is safe to assume unidimensionality in this scale, making parcelling acceptable here (Kline, 2011).

5.3.8 Systemising

Systemising was measured using 8 items taken from the systemising quotient—short form (Wakabayashi et al., 2006). This scale measures desire to construct and analyse systems. Participants responded to statements, for example, **"**I find it easy to grasp exactly how odds work in betting", on a 7-point Likert scale from "strongly agree" to "strongly disagree". Wakabayashi et al. reported an internal reliability coefficient of $\alpha = .88$, discriminant validity between males versus females and science students versus humanities students for a 23 item version of the systemising quotient.

Assessment of the systemising quotient with confirmatory factor analysis has found evidence for a four factor model (Ling, Burton, Salt, & Muncer, 2009; Wakabayashi et al., 2006). These four factors which have been labelled technicity, topography, DIY (do it yourself), and structure.

The social desirability, abuse, and adult and childhood gender-variance scale questions were all grouped together. Using the random number generator in Microsoft Excel which is based on the algorithm developed by Wichman and Hill (1982), the order with which these questions were presented to participants was randomised. This order is given in Appendix B (p. 183). This was undertaken to minimise the effects of having recently thought about similar questions biasing response to a particular question (Choi & Pak, 2005).

5.3.9 Degree of gender-variance

Recalled childhood gender-variance was measured using Zucker et al.'s (2006) recalled childhood gender identity/gender role questionnaire. This scale measures recalled childhood gender identity and gender role on 5-point response scales, with one or two extra response items to allow respondents to indicate that they did not remember or that the behaviour did not apply. The seven items with the highest loading on the gender identity/gender role factor questionnaire were included. Zucker et al. found an internal consistency coefficient of .92 for this factor among a sample of 110 women and 109 men who were mostly university students and staff. They also found evidence for discriminant validity for the scale. The scale was able to identify variation between males versus females, heterosexual versus homosexual adults, women with congenital adrenal hyperplasia (CAH) versus their sisters/female cousins, and adolescents diagnosed with gender identity disorder versus transvestic fetishism.

Adult gender-variance was measured using the four items on the cross-gender identity, cross-gender feminisation, and cross-gender social/sexual role subscales of Docter and Fleming's (1992) cross gender questionnaire that were appropriate for participants with gender-typical identities, and for birth-assigned females if the genders in the questions were reversed. For example, "Since the age of 17, have you wished you had been born a boy instead of a girl?" is reversed to "Since the age of 17, have you wished you had been born a girl instead of a boy?" Participants responded on 7-point Likert scales from "strongly agree" to "strongly disagree". From a sample of 682 birth-assigned male transvestites and transsexuals, Docter and Fleming reported internal

consistency reliability coefficients of α = .86-.92 on the four subscales of the cross gender questionnaire, and the scale demonstrated discriminant validity betweem transvestite and transsexual groups.

5.4 Sampling issues

Using an online survey to collect the data for this thesis allowed a number of advantages over traditional formats—anonymity, ease of use with data collection, and the ability to access a larger and more geographically diverse sample (Hewson, Laurent, & Vogel, 1996; Lefever, Dal, & Matthíasdóttir, 2007; Topp & Pawloski, 2002). Although online surveys have been criticised for potentially being open to non-serious or repeat responders and biased towards young, middle class, white people (Gosling, Vazire, Srivastava, & John, 2004), there is no empirical evidence that that is the case. From a review of 510 internet and paper-and-pencil studies, Gosling et al. found no evidence that online surveys have less diversity in their samples or are more affected by non-serious or repeat responding that the more traditional method. There is also evidence that these two types of data collection methods do not produce different responses on psychological measures (Gosling et al., 2004; Ritter, Lorig, Laurent, & Matthews, 2004).

Samples recruited for research on sexuality have shown some evidence of bias. A number of studies have shown that participants in these samples are more liberal, sexually experienced, and have more interest in the topic (Bogaert, 1996; Dunne et al., 1997; Strassberg & Lowe, 1995). These biases are also likely to be present in this research. Lawrence and Bailey (2009) also postulated that MF transsexual participants in previous research by the same author that used similar internet methodology (Veale et al., 2008) were overwhelmingly of the non-androphilic subtype due to their perception that this group is much more likely to have an interest in computer-related occupations and hobbies and therefore be more likely to have an online presence. Certainly, the sample used in this study will exclude those who not have computer and internet access. The participants with gender-variant identities are also more likely to be those who use a computer to access online support groups and mailing lists and less likely to be those who have not yet, or no longer have contact with the transgender community.

5.5 Procedure

After gaining ethical approval for this study (Massey University Human Ethics Committee, ALB 07/006), this survey was hosted online and participants were recruited through advertising outlined in Section 5.1. Before completing the questionnaire, participants viewed an information sheet describing the nature of the study and outlining that any person over age 16 can participate in the study (see Appendix B, p. 160).

As noted above, 236 responses were removed because they were duplicates. Checks for inconsistencies in the data were also carried out—for instance, if a participant reported more homosexual or gender-variant relatives than their total relatives. Also, responses were checked for consistently reporting the same score or extreme scores. None of the responses needed to be removed for not meeting these conditions. Furthermore, a *cookie* (a small amount of data) was left in the computer of anyone who had completed the questionnaire so they could not give multiple responses unless they deleted the cookie.

5.5.1 Preparation of data

A significant proportion of participants dropped out before completing the entire questionnaire. In total, 1,612 participants (71% of total participants) completed the entire questionnaire. A total of 10% of all possible responses (excluding demographic data) for the 2,277 participants were missing. The pattern of missing data from all of the variables collected in the survey was analysed. Little's missing completely at random test (Clements-Nolle et al., 2006) indicated that a null hypothesis that data were missing completely at random could not be rejected, $\chi^2(195663) = 196177.89$, $p = .205$. This suggests that the data can be assumed to be missing completely at random, which means that the full range of missing data handling procedures, including listwise and pairwise deletion, were appropriate to use (Kline, 2011; Byrne, 2010).

Missing values were imputed using the expectation-maximisation method (R. J. Little & Rubin, 1987). This method includes two steps. In the first step, missing variables are imputed using regressions in which a missing score is predicted based on the other scores in the case. In the second step, maximum likelihood estimation commences, and these steps repeat until the maximum likelihood estimates converge on a stable solution (Kline, 2011). This technique is preferable to case deletion because it does not result in a smaller sample size, leading to reduced statistical power. It is preferable to single imputation techniques such as mean substitution which give an

"over-precise" estimation because they do not take into account the variability of the data (Schafer, 1999). Expectation-maximisation estimation technique was also found to be preferable in Monte-Carlo studies as it did not bias standard errors if the missing at random assumption is met (McDonald, Thurston, & Nelson, 2000; Roth, Switzer, & Switzer, 1999). One study found that this technique is appropriate for up to 50% missing data when the data are missing completely at random (Scheffer, 2002).

5.6 Data analysis

Confirmatory factor analysis, logistic regression, and SEM analysis in this thesis were conducted using *Mplus* software version 5.1 (L. K. Muthén & Muthén, 2008). Missing value analysis and imputation and *t*-tests were conducted using *Predictive Analysis Software (PASW)* for Windows version 18 (SPSS Corporation, 2007) as these analyses could not be conducted in Mplus. The remainder of this section outlines the rationale, analysis, interpretation and procedure for conducting SEM.

5.6.1 Overview of structural equation modelling

SEM techniques are a family of statistical analysis procedures that take a confirmatory approach to testing hypothesised causal relationships between variables. Of course, in a study with a correlational design it is not possible to demonstrate a causal relationship using this technique; however, SEM helps to establish which causal explanation seems to be most *probable* (Blunch, 2008). These proposed causal relationships constitute a "model", and the model is tested to assess whether it "fits with the actual relationships in a collected data set (Byrne, 2010). SEM also allows for the modelling of latent variables—hypothetical constructs that are not directly observable, such as gender identity. Instead of assuming that we measure these variables without error as is often done with other statistical analyses, SEM represents this unreliability as part of the model. This allows for testing of the validity of the factor structure and greater accuracy in estimation of the relationships between the variables in the model (Kline, 2011). The process of testing the validity of the factor structure is called "confirmatory factor analysis" (see Section 5.6.4.1). Confirmatory factor analysis is required before SEM can be conducted. The first chapter of the results section, Chapter 8, devoted largely to confirmatory factor analysis.

SEM is used to test whether the model fits with the data. This is essentially testing whether the covariance structure of the proposed model fits with the covariance

matrix of the raw data. Just because a model fits the data well does not necessarily mean it is anything more than plausible—it is possible that another model may fit the data as well. In this case, a thorough examination of the meaning and theory behind the proposed paths in the model is required (Kline, 2011). For example, when examining the relationship between number of older brothers and gender-variant identity, number of older brothers has time precedence—it occurs before a gender-variant identity develops. Therefore, it can be concluded that it is more likely that number of older brothers causes a gender-variant identity, rather than causation in the opposite direction.

A further reason for using SEM, is that it is possible to test mediation and moderation effects (Kline, 2011) that were hypothesised in Chapter 4. Blanchard's (1989b) theory proposes that biological and psychosocial determinants of gender-variant identity will differ (be moderated) by sexual orientation for birth-assigned males. It is also feasible that the relationship between abuse and adult gender-variance is mediated by childhood gender-variance.

Although SEM is gaining widespread popularity in disciplines such as psychology where latent constructs are often measured, it has had relatively little usage in the study of gender identity and sexuality.

SEM using maximum likelihood estimation (the most common type of estimation used in SEM) has three main assumptions—a large sample size and continuous variables that are normally distributed. A large sample size is needed to adequately test the fit of the model and to have accurate standard errors parameter estimates. Kline (2011) suggested that when conducting SEM, at least 20 participants per parameter are needed for the estimation, and a minimum sample of 200 is required. SEM with maximum likelihood estimation assumes multivariate normality. Having each individual variables univariate normally distributed is a necessary but not sufficient condition of multivariate normality (Kline, 2011). Skew and kurtosis statistics are given for all of the variables used in analyses. A number of variables in the present study, such as handedness and number of older brothers are not normally distributed. To account for this, the Satorra-Bentler robust maximum likelihood method of parameter estimation is used (Satorra & Bentler, 2001) as it provides parameter estimates, standard errors, and fit statistics that are robust to violations of multivariate normality (Raykov & Marcoulides, 2006). Computer simulation studies suggest that indicator items should have at least 5 data points to be considered continuous and suitable for use in SEM analyses using maximum likelihood estimation (DiStefano, 2002; S. B. Green et al.,

1997; Lozano et al., 2008). All of the variables used in this study have Likert scales with five to seven response options, so can be considered continuous. In summary, this study meets the assumptions of large sample size and continuous indicators, and adjustments are made to allow for violations of the multivariate normality assumption.

5.6.2 Reliability analysis

According to classical test theory, the score that is observed is influenced by that variable's true score and random measurement error. Reliability, or the consistency of a measurement instrument, can is defined the amount of the observed score that is attributable to the true score (Revelle, 2011). Another definition given for reliability is the proportion of variance in a scale that can be accounted for by a single latent factor "that is common to all the indicators" of that factor (Zinbarg, Yovel, Revelle, & McDonald, 2006, p. 121). Traditionally, a reliability coefficient value over .70 is considered adequate, and over .80 as "good" (Kline, 2011). Scales with lower reliability coefficient scores can also be tolerated when using SEM, which corrects for a scale's unreliability (T. D. Little, Lindenberger, & Nesselroade, 1999).

A number of reliability coefficients were calculated in this thesis. Cronbach's alpha (α) is a measure of internal consistency reliability, which is the level of consistency of responses across scale items (Kline, 2011). It is widely reported and is calculated with higher intercorrelations between scale items giving a higher α statistic (Cortina, 1993).

Research by Zinbarg and others has shown that reliability coefficient McDonald's omega (ω) is a better estimate of a single general factor saturation (variance accounted for by a single factor) than Cronbach's α or Revelle's β which can be biased by group factor saturation (variance accounted for that is common to some but not all scale items) and variability in factor loadings (Revelle & Zinbarg, 2009; Zinbarg, Revelle, Yovel, & Li, 2005; Zinbarg et al., 2006). Total omega (ω_t) is preferred to hierarchical omega, as the prediction of dependent variables in this study is not necessarily limited to a single dimension of a scale (Revelle, 2011). Therefore, McDonald's ω_t scores are reported for scales used in this thesis.

Raykov's factor rho (ρ) is a composite reliability coefficient that is commonly reported in confirmatory factor analysis and SEM studies (Raykov, 1997). Raykov's ρ is calculated as the ratio of variance explained by the factor to the total variance, and has

the advantage of incorporating correlated measurement errors in its calculation (Kline, 2011). This statistic is also reported for scales used in this thesis.

5.6.3 Model fit indices

In SEM, it is generally accepted practice to report the χ^2 goodness of fit statistic and approximate fit indices to evaluate the fit of the proposed model with the covariance matrix of the data (Kline, 2011). In the results of this thesis the following approximate fit statistics are reported: the comparative fit index (CFI), the Tucker-Lewis index (TLI), root mean square error of approximation (RMSEA), the standardised root mean square residual (SRMR), and the expected cross-validation index (ECVI). These indices were selected because they are widely accepted. As well as giving detail on the absolute model fit, these approximate fit statistics also give detail of the how well the model fits relative to the most restrictive and least restrictive models and allow for the fact that no model can be absolutely "correct" (Blunch, 2008; Kline, 2011). All analysis will be conducted with Satorra-Bentler robust maximum likelihood estimation, in which these fit indices are adjusted to allow for it variations of multivariate normality (Raykov & Marcoulides, 2006). When assessing differences between models' fit, χ^2 goodness of fit statistics with Satorra-Bentler adjustment are not directly comparable. A "scaled difference" χ^2 statistic needs to be calculated that incorporates the non-normality adjustment (Satorra & Bentler, 2001). This statistic is calculated for comparisons between models' fit in this thesis.

Although suggested cut off points for adequate model fit are outlined in the following sections, because each of these indices have strengths and weaknesses it is generally recommended that these be seen as guidelines. It is suggested that a range of indices are reported and that these are interpreted by looking at whole picture with the knowledge of each of the fit index's biases (Kline, 2011).

5.6.3.1 χ^2 likelihood ratio test

This most widely used test of model fit tests the *exact fit hypothesis* with the null hypothesis that the proposed model perfectly fits the population covariance matrix (Kline, 2011). If the *p* value associated with the χ^2 statistic is less than a certain level (usually .05) then the null hypothesis of exact fit is rejected (Raykov & Marcoulides, 2006). It has been widely noted that because the χ^2 statistic is calculated by multiplying the minimised discrepancy function by the sample size, there is a tendency for models

with a large number of participants to spuriously inflate the χ^2 value leading to a greater likelihood of rejection of the null hypothesis in large samples (Kline, 2011; Raykov & Marcoulides, 2006). It has also been argued that the standard of perfect fit is not common or realistic in social science research (Miles & Shevlin, 2007). Because of these limitations of the χ^2 likelihood ratio test, a number of more pragmatic fit indices have been developed. Nonetheless, it is still recommended that χ^2 value be reported (Blunch, 2008; Kline, 2011).

5.6.3.2 Comparative fit index (CFI) and Tucker-Lewis index (TLI)

The CFI and TLI are indices comparing the proposed model to a model with no relationships between observed variables (the independence model; Raykov & Marcoulides, 2006). The CFI is the ratio of improvement of fit of the observed model over the independence model. The TLI is a similar index that also takes into account the number of degrees of freedom to advantage more parsimonious models (Kenny & McCoach, 2003). The CFI and TLI indices generally range from 0 to 1. It was originally suggested that scores greater than .90 are indicative of good model fit. However, it has more recently been argued that a score .95 is a more appropriate cut off (Byrne, 2010; Hu & Bentler, 1999).

5.6.3.3 Root mean square error of approximation (RMSEA)

The RMSEA assesses the extent to which the proposed model fits the data "reasonably" well (T. A. Brown, 2006), rather than the "exact" fit being assessed by the χ^2 likelihood ratio test. The RMSEA is calculated using the non-central χ^2 distribution which is used to calculate the degree to which the model is incorrectly specified (T. A. Brown, 2006). It has been suggested that a RMSEA score less than .05 indicates good model fit, up to .08 it can be concluded that the model has reasonable fit, and RMSEA scores between .08 and .10 indicate mediocre model fit (Byrne, 2010; Hu & Bentler, 1999; MacCallum, Browne, & Sugawara, 1996). Confidence intervals for RMSEA can also be calculated, and these are reported in this thesis in accordance with suggestions that this is good practice (Kelley & Lai, 2011; Kline, 2011).

5.6.3.4 Standardised root mean square residual (SRMR)

The SRMR is a measure of the discrepancy between the correlation matrix in the data and those proposed by the model (T. A. Brown, 2006). Lower values indicate better model fit. Hu and Bentler (1999) proposed that values less than .08 suggest good

model fit, although Byrne (2010) suggested a more stringent qualification of .05. Yu (2002) suggested that SRMR scores of .07 or less indicate good model fit.

5.6.3.5 Expected cross-validation index (ECVI)

This index examines the input covariance matrix against and expected covariance matrix of another sample from the same population (Byrne, 2010). The ECVI is used compare different models—the model with the lowest value is most likely to be replicable across other samples from the same population (Byrne, 2010). This statistic will be used when models are being compared.

5.6.4 Data analysis procedure

5.6.4.1 Confirmatory factor analysis

In the following chapter, the measurement models for latent constructs being used in this thesis are tested and modified using confirmatory factor analysis. In this process, the fit of the scale items with the underlying latent variables (or factors) are assessed (T. A. Brown, 2006). Confirmatory factor analysis offers assessment of the reliability and construct validity of a scale, as well as assessment of method effects (T. A. Brown, 2006).

5.6.4.2 Measurement invariance testing

Using SEM, it is possible to test for measurement invariance between groups to conclude that differences between groups cannot be accounted for by measurement biases (Raju, Laffitte, & Byrne, 2002). Finding measurement invariance shows stability of the model across groups and that the proposed measurement model is homogenous for the groups being tested. This makes it legitimate to combine groups for an overall analysis. Findings of non-invariance for differences in groups can also be explained as legitimate or expected on theoretical grounds— i.e. the model fit may be the same but the coefficients expected to be different for understandable reasons.

Cheung and Rensvold (2002) outlined different levels of measurement invariance that should be tested for. Firstly, *metric invariance* occurs when factor loadings of items on factors do not differ between groups, suggesting factors are manifested consistently between groups. A more stringent form of measurement invariance is *scalar invariance* which occurs when factor loadings and intercepts of items do not differ between groups. Metric invariance is required for meaningful comparison of factor relationships between groups, and scalar invariance is required for

meaningful comparison of mean factor score differences between groups (Conroy, Metzler, & Hofer, 2003; Gregorich, 2006). Because both of these types of comparisons are made in this thesis, both metric and scalar invariance is tested for.

Testing for measurement invariance is conducted on all of the latent variables used in this thesis between birth-assigned genders to ensure items have the same meaning for each birth-assigned gender group. This allows the conclusion that any findings of group difference cannot be explained by measurement invariance between the groups. The majority of participants sampled in this thesis lived in two areas: the USA (54%) or Australia and New Zealand (23%). Invariance testing for all latent variables is conducted between participants in these two areas to test for differences in item meaning for participants living in these regions. Measurement invariance is also be tested between level of gender identity (transsexual, other gender-variant identity, or gender-typical identity) and sexual orientations (androphilic or non-androphilic) for all of the biological and psychosocial latent variables, as concluding that any group differences of these variables are not due to perceived differences in item meaning between participants in these groups is important. Finally, because the questionnaire was upgraded to a second version, invariance is tested for between participants who completed the different versions of the questionnaire. This testing is only necessary for the adult gender-variance scale as this was the only scale that was presented after changes and additions had been made to items occurring previously in the questionnaire. Therefore questionnaire version measurement invariance testing was only conducted for the adult gender-variance scale.

Metric invariance and scalar invariance were tested by comparing these to a model where these invariance constraints were not imposed (the unconstrained model). A statistically significant change in scaled difference χ^2 likelihood ratio test may indicate scale non-invariance (Kline, 2011). However, because this test can be over-sensitive when sample size is large, another criterion for assessing invariance has been proposed (Cheung & Rensvold, 2002). From findings of Monte Carlo simulation studies controlling for sample size, model complexity, and overall model fit, Cheung and Rensvold suggested a decrease in CFI of less than .01 is evidence for measurement invariance. Their study also showed that a decrease in CFI of between .01 and .02 indicates possible measurement invariance. No similar criteria have been developed for other fit indices. In this thesis, measurement invariance was assessed by considering the scaled difference χ^2 likelihood ratio and change in CFI.

5.6.4.3 Hypothesis testing

In Chapter 7, testing of the hypotheses outlined in Chapter 4 was conducted using SEM. SEM allows assessment of complex regression structures between the latent as well as observed variables measured in this thesis, as well as testing for the sexual orientation moderation effect that is outlined in the hypotheses (Byrne, 2010).

SECTION IV - RESULTS

CHAPTER 6 - TESTING AND MODIFICATION OF MEASURES

The main focus of this chapter is on testing the reliability and validity of measures of latent constructs used in this thesis using confirmatory factor analysis. Variables measuring latent constructs subjected to confirmatory factor analysis were the Edinburgh handedness inventory, emotional abuse, mental rotation, systemising quotient, adult gender-variance, recalled childhood gender-variance, and BIDR. Testing for measurement invariance was also conducted. The procedure for this is outlined in Section 5.6.4.2.

6.1 Edinburgh handedness scale

Confirmatory factor analysis was conducted to confirm the well-established one-factor model with this sample. Analysis using all ten items of the Edinburgh handedness inventory elicited similar concerns to previous studies outlined in Section 5.3.3—collinearity between the drawing and writing items, $r(1891) = .98$, $p < .001$, and high proportion of residual error for the broom (.54), knife (.61), and lid opening (.53). As outlined in Table 6.1, the altered 6-item scale with the writing, broom, knife, and lid opening items removed had substantially better fit. Although the χ^2 test for the 6-item scale was statistically significant, all of the other fit indices were within the acceptable ranges outlined in Section 5.6.3 and the ECVI was lower than for the previous model.

Table 6.1 *Models and fit statistics for the Edinburgh handedness inventory estimated with robust maximum likelihood*

Model	χ^2	*df*	*p*	CFI	TLI	RMSEA[a]	SRMR	ECVI
One-factor, 10 item	1135.94	35	< .001	.89	.86	.13, .13-.13	.05	0.63
One-factor, 6 item	48.37	9	< .001	.99	.99	.05, .04-.06	.01	0.05

Note. $N = 1892$; [a] 90% confidence interval is given after the RMSEA value

Robust maximum likelihood estimates for this 6 item model are given in Table 6.2. Standardised factor loadings for the items were all greater than .50, suggesting convergent validity (Kline, 2011).

Table 6.2 *Robust maximum likelihood estimates for the 6-item Edinburgh handedness inventory*

Parameter	Unstandardised	*SE*	Standardised
	Factor loadings		
Writing	1.00[a]	__	.92
Throwing	0.84	.02	.87
Scissors	0.81	.02	.88
Toothbrush	0.98	.02	.92
Spoon	1.02	.01	.94
Striking match	0.88	.02	.90
	Factor variance		
Handedness	34.34	1.98	1.00

Note. SE = standard error. [a] This parameter is fixed because this item is used as a marker variable, therefore it is not tested for statistical significance. All other estimates were statistically significant $p < .001$.

Table 6.3 presents results of testing for measurement invariance for the Edinburgh handedness inventory. Section 5.6.4.2 gives details of invariance testing and the types of invariance that are tested for in this chapter. Constraining metric and scalar invariance between birth-assigned genders, levels of gender identity (transsexual, other gender-variant identity, and gender-typical identity), androphilic and non-androphilic birth-assigned male groups, or between participants from USA or Australia/New Zealand did not result in significant changes in scaled difference χ^2 score and changes in CFI were also less than .01.

Table 6.3 *Invariance testing fit statistics for the Edinburgh handedness inventory*

Model	χ^2	*df*	*p*	χ^2_{SD}	Δdf	*p*	CFI	ΔCFI
Birth-assigned gender					*N* = 1892			
Unconstrained	68.96	18	< .001	-	-	-	.989	-
Metric invariance	78.43	23	< .001	3.10	5	.685	.988	.001
Scalar invariance	98.44	28	< .001	10.95	10	.362	.985	.004
Level of gender identity					*N* = 1892			
Unconstrained	68.83	27	< .001	-	-	-	.991	-
Metric invariance	84.17	37	< .001	5.13	10	.882	.990	.001
Scalar invariance	109.93	47	< .001	16.01	20	.716	.987	.004
Androphilic/non-androphilic birth-assigned males					*n* = 1254			
Unconstrained	90.79	18	< .001	-	-	-	.981	-
Metric invariance	104.75	23	< .001	4.65	5	.255	.978	.003
Scalar invariance	119.13	28	< .001	11.34	10	.331	.976	.005
Country: USA/Australia or New Zealand					*n* = 1457			
Unconstrained	38.88	18	.003	-	-	-	.994	-
Metric invariance	51.42	23	.001	3.59	5	.609	.992	.002
Scalar invariance	56.11	28	.001	6.14	10	.804	.992	.002

For this factor, Cronbach's internal consistency reliability coefficient α = 96. Raykov's composite reliability coefficient ρ = .96, McDonald's reliability coefficient ω_t = .93, skew coefficient was -1.57, and kurtosis coefficient was 1.68.

6.2 Emotional abuse

Confirmatory factor analysis was conducted to confirm the well-established one-factor model (see Section 5.3.6) with this sample. As illustrated in Table 6.4, confirmatory factor analysis of all five items of the emotional abuse scale elicited a poor fitting model. One item, AbusEm5: "When I was growing up, someone in my family yelled or screamed at me" was reported as having a large proportion of measurement error (.69) in the model, so was removed from the analysis. Examination of modification indices suggested significant error covariance between the items AbusEm1 and Abusem3 (modification index score 32.39). This appears to be due to overlap in item content (both items ask about participants having insulting things said to them). In the revised model outlined in the second row of Table 6.4, the item AbuseEm5 was

removed and the items AbusEm1 and AbusEm3 were allowed to covary. This model had substantially better fit with χ^2 test not statistically significant, all of the other fit indices within the acceptable ranges outlined in Section 5.6.3, and the ECVI was lower than for the previous model.

Table 6.4 *Models and fit statistics for the emotional abuse scale estimated with robust maximum likelihood*

Model	χ^2	*df*	*p*	CFI	TLI	RMSEA[a]	SRMR	ECVI
One-factor, 5 item	118.61	5	< .001	.97	.94	.11, .10-.13	.03	0.08
One-factor, 4 item with AbusEm1 ↷ AbusEm3	3.70	1	.054	1.00	1.00	.04, .01-.08	.01	0.02

Note. N = 1892; [a] 90% confidence interval is given after the RMSEA value

Robust maximum likelihood estimates for this final model are given in Table 6.5. Standardised factor loadings for the items were all greater than .50, suggesting convergent validity.

Table 6.5 *Robust maximum likelihood estimates for the four-item emotional abuse scale*

Parameter	Unstandardised	*SE*	Standardised
	Factor loadings		
AbusEm1	1.00[a]	-	.73
AbusEm2	1.16	0.04	.79
AbusEm3	1.03	0.03	.74
AbusEm4	1.01	0.04	.75
	Covariance		
AbusEm1 ↷ AbusEm3	0.61	0.11	.24
	Factor variance		
Emotional abuse	2.80	0.15	1.00

Note. [a] Marker variable, not tested for statistical significance. All other estimates were statistically significant $p < .001$.

Table 6.6 presents results of testing for measurement invariance for the emotional abuse scale. Constraining metric and scalar invariance between birth-assigned genders and androphilic/non-androphilic birth-assigned male groups did not result in statistically significant changes in scaled difference χ^2 score and the changes in CFI

were less than .01. Likewise, constraining metric invariance between levels of gender identity and country groups did not result in statistically significant changes in scaled difference χ^2 score and the changes in CFI were less than .01. Although constraining scalar invariance between levels of gender identity and country groups resulted in statistically significant changes in scaled difference χ^2 score, the changes in CFI were less than .01.

Table 6.6 *Invariance testing fit statistics for the emotional abuse scale*

Model	χ^2	*df*	*p*	χ^2_{SD}	Δ*df*	*p*	CFI	ΔCFI
Birth-assigned gender					*N* = 1892			
Unconstrained	3.52	2	.172	-	-	-	1.000	-
Metric invariance	11.04	5	.051	5.41	3	.144	.999	.001
Scalar invariance	12.72	8	.122	9.02	6	.172	.999	.001
Level of gender identity					*N* = 1892			
Unconstrained	4.38	3	.223	-	-	-	1.000	-
Metric invariance	18.10	9	.034	10.51	6	.105	.997	.003
Scalar invariance	43.63	15	< .001	9.02	12	.003	.991	.009
Androphilic/non-androphilic					*n* = 1254			
Unconstrained	7.48	2	.024	-	-	-	.995	-
Metric invariance	8.95	5	.111	1.06	3	.786	.995	.000
Scalar invariance	17.92	8	.022	6.03	6	.274	.990	.005
Country: USA/Australia or New Zealand					*n* = 1457			
Unconstrained	3.04	2	.218	-	-	-	1.000	-
Metric invariance	12.18	5	.032	7.12	3	.068	.997	.003
Scalar invariance	25.97	8	.001	22.26	6	.001	.993	.007

For this factor, Cronbach's α = .75, Raykov's ρ = .82, McDonald's ω_t = .82, skew coefficient was 0.13, and kurtosis coefficient was -1.19.

6.3 Mental rotation

As outlined in Section 5.3.7, mental rotation items were parcelled into three composite indicators, and this was appropriate because of the unidimensionality of the scale. To conduct confirmatory factor analysis for the mental rotation factor, two of the variables needed to be constrained equal so that the model could be identified. These

items passed the Wald test of parameter constraints, $\chi^2(1, N = 1{,}892) = 2.42$, $p = .120$. Robust maximum likelihood estimates for the confirmatory factor analysis using one factor are outlined in Table 6.7, and this analysis produced results consistent with a model that fits the data well on the fit indices, $\chi^2(1, N = 1{,}892) = 2.46$, $p = .117$, CFI = 1.00, TLI = 1.00, SRMR = .02, and RMSEA = .03 with a 90% confidence interval of .00 to .06. Standardised factor loadings for the items were all greater than .50, suggesting convergent validity.

Table 6.7 *Robust maximum likelihood estimates for the mental rotation test*

Parameter	Unstandardised	*SE*	Standardised
	Factor loadings		
Mental rotation parcel 1	0.80[b]	.03	.73
Mental rotation parcel 2	0.80[b]	.00	.84
Mental rotation parcel 3	1.00[a]	-	.86
	Factor variance		
Mental rotation	3.70	.23	1.00

Note. [a] Marker variable, not tested for statistical significance. All other estimates were statistically significant $p < .001$. [b] Loadings constrained to be equal.

Table 6.8 presents results of testing for measurement invariance for the mental rotation test. Constraining metric and scalar invariance between birth-assigned genders, levels of gender identity, and country groups did not result in statistically significant changes in scaled difference χ^2 score and the changes in CFI were less than .01. Constraining metric invariance between androphilic/non-androphilic birth-assigned male groups also did not result in a statistically significant change in scaled difference χ^2 score and the change in CFI was less than .01; constraining scalar invariance between these groups did not result in a statistically significant change in scaled difference χ^2 score, but the change in CFI was greater than .01 but less than .02, indicating possible scalar non-invariance (see Section 5.6.4.2).

For this factor, reliability coefficients were not calculated as it is not possible to calculate these on variables that use parcelling. The skew coefficient was 0.05, and kurtosis coefficient was 0.02

Table 6.8 *Birth-assigned gender invariance testing models and fit statistics for the mental rotation test*

Model	χ^2	*df*	*p*	χ^2_{SD}	Δ*df*	*p*	CFI	ΔCFI
Birth-assigned gender					*N* = 1892			
Unconstrained	0.93	1	.335	-	-	-	1.000	-
Metric invariance	2.78	3	.427	0.78	2	.676	1.000	.000
Scalar invariance	6.08	5	.299	2.98	4	.561	.999	.001
Level of gender identity					*N* = 1892			
Unconstrained	0.05	1	.820	-	-	-	1.000	-
Metric invariance	9.84	5	.080	4.47	4	.347	.996	.004
Scalar invariance	20.26	9	.016	12.15	8	.144	.991	.009
Androphilic/non-androphilic					*n* = 1254			
Unconstrained	1.70	1	.193	-	-	-	.999	-
Metric invariance	10.15	3	.017	3.49	2	.175	.992	.007
Scalar invariance	16.80	5	.005	6.23	4	.182	.986	.013
Country: USA/Australia or New Zealand					*n* = 1457			
Unconstrained	0.76	1	.385	-	-	-	1.000	-
Metric invariance	2.64	3	.450	0.88	2	.644	1.000	.000
Scalar invariance	4.22	5	.271	2.05	4	.727	1.000	.000

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6.4 Systemising

As illustrated in the first row of Table 6.9, confirmatory factor analysis of the one factor model of the systemising scale model produced inadequate fit statistics. The four-factor model (technicity, topography, DIY, and structure) that has been found in previous studies (see Section 5.3.8) was tested with an overall systemising factor as a second-order factor. As the second row of Table 6.9 shows, this resulted in an improvement in model fit. Because the first-order factor DIY only one indicator (Sys2), this indicator was modelled directly to the overall systemising factor. Examination of the residuals of the four-factor model showed that the item, Sys5, which loaded on technicity: “I can remember large amounts of information about a topic that interests me e.g. flags of the world, airline logos” had an unacceptably large proportion of error variance (.91). Examination of modification indices suggested significant error covariance between the items Sys3 and Sys8 (modification index score 50.92). This

appeared to be due to overlap in item content (interest in technicalities of a video recorder in Sys3 and interest in technicalities of a stereo in Sys8). In the final model outlined in the third row of Table 6.9, the item Sys5 was removed and the items Sys3 and Sys8 were allowed to covary. This resulted in a model with a statistically significant χ^2 test, but all of the other fit indices were within the acceptable ranges outlined in Section 5.6.3 and the ECVI was lower than for the other models.

Table 6.9 *Models and fit statistics for the systemising quotient estimated with robust maximum likelihood*

Model	χ^2	*df*	*p*	CFI	TLI	RMSEA[a]	SRMR	ECVI
One-factor, 8 items	324.75	20	< .001	.87	.81	.09, .08-.10	.05	0.19
Four-factors, 8 items	129.27	18	< .001	.95	.92	.06, .05-.07	.03	0.09
Four-factors, 7 items with Sys3 ↷ Sys8	47.60	11	< .001	.98	.97	.04, .03-.05	.02	0.04

Note. N = 1892; [a] 90% confidence interval is given after the RMSEA value

Robust maximum likelihood estimates for this 6 item model are given in Table 6.10. Standardised factor loadings for the items were all greater than .50 except one indicator of .49. This suggests adequate evidence for convergent validity. Standardised factor covariances between the first-order factors were all less than .90, suggesting discriminant validity (Kline, 2011).

Table 6.10 *Robust maximum likelihood estimates for the four-factor systemising quotient*

Parameter	Unstandardised	*SE*	Standardised
	Factor loadings		
Sys1 → Topograpy	1.00[a]	-	.70
Sys6 → Topograpy	1.21	.06	.76
Sys3 → Structure	1.00[a]	-	.62
Sys4 → Structure	0.94	.08	.56
Sys7 → Technicity	1.00[a]	-	.84
Sys8 → Technicity	0.85	.04	.71
Sys2 → Systemising	1.00[a]	-	.49
Topography → Systemising	1.00[a]	-	.81
Structure → Systemising	0.90	.07	.75
Technicity → Systemising	1.40	.08	.82
	Covariance		
Sys3 ↷ Sys8	0.48	.07	.23
	Factor variance		
Systematising	0.78	.06	1.00
	Factor covariance		
Topograpy ↷ Structure	0.71	.06	.60
Topograpy ↷ Technicity	1.14	.07	.67
Technicity ↷ Structure	1.00	.06	.60

Note. [a] Marker variable, not tested for statistical significance. All other estimates were statistically significant $p < .001$.

Table 6.11 presents results of testing for measurement invariance for the systemising quotient. Constraining metric invariance between birth-assigned genders did not result in a significant change in scaled difference χ^2 score and the change in CFI was less than .01. Constraining scalar invariance between birth-assigned genders resulted in a significant change in scaled difference χ^2 score and the change in CFI was greater than .01 but less than .02, indicating possible scalar non-invariance (see Section 5.6.4.2). Constraining metric and scalar invariance between levels of gender identity, sexual orientation groups, and country groups did not result in significant changes in scaled difference χ^2 score and changes in CFI were less than .01.

Table 6.11 *Invariance testing fit statistics for the systemising quotient*

Model	χ^2	*df*	*p*	χ^2_{SD}	Δ*df*	*p*	CFI	ΔCFI
Birth-assigned gender						*N* = 1892		
Unconstrained	56.12	22	< .001	-	-	-	.985	-
Metric invariance	65.14	25	< .001	7.79	3	.051	.982	.003
Scalar invariance	100.29	28	<.001	31.55	6	< .001	.968	.013
Level of gender identity						*N* = 1892		
Unconstrained	67.63	33	< .001	-	-	-	.982	-
Metric invariance	75.83	39	< .001	5.66	6	.462	.981	.001
Scalar invariance	94.35	45	<.001	31.55	12	.103	.974	.008
Androphilic/non-androphilic						*n* = 1254		
Unconstrained	47.53	22	.001	-	-	-	.984	-
Metric invariance	54.36	25	.001	4.50	3	.212	.982	.002
Scalar invariance	62.46	28	< .001	10.51	6	.105	.979	.005
Country: USA/Australia or New Zealand						*n* = 1457		
Unconstrained	51.12	22	< .001	-	-	-	.984	-
Metric invariance	55.99	25	< .001	3.40	3	.334	.983	.001
Scalar invariance	71.20	28	< .001	14.45	6	.025	.976	.008

For this factor, Cronbach's α = .75, Raykov's ρ = .75, McDonald's ω_t = .80, skew coefficient was -0.38, and kurtosis coefficient was -0.39.

6.5 Adult gender-variant identity

As illustrated in Table 6.12, confirmatory factor analysis of the four-item one-factor adult gender-variant identity scale with no correlated error terms produced a poor-fitting model. Examination of modification indices suggests significant error covariance between the items AGV1 and AGV4 (modification index score 88.00). This appears to be due overlap in item content (not feeling similar to men/women in AGV1 and not feeling masculine/feminine in AGV4). Allowing these items to covary produced a model with acceptable levels of fit on all indices (see Table 6.12).

Table 6.12 *Models and fit statistics for adult gender-variant identity estimated with robust maximum likelihood*

Model	χ^2	*df*	*p*	CFI	TLI	RMSEA[a]	SRMR	ECVI
One-factor, four item	88.22	2	< .001	.98	.95	.15, .13-.17	.03	0.05
One-factor, four item, with AGV1 ↷ AGV4	0.67	1	.413	1.00	1.00	.00, .00-.04	.00	0.01

Note. N = 1892; [a] 90% confidence interval is given after the RMSEA value

Robust maximum likelihood estimates for this four item model are given in Table 6.13. Standardised factor loadings for the items were all greater than .50, suggesting convergent validity.

Table 6.13 *Robust maximum likelihood estimates for the adult gender-variant identity scale*

Parameter	Unstandardised	*SE*	Standardised
	Factor loadings		
AGV1	1.00[a]	-	.71
AGV2	1.04	.03	.93
AGV3	1.60	.04	.93
AGV4	0.86	.03	.67
	Covariance		
AGV1 ↷ AGV4	0.54	.06	.26
	Factor variance		
Adult gender-variant identity	2.23	.12	1.00

Note. [a] Marker variable, not tested for statistical significance. All other estimates were statistically significant $p < .001$.

Table 6.14 presents results of testing for measurement invariance for the adult gender-variant identity scale. Constraining metric invariance between birth-assigned genders did not result in statistically significant changes in scaled difference χ^2 score and the changes in CFI were less than .01. Although constraining scalar invariance between birth-assigned genders resulted in statistically significant changes in scaled difference χ^2 score, this measure is sensitive to large sample size and the changes in CFI were less than .01. Constraining metric and scalar invariance between participants'

questionnaire version and between regions did not result in significant changes in scaled difference χ^2 scores and the changes in CFI were less than .01.

Table 6.14 *Invariance testing fit statistics for the adult gender-variant identity scale*

Model	χ^2	*df*	*p*	χ^2_{SD}	Δ*df*	*p*	CFI	ΔCFI
Birth-assigned gender						*N* = 1892		
Unconstrained	0.76	2	.684	-	-	-	1.000	-
Metric invariance	6.83	5	.234	4.94	3	.176	1.000	.000
Scalar invariance	41.71	8	< .001	36.89	6	< .000	.993	.007
Questionnaire version						*N* = 1892		
Unconstrained	2.20	2	.334	-	-	-	1.000	-
Metric invariance	3.36	5	.644	1.46	3	.691	1.000	.000
Scalar invariance	15.98	8	.043	10.95	6	.090	.994	.006
Country: USA/Australia or New Zealand						*n* = 1457		
Unconstrained	0.02	2	.993	-	-	-	1.000	-
Metric invariance	9.21	5	.101	8.93	3	.030	.999	.001
Scalar invariance	13.39	8	.099	13.06	6	.042	.998	.002

For this factor, Cronbach's α = .65, Raykov's ρ = .86, McDonald's ω_t = .77, skew coefficient was -0.44, and kurtosis coefficient was -0.88.

6.6 Recalled childhood gender-variance

Confirmatory factor analysis was conducted to confirm the well-established one-factor model (see Section 5.3.9) of the recalled childhood gender-variance scale with this sample. Confirmatory factor analysis of the one factor, seven item recalled childhood gender-variance scale analysis produced results consistent with a model that fits the data adequately on the fit indices, $\chi^2(5, N = 1{,}892) = 45.10$, $p < .001$, CFI = .99, TLI = .99, SRMR = .02, and RMSEA = .07 with a 90% confidence interval of .06 to .08. Robust maximum likelihood estimates for this factor for outlined in Table 6.15. Standardised factor loadings for the items were all greater than .50, suggesting convergent validity.

Table 6.15 *Robust maximum likelihood estimates for the three factor recalled childhood gender-variance scale*

Parameter	Unstandardised	*SE*	Standardised
	Factor loadings		
RGI1 → Recalled gender-variance	1.00[a]	-	.81
RGI2 → Recalled gender-variance	1.22	.03	.85
RGI4 → Recalled gender-variance	1.37	.03	.90
RGI5 → Recalled gender-variance	1.28	.03	.83
RGI7 → Recalled gender-variance	1.00	.03	.62
	Factor variance		
Recalled gender-variance	0.62	.03	1.00

Note. [a] Marker variable, not tested for statistical significance. All other estimates were statistically significant $p < .001$.

Table 6.16 presents results of testing for measurement invariance for the recalled childhood gender-variance scale. Constraining metric invariance between birth-assigned genders and metric and scalar invariance between country groups resulted in significant changes in the sensitive scaled difference χ^2 scores, but the changes in CFI were less than .01. Constraining scalar invariance between birth-assigned genders resulted in a significant change in scaled difference χ^2 score and the change in CFI was greater than .02, indicating that this scale is not scalar invariant between birth-assigned gender. Constraining metric and scalar invariance between homosexual and non-homosexual groups did not result in significant changes in scaled difference χ^2 scores and changes in CFI were less than .01.

For this factor, Cronbach's $\alpha = .70$, Raykov's $\rho = .90$, McDonald's $\omega_t = .77$, skew coefficient was -0.07, and kurtosis coefficient was -0.65.

6.7 Balanced inventory of desirable responding

Confirmatory factor analysis was conducted to confirm the established three-factor model (see Section 5.3.5) of the BIDR with this sample. As illustrated in the first row of Table 6.17, while this model had reasonable evidence of fit on some indices (RMSEA, SRMR, ECVI), this model's CFI and TLI scores are indicative of poor fit. Inspection of residuals in this model revealed a number of items that had a large proportion of error variance. Proportion of residual variance for IM1 was .87, .IM2 was

.91, SD6 was .90, and SD7 was .94. Examination of modification indices suggested significant error covariance between the items SD4 and SD5 (modification index score 33.05). This appears to be due overlap in item content (always knowing why one likes things in SD4 and being rational in SD5). With these four items removed and SD4 and SD5 errors allowed to covary, the remaining 12 item model had adequate CFI and TLI scores.

Table 6.16 *Invariance testing fit statistics for the recalled childhood gender-variance scale*

Model	χ^2	*df*	*p*	χ^2_{SD}	Δdf	*p*	CFI	ΔCFI
Birth-assigned gender				*N* = 1892				
Unconstrained	54.28	10	< .001	-	-	-	.992	-
Metric invariance	71.89	14	< .001	15.73	4	.003	.990	.002
Scalar invariance	210.48	18	< .001	142.91	8	< .001	.967	.025
Country: USA/Australia or New Zealand				*n* = 1497				
Unconstrained	40.35	10	< .001	-	-	-	.993	-
Metric invariance	58.74	14	< .001	16.27	4	.003	.990	.003
Scalar invariance	64.72	18	< .001	22.16	8	.005	.990	.003

Table 6.17 *Models and fit statistics for recalled childhood gender-variance estimated with robust maximum likelihood*

Model	χ^2	*df*	*p*	CFI	TLI	RMSEA[a]	SRMR	ECVI
Three-factors, 16 items	497.01	101	< .001	.87	.85	.05, .04-.05	.04	0.32
Three-factors, 12 items, with SD4 ↷ SD5	248.30	51	< .001	.92	.90	.05, .04-.05	.04	0.17

Note. *N* = 1892; [a] 90% confidence interval is given after the RMSEA value

Robust maximum likelihood estimates for this three factor, 12 item model are given in the second row of Table 6.18. A number of standardised factor loadings for the items were less than .50, suggesting evidence for convergent validity is tenuous. Standardised factor covariances were all less than .90, suggesting discriminant validity.

Table 6.18 *Robust maximum likelihood estimates for the three factor, 12 item BIDR*

Parameter	Unstandardised	*SE*	Standardised
	Factor loadings		
IM3 → Impression management	1.00[a]	-	.36
IM4 → Impression management	1.76	.17	.60
IM5 → Impression management	1.37	.14	.43
IM6 → Impression management	1.69	.16	.57
SD1 → Denial of negative	1.00[a]	-	.49
SD4 → Denial of negative	1.00	.07	.50
SD8 → Denial of negative	0.88	.07	.48
SD9 → Denial of negative	0.83	.07	.42
SD10 → Denial of negative	1.31	.08	.67
SD2 → Over confident rigidity	1.00[a]	-	.43
SD3 → Over confident rigidity	1.31	.10	.63
SD5 → Over confident rigidity	0.96	.09	.44
	Covariance		
SD4 ↷ SD5	0.41	.07	.16
	Factor variance		
Impression management	0.38	.06	1.00
Denial of negative	0.89	.09	1.00
Over confident rigidity	0.66	.09	1.00
	Factor covariance		
Impression management ↷ Denial of negative	0.23	.03	.39
Impression management ↷ Over confident rigidity	0.12	.02	.24
Denial of negative ↷ Over confident rigidity	0.59	.06	.77

Note. [a] Marker variable, not tested for statistical significance. All other estimates were statistically significant $p < .001$.

Table 6.19 presents results of testing for measurement invariance for the BIDR scale. Constraining metric and scalar invariance between birth-assigned genders did not result in statistically significant changes in scaled difference χ^2 scores and the change in

CFI were less than .01. This result was also achieved for constraining metric invariance between country groups. However, constraining scalar invariance between country groupings resulted in a significant change in scaled difference χ^2 scores and the change in CFI was greater than .02, indicating that this scale is not scalar invariant between country groups.

Table 6.19 *Invariance testing fit statistics for the BIDR*

Model	χ^2	*df*	*p*	χ^2_{SD}	Δdf	*p*	CFI	ΔCFI
Birth-assigned gender				*N* = 1892				
Unconstrained	305.55	100	< .001	-	-	-	.919	-
Metric invariance	313.94	109	< .001	7.77	9	.557	.919	.000
Scalar invariance	339.46	118	< .001	31.54	18	.025	.913	.006
Country: USA/Australia or New Zealand				*n* = 1497				
Unconstrained	272.26	100	< .001	-	-	-	.913	-
Metric invariance	281.87	109	< .001	8.86	9	.450	.913	.000
Scalar invariance	356.34	118	< .001	77.85	18	< .001	.879	.034

For the total BIDR scale, Cronbach's α = .70, Raykov's ρ = .62, McDonald's ω_t = .81, skew coefficient was 0.15, and kurtosis coefficient was -0.06.

6.8 Summary of confirmatory factor analyses

While some modifications were required to the measurement models of some of the latent variables measured in this thesis, these were in accordance with well-established factor structures. Measurement models that had adequate fit for the data were established for all of the latent variables and acceptable reliability coefficients were calculated. With the exception of the BIDR, standardised factor loadings for the items were greater than .50, suggesting convergent validity. Convergent and discriminant validity was also tested through examination of the correlations between latent variables used in this thesis. These correlation coefficients are given in Appendix E (p. 193). It suffices to summarise here that all of the related constructs correlated in the expected direction and correlation coefficients were all less than .80, suggesting discriminant validity (T. A. Brown, 2006; Kline, 2011). Metric and scalar measurement invariance was also established for these variables between birth-assigned gender, level of gender identity, sexual orientation, and country, with the exception of some evidence

for scalar non-invariance between birth-assigned genders for systemising and recalled childhood gender-variance, between androphilic and non-androphilic birth-assigned males for mental rotation, and between country groups for the BIDR.

6.9 Descriptive statistics for observed variables

Descriptive statistics for the variables remaining observed variables used in this study are outlined in Table 6.20.

Table 6.20 *Descriptive statistics for non-latent measures used in this thesis.*

Measure	*M*	*SD*	Range	Skew	Kurtosis
Number of older brothers	0.53	0.86	0 to 7	2.20	6.59
Maternal birth age	27.25	5.87	13 to 44	0.43	-0.30
Paternal birth age	30.49	6.90	16 to 60	0.66	0.45
Number of years until age 18 living with mother	16.69	3.42	0 to 18	-3.26	10.48
Number of years until age 18 living with father	14.66	5.79	0 to 18	-1.63	1.14
Maternal aunt:uncle ratio	0.96	1.03	0 to 10	2.14	8.00
Paternal aunt:uncle ratio	0.87	0.92	0 to 7	1.93	5.70
Proportion of gender-variant relatives	.0091	.0356	0 to.4737	5.63	44.00
Sexual fantasy	3.82	1.84	1 to 7	0.15	-1.16
Sexual experience	3.27	2.11	1 to 7	0.53	-1.15
Physical abuse	1.82	2.36	0 to 6	0.76	-1.15
Sexual abuse	0.92	1.57	0 to 5	1.45	-0.60
2D:4D	0.99	0.06	0.80 to 1.20	0.25	1.15

CHAPTER 7 - RESULTS OF HYPOTHESES

As outlined in Section 4.1, Aim 1 of this thesis was to broaden understanding of the biological and psychosocial factors that are related to the development of gender-variant and gender-typical identities. Results outlined in this chapter will identify biological and psychosocial factors that predict adult gender-variance.

In this chapter, the scales subjected to confirmatory factor analysis in Chapter 6 were included as latent variables with the same measurement models that were tested and found to have evidence of adequate model fit in that chapter. The remainder of the variables used were treated as observed variables in the remaining analyses (Table 6.20 gives a list of these). Estimated measurement error was taken into account for physical abuse and 2D:4D in these analyses. (For details of the estimation of the proportions of measurement error, refer to the relevant sections of each of these variables in Section 5.3 and Appendix F, p. 197.)

7.1 Between-group differences

A multinomial logistic regression model was conducted to establish group differences in biological and psychosocial variables. Differences between transsexuals, participants with other gender-variant identities, and participants with gender-typical identities of both birth-assigned genders were examined to assess the hypothesis that participants with other gender-variant identities would score intermediary between transsexuals and participants with no gender-variant identity.

Table 7.1 presents results of this logistic regression. As outlined in the odds ratios, birth-assigned females reported fewer of older brothers, less physical abuse, and less paternal cohabitation than birth-assigned males. They also reported higher sexual abuse and mother’s ages. There were significant main effects for degree of gender-variant identity and interaction effects for number of older brothers, emotional and sexual abuse, handedness, mental rotation, systemising, maternal age, and paternal cohabitation. Graphic representation of these group differences is given in Figures 7.1-7.9. No significant group differences were found for the 2D:4D finger length ratio.

Table 7.1 *Logistic regression of biological and psychosocial variables with level of gender-variant identity and birth-assigned gender as independent variables.*

	$OR_{BAfemale}$	*p*	$OR_{GVidentity}$	*p*	$OR_{interaction}$	*p*
Number of older brothers	0.62	< .001	1.14	.023	0.85	.002
Proportion of relatives with a gender-variant identity	0.62	.735	21.98	.009	16.71	.017
Emotional abuse	1.02	.647	1.22	< .001	1.20	< .001
Physical abuse	0.92	.002	1.04	.089	1.00	.900
Sexual abuse	1.31	< .001	0.93	.016	1.10	.001
Edinburgh handedness inventory	1.02	.022	0.97	.001	0.99	.100
2D:4D	1.27	.896	1.53	.768	1.21	.820
Mental rotation	0.99	.852	1.15	.001	1.14	.004
Systemising quotient	1.09	.322	0.60	< .001	0.68	< .001
Mother's age	1.07	< .001	1.00	.808	1.04	< .001
Years until age 18 living with father	0.97	.004	0.99	.455	0.97	.008

Note. *OR* = odds ratio. BAfemale = birth-assigned female. GVidentity = level of gender-variant identity. *CI* = 99% confidence interval.
ns: MF transsexuals = 527, birth-assigned males with other gender-variant identities = 535, males with gender-typical identities = 192, FM Transsexuals = 118, birth-assigned females with other gender-variant identities = 217, females with gender-typical identities = 303.

The significant interaction effect for number of older brothers is illustrated in Figure 7.1. A tendency for a higher average number of older brothers with higher degrees of gender-variant identities—transsexuals being the highest degree of gender-variant identity and other gender-variant identities having a lower degree of gender-variant identity—in birth-assigned males can be observed. There was no difference for number of older brothers in birth-assigned females. The significant main effect for birth-assigned gender can also be observed in this figure—birth-assigned males reported a significantly higher average number of older brothers than birth-assigned females.

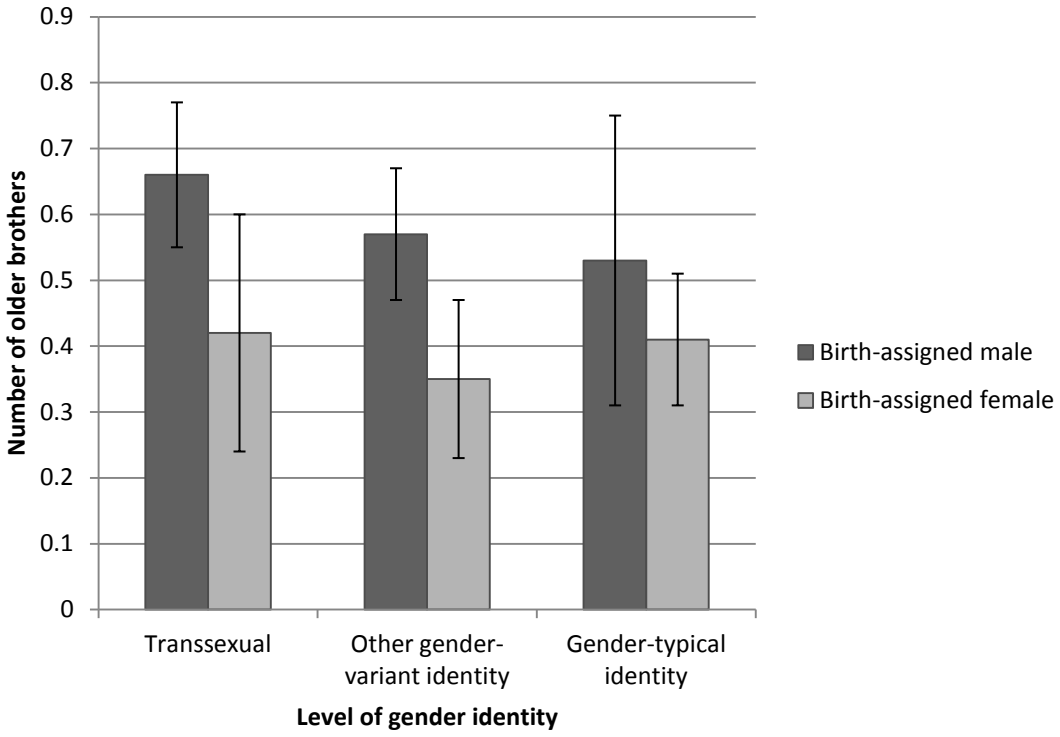

Figure 7.1 *Gender identity group means and 99% confidence intervals for number of older brothers.*

The significant main effect for gender identity on average proportion of relatives with a gender-variant identity is illustrated in Figure 7.2. Participants with gender-variant identities (transsexuals and other gender-variant identities) had significantly higher average proportions of relatives with a gender-variant identity.

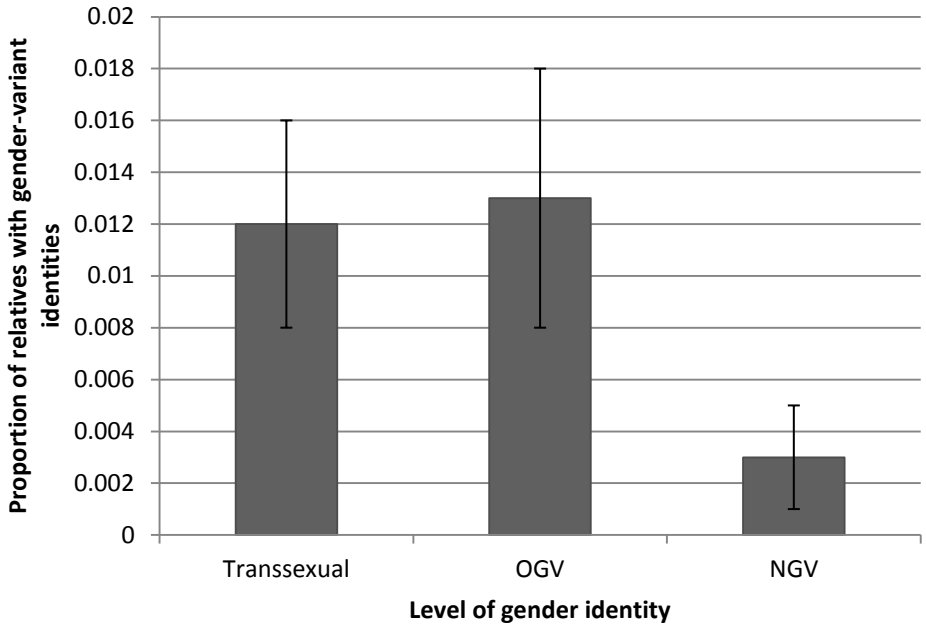

Figure 7.2 *Gender identity group means and 99% confidence intervals for proportion of relatives with gender-variant identities.*

The statistically significant main effect for gender identity on emotional abuse is illustrated in Figure 7.3. Participants with a lower degree of gender-variant identity reported less emotional abuse. Note that MF (birth-assigned male) transsexuals were the comparison group in this analysis, having a latent mean score of 0. The statistically significant interaction effect is also illustrated in this figure—this main gender identity effect was stronger in birth-assigned males.

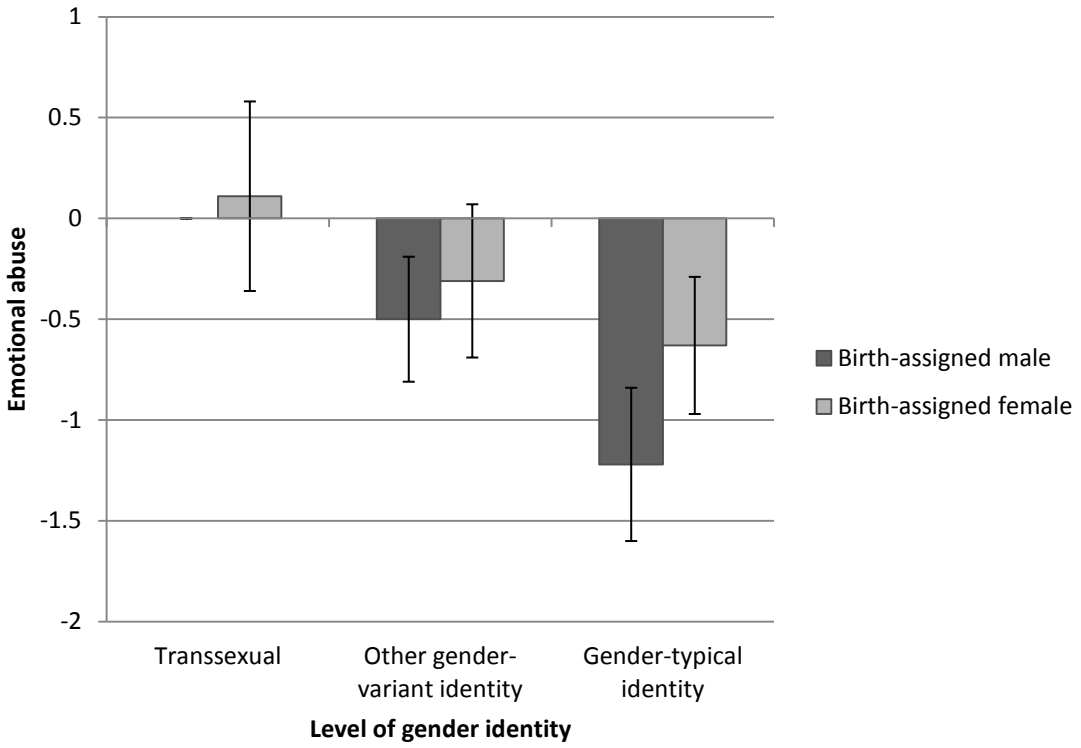

Figure 7.3 *Gender identity group latent means and 99% confidence intervals for emotional abuse, with MF transsexuals as comparison group.*

The significant interaction effect for sexual abuse is illustrated in Figure 7.4. MF transsexuals reported a significantly higher amount of sexual abuse than the other two birth-assigned male groups, while there was no difference in sexual abuse between these groups in birth-assigned females. The significant main effect for birth-assigned gender can also be seen in this figure—birth-assigned females reported a significantly higher sexual abuse score than birth-assigned males.

The significant main effect for level of gender identity on handedness is illustrated in Figure 7.5. There was a tendency for a higher average handedness score with higher degrees of gender-variant identity. Higher handedness score are reflective of non-right handedness.

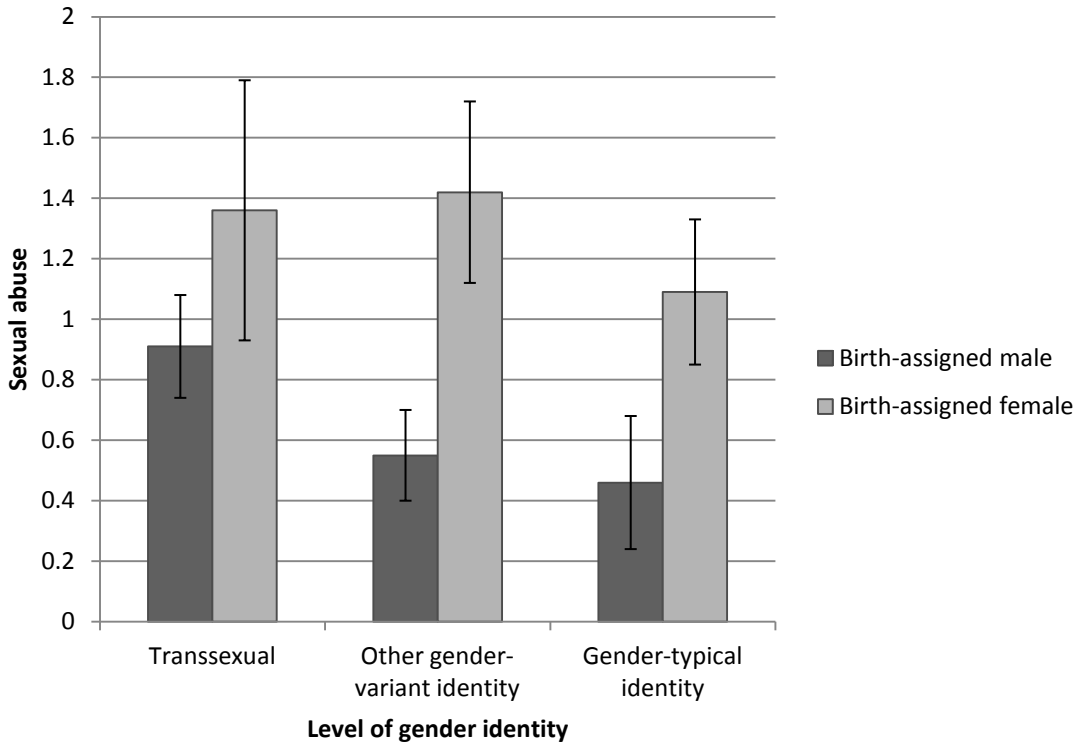

Figure 7.4 *Gender identity group means and 99% confidence intervals for sexual abuse.*

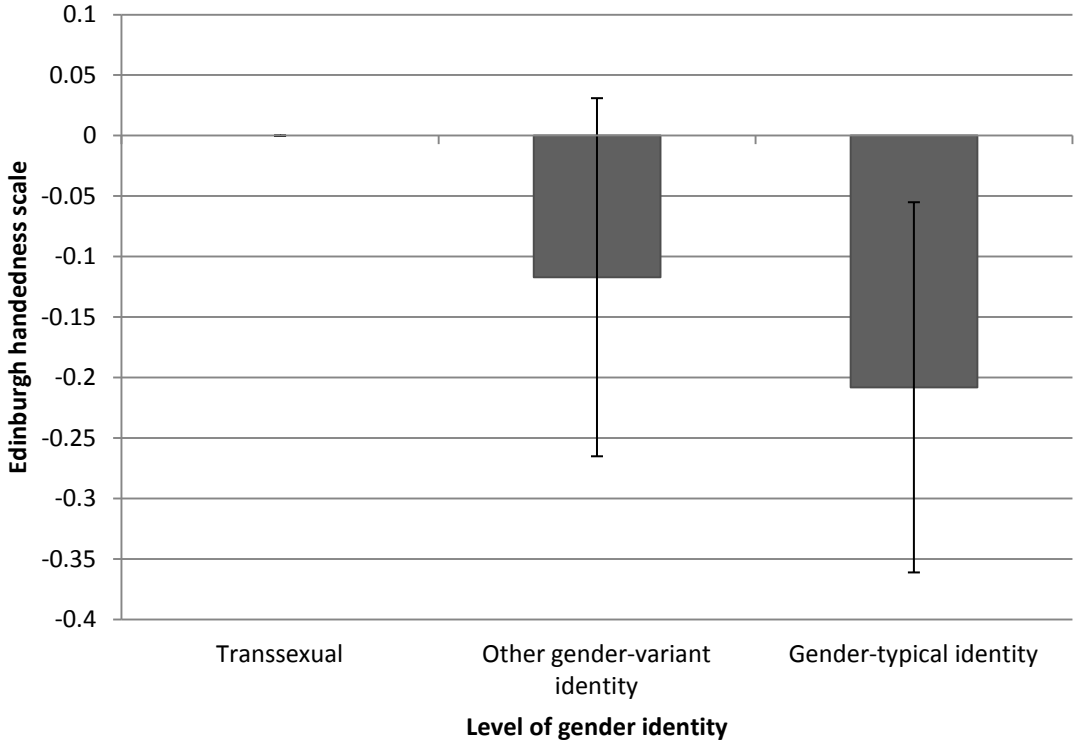

Figure 7.5 *Gender identity group latent means and 99% confidence intervals for handedness, with transsexuals as comparison group*

The significant interaction effect for mental rotation is illustrated in Figure 7.6. Gender-variant birth-assigned males tended to score lower than gender-typical birth-assigned males and FM transsexuals tended to score higher than the other two birth-assigned female groups.

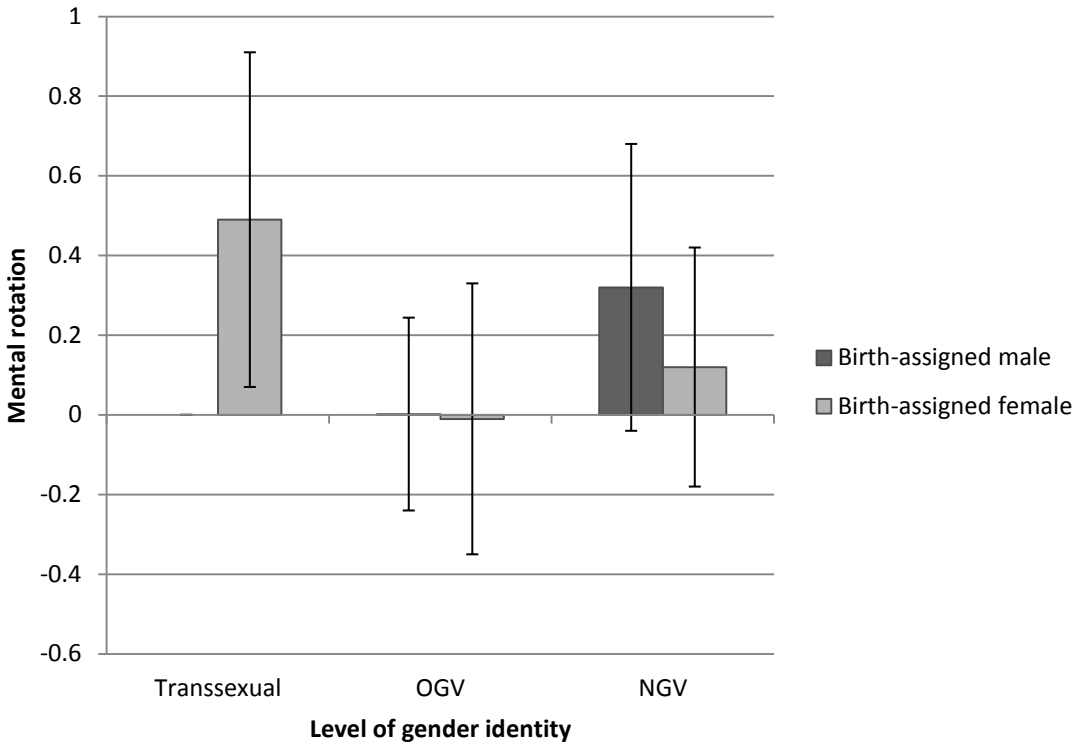

Figure 7.6 *Gender identity group latent means and 99% confidence intervals for mental rotation, with MF transsexuals as comparison group.*

The significant interaction effect for systemising quotient is illustrated in Figure 7.7. Groups with higher degrees of gender-variant identity had lower average scores on the systemising quotient among birth-assigned males. There were no significant differences between birth-assigned female groups.

The significant interaction effect for mother's age is illustrated in Figure 7.8. There was a tendency for a higher average mother's age with higher degrees of gender-variant identity among birth-assigned females and a tendency for gender-typical birth-assigned males to have a higher mother's age than birth-assigned males with a gender-variant identity. However, confidence intervals for all of these groups were overlapping.

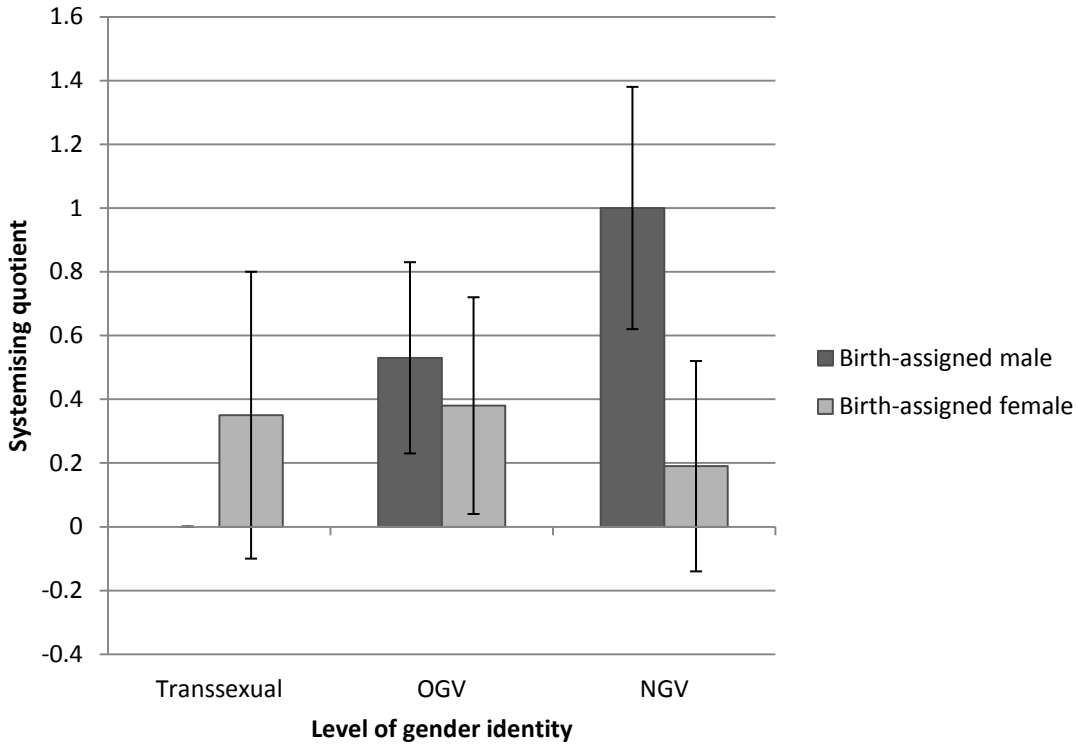

Figure 7.7 *Gender identity group latent means and 99% confidence intervals for systemising quotient, with MF transsexuals as comparison group.*

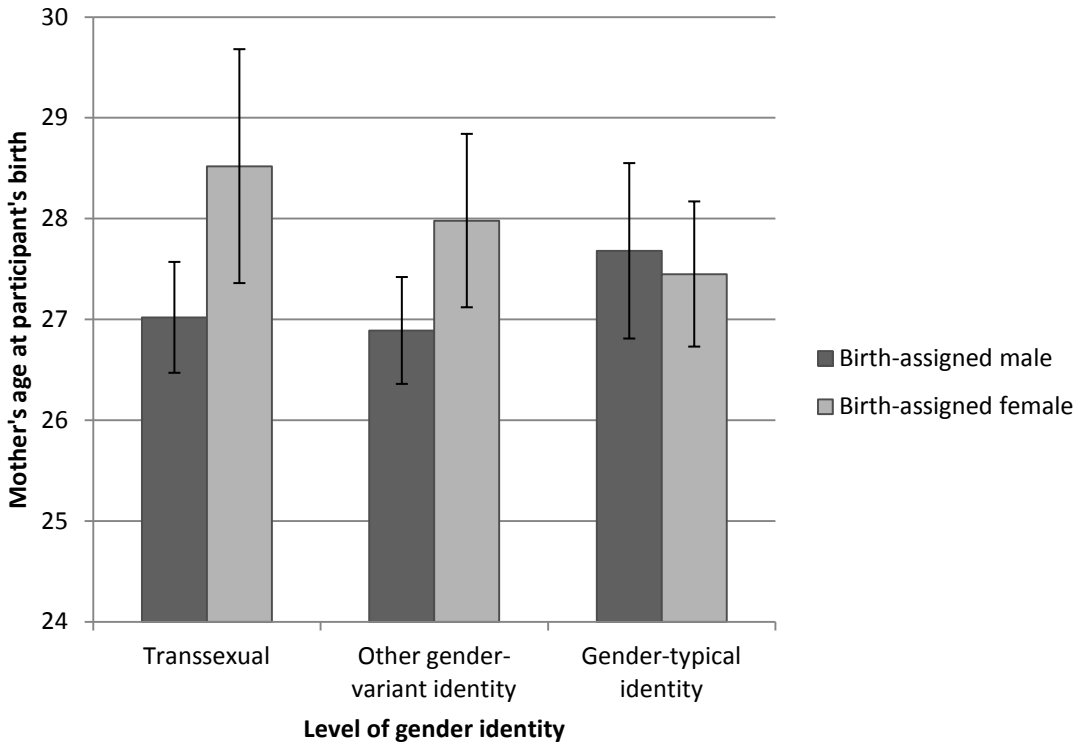

Figure 7.8 *Gender identity group means and 99% confidence intervals for mother's age.*

The significant interaction effect for paternal cohabitation is illustrated in Figure 7.9. There was lower average paternal cohabitation with higher levels of gender-variant identity among birth-assigned females. There were no significant differences between birth-assigned male groups.

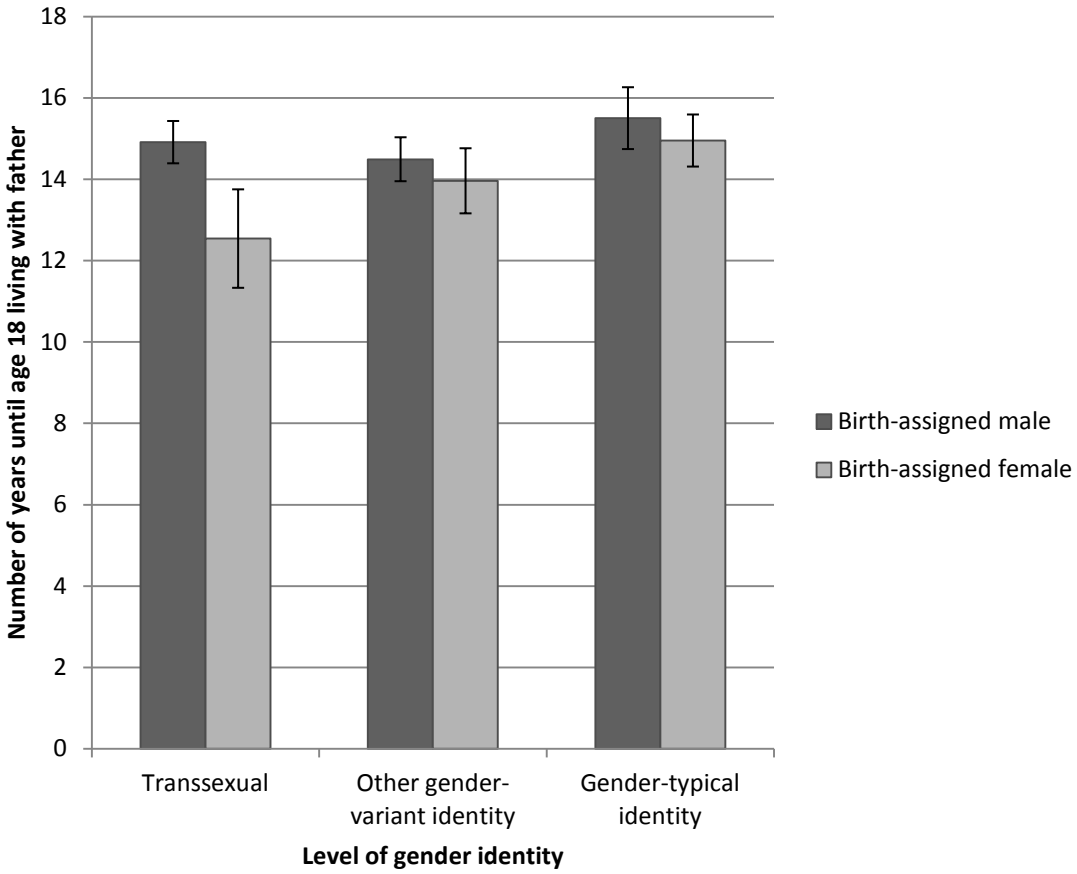

Figure 7.9 *Gender identity group means and 99% confidence intervals for paternal cohabitation.*

Paired samples *t*-tests were conducted to assess whether the six participant groups had discrepancies between their number of brothers and sisters. This analysis calculated the mean difference between number of brothers and number of sisters and tested whether this differed from 0. The results outlined in Table 7.2 show that MF transsexuals and birth-assigned males with other gender-variant identities had significantly more brothers than sisters and these groups had an elevated sibling sex ratio. However, this was also found among birth-assigned males with gender-typical identities. Further analysis revealed that this effect was due to a greater number of younger brothers than younger sisters among all three groups; MF transsexuals were the

only group out of these three to have a significantly different number of older brothers than older sisters, mean difference = 0.14, $t(510) = 3.25$, $p = .001$. Among birth-assigned females, those with other gender-variant identities reported significantly fewer brothers than sisters. However, this did not differ markedly from the other two birth-assigned female groups.

Table 7.2 *Paired samples* t-*test for difference between number of brothers and number of sisters.*

Birth assignment	Identity	*n*	Mean difference	*SD*	*t*	*p*	Sibling sex ratio[1]
Male	Transsexual	511	0.48	1.68	6.44	< .001	140
	OGV	519	0.68	1.89	8.20	< .001	165
	Gender-typical	189	0.49	1.46	4.59	< .001	155
Female	Transsexual	114	-0.23	1.34	-1.81	.073	78
	OGV	209	-0.30	1.41	-3.05	.003	73
	Gender-typical	293	-0.04	1.45	-0.44	.660	98

Note. [1]Number of brothers per 100 sisters. OGV = other gender-variant identity.

Assessment of whether there were discrepancies between number of aunts and uncles in persons with gender-variant identities as has been found previously was conducted using pared samples *t*-tests. As outlined in Table 7.3, number of maternal aunts did not significantly differ from number of maternal uncles in any of these six groups.

Table 7.3 *Paired samples* t-*test for difference between number of maternal aunts and number of maternal uncles.*

Birth assignment	Identity	*n*	Mean difference	*SD*	*t*	*p*
Male	Transsexual	503	0.00	2.27	-0.02	.984
	Other gender-variant	514	-0.04	1.90	-0.49	.626
	Gender-typical	185	-0.09	1.71	-0.69	.493
Female	Transsexual	112	-0.11	1.74	-0.65	.516
	Other gender-variant	211	-0.05	1.76	-0.43	.667
	Gender-typical	293	-0.22	1.70	-2.17	.031

7.2 Biological and psychosocial variables predicting adult gender-variance

To test Hypothesis 1, a SEM for biological and psychosocial variables predicting adult gender-variant identity was conducted. Nine biological and psychosocial variables were significantly related to adult gender-variance in the SEM. The remaining variables—number of siblings, aunt:uncle ratios, physical and sexual abuse, 2D:4D, father's age, cohabitation with mother, and parental death—were excluded from this analysis. It was assumed that predictor variables would be the same for birth-assigned males and females unless there was evidence to the contrary due to the principle that more parsimonious models are preferable (Kline, 2011). To test whether parameters differed, predictor variables were initially constrained equal between birth-assigned genders. Table 7.4 outlines the improvement in overall model fit from freeing estimates for each of the predictor variables between birth-assigned genders. These results show that freeing handedness, mental rotation, systemising quotient, and mother's age at birth of participant between genders resulted in a significant improvement in model fit.

Table 7.4 *Scaled difference χ^2 from freeing between-gender parameter constraints*

Parameter freed	$\chi^2_{SD}(1)$	*p*
Number of older brothers → Adult gender-variance	4.71	.030
Proportion of gender-variant relatives → Adult gender-variance	0.97	.325
Emotional abuse → Adult gender-variance	0.32	.572
Edinburgh handedness inventory → Adult gender-variance	8.48	.004
Mental rotation → Adult gender-variance	8.52	.004
Systemising quotient → Adult gender-variance	83.91	< .001
Mother's age at birth of participant → Adult gender-variance	7.54	.006
Years until age 18 living with father → Adult gender-variance	3.57	.059
Recalled gender-variance → Emotional abuse	9.07	.003

Note. $N = 1892$

Figure 7.10 outlines this SEM, which uses robust maximum likelihood estimation. Two standardised regression coefficients are given for those parameters which significantly differed between birth-assigned genders as identified in Table 7.4—the first coefficient is for birth-assigned males and the second for birth-assigned females. There was evidence for adequate model fit: $\chi^2(581, N = 1892) = 1903.71$, $p <$

.001, CFI = .94, TLI = .93, RMSEA = .05, 90% confidence interval or RMSEA = .04-.05, SRMR = .05. Correlations between predictor variables and unstandardised regression coefficients with further details of *p* values for structural regression paths are presented in Appendix E (p. 193). Figure 7.10 shows that emotional abuse, proportion of gender-variant relatives, time of cohabitation with father, and systemising significantly predicted adult gender identity among both birth-assigned genders; mother's age significantly predicted adult gender identity among birth-assigned females and mental rotation significantly predicted adult gender identity among birth-assigned males. Proportion of the degree of adult gender-variance accounted for was .23 among birth-assigned males and .20 among birth-assigned females. Adjusted R^2 scores are .23 and .19 respectively.

A separate model was analysed with the systemising quotient excluded because it is questionable whether it is measuring a biological marker that could cause a gender-variant identity. This issue is taken up in the discussion (Section 8.1.8). The model that excludes the systemising quotient is outlined in Figure 7.11. There was evidence for adequate fit for this model: $\chi^2(578, N = 1892) = 1546.01$, $p < .001$, CFI = .97, TLI = .96, RMSEA = .04, 90% confidence interval of RMSEA = .04-.05, SRMR = .04. Correlations between predictor variables and unstandardised regression coefficients with exact *p* values for structural regression paths are presented in Appendix E (p. 193). Proportion of the degree of adult gender-variant identity variable accounted for was .07 among birth-assigned males and .09 among birth-assigned females. Adjusted R^2 scores are .07 for birth-assigned males and .08 for birth-assigned females. The model illustrated in Figure 7.11 differs from the model illustrated in Figure 7.10 in a number of ways: mental rotation becomes non-significant among birth-assigned males but significant in the same direction among birth-assigned females, number of older brothers becomes significant amongst all participants, and handedness becomes significant among birth-assigned females.

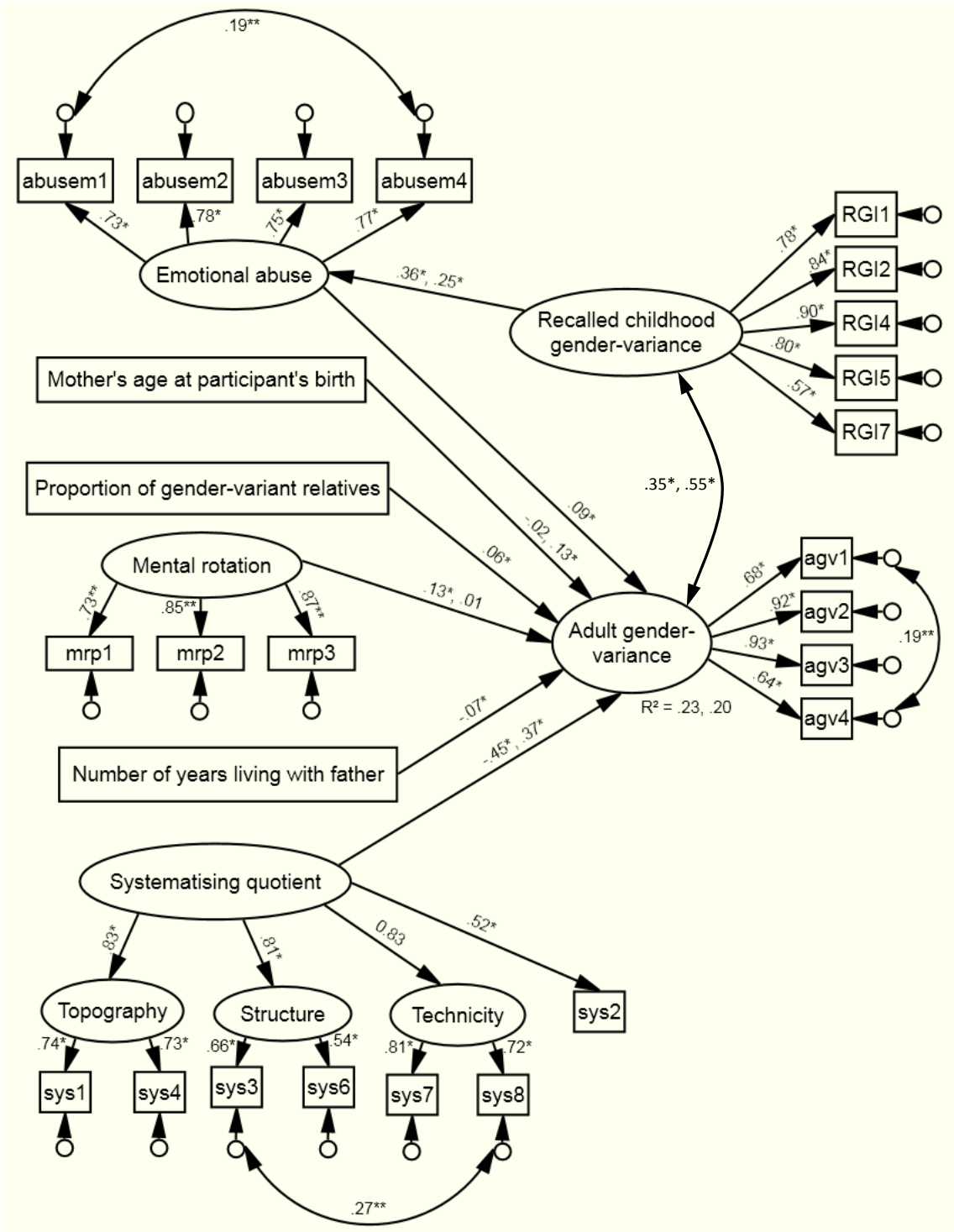

Figure 7.10 *Structural equation model for biological and psychosocial variables predicting adult gender-variant identity showing standardised coefficients.*

Note. N = 1892, * $p < .01$. When two parameters are given, the first is for birth-assigned males, the second for birth-assigned females.

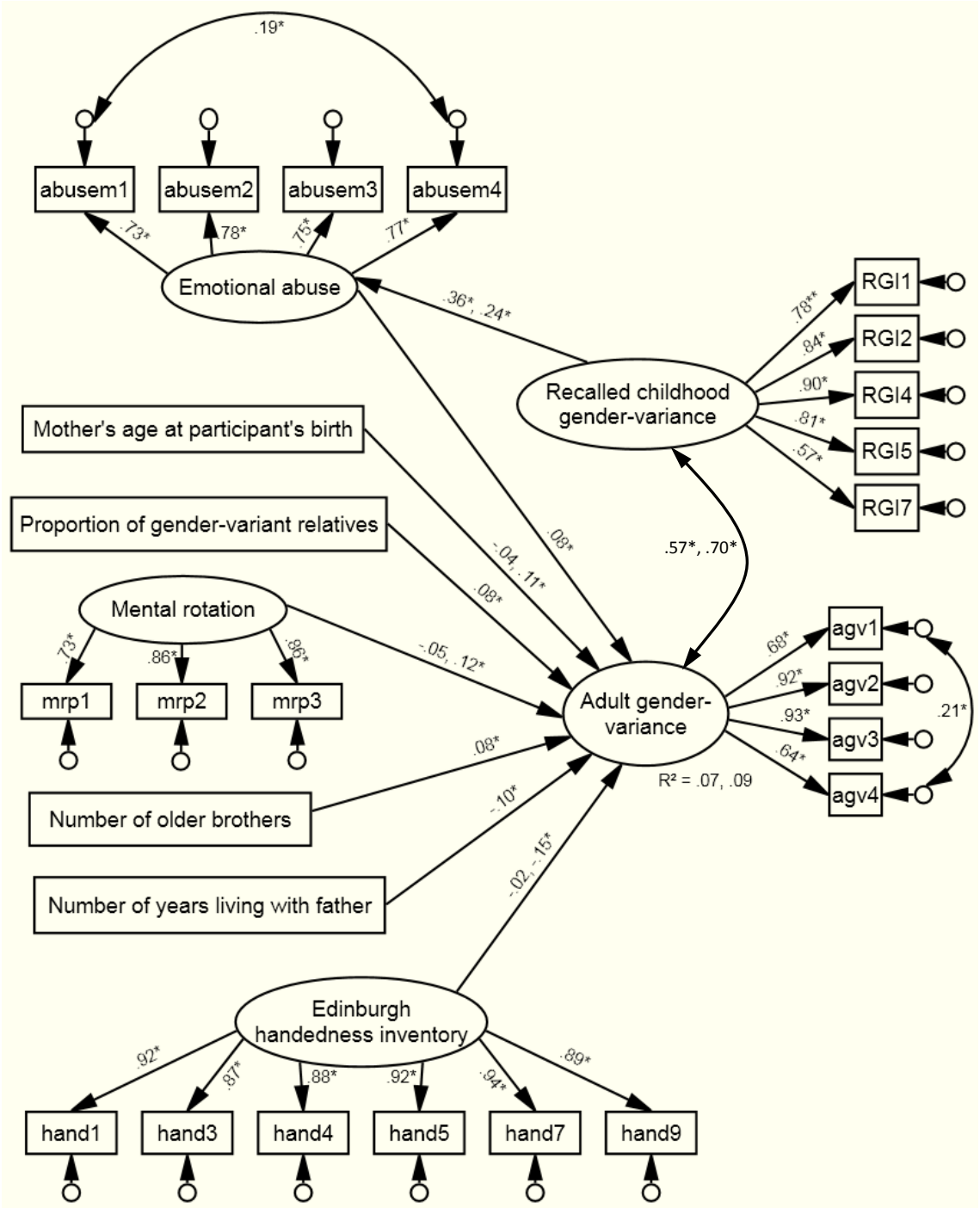

Figure 7.11 *Structural equation model for biological and psychosocial variables (excluding systemising quotient) predicting adult gender-variant identity showing standardised coefficients.*

Note. N = 1892, * p < .01. When two parameters are given, the first is for birth-assigned males, the second for birth-assigned females.

The SEMs in Figures 7.10 and 7.11 allow for the logical causal pathways between emotional abuse, recalled childhood gender-variance, and adult gender-

variance. The causal pathway from recalled childhood gender-variance is included because as well as being a direct cause of adult gender-variance, emotional abuse may also be caused by gender-variant children being the target for abuse. There is evidence that allowing for childhood gender-variance in the models partially mediates the effect of emotional abuse on adult gender-variance. When recalled childhood gender-variance is excluded from the model in Figure 7.10, the unstandardised coefficient of emotional abuse → adult gender variance is $B = 0.16$ with a 99% confidence interval of 0.10 to 0.21. This decreases to $B = 0.07$ with a 99% confidence interval of .01 to .15 when recalled childhood gender-variance is included as a mediator variable in the model in Figure 7.10. A partial mediation is also found with the model illustrated in Figure 7.11—$B = 0.22$ with a 99% confidence interval of 0.16 to 0.28 becomes $B = 0.06$ with a 99% confidence interval of 0.02 to 0.11 with the mediator variable included. Including the mediator variable results in a decrease in the effect of the path, but the path still remains statistically significant.

When the three BIDR (social desirability) factors were also included as predictor variables in the SEM outlined in Figure 7.10, this did not result in significant changes to the other predictor variables[2]. For emotional abuse, the standardised regression coefficient changed to $\beta = .07$ with a 99% confidence interval of .01 to .12. For systemising, β changed to -.59 with a 99% confidence interval of -.82 to -.38 among birth-assigned males and $\beta = .40$ with a 99% confidence interval of β was .08 to .71 among birth-assigned females. Details of this entire model are given in Appendix E (p. 193).

7.3 Moderation of sexual orientation

Blanchard's theory's proposed biological and psychosocial variables differ in birth-assigned males with different sexual orientations. If this were the case, then allowing regression weights for biological and psychosocial variables to freely differ between androphilic and non-androphilic birth-assigned male groups would be expected to result in a significant improvement in model fit. However, when this assessment was conducted, there was no evidence that allowing regression weights to differ resulted in a

[2] The SEM outlined in Figure 7.10 was used instead of the SEM outlined in Figure 7.11 because it included the two variables that may have been susceptible to socially desirable responding – emotional abuse and systemising.

better fitting model: scaled difference $\chi^2(9, n = 1254) = 12.11$, $p = .207$. Table 7.5 outlines results of improvement in model fit from freeing the regression parameters for individual items. These results show that a significantly better fitting model does not eventuate from freeing any of the biological or psychosocial variables' parameters.

Table 7.5 *Scaled difference χ^2 from freeing parameter constraints for variables predicting adult gender-variance in samples excluding homosexual and non-homosexual birth-assigned males*

Parameter freed	$\chi^2_{SD}(1)$	*p*
Number of older brothers	0.89	.345
Proportion of gender-variant relatives	2.60	.107
Emotional abuse	2.48	.115
Edinburgh handedness inventory	1.11	.292
2D:4D	0.82	.365
Mental rotation	0.40	.527
Systemising quotient	3.76	.052
Mother's age at birth of participant	0.20	.654
Years until age 18 living with father	2.50	.114

Note. $n = 1254$.

A model with these parameters allowed to vary was conducted to assess effect size of the sexual orientation group differences in these biological and psychosocial variables. This model is outlined in Table 7.6. There was adequate fit for the data: $\chi^2(1002, n = 1254) = 2260.86$, $p < .001$, CFI = .95, TLI = .95, RMSEA = .04, 90% confidence interval of RMSEA = .04-.05, SRMR = .05. In this sample there was adequate power to detect a *small* effect of $d = 0.2$ (Cohen, 1988)—for analysis with this sample size with alpha level at .01, the observed power is .89. In other words, if even a small effect existed, given the sample size the probability of this analysis failing to detect it is .11 (Cohen, 1988). It is notable that effect sizes (*d*) for the parameter differences outlined in Table 7.6 were all below the small effect size level.

Table 7.6 *Unstandardised regression coefficients for biological and psychosocial predictors of adult gender-variance in birth-assigned male androphilic and non-androphilic groups*

Predictor	Non-androphilic			Androphilic			*d*
	B	*SD*	99% *CI*	*B*	*SD*	99% *CI*	
Number of older brothers	0.06	1.34	-0.04, 0.17	0.03	1.48	-0.20, 0.26	0.02
Proportion of gender-variant relatives	1.92	27.13	-0.12, 3.96	6.34	83.40	-6.75, 19.44	0.07
Emotional abuse	0.07	0.72	0.02, 0.12	0.11	0.74	0.00, 0.23	0.05
Handedness	-0.01	0.21	-0.02, 0.01	-0.02	0.16	-0.05, 0.01	0.05
2D:4D	0.66	21.65	-0.97, 2.29	0.95	20.39	-2.26, 4.15	0.01
Mental rotation	0.11	0.96	0.04, 0.19	0.19	0.79	0.07, 0.31	0.09
Systemising quotient	-0.62	1.96	-0.77, -0.47	-0.83	1.36	-1.04, -0.61	0.12
Mother's age	-0.01	0.27	-0.04, 0.01	0.00	0.30	-0.04, 0.05	0.04
Paternal cohabitation	-0.02	0.24	-0.03, 0.00	-0.04	0.28	-0.09, 0.00	0.09

Note. CI = confidence interval; *n* = 158 androphilics, *n* = 1096 non-androphilics.

7.4 Within-family concordance of transsexualism

Because a very small proportion of participants reported transsexual relatives, this variable was not included in the statistical analyses reported above. However, there were three MF transsexuals who reported a transsexual relative—a maternal uncle, a paternal aunt, and a maternal grandparent, and one FM transsexual reported a transsexual maternal aunt. Assuming that participants were aware of the gender identity of all their reported relatives, this equates to a prevalence ratio of transsexualism of 1:1,567 among reported relatives of MF transsexuals and 1:1,209 among reported relatives of FM transsexuals, although it is notable that these ratios were based on a small sample in terms of incidence.

SECTION V - DISCUSSION

CHAPTER 8 - DISCUSSION

This chapter discusses the results from hypotheses testing for biological and psychosocial variables which were found in Chapter 7. Limitations for measures of specific scales are discussed here. General limitations of the study are given in Chapter 9.

8.1 Biological and psychosocial correlates

Chapter 3 outlined previous studies that have reported biological and psychosocial variables relevant to the development of gender-variant and gender-typical identities. Most of these studies have only reported on a single variable and these studies only include a specific gender-variant identity group (e.g. transsexuals in a clinic or members of a cross-dresser club). In addition, often these studies have not been replicated and sometimes they do not include comparison groups of persons with gender-typical identities.

This thesis's assessment of biological and psychosocial variables relevant to the development of gender-variant and gender-typical identities overcomes these limitations. The results of this assessment were presented in Chapter 7. Using regression-type SEMs, this thesis assessed a number of factors that previous research has found to be related to adult gender-variance: number and ratio of siblings and aunts/uncles, within family concordance of gender-variance, handedness, abuse, parental age, 2D:4D, and mental rotation. In accordance with Hypothesis 1, a number of these biological and psychosocial factors were related to adult gender-variance. This was also the first research to test whether systemising and parental cohabitation are related to adult gender-variance and it was found that they were.

Only a small proportion of the variance of the dependent variable, adult gender-variance, was predicted in the study. The SEMs estimated that 7-9% of the variance was accounted for from the biological and psychosocial factors excluding the systemising quotient. This estimate increased to 20-23% of the variance when the systemising quotient was included as a predictor. This is lower than would be expected considering the number of biological and psychosocial predictor variables and that measurement error was accounted for in the models. There could be two reasons for this. Firstly, more proximate estimates of the biological and psychosocial factors are likely to be needed, especially with prenatal androgen exposure and genetics. Secondly, there may be some

other biological or psychosocial factors that were not measured in the study. However, this second possibility seems less likely as this thesis measured factors in all of the areas that have been proposed to be related to gender identities, with the exception of environmental encouragement of gender-variance.

The following sections discuss each of these biological and psychosocial variables in detail, including the implications these results have on the etiology of gender-variant identities. Assessment of the impact of socially desirable responding is discussed in Section 8.1.11. Theoretical proposals of different biological and factors among those with different sexual orientations (i.e. a moderation effect) and participants with other gender-variant identities having intermediary scores between transsexuals and participants with gender-typical identities are discussed in the remaining two sections.

8.1.1 Number and ratio of siblings

In accordance with previous research, an elevated number of older brothers and sibling sex ratio was found among MF transsexuals compared to birth-assigned females (Blanchard & Sheridan, 1992; Blanchard et al., 1996; R. Green, 2000a). However, in contrast to previous findings, MF transsexuals did not differ significantly from males with gender-typical identities. Birth order and sibling sex ratio did not differ between birth-assigned males with other gender-variant identities and males with gender-typical identities in spite of previous research suggesting that cross-dressers are more likely to be first-born males (Prince & Bentler, 1972; Schott, 1995). Also contrary to previous research (Blanchard et al., 1996; R. Green, 2000a), this study found that younger siblings played a significant part in this elevated sibling sex ratio.

The fraternal birth order effect found in MF transsexuals has been hypothesised to be linked to demasculinised prenatal hormone exposure due to progressive immunisation of H-Y antigens (see Section 3.1.5). This effect has only previously been found in MF transsexuals who are exclusively sexually attracted to males. The finding in this thesis could be the result of this sexual orientation effect (Blanchard & Sheridan, 1992; Blanchard et al., 1996; R. Green, 2000a), although there was no evidence that number of older brothers differently predicted adult gender-variance in birth-assigned males with different sexual orientations (see Section 8.1.12 for further discussion). In the SEM, number of older brothers was a significant predictor of adult gender-variance, but there was insufficient evidence to suggest birth-assigned males differed from birth-

assigned females as previous studies have found. The finding that this relationship is suppressed when systemising—which is thought to be related to prenatal androgen exposure—is included in the model is in accordance with H-Y antigen immunisation demasculinising prenatal hormone exposure hypothesis.

8.1.2 Number of aunts and uncles

Contrary to the findings of R. Green and Keverne (2000), a greater number of maternal aunts than uncles was not found among any of the groups in this study. From this finding, there is no evidence that an X chromosome linked gene plays a role in the etiology of gender-variance as R. Green and Keverne proposed. Given the discrepancy between the findings of this thesis and R. Green and Keverne's study, further research is required to assess this phenomenon. There were also no differences in the numbers of paternal aunts and uncles in accordance with previous research.

8.1.3 Within-family concordance of sexuality- and gender-variant relatives

Transsexuals and participants with other gender-variant identities of both genders were significantly more likely to report gender-variant relatives than participants with gender-typical identities. Furthermore, the prevalence of reported transsexualism among relatives of transsexuals was higher than the most liberal estimates amongst the general population (Tsoi, 1988; Veale, 2008). This is in line with previous research that has found elevated levels of within-family concordance of gender-variance outlined in Section 3.1.1.2 (e.g. R. Green, 2000b). Given the methodology of this research, it is not possible to distinguish whether this concordance is the result of a genetic or social learning effect. However, it has been reported elsewhere that usually these individuals are not aware that their relative is gender-variant until they reach adulthood (R. Green, 2000b) suggesting a genetic explanation is more likely. The genes that play a role in this development may be those that are responsible for prenatal androgen levels, as there is some evidence for these genes having involvement from linkage studies (see Section 3.1.1.3).

The operational definition of gender-variant relatives used in the questionnaire was somewhat open to interpretation. Participants were asked the number of relatives they "know or suspect are gender-variant (e.g. transsexuals, transgender, transvestites, cross-dressers, drag artistes, gender-queer)". It is possible that participants with gender-variant identities had a lower threshold for describing their relatives as gender-variant

than participants with gender-typical identities did. The operational definition for transsexual relatives was stricter though—a participant needed to "know" this relative was transsexual. Furthermore, it might be expected that participants with gender-typical identities would report a greater number of gender-variant relatives as one of the reasons that they had become interested in this research in the first place could have been because of having a gender-variant relative. For this reason, no active recruitment of participants from online groups for family members or "significant others" of gender-variant persons was undertaken. A limitation of this finding is that it is not possible to determine the extent that this was due to response or sample bias.

8.1.4 Handedness

The study found non-right-handedness was significantly related to adult gender-variance in birth-assigned females, but not birth-assigned males. These results are in accordance with previous findings for birth-assigned females and consistent with the hypothesis that developmental instability has a role to play in the development of gender identities. However, this is the first study with a sample size greater than 12 to find gender-variant birth-assigned males are no more likely to be non-right-handed (see Section 3.1.4 for an outline of previous research on handedness among this population).

It is difficult to interpret this unexpected result, and given it seems to be anomalous, replication is required before conclusions should be drawn about it. This finding is not the result of a suppression effect from the other biological and psychosocial as the bivariate correlation between handedness and adult gender-variance in birth-assigned males was not significant. Handedness is a variable that is significantly negatively skewed, and in this research a greater number of participants reported a higher Edinburgh handedness scale score indicating right-handedness. This relationship between handedness and adult gender-variance only became non-significant in birth-assigned males when estimation that is robust for violations of normal distribution assumptions was used. Analyses that are not robust to these violations will underestimate standard errors in non-normally distributed variables (B. O. Muthén & Kaplan, 1992). This could explain the results being non-significant among birth-assigned males in this research.

8.1.5 Abuse

Analysis of between group differences showed an increased level of emotional, physical, and sexual abuse among transsexuals and participants with other gender-variant identities. This finding is in line with trends of previous research (outlined in Section 3.2.2). Emotional abuse was the only significant abuse predictor of adult gender-variance in the regression models. All three of these potential predictors were significantly correlated, but physical abuse and sexual abuse did not have a unique contribution towards adult gender-variance that was independent of its relationship with emotional abuse.

This research was one of the few studies of abuse in persons with gender-variant identities to use a comparison group. It was also the first to address the question of whether the abuse plays a role in gender-variant identity development or whether this elevated level of abuse is the result of these individuals being more of a target for abuse because of their gender-variance. The SEM results showed that recalled childhood gender-variance partially mediated the relationship between emotional abuse and adult gender-variance among both birth-assigned genders. This suggests that as well as having a direct influence on adult gender-variance, emotional abuse was also the result of gender-variant children being the target for abuse. Further research is required to explore whether the coping mechanisms employed by gender-variant persons in response to their abuse (such as dissociation) play a role in the formation of a gender-variant identity as Devor (1994) proposed.

A limitation of this finding is the reliance on recall of childhood gender-variance. While it would be preferable to have a more direct measure of childhood gender-variance, this is generally not practicable, and most studies of childhood gender-variance in adults rely on the adults' recall (Bailey & Zucker, 1995). One study found recalled childhood gender-variance moderately correlated with independent observers' ratings of gender-variance in childhood home videos (Rieger, Linsenmeier, Gygax, & Bailey, 2008). This is evidence for the validity for using recall to measure childhood gender-variance.

8.1.6 Finger length ratio

Finger length ratio 2D:4D is thought to be a marker for prenatal androgen exposure. No group differences between birth-assigned gender or level of gender-variant identity were found in 2D:4D and 2D:4D was not a significant predictor of adult

gender-variance in the SEMs. Although previous research has generally found differences in the expected direction in studies of transsexuals (Kraemer et al., 2009; Schneider et al., 2006; Wallien et al., 2008), these is some inconsistency. Kraemer et al. unexpectedly found hyperfeminised 2D:4D in FM transsexuals. Studies of 2D:4D in other domains, such as sexual orientation have also yielded inconsistent results, especially among males (Kraemer et al., 2006; Lippa, 2003; Manning et al., 2007; Puts, McDaniel, Jordan, & Breedlove, 2008; Rahman & Wilson, 2003b; Williams et al., 2000).

The present research also did not find the usual sex difference between males and females with gender-typical identities. This is likely to be because a significant proportion of gender-typical participants in the study were not heterosexual, and non-heterosexuality has been related to sex-atypical 2D:4D. Although attempts were made to control for measurement error (see Section 5.3.3), participants' self-measures of their finger lengths could be one reason for this negative finding. While the group difference findings were non-significant, group mean differences tended to be in the expected direction—i.e. feminised 2D:4D when compared to gender-typicals for gender-variant birth-assigned males and masculinised 2D:4D for gender-variant birth-assigned females. Therefore, while the group means differed, the reason for the non-significant finding may have been the increased measurement error from participant self-measurement noted above. Overall, these findings tell us little about the extent to which 2D:4D is related to prenatal androgen exposure, or the role that prenatal androgen exposure might play in the development of gender identities.

8.1.7 Mental rotation

Past studies have found that transsexuals are more likely to perform on tests of three-dimensional object mental rotation as persons of the gender to which they identify than as persons of the gender to which they were assigned at birth. The studies suggest a neurobiological explanation for gender-variant identity development (see Section 3.1.3). In accordance with past studies, the present study found FM transsexuals significantly outperformed MF transsexuals on the mental rotation task. Neither of the transsexual nor the other gender-variant identity groups differed significantly from the gender-typical groups. Mental rotation performance was associated with adult gender-variance in the unexpected direction among birth-assigned males in the SEM that included the systemising quotient, and predicted adult gender-variance in the expected direction

among birth-assigned females in the SEM that excluded the systemising quotient. It can be concluded from these inconsistent results that there is at best limited further evidence for a neurobiological explanation of gender-variant identity development among birth-assigned females.

There are a number of possible reasons for this limited finding. The mental rotation test used differed from the original by (Vandenberg & Kuse, 1978) in that it only had one comparison stimulus instead of three. This alteration was made because it was not possible to publish the original test online for copyright reasons and it is likely that it made the test easier. By being conducted online as a timed test, this test may have been influenced by confounding factors computer ability and speed of internet loading the page. Also, the mental rotation test used in this thesis did not show the usual sex difference among participants with gender-typical identities. Again, this could have been because a significant proportion of gender-typical participants were not heterosexual, and non-heterosexuality has been related to sex-atypical mental rotation scores (see Section 3.1.3).

8.1.8 Systemising quotient

The concept of systemising has been used as an explanation of the development of autism (Baron-Cohen, 2002). Systemising refers to a person's propensity to understand and be able to construct systems. Examples of systems include computers, musical instruments, weather, mathematics, political systems, and library organising systems (Baron-Cohen, 2002). The systemising quotient was developed to measure this construct. Other studies (as well as this one) have shown that gender-typical males score significantly higher on this measure than gender-typical females (Wakabayashi et al., 2007). Baron-Cohen proposed a theory called the "extreme male brain theory of autism" (p. 248). He theorised that persons with autism have a markedly greater systemising ability (a male-enhanced trait) than their empathising ability (a female-enhanced trait). As the name of the theory suggests, those scoring higher on systemising have more of a "male brain". Whilst social environment may play a role in systemising development, there is evidence that autism develops prenatally, probably due to the effects of prenatal hormone levels (reviewed by Baron-Cohen, Knickmeyer, & Belmonte, 2005). A study of children found that systemising was a significant predictor of fetal testosterone levels measured in amniotic fluid—in fact it was a stronger predictor of this than sex itself

(Auyeung et al., 2006). Therefore, there is reason to believe that prenatal androgen levels are a significant contributor to the development of systemising.

A separate model was conducted that excluded the systemising quotient, as this was the first time that this variable has been used as a proxy measure of prenatal androgen exposure. It is also likely that systemising develops from a range of factors, including possible psychosocial factors such as social learning, rather than just prenatal androgen levels.

There were significant between-group differences in systemising latent mean scores in the expected direction for birth-assigned males—i.e. participants with gender-variant identities scoring as would be expected with lower prenatal androgen exposure than participants with gender-typical identities. There were, however, no significant differences between birth-assigned females with gender-variant or gender-typical identities for systemising. The reader is cautioned in their interpretation of these latent mean differences, as there was evidence for scalar non-invariance between birth-assigned genders in the systemising quotient (see Section 6.4). This suggests the latent mean differences could also be explained by measurement differences between groups. Systemising was a significant predictor of adult gender-variance in the expected direction in the SEM among participants assigned to both genders at birth. Including systemising in the models resulted in the variance accounted for of adult gender-variance more than doubling. The more stringent scalar invariance requirement was not required for the SEM analysis, and the less stringent metric invariance requirement was met (see Section 6.4 for results of invariance testing and Section 5.6.4.2 for details of measurement invariance requirements).

There was a marginally significant tendency for gender-variant birth-assigned males and all birth assigned females to respond in a socially desirable way to the systemising quotient to appear more atypical of birth-assigned gender. However, including the BIDR factors as covariates in SEMs did not significantly change the results discussed here.

Overall, these results are consistent with a prenatal hormone predisposition for gender-variant or gender-typical identities, although the possibility of systemising being caused by more than prenatal androgens and the role of socially desirable responding should not be discounted. Future research could examine the relationship between empathising as well as systemising amongst persons with gender-variant identities.

8.1.9 Parental age

Contrary to previous research that has found no differences (Blanchard & Sheridan, 1992; Buhrich & McConaghy, 1978a), the present study found that maternal age was a significant predictor of adult gender-variance among birth-assigned females. The more gender-variant a birth-assigned female's identity was, the older their mother tended to be. An advantage of the study was that it controlled for birth-order effects, and this maternal age effect occurred independently of birth order. This is the first research to show such a finding, and there is no evidence that homosexual females have an elevated maternal age compared to heterosexuals (Frisch & Hviid, 2006; E. H. Hare & Moran, 1979).

Explanations for this finding could be biological. There is also evidence that autism is related to elevated parental age (Croen, Najjar, Fireman, & Grether, 2007; Grether, Anderson, Croen, Smith, & Windham, 2009; Reichenberg, Gross, Sandin, & Susser, 2010). Proposed explanations for this include prenatal hormones, the side-effects of reproductive assistive technologies, and developmental instability (Grether et al., 2009; Newschaffer et al., 2007). These explanations remain as proposals as there has been no direct testing of prenatal hormone levels or use of infertility treatment among persons with autism to date (Newschaffer et al., 2007). The link between autism and adult gender-variance that is discussed in Section 8.1.8 is also relevant here, and it is notable that it was also birth-assigned females with gender-variant identities that this study found tended to score more autistic-typically (as opposed to gender-variant birth-assigned males who scored less autistic-typically). Proposals for developmental instability include genetic mutations or maternal body stressors prenatally including infection and exposure to toxic substances (Newschaffer et al., 2007). Section 3.1.4 gives detail of the developmental instability concept.

Future research examining the relationship between parental age and gender-variance should also examine socioeconomic status to see if it acts as a common-causal variable, influencing both a later maternal age and greater physical and psychological resources to accept having a socially-devalued gender-variant identity.

8.1.10 Parental cohabitation

In the study, cohabitation (operationally defined as the number of years until age 18 living with) with father was negatively related to adult gender-variance. Cohabitation with mother and parental death were not related to adult gender-variance. This is the

first study to assess parental cohabitation in participants with gender-variant identities. However, other studies have found that persons with gender-variant identities were more likely to report parental separation or death (S. M. Bernstein et al., 1981; Langstrom & Zucker, 2005), although one other study has failed to replicate these findings (Hogan-Finlay, 1995). Generally, this finding provides some evidence in favour of theories that have proposed that parental absence plays a role in the causation of gender-variance as a psychosocial factor. As outlined in Section 2.2.1, Coates et al. (1991) proposed paternal absence plays a role in early gender-variance in birth-assigned males, although it is notable that this thesis found some evidence for paternal absence in birth-assigned females but not birth-assigned males. Further proposals by Coates et al. and Zucker and Bradley (1995) of emotional separation from parents, parents preventing the child from developing a sense of autonomy, and marital discord were not assessed in this study. These remain largely untested. Because this is the first time parental cohabitation has been assessed among persons with gender-variant identities, replication of these findings is needed.

8.1.11 Socially desirable responding

Past authors have claimed that research relying on MF transsexuals' self-report of their development and experience is particularly susceptible to socially desirable responding (Bailey & Triea, 2007; Lawrence, 2004), and there is some evidence for this (Blanchard et al., 1985). In the present research, social desirability was modelled in analysis of biological and psychosocial variables predicting adult gender-variant identity. Accounting for social desirability did not significantly change the results. It is possible that the anonymous nature of the survey made it less susceptible to social desirability bias than the past research conducted by Blanchard et al. (Joinson, 1999; Richman, Kiesler, Weisband, & Drasgow, 1999), and this differs from participants in Blanchard et al.'s study which assessed participants' reports of gender-variance experience. Furthermore, participants in Blanchard et al.'s study may have believed that their access to treatment was contingent on how they responded. If this was so, then it is more likely that their responses would have socially desirability bias.

Low standardised regression scores indicate questionable evidence for convergent validity of the BIDR. The results discussed in this section should be interpreted with this in mind. This result was not entirely unexpected, as other studies have reported such concerns with the BIDR (Leite & Beretvas, 2005; Li & Bagger,

2007). Psychometric properties for the BIDR are comparable to the other widely used measure of social desirability, the Marlowe-Crowne social desirability scale (Beretvas, Meyers, & Leite, 2002; Hopwood, Flato, Ambwani, Garland, & Morey, 2009), which Blanchard and colleagues (1985) used in their research. The BIDR was preferred to the Marlowe-Crowne social desirability scale in this study because there is evidence that social desirability is not a unitary construct (Leite & Beretvas, 2005), and the BIDR is the only scale that has attempted to differentiate between these constructs (Paulhus, 1991). In sum, although the psychometric properties of the BIDR are less than ideal, it is the most useful tool available for social desirability assessment.

8.1.12 Sexual orientation as a moderating variable among birth-assigned males

Blanchard's theory predicts that there would be improvement in model fit if biological and psychosocial variables' prediction of adult gender-variance in this study were allowed to vary between androphilic and non-androphilic birth-assigned males. However, when these restrictions were relaxed, no significant improvement in model fit was observed. Regression coefficients for each of these variables predicting adult gender-variance had overlap in their confidence intervals. Power analysis revealed that in the current study there was a power level of .89 to detect a between-group difference in these biological and psychosocial variables of small effect size magnitude. This can be considered an adequate level of statistical power (Cohen, 1988). Effect sizes for differences between these groups on observed parameters of biological and psychosocial variables predicting adult gender-variance between were all less than the d = .20 convention of small effect size. This suggests no evidence for the proposed moderation effect of sexual orientation on these relationships as predicted by Blanchard's theory, which proposed distinct etiologies dependent on sexual orientation type (Bailey & Triea, 2007; Freund & Blanchard, 1993; Freund et al., 1982). Evidence for measurement invariance between androphilic and non-androphilic groups conducted in Chapter 6 suggests that these results cannot be explained by differences in the measurement model between these two groups.

This lack of a sexual orientation moderation effect is consistent with Hypothesis 2 (see Section 4.1). This hypothesis was based on past research that found transsexuals' sexual orientation is unrelated to handedness effects (R. Green & Young, 2001), 2D:4D (Kraemer et al., 2009), and differences found in neuroimaging (Luders et al., 2009), but inconsistent with fraternal birth-order research (see Section 3.1.5).

Lawrence and Bailey (2009) argued that transsexual participants in previous research by the same author that used similar internet methodology (Veale et al., 2008) were overwhelmingly non-androphilic. Because of this, strict criteria for being categorised as androphilic were imposed in this study—participants needed to report exclusive or almost exclusive sexual fantasies and experience with males. Although a small proportion of the birth-assigned male participants with gender-variant identities were categorised as androphilic, this sample size was large enough to detect group differences of small effect size.

8.1.13 Findings of participants with other gender-variant identities relative to transsexual and gender-typical participants

As outlined in Chapter 2, Docter's (1988) theory of gender-variant identity development proposed a continuum from no gender-variant identity to transsexualism at the ends, with persons with other gender-variant identities being somewhere between these. If this proposal is correct, then it would be expected that participants with other gender-variant identities would score intermediary between transsexuals and participants with gender-typical identities on biological and psychological variables. This was the case for the majority of the biological and psychosocial variables in the present research that showed between-group differences. This finding is consistent with Hypothesis 3 (see Section 4.1), and the finding provides support for this aspect of Docter's theory. This is the first research to study variables relevant to the development of gender-variant identities in both transsexuals and participants with other gender-variant identities.

8.1.14 Conclusions

In this thesis, additional evidence was presented to build on past findings that biological factors play a role in the etiology of gender-variant identities. Results discussed in this chapter showed that systemising, within-family concordance of gender-variance, and number of older brothers were related to adult gender-variant identity development among all participants. Additionally, non-right handedness, mental rotation ability, and mother's age were related to adult gender-variant identity in birth-assigned females. A review of cases reported in the academic literature of twin pairs where at least one twin was transsexual was given in Section 3.1.1.1. A significantly greater concordance of transsexualism amongst MZ twins than DZ twins

suggests a genetic predisposition for gender-variant identities. Persons with intersex and related conditions have significant biological differences from the rest of the population, especially with prenatal androgen exposure. A review of these cases reported in the academic literature given in Section 3.1.2.1 suggests that persons with these conditions are more likely to develop a gender-variant identity than persons in the general population. This is further evidence that prenatal androgen exposure plays a role in gender identity development.

While there is evidence for a number of biological variables, this does not necessarily imply more than one biological mechanism plays a role—these biological factors may be related and share a common precursor. For instance, it is plausible that there is a causal pathway in which genes that cause atypical prenatal hormones levels lead to neuroanatomical differences linked to gender identity.

This chapter also discussed evidence for psychosocial factors that may play a role in the development of gender-variant identities. Paternal cohabitation and abuse were related to adult gender-variant identity development in all participants. Modelling suggested that abuse may be a cause as well as a result of having a gender-variant identity. Also, the review of persons with intersex and related conditions shows a significant proportion of cases with male-typical biology who were assigned female gender at birth developed female gender identities in adulthood. This gives further evidence that psychosocial factors play a role in their gender identity development. It is likely that these factors are complex and work in interaction with biological variables.

In accordance with Docter's (1988) theory, this study found the biological and psychosocial variables related to gender-variant identity development were the same for transsexuals as they were for participants with other gender-variant identities. The results also showed no evidence that sexual orientation moderated the effects of these biological and psychosocial variables on adult gender-variance. This result is inconsistent with Blanchard's (1989b) theory of gender-variant identity development.

8.2 Social context of gender-variant identities

The social, cultural and historical contexts of different gender-variant identities are beyond the scope of the thesis. The focus has been limited to contemporary understandings of gender-variant identities in the Anglo-West. Across different cultures and time periods there will be context specific understandings given to different identities that could be understood as gender-variant. A person will be more or less

likely to identify with gender-variant identities depending on their context. It has been noted that in cultures that have less tolerance for feminine homosexual males but relatively more tolerance for persons of a “third sex”, persons in these countries will be more likely to have the latter identity (Koolaee, 2011; Veale et al., 2010).

From studying reports of the sexual orientation of MF transsexuals from around the world, Lawrence (2010) found that MF transsexuals from collectivist cultures were more likely to report androphilic transsexualism, while studies from individualist cultures were more likely to report non-androphilic transsexualism. In collectivist cultures there is sometimes a socially sanctioned accommodation for birth-assigned males having cross-gender roles. However, it is possible that non-androphilic transsexuals do exist in these collectivist cultures, but in secrecy. It may be that it is only acceptable for those with an androphilic experience of transsexualism to undergo transition. Lawrence suggested that it might be more socially disruptive for non-classical transsexuals to undergo transition because these individuals look less convincingly female, are often married to women, have children, and may hold positions of authority.

The thesis is concluded in the next chapter with discussion of the strengths, limitations, and implications of this study from which these results and conclusions are drawn.

CHAPTER 9 - LIMITATIONS, IMPLICATIONS, AND CONCLUSIONS

This chapter aims to contextualise the results discussed in Chapter 8 by evaluating the reliability and validity of the scales. It discusses the limitations of the study, and suggests some implications of its findings for theory and future research. Conclusions include further evidence for biological and psychosocial variables, especially in those biological variables related to prenatal androgen exposure. These biological and psychosocial variables were the same for transsexuals as those with other gender-varaint identities and there was no evidence that these differed in birth-assigned males of different sexual orientations. The strengths and contributions of the study include a large sample size, robust data analysis, and a larger range of biological and psychosocial factors than has been previously studied across a diverse range of persons with gender-variant identities.

9.1 Reliability and validity of the measures

In Chapter 6, all of the latent variables used in this thesis were subjected to confirmatory factor analysis. While some modifications were required to the scales, all of the confirmatory factor analyses were modelled in a way that had adequate fit for the data. Generally, the modifications that were made to the items were consistent with those made in previous studies performing the same analyses on the respective scales. Correlations in error terms were freely estimated between two items in the emotional abuse, systemising quotient, and BIDR scales respectively. Because these items appear to be due to overlap in item content rather than any method effects, it is appropriate that these correlations be estimated (Byrne, 2010; Kline, 2011). Reliability of the scales was acceptable (reliability coefficients greater than .70) for all scales (George & Mallery, 2003).

Factorial validity was assessed. Standardised factor loadings for items on all of the scales except the BIDR were around .70 or greater, indicating evidence for convergent validity (Kline, 2011). Standardised factor loadings for the BIDR tended to be .40 to .60, suggesting evidence for convergent validity is tenuous. This issue was discussed further in Section 8.1.11. Correlations between variables used in this study are outlined in Appendix E (p. 193). None of these correlations are excessively large (i.e. greater than .90) indicating evidence for discriminant validity (Kline, 2011).

Testing for measurement invariance was also conducted. As outlined in Section 5.6.4.2, metric invariance is required for group difference comparisons in the relationships between variables to have meaning and scalar invariance is required for group latent mean difference comparisons to have meaning (Conroy et al., 2003; Gregorich, 2006). Evidence for scalar non-invariance between birth-assigned genders for systemising and recalled childhood gender-variance was found. Evidence for scalar non-invariance between androphilic and non-androphilic birth-assigned males for mental rotation and between countries for the BIDR was also found. Latent mean differences for recalled childhood gender-variance and the BIDR were not assessed in the thesis, so these findings do not limit the results. However, latent mean differences for systemising were assessed, so this non-invariance finding was considered when these results were discussed in Section 8.1.8. With the exception of this systemising between-group difference, all findings of differences between these groups discussed in Chapter 8 could not be the result of measurement non-invariance. The questionnaire was available to a global sample so it was possible some wording used in the questions had different meanings for participants in different countries. However, the finding of measurement invariance between participants in the USA and those in Australia/New Zealand (67% of the sample) for all of the latent variables used in this thesis does not support these concerns.

Overall, these findings suggest that latent variables used in this thesis have adequate reliability and validity. Measurement models had adequate fit for the data and there was no evidence of measurement invariance between groups. These findings strengthen the results of the hypothesis testing.

9.2 Limitations

The correlational design of the study limits the causal inferences that can be made from the findings (Goodwin, 2010). Causal pathways from biological and psychosocial variables to adult gender identity could be modelled because there is time precedence for the biological and psychosocial variables. However, it is also possible that the relationships between these could be explained by a common causal factor (Goodwin, 2010). Future research could use longitudinal design to directly measure variables such as prenatal androgen levels and childhood gender-variance, following up to adult gender identity.

Another limitation of this study was possible response bias on the basis that 25% of participants who began the questionnaire did not complete all questions. Those participants who dropped out may have differed from the population. Some participant dropout should be expected in an internet questionnaire of the length used in this study. Dropout rate was significantly lower than another study that used a sexuality questionnaire of a similar length (Ross, Daneback, Mansson, Tikkanen, & Cooper, 2003). One previous sexuality-related study found there are few internet use or demographic biases due to internet questionnaire dropout (Ross, Rosser, Stanton, & Konstan, 2004), suggesting this response bias may have been minor.

Findings of the study may also have been affected by selection bias. Because the recruitment and data collection was carried out online, the sample represented only internet users. Also, the recruitment method of targeted mainly online transgender social and support groups, and accordingly those persons with gender-variant identities who do not have contact with this online transgender community were not likely to be reached. Those persons who use a computer to access such groups may be over-represented in the sample. It is unclear what effect this result had on conclusions. In a similar worldwide online study examining the sexuality of MF transsexuals and gender-typical birth-assigned females, Veale (2005) found the sample over-represented younger and European people when compared to New Zealand census data. Nevertheless, it is unlikely that the sample used was more biased than samples used for other sexuality research (see Strassberg & Lowe, 1995).

Another limitation of internet-based methodology is the lack of controls on responding. Given that the subject matter of the current study is contentious (Dreger, 2008) this research may have been subject to deliberately misleading or malicious responding. However, there were some checks built into the online survey to prevent this. Participants could not respond to the questionnaire more than once on one computer. There were checks on participants giving responses that were not possible, consistent outlier scores, or consistently giving the same responses. There was no evidence that this occurred (see Section 5.5). In addition, no suspicious patterns in the timing of responses, such as a large number of responses in a short time period, were noticed. Therefore, it is unlikely this issue had an effect on results.

The questionnaire was updated to a second version with additional questions. This could potentially have altered participants' responses between those who had or had not been exposed to the additional questions. However, there was no evidence for

measurement invariance between participants completing the different versions of the questionnaire. This suggests that the different questionnaire versions had negligible impact on the results.

While this research was subject to a number of possible limitations, it is unlikely that these had marked effects on the conclusions of this thesis.

9.3 Theoretical implications

This is the first study to directly test and find evidence that the biological and psychosocial variables involved in the development of gender-variant identities are the same for transsexuals as they are for persons with other gender-variant identities. As outlined in Section 8.1.13, this study found participants with other gender-variant identities tended to score intermediary between transsexuals and participants with gender-typical identities in these biological and psychosocial variables. Docter's (1988) theory proposed that persons with other gender-variant identities have a form of gender-variant identity that is the same as transsexualism, just to a less strong or enduring degree. This study provides evidence for a continuum between those who are gender-typical and transsexuals. It shows that other forms of gender-variant identity are at an intermediary position within this spectrum.

This research provides evidence against Blanchard's (1989b) theory of gender-variant identity development which proposed that there are two distinct types of gender-variance in birth-assigned males. As outlined in Section 8.1.12, it was found that androphilic and non-androphilic gender-variant birth-assigned males did not differ in their pattern of etiologically relevant variables (number of older brothers and gender-variant relatives, 2D:4D, systemising, emotional abuse, handedness, mental rotation, mother's age, and paternal cohabitation) predicting adult gender-variance. The current study had adequate power to detect a difference of small effect size magnitude. This is highly significant for the conceptualisation of gender-variance because it challenges the theoretical precept of different types of gender-variance based on different biological and psychosocial factors in those with different sexual orientations.

Further theoretical development could take into account evidence that there appear to be similar biological (and possibly psychosocial) etiological factors for gender-variant identities (regardless of sexual orientation), paraphilias, and sexual orientation (see Rahman & Symeonides, 2008; Rahman & Wilson, 2003a; and Chapter 3 of this thesis for summaries of these factors). It may be that these biological (and

psychosocial) factors interact with other proposed psychological factors (environmental/cultural acceptance, personality, defence and coping styles; Veale et al., 2010) and other unknown factors to determine eventual gender identity and sexual attraction outcomes.

9.4 Wider implications

The findings of this thesis may help persons with gender-variant identities to make sense of their own history and experiences. Blanchard's (1989b) theory of two types of gender-variance based on sexual orientation was formulated in a way that proposed non-androphilic gender-variance in birth-assigned males is caused by sexual deviance. He proposed that *errors* in erotic target localisation are the cause of this type of gender-variant identity (Blanchard, 1991). In the context of broader social stigma against persons with gender-variant identities, Blanchard's theory has been experienced negatively by many in this community (Dreger, 2008; Veale et al., 2009). These findings suggest sexual orientation is not a moderating factor in the development of gender-variant identities in birth-assigned males. This is likely to decrease the social stigma associated with gender-variant identities.

This research evidence against Blanchard's theory of autogynephilia gives clinicians working with people with gender-variant identities more confidence in working with alternative frameworks for understanding gender-variance. The perceived negative implications of Blanchard's theory for people with gender-variant identities and the associated response to Blanchard's theory from within the gender-variant community have meant that clinicians are unlikely to openly use this theory to understand and discuss the development and experiences of their client. As an alternative to Blanchard's theory, clinicians have used what has been called the *feminine essence narrative* when referring to gender-variant birth-assigned males (Bailey & Triea, 2007; Blanchard, 2008; Dreger, 2008). A masculine essence narrative could equally be applied to gender-variant birth-assigned females. This framework has been used by clinicians to be able to work more openly and collaboratively with clients with gender-variant identities (Ettner, 1996; Lev, 2004).

The etiology of gender-variant identities should not impact on access to healthcare and freedom from discrimination and violence for expressing one's gender identity. This access has been proposed to be recognised as an international human right, and this recognition is becoming realised in many countries (e.g. Hammarberg,

2009; O'Flaherty & Fisher, 2008). Therefore, it is important to underscore that while these findings suggest there are biological and psychosocial components to the etiology of gender-variant and gender-typical identities, these findings should be limited to advancing our scientific understanding, rather than determining access or eligibility to medical services. There has been concern that Blanchard's claims about autogynephilia will lead to restrictions of the health treatment offered to persons with gender-variant identities because it is politically unpalatable (e.g. James, 2006). Blanchard himself rightly pointed out that access to health treatment should not be impacted by whatever the etiology of gender-variant identities might be (Blanchard & Fedoroff, 2000). The growing international recognition of the right to express one's gender identity without discrimination is paramount, regardless of which biological or psychosocial factors are relevant to the development of gender-variant identities.

9.5 Suggestions for future research

This thesis found evidence for a number of biological and psychosocial variables related to the development of gender identities. Future research could conduct investigation into the relative importance of these predictor variables using dominance analysis (Budescu, 1993). Commonality analysis could be conducted to assess the amount of adult gender-variance that is explained by each predictor uniquely or common to a number of predictors (Seibold & McPhee, 1979). This analysis could further our understanding of whether there are different etiological pathways to gender-variant and gender-typical identity development as has been proposed.

Section 3.1.2.1 reviews follow-up of people who have intersex and related conditions with male-typical biology who were assigned female at birth. Many of these people were reported to have a female gender identity in adulthood. This suggests environmental encouragement of gendered behaviour plays a role as a psychosocial factor in gender identity development. This factor was overlooked in the present study. Future research could assess this.

As outlined in Section 9.2, this research was conducted on an internet-based sample that was susceptible to sampling bias. Future research could replicate these findings among a population-based sample by using a wider range of data collection methods.

This research examined one area related to gender identity development—the ways in which biological and psychosocial factors predict adult gender-variant identity.

Future research could look at broader areas. Blanchard's theory proposed that cross-gender eroticism causes a gender-variant identity to develop in birth-assigned males with sexual attractions to females (Blanchard, 1991; Freund & Blanchard, 1993). This theory states that cross-gender eroticism is caused by an erotic target localisation error, but Blanchard never speculated what might cause this error. Boyd (2003) proposed that this error could occur because of being sexually intimidated by women in adolescence. A pathway for Blanchard's theory that could be tested would look like: sexual intimidation from women → cross-gender eroticism → adult gender-variance.

It may be that the biological and psychosocial factors linked to gender-variant identity interact with other unknown factors to determine eventual gender identity and sexual attraction outcomes. A more recently developed theory proposes that environmental tolerance or acceptance of early gender-variance expression, childhood coping and defence styles, and childhood personality all predict whether an individual with a gender-variant identity will repress that identity and develop along the non-androphilic pathway, or not and develop along the androphilic pathway (Veale et al., 2010). Some previous studies have assessed perceived environmental tolerance or acceptance of early gender-variance expression (B. Bullough & Bullough, 1997a; Langstrom & Zucker, 2005; Rieger et al., 2008) but these have not examined whether it is related to a androphilic/non-androphilic gender-variance experience. Also, no previous research has assessed defence mechanisms and coping styles among persons with gender-variant identities. There is, however, some work on personality conducted on persons with gender-variant identities. In accordance with the theory, this work has found that those reporting a non-androphilic experience report less extraversion than those with a androphilic experience (Bentler & Prince, 1969; Smith, van Goozen, Kuiper, & Cohen-Kettenis, 2005a; Wilson & Gosselin, 1980). One study reported signs of agreeableness among participants with a non-androphilic experience (B. Bullough & Bullough, 1997b) in persons with gender-variant identities. Future research could assess the extent to which environmental tolerance or acceptance of early gender-variance expression, childhood coping and defence styles, and childhood personality predict whether an individual with a gender-variant identity will report an androphilic or non-androphilic gender-variance experience.

9.6 Conclusions

This thesis broadened our understanding of etiological factors that are involved in gender-variant or gender-typical identity development. As with previous research, the current study provided evidence that fraternal birth order, familial co-occurrence of gender-variance, handedness, abuse, and mental rotation ability were related to adult gender-variance. Some previously untested biological and psychosocial variables were also related to adult gender-variance in this study: systemising, maternal age, and paternal cohabitation. The study was also able to confirm the factor structure of a number of latent variables and account for socially desirable responding.

These findings had implications for theories of gender-variant identity development. Specifically, in accordance with Docter's (1988) theory, it was found that biological and psychosocial variables tended to occur on a continuum between participants with gender-typical identities and transsexuals. Participants with other gender-variant identities scored intermediary between participants with gender-typical identities and transsexuals. This research suggests the same biological and psychosocial factors are involved with the development of transsexualism and other gender-variant identities.

There was also no evidence that biological and psychosocial factors differed between gender-variant birth-assigned males with different sexual orientations, as Blanchard's (1989b) theory predicts. Blanchard's theory suggested that sexual orientation was paramount in understanding two different etiologies of gender-variance: rational choice amongst androphilic birth-assigned males and autogynephilia amongst non-androphilic birth-assigned males. This research shows similar biological and psychosocial variables regardless of sexual orientation.

These findings build evidence for a biological predisposition to gender-variant and gender-typical identities with the strongest evidence for genetic and prenatal hormone effects. Any psychosocial determinants of gender identities are likely to be complex and work in interaction with biological factors, although further research is required to explore whether different developmental pathways can be observed from these biological and psychosocial variables.

This thesis makes an important contribution to our understanding of the development of gender-variant and gender-typical identities. This study was the first to examine a large number of biological and psychosocial factors relevant to the etiology of gender identities in one sample. It included factors that have been linked to gender

identity development in the past and explored new variables. Unlike previous studies, the present research included multiple factors predicting adult gender-variance in a regression-type model. Although past studies have identified a relationship between a single biological or psychosocial variable and adult gender-variance, the purported causal relationship may have been hidden or suppressed by the relationship between other biological and psychosocial variables (Cohen et al., 2003). By including a number of biological and psychosocial variables in this study, this problem was minimised. In addition, this research was open to all participants, making it one of the first studies to include participants from the entire spectrum of gender-variant identities. It was the first research to assess whether biological and psychosocial factors are the same for transsexuals as for participants with other gender-variant identities. It was also possible to explore mean differences between transsexual, other gender-variant identity, and gender-typical identity groups.

One of the main strengths of this thesis is the large sample size (N = 2,277). The large sample size allowed the use of, SEM to model latent constructs. It was also possible to detect effects of small sizes. The sample size allowed for assessment of the validity of the latent variables using confirmatory factor analysis. By taking into account measurement error in the variables used in the study, a more accurate estimation of the relationships between these variables and their predictive power could be undertaken. Invariance testing was also conducted to rule out findings of group differences being explained by measurement non-invariance. There was evidence for measurement invariance between participants in different regions (USA and Australia/New Zealand), suggesting cultural differences in word meaning were unlikely to have affected the findings.

The large sample size made it possible to test for differences between birth assigned males versus birth-assigned females and different sexual orientation groups. Power analysis showed it was possible to detect small effect size differences between these groups. By using SEM, it was possible to assess evidence for the causal direction of abuse as an etiological factor. In addition, unlike most past research in this area, this research was conducted using a statistical technique that was robust to non-normality in the distribution of variables.

Research on this topic tends to rely on self-report measures which are susceptible to response biases such as social desirability. However, social desirability was controlled for in the present study. This was the first study of biological and

psychosocial correlates of gender-variant identity development that has accounted for social desirability.

Table 9.1 summarises the contributions that the thesis makes.

Table 9.1 *Summary of contributions of the research*

This is the first research examining the development of gender-variant identities to:
- examine a large number of biological and psychosocial variables to be able to analyse these in a regression-type model to gain further insight into the true relationship of these. - include both transsexuals participants with other gender-variant identities to assess whether biological and psychosocial factors are the same for these different groups. - incorporate social desirability in a study of biological and psychosocial correlates. - use SEM methodology and use estimation robust to violations of multivariate normality.

By improving our understanding of the biological and psychosocial factors related to gender-variant and gender-typical identities, this thesis deepens understandings of the development of their gender identities. The results of this thesis have potential to aid clinicians working with people with gender-variant identities to understand their clients' gender identity development. In turn, these findings may help persons with gender-variant identities to understand their own gender identity development and make meaning of their lives.

SECTION VI - REFERENCES

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SECTION VII - APPENDICES

APPENDIX A - CALL FOR PARTICIPANTS ON ONLINE FORUMS

Hi everyone,

I'm Jaimie, a transwoman currently doing my PhD thesis (dissertation) at Massey University in New Zealand. My research is looking at influences on the development of gender and sexuality. I am looking to recruit people to participate in this research, which is open to anybody, whether you are queer*/LGBTIQ, gender-variant, sexuality-variant, or not. Taking part involves completing a survey of mostly multiple-choice questions that will take about 25-50 minutes. If you would be kind enough to participate in my research the questionnaire can be accessed by clicking here.

More information about my project and my contact information can also be found by going to that link.

All responses to this survey are kept confidential. You will not be asked any information that will distinguish you (for example, your name), so your responses will be completely anonymous.

I've also tried to make the process a little bit educational for participants: I've included some information within the questionnaire about the questions you are being asked and how they relate to gender and sexuality development. Also when you complete the survey you will be given the opportunity to be sent an outline of the results of my project once these become available.

Thank you, your help is greatly appreciated,

Jaimie Veale

* "Queer" is a reclaimed word that represents sexual and gender diversity. I acknowledge that it is not a term that all people identify with, and it's not the preferred term for everybody.

APPENDIX B - QUESTIONNAIRE

B.1 Information sheet

QueerDevelopment.com—Development of Gender and Sexuality Project.

This is a survey examining aspects of the development of gender and sexuality-variance. This survey is open to anyone to take, whether you are queer*/LGBTI, gender-variant, sexuality-variant, or not. Your participation is greatly appreciated.

The attributes that this survey will be questioning on include personality, coping mechanisms, personality, early childhood experiences, and measures biological variables that have been found to be associated with sexuality and gender-variance—including handedness, three-dimensional mental rotation skills, finger lengths, and family history of sexuality and gender variance. If you are still interested, at the end of the questionnaire there is more detailed information about what exactly I am looking for in my research, and how I am going about testing it.

At times, when you are completing the questionnaire, you may wonder why you are being asked some of the questions, and what they have to do with gender and sexuality. Because of this, I have included links in various places throughout the questionnaire which say "Why am I being asked about this?" (or something similar). When you click on the link you will be given background information about what I am asking about, and why it is relevant. This way I hope to educate you about the interesting topics of gender and sexuality as a way of saying thank-you for taking the time to complete the survey.

Please note that this questionnaire is only open to persons aged 16 and over. More details about this project are presented in the further information section below, otherwise click the "Next" button below to continue to the survey.

* Queer is a reclaimed word that represents sexual and gender diversity. I acknowledge that it is not a term that all people identify with, and it’s not the preferred term for everybody.

Further Information about the Project.

My name is Jaimie Veale, I am undertaking this research for my Doctoral thesis in psychology at Massey University. This research is testing a model that I developed to explain the development of gender-variance e.g. transsexualism, transvestism, and other forms of gender diversity. If you would like to know more about this model, you will be given the opportunity at the end of the questionnaire to read a more detailed explanation, and comment on whether you believe it is feasible.

Because you won’t be giving any information that will identify you, you and all the other participants in this project will be completely anonymous. In addition, the Apache server used to collect this data provides a high level of security.

If you wish to participate, you complete a multiple-choice survey of approximately 150 items. I estimate that this will take 30-55 minutes for you to complete. Completion and submission of the questionnaire implies acknowledgement you are over the age of 16 and give consent.

There are questions in the survey that ask about sexuality, family history, gender expression, childhood experiences including abuse, and ways of coping with stressful situations. If you are not comfortable with answering questions on these topics then I suggest you do not proceed with this questionnaire. You have the right to decline to answer any question.

If you have personal concerns about any issues raised in the questionnaire, click here and a list of organisations that may be contacted for support, information, or

counselling will appear in a popup window. Please note that the list is provided as information only—I have not been in contact with any of the organisations, or put in place any services from them for support or counselling.

Only the researcher and the supervisors will have access to your answers, which will be sent using a secure encryption. However if you believe you are potentially at risk from other people seeing your responses to this questionnaire we recommend you don't respond to this questionnaire from a public computer (e.g. your workplace or an Internet cafe), and delete all "cookies" and "history" from your browser once you have submitted your answers to this questionnaire. If you are unsure how to delete these, instructions can be found here http://www.boutell.com/newfaq/privacy/history.html.

On completion of the questionnaire you will be given the option of emailing me to request to be sent a copy of the results once they become available. You are also most welcome to contact me and/or my supervisors if you have any questions or concerns about the project or would like more information about the questions that the survey contains. Your queries will be responded to promptly.

Researcher contact details:	Supervisor contact details:	
Jaimie Veale	Dr Dave Clarke	Dr Tess Lomax
jaimie.veale.1@uni.massey.ac.nz	d.clarke@massey.ac.nz	tess@aut.ac.nz

This project has been reviewed and approved by the Massey University Human Ethics Committee: Northern, Application 07/0 06. If you have any concerns about the conduct of this research, please contact Associate-Professor Ann Dupuis, Chair, Massey University Human Ethics Committee: Northern, telephone 09 414 0800 x 9054, email humanethicsnorth@massey.ac.nz.

Please note that this questionnaire is only open to persons aged 16 and over. Click the "Next" button below to continue to the survey.

List of organisations that may be contacted for support, information, or counselling:
Save Our Selves International drug, alcohol, addiction support – www.sossobriety.org
International Child Abuse Network – www.yesican.org
Bisexual Resource Center – www.biresource.org
International Lesbian and Gay Association – www.ilga.org
International list of transgender support organisations, care of Wikipedia – en.wikipedia.org/wiki/User:Ntennis/List_of_transgender_support_organisations

B.2 Demographics

Please select your gender
Response options: Female; Male; Other.

Please select the gender you were assigned at birth
Response options: Female; Male.

Do you identify as any of the following?
Response options: Transvestite; Genderqueer; Transgendered; Drag king; Drag queen; Cross-dresser; Transsexual; Androgyne; Non-gendered; Bi-, Third-, or Omni-gendered.

Ethnicity

Response options: White/Caucasian/European; Black/African/Negro; East Asian e.g. Chinese, Japanese, South-East Asian; Indian, Pakistani, Bangladeshi, or any other Asian; Pacific Islander; Hispanic/Latino; Arabic, Egyptian or Maghreb; Maori; American Indian; Australian Aboriginal; Other.

Which country do you live in?

Level of education (please select highest obtained)
Response options: 3 years of high school or less; 4 years of high school; 5 years of high school; Diploma, trade certificate or apprenticeship; Bachelor's degree; Master's degree; Doctoral degree; Other.

Do you hold a diploma or higher-level qualification in any of the following fields?
Response options: Engineering, mathematics, or physical sciences; Medicine or biological sciences; Arts, law, social sciences or humanities; Fine arts, music, sports or dance.

B.3 Family information

How many biologically male children has your biological mother given birth to? (Excluding yourself if applicable).

How many of these biological males were born before you?

How many biologically female children has your biological mother given birth to? (Excluding yourself if applicable)

How many of these biological females were born before you?

How many biological sisters did your biological mother have? This includes half-sisters

How many biological brothers did your biological mother have? This includes half-brothers

How many biological sisters did your biological father have? This includes half-sisters

How many biological brothers did your biological father have? This includes half-brothers

How many of your blood relatives (relatives with whom you share a common ancestor) do you know or suspect are or were homosexual or bisexual?

How many of your blood relatives do you know or suspect are gender-variant (e.g. transsexuals, transgender, transvestites, cross-dressers, drag artistes, gender-queer)?

Of these gender-variant relatives, how many do you know are transsexual?

Response options: Brothers; Sisters; Mother; Father; Aunts on your mother's side; Uncles on your mother's side; Aunts on your father's side; Uncles on your father's side; Grandparents on your mother's side; Grandparents on your father's side

You are only required to answer one of the following three questions

How old is your biological mother?
How old was your biological mother when you were born?
In what year was your biological mother born?

You are only required to answer one of the following three questions

How old is your biological father?
How old was your biological father when you were born?
In what year was your biological father born?

For how many years until age 18 did you live with both of your biological parents?

For how many years until age 18 did you live with your biological mother but not your biological father?

For how many years until age 18 did you live with your biological father but not your biological mother?

Please select the statement below which best describes you biological parents' marital situation
Response options: My biological parents never married; My biological parents divorced before I was 18; My biological parents were married until I was 18

Please select the statement(s) below which apply to your situation
Response options: Both of my biological parents were alive at my 18th birthday; My biological mother died before my 18th birthday; My biological father died before my 18th birthday

B.4 Hand variables

Edinburgh Handedness Inventory

Please indicate your preferences in the use of hands in the following activities. Some of the activities require both hands. In these cases the part of the task, or object, for which hand preference is wanted is indicated in brackets: Writing; Drawing; Throwing; Scissors; Toothbrush; Knife (without fork); Spoon; Broom (upper hand); Striking match (match); Opening box (lid).
Response options: Always right; Usually right; Both equally; Usually left; Always left.

Finger lengths

This task involves measuring the lengths of your fingers. For this task you will need a ruler or tape measure. If you don't have either of these, click here and an online ruler will open in a new window for you to use. This online ruler is more difficult to use, and not as accurate, so it is preferable for you to use a physical ruler if you can.

* Hold your right hand in front of you.
* Look at where your ring finger joins the palm of your hand.
* Find the bottom crease. Go to the middle of this crease.
* Put the 0 of your ruler exactly on the middle of the bottom crease. Make sure the ruler runs straight up the middle of your finger.
* Measure to the tip of your finger (not your nail) in millimetres
* Every millimetre counts so it is important to do this as accurately as possible.

For my records, I'd like to know how many people use the online ruler. Please select the type of ruler you used.

Response options: Online rule; Physical (not online) ruler or tape measure.

B.5 Sexuality variables

Please select the one choice which best describes you:

I have never had a sexual fantasy about a man. My sexual fantasies always involve women

I have had very few sexual fantasies about men. The vast majority of my sexual fantasies have been about women

I have had many sexual fantasies about men. However, I more often fantasise about women

My sexual fantasies have been equally often about men and women

I have had many sexual fantasies about women. However, I more often fantasise about men

I have had very few sexual fantasies about women. The vast majority of my sexual fantasies have been about men

I have never had a sexual fantasy about women. My sexual fantasies always involve men

I have not had sexual fantasies about men or women.

Please select the one choice which best describes you:

I have never had any sexual experiences with another person. (By sexual experience we mean an activity which led to orgasm)

I have never had a sexual experience with men. My sexual experiences have always involved women

I have had very few sexual experiences with men. The vast majority of my sexual experiences have been with women

I have had several sexual experiences with men. However, most of my sexual experiences have been with women

My sexual experiences have equally often involved men and women

I have had several sexual experiences with women. However, most of my sexual experiences have been with men

I have had very few sexual experiences with women. The vast majority of my sexual experiences have been with men

I have never had a sexual experience with women. My sexual experiences have always involved men.

At present, do you regard yourself as

Response options: Primarily heterosexual; Primarily homosexual; Primarily bisexual; Primarily asexual

How would you characterize yourself on the following dichotomy?[1]
Response options: Completely "straight acting"; More "straight acting" than "gay acting"; Equally "straight acting" and "gay acting"; More "gay acting" than "straight acting"; Completely "gay acting"; This does not apply.

How would you characterise yourself on the following dichotomy?[2]
Response options: Completely "butch"; More "butch" than "femme"; Equally "butch" and "femme"; More "femme" than "butch"; Completely "femme"; This does not apply

How often do you assume the dominant role or position during sex?[3]
Response options: Never; Rarely; Sometimes; Most of the time; All of the time; Never had sex.

Sexual intimidation from women

SexIn1 During my early teenage years I felt intimidated by sexually attractive women[4]
SexIn2 I would often feel anxious around sexually attractive women during my early teenage years[4]
SexIn3 When I first became sexually interested in girls I was shyer around them than other boys I knew[4]
SexIn4 During my early teenage years, I had more difficulty approaching girls I like than my peers had[4]
SexIn5 In the past, I've found sexually attractive girls quite intimidating[4]

Response options: Strongly disagree; Moderately disagree; Slightly disagree; Neither agree or disagree; Slightly agree; Moderately agree; Strongly agree; I do not remember

B.6 Recalled childhood personality

Questions that ask about your experiences "as a child" refer to ages 0 to 12.

Agreeableness

Agr1: As a child, I would feel little concern for others
Agr2: As a child, I was on good terms with nearly everyone
Agr3: Were you considered a "good" child or did you get in trouble and get a "bad" label?
Agr5: As a child, I had a good word for everyone

Co-operativeness

Coop1: As a child, I hated to seem pushy
Coop2: During my childhood I couldn't stand confrontations
Coop3: As a child, I had a sharp tongue
Coop4: As a child, I was easy to satisfy
Coop5: As a child, I resisted authority
Coop6: As a child, I broke rules
Coop7: As a child, I loved a good fight
Coop8: During my childhood I yelled at people

Conformity

Conf1: As a child, I didn't care what others thought of me

Conf2: As a child, I worried what people thought of me

Conf3: As a child, I did what others did
Conf4: As a child, I was not concerned with making a good impression
Conf5: As a child, I wanted to be different from others
Conf6: As a child, I would feel it was OK that some people didn't like me

Extraversion

Ex1: As a child, I warmed up quickly to others
Ex2: As a child, I kept in the background
Ex3: As a child, I had little to say
Ex4: As a child, I didn't like to draw a lot of attention to myself
Ex5: As a child, I didn't talk a lot
Ex6: As a child, I felt comfortable around people
Ex7: As a child, I didn't mind being the centre of attention
Ex8: As a child, I was quiet around strangers
Ex9: As a child, I would start conversations
Ex10: As a child, I found it difficult to approach others

Impulse control

IC1: As a child, I was easily excited
IC2: As a child, I often made a fuss
IC3: As a child, I would follow through with my plans
IC4: As a child, I demanded attention
IC5: As a child, I would shoot my mouth off
IC6: As a child, I would choose my words with care
IC7: As a child, I kept my emotions under control
IC8: As a child, I would blurt out whatever came into my mind
IC9: As a child, I would let others finish what they were saying
IC10: As a child, I talked even when I knew I shouldn't

Response options: Strongly disagree; Moderately disagree; Slightly disagree; Neither agree or disagree; Slightly agree; Moderately agree; Strongly agree; I do not remember

B.7 Balanced Inventory of Desirable Responding

Impression management

IM1 I never swear
IM2 I sometimes drive faster than the speed limit
IM3 I always declare everything at customs
IM4 I sometimes tell lies if I have to
IM5 I sometimes try to get even rather than forgive and forget
IM6 I never take things that don't belong to me

Self deception

SD1 I sometimes lose out on things because I can't make up my mind soon enough
SD2 I never regret my decisions
SD3 I am very confident of my judgments
SD4 I always know why I like things
SD5 I am a completely rational person

SD6 It's hard for me to shut off a disturbing thought
SD7 My first impressions of people usually turn out to be right
SD8 I have not always been honest with myself
SD9 I have sometimes doubted my ability as a lover
SD10 I don't always know the reasons why I do the things I do

Response options: Not true at all; Moderately untrue; Slightly untrue; Neither true or untrue; Slightly true; Moderately true; Very true

B.8 Abuse

Emotional abuse

AbusEm1: When I was growing up, people in my family said hurtful or insulting things to me
AbusEm2: When I was growing up, I felt that someone in my family hated me
AbusEm3: When I was growing up, people in my family called me things like stupid, lazy, or ugly.
AbusEm4: When I was growing up, I thought my parents wished I had never been born
AabusEm5: When I was growing up, someone in my family yelled or screamed at me

Physical abuse

When I was growing up, people in my family hit me so hard that it left me with bruises or marks

Response options: Not true at all; Moderately untrue; Slightly untrue; Neither true or untrue; Slightly true; Moderately true; Very true

Sexual abuse

Please select the statement which best fits your experiences
Response options: I know I was not sexually abused; I think I might have been sexually abused; It is probable that I was sexually abused; I know for sure that I was sexually abused somewhat; I know for sure that I was sexually abused for an extended period; My mind goes blank when I try to think about this

B.9 Coping and defence styles

I am interested in how people respond when they confront difficult or stressful events in their lives. There are lots of ways to try to deal with stress. These questions ask you to indicate what you generally do and feel when you experience stressful events. Obviously, different events bring out somewhat different responses, but think about what you usually do when you are under a lot of stress.

There are no "right" or "wrong" answers, so choose the most accurate answer for YOU--not what you think "most people" would say or do. Indicate what YOU usually do when YOU experience a stressful event.

Cognitive avoidance

CopCa1: Try to deny how serious the problem really is
CopCa2: Try to forget the whole thing
CopCa3: Pretend that it hasn't really happened
CopCa4: Don't let it get to you; refuse to think too much about it
CopCa5: Do things to think about it less, such as going to movies, watching TV, reading, daydreaming, sleeping, or shopping
CopCa6: Go on as if nothing has happened
CopCa7: Try to put off thinking about the situation, even though you know you will have to at some point

Emotional discharge

CopED1: Get upset and let your emotions out
CopED2: Express your negative feelings
CopED3: Try to keep your feelings to yourself
CopED4: Let your feelings out
CopED5: Get upset, and become really aware of it
CopED6: Express anger towards who/whatever caused the problem
CopED7: Say things to let your unpleasant feelings escape
CopED8: Take it out on other people
CopED9: Feel a lot of emotional distress and find yourself expressing those feelings a lot

Response options: I usually don't do this at all; I usually do this a little bit; I usually do this a medium amount; I usually do this a lot

Isolation

DMIso1: I am often told that I don't show my feelings
DMIso2: Often I find that I don't feel anything when the situation would seem to warrant strong emotions
DMIso3: When someone close to me dies, I don't feel upset
DMIso4: When I should have strong feelings, I don't feel anything

Denial

DMDen1: People say I tend to ignore the unpleasant facts as if they don't exist
DMDen2: When I am upset I remind myself that everything is really okay

Suppression

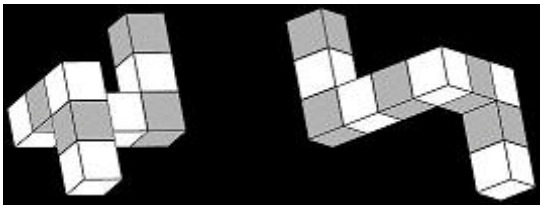
DMSup1: When I need to, I can put my problems on hold until later when I can think about them
DMSup2: I can keep a lid on my feelings if letting them out would interfere with what I am doing
DMSup3: I am able to keep a problem out of my mind until I have time to deal with it

Response options: Strongly disagree; Moderately disagree; Slightly disagree; Neither agree or disagree; Slightly agree; Moderately agree; Strongly agree; I do not remember

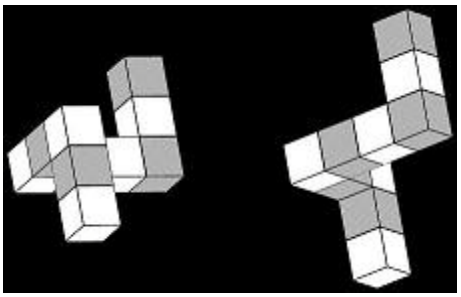
B.10 Spatial ability

Mental rotation

On the next page you will complete a timed "mental rotation" test. ou will be presented with a number of pairs of three-dimensional blocks and you are required to answer whether you think the two blocks are the same or different. This will require you to imagine rotating the blocks in your head. For example, the two blocks in the picture below are the same, only rotated.

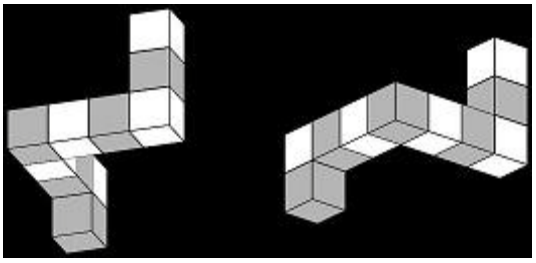
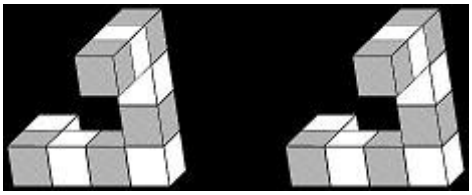


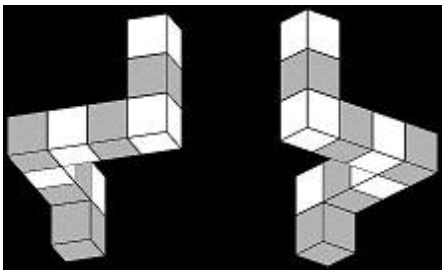
The two blocks in the picture below are different. Even if you rotate them they aren't the same block.

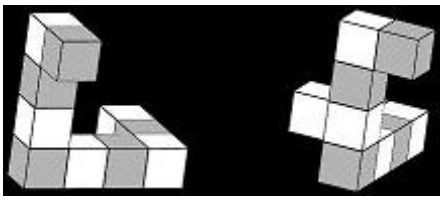


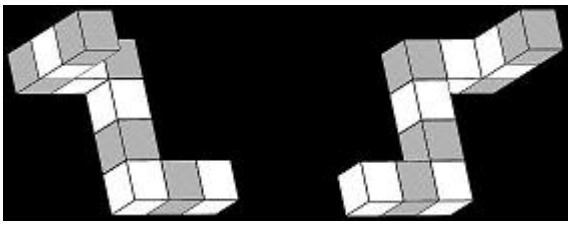
You will have two minutes to give as many correct answers as possible. If you don't know the answer to a question it is best to just move on to the next question, rather than guess, because incorrect answers will incur a penalty.

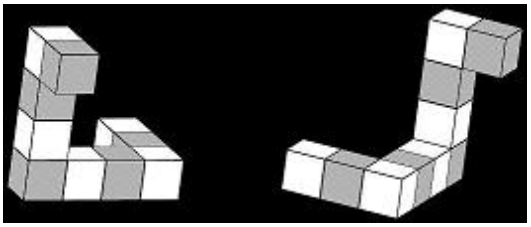
Press the 'next' button below when you are ready to begin

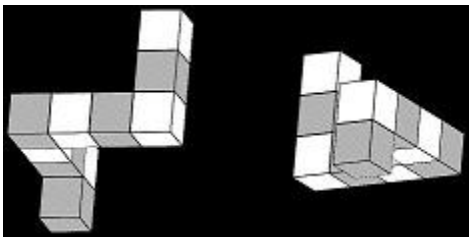
1. 
2. 

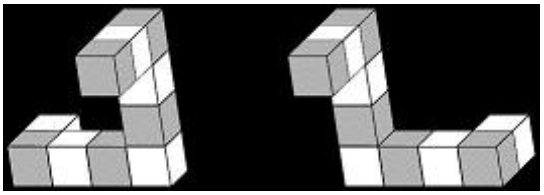
3. 

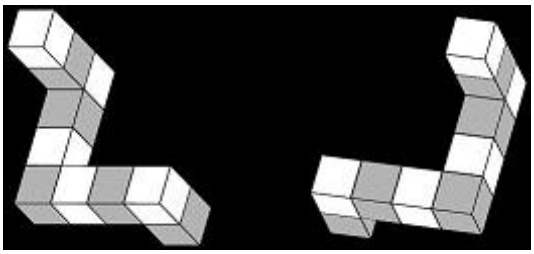
4. 

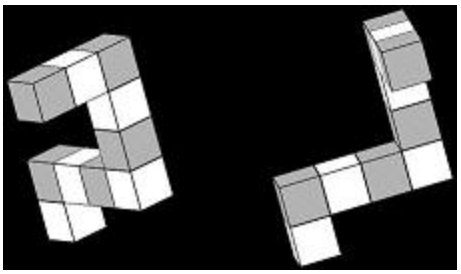
5. 

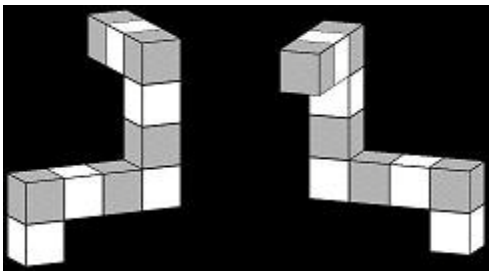
6. 

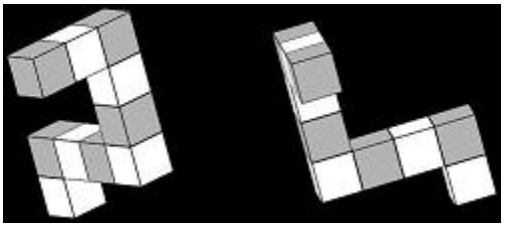
7. 

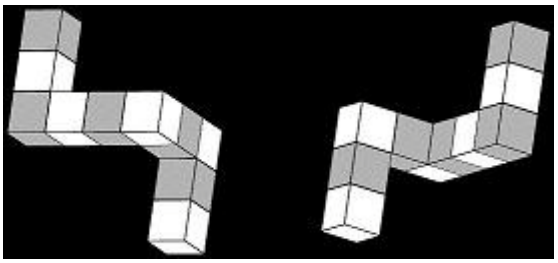
8. 

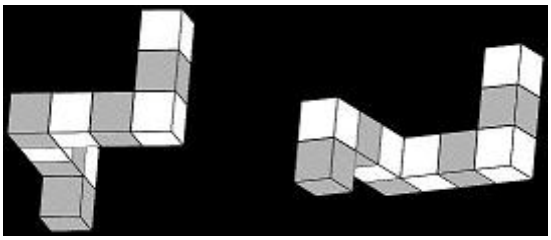
9. 

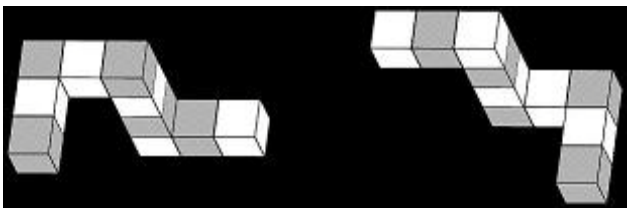
10. 

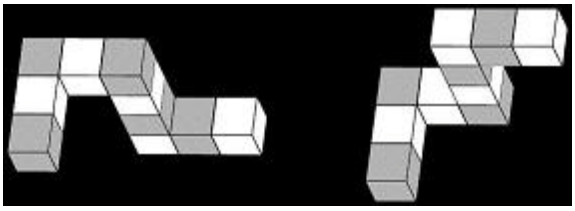
11. 

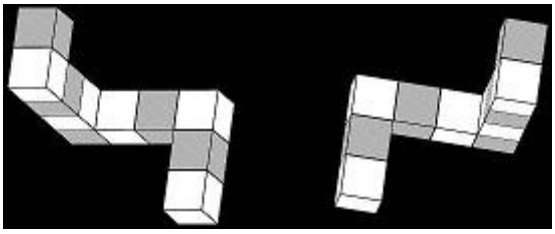
12. 

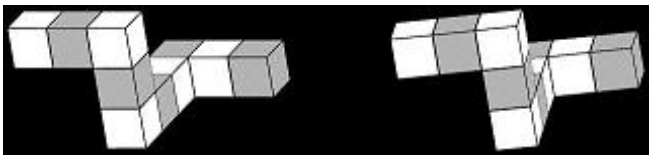
13. 

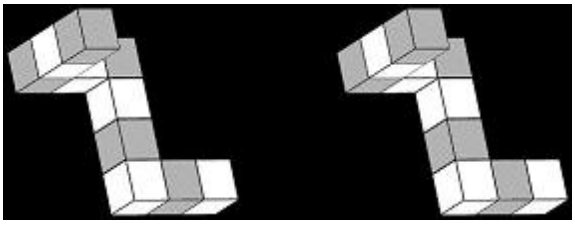
14. 

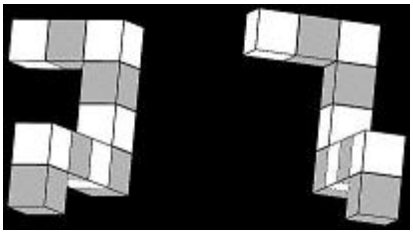
15. 

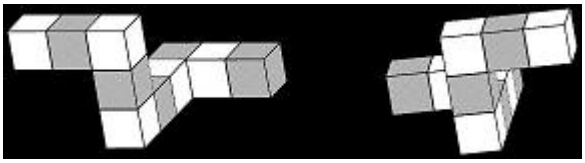
16. 

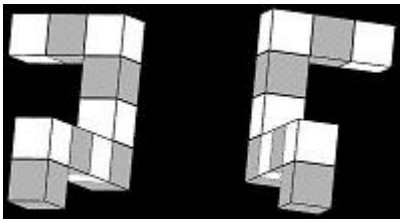
17. 

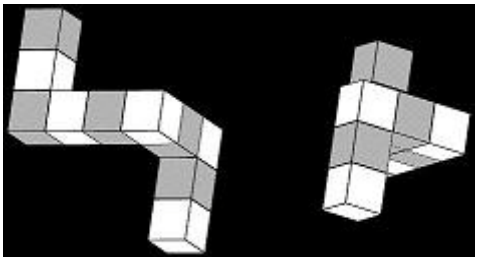
18. 

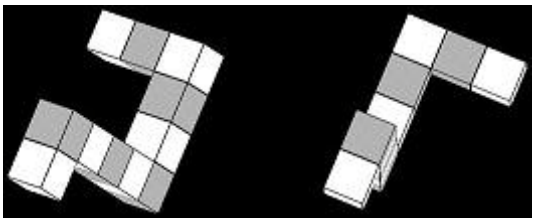
19. 

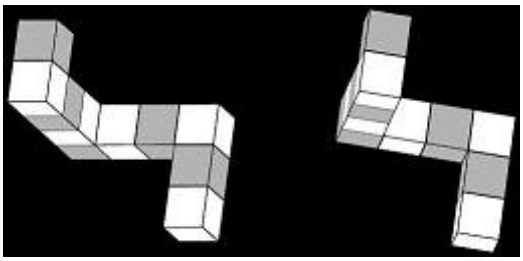
20. 

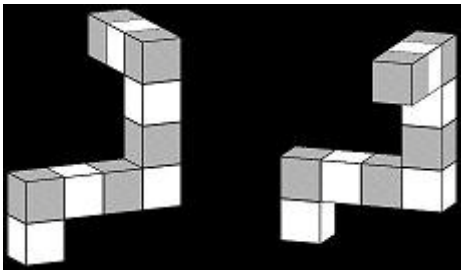
21. 

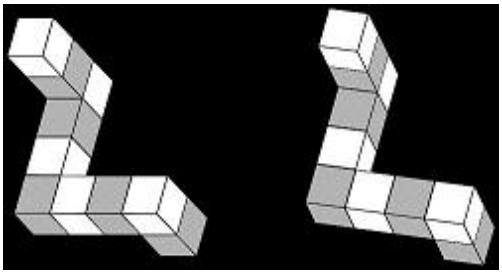
22. 

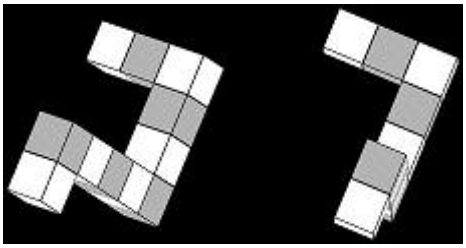
23. 

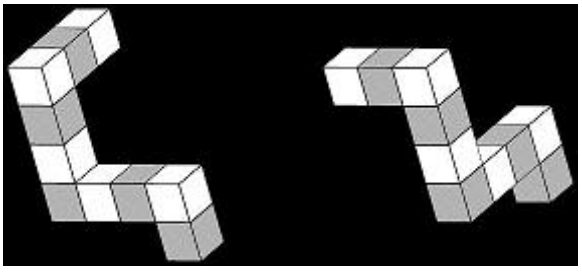
24. 

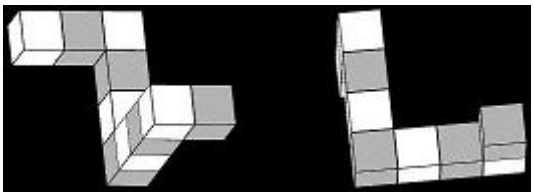
25. 

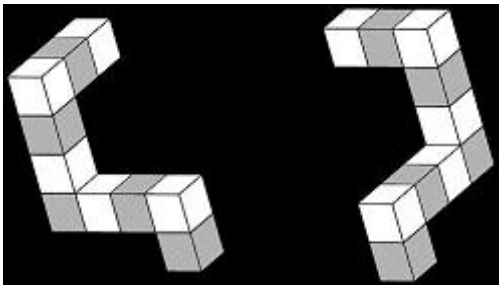
26. 

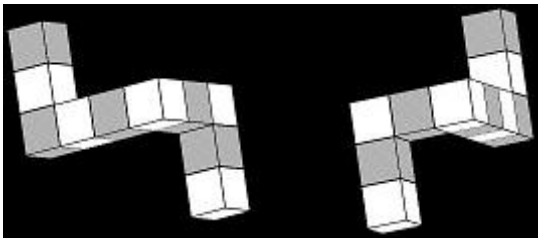
27. 

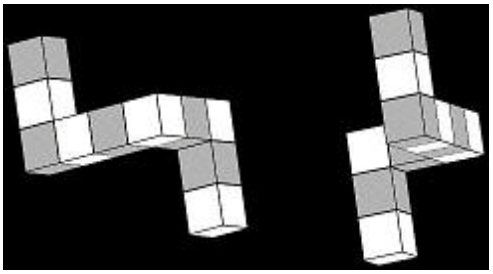
28. 

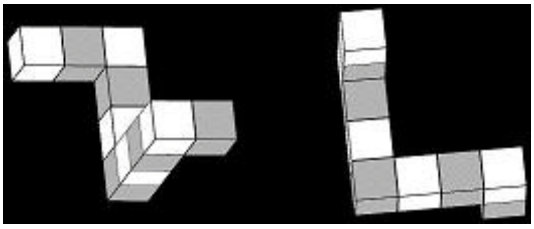
29. 

30. 

31. 

32. 

33. 

34. 

Response options: Same; Different

B.11 Systemising Quotient

Sys1: I find it difficult to read and understand maps

Sys2: I find it easy to grasp exactly how odds work in betting

Sys3: I find it difficult to learn how to programme video recorders

Sys4: I do not enjoy games that involve a high degree of strategy (e.g. chess, Risk, Games Workshop)

Sys5: I can remember large amounts of information about a topic that interests me e.g. flags of the world, airline logos

Sys6: I can easily visualise how the motorways in my region link up

Sys7: I am fascinated by how machines work

Sys8: If I were buying a stereo, I would want to know about its precise technical features

Response options: Strongly disagree; Moderately disagree; Slightly disagree; Neither agree or disagree; Slightly agree; Moderately agree; Strongly agree

B.12 Gender-variance degree

Recalled childhood gender identity/role

Questions that ask about your experiences "as a child" refer to ages 0 to 12.

RGI1: As a child, my favourite toys and games were
Response options: Always "masculine"; Usually "masculine"; Equally "masculine" and "feminine"; Usually "feminine"; Always "feminine"; Neither "masculine" or "feminine"; I do not remember

RGI2: As a child I felt
Response options: Very masculine; Somewhat masculine; Masculine and feminine equally; Somewhat feminine; Very feminine; I did not feel masculine or feminine; I do not remember

RGI4: As a child, I had the reputation of a "tomboy" [5]
Response options: All of the time; Most of the time; Some of the time; On rare occasions; Never; I do not remember

RGI4: As a child, I put on or used cosmetics (make-up) and girls' or women's jewellery[6]
Response options: Never; Very rarely; Once-in-a-while; Frequently; As a favourite activity; I do not remember

RGI5: As a child, in dress-up play I would
Response options: Wear boys' or men's clothing all the time; Usually wear boys' or men's clothing; Half the time wear boys' or men's clothing and half the time wear girls' or women's clothing; Usually wear girls' or women's clothing; Wear girls' or women's clothing all the time; I did not do this type of play; I do not remember

RGI7: As a child, my favourite playmates were
Response options: Always boys; Usually boys; Boys and girls equally; Usually girls; Always girls; I did not play with other children; I do not remember

Feeling different

RGI3: As a child, I felt different from boys my age because I was
RGI6: As a child, I felt different from girls my age because I was

Response options: Much more masculine; Somewhat more masculine; Slightly more masculine; I did not feel different from boys my age in terms of my masculinity of femininity; Slightly more feminine; Somewhat more feminine; Much more feminine; I do not remember

RGI8: I didn't feel the same as boys my age when I was growing up because they were more masculine than I was.

RGI9: I didn't feel the same as girls my age when I was growing up because they were more feminine than I was.

Response options: Strongly disagree; Moderately disagree; Slightly disagree; Neither agree or disagree; Slightly agree; Moderately agree; Strongly agree; Uncertain

Adult gender-variance

AGV1: In many ways I feel more similar to men than to women[5]
AGV1: In many ways I feel more similar to women than to men[6]
AGV3: If it were possible, I'd choose to live my life as a man (or I now do so)[5]
AGV3: If it were possible, I'd choose to live my life as a woman (or I now do so)[6]
AGV4: I don't feel very feminine[5]
AGV4: I don't feel very masculine[6]

Response options: Strongly disagree; Moderately disagree; Slightly disagree; Neither agree or disagree; Slightly agree; Moderately agree; Strongly agree

AGV2: Since the age of 17, have you wished you had been born a boy instead of a girl[5]

AGV2: Since the age of 17, have you wished you had been born a girl instead of a boy[6]

Response options: Often; Occasionally; Never

AGV5: How feminine do you believe you act, appear, and come across to others?
AGV7: In general, how feminine do you think you are?

Response options: Not at all feminine; Slightly feminine; Moderately feminine; Very feminine; Extremely feminine; I don't know

AGV6: How masculine do you believe you act, appear, and come across to others?
AGV8: In general, how masculine do you think you are?

Response options: Not at all masculine; Slightly masculine; Moderately masculine; Very masculine; Extremely masculine; I don't know

B.13 Gender-variance experience

Are you currently taking, or do you usually take male hormones?[7]
Are you currently taking, or do you usually take female hormones?[8]
Have you undertaken breast reduction surgery?[7]
Have you undertaken genital reconstruction surgery (sometimes known as sexual reassignment surgery)?[8]

Response options: Yes; No

At what age did you first become aware that your gender was different from what was considered normal by society?[9]

Response options: Since my earliest memories; At a later age than my earliest memories

Please enter the age that you were when you first became aware that your gender was different from what was considered normal by society[10]

Please select the statement which best fits your experiences prior to your awareness of your gender-variance. (For the purposes of this question, "gender-variance" refers to your sense of not belonging completely to the gender of your birth-assigned sex)[10]

I believe that my gender-variance was a part of me prior to me realising its existence within me. I had just managed to avoid/deny/suppress it

I believe my gender-variance was not a part before I realised it existed. I believe it only developed when I first became aware of it

I expressed my gender-variance from my earliest memory. I just didn't realise that it wasn't considered normal by society

I don’t have enough recollection of my feelings prior to my realisation that my gender was different to select any of the above statements.

Self-identification with classical/non-classical gender-variance

Some people who experience gender-variance notice that their experience is different from what has been called the "classical" experience of gender-variance. These persons who were assigned the gender of female at birth often live outwardly prosperous lives in the female gender role in the earlier years of their life, sometimes marry and have children, and were not overly masculine as children. These persons usually report being sexually attracted to males or bisexual, and sometimes report experiencing cross-gender eroticism (e.g. to cross-dressing, being in the male social role, or obtaining a male body). This has been called the "non-classical", or sometimes "secondary" experience of gender-variance.

On the other hand, those experiencing "classical" (sometimes called "primary") gender-variance generally were very masculine as children, don't have as much success living in the female role in the earlier years of their life, and tend not to marry or have children. These persons are usually only sexually attracted to females, and don't experience cross-gender eroticism.

Please select one of the following statements that best describes your experiences of gender-variance.[7]

My experiences completely match the "non-classical" experience of gender-variance

My experiences more match the "non-classical" than the "classical" experience of gender-variance

My experiences equally match both the "non-classical" and "classical" experiences of gender-variance

My experiences more match the "classical" than the "non-classical" experience of gender-variance

My experiences completely match the "classical" experience of gender-variance

This distinction does not apply to my experiences.

Some people who experience gender-variance notice that their experience is different from what has been called the "classical" experience of gender-variance. These persons who were assigned the gender of male at birth often live outwardly prosperous lives in the male gender role in the earlier years of their life, sometimes marry and have

children, and were not overly feminine as children. These persons usually report being sexually attracted to females or bisexual, and sometimes report experiencing cross-gender eroticism (e.g. to cross-dressing, being in the female social role, or obtaining a female body). This has been called the "non-classical", or sometimes "secondary" experience of gender-variance.

On the other hand, those experiencing "classical" (sometimes called "primary") gender-variance generally were very feminine as children, don't have as much success living in the male role in the earlier years of their life, and tend not to marry or have children. These persons are usually only sexually attracted to males, and don't experience cross-gender eroticism.

Please select one of the following statements that best describes your experiences of gender-variance.[8]

My experiences completely match the "non-classical" experience of gender-variance

My experiences more match the "non-classical" than the "classical" experience of gender-variance

My experiences equally match both the "non-classical" and "classical" experiences of gender-variance

My experiences more match the "classical" than the "non-classical" experience of gender-variance

My experiences completely match the "classical" experience of gender-variance

This distinction does not apply to my experiences.

Environmental tolerance of gender-variance

Acc1: Please rate how your gender-variant behaviour was, or how you believed it would have been reacted-to by your parents/caregivers, in your childhood[9]

Acc2: Please rate how your gender-variant behaviour was, or how you believed it would have been reacted-to by your peers, in your childhood[9]

Response options: 1. Scorn; 2.; 3.; 4. Tolerance; 5.; 6.; 7. Full acceptance; I do not remember

Acc3: How safe do you believe that the environment you grew up in was, or would have been, to express your gender-variance? [9]

Response options: 1. Very unsafe; 2.; 3.; 4. Somewhat safe; 5.; 6.; 7. Very safe; I do not remember

Cross-gender eroticism

CGE2 Have you ever become sexually aroused while picturing yourself having a nude male body or with certain features of the nude male form?[7]

CGE2 Have you ever become sexually aroused while picturing yourself having a nude female body or with certain features of the nude female form?[8]

CGE3 Have you ever been sexually aroused by the thought of being a man?[7]

CGE3 Have you ever been sexually aroused by the thought of being a woman?[8]

Response options: Yes; No

CGE1 I find stories in which a male and female character swap places, either by magical or science fiction means sexually arousing.[11]

CGE4 Sometimes I get a sexual thrill when I see my masculine image in the mirror[12]

CGE4 Sometimes I get a sexual thrill when I see my feminine image in the mirror[8]

CGE5 Being in the masculine role has been a sexually arousing experience for me[12]

CGE5 Being in the feminine role has been a sexually arousing experience for me[8]

CGE6 In the past, I have become sexually excited when I read about women becoming men[12]

CGE7 In the past, I have become sexually excited when I read about men becoming women[8]

Response options: Strongly disagree; Somewhat disagree; Slightly disagree; Neither agree or disagree; Slightly agree; Somewhat agree; Strongly agree

Other non-classical gender-variance experiences

I dislike(d) the genitalia that I was born with

I am/was not concerned about using the genitalia I was born with for sexual activity

I am sexually attracted to masculine features on females (e.g. short hair, masculine facial features)

I am sexually attracted to feminine features on males (e.g. long hair, feminine facial features)

In the past, I have made relatively successful attempts at living in the female gender role

In the past, I have made relatively successful attempts at living in the male gender role

Response options: Strongly disagree; Somewhat disagree; Slightly disagree; Neither agree or disagree; Slightly agree; Somewhat agree; Strongly agree

B.14 Appraisal of the identity-defence theory

Thank you for taking the extra time to fill out this part of the questionnaire. My research is focusing on examining the efficacy of the Identity-Defence Model of Gender-Variant Development. This model is explained below, following this you are given the opportunity to comment on the model.

Before explaining the model, I would like to first define some of the terms I use. In explaining the model will refer to "gender-variant identity" which I define as a *subjective sense of not belonging completely to the gender of one's birth-assigned sex*. I use "gender-variance" to refer to the behavioural expression of this identity.

The terms "transmen" and "transwomen" are used to refer to female-to-male and male-to-female transsexuals respectively. These persons have a sustained gender identity that is discrepant with their biological sex along with a desire to alter their bodily appearance towards that of the opposite sex. The term "drag artist" will refer to those persons who dress in "drag" as the opposite birth-assigned sex for the purposes of performing. These persons are usually sexually attracted to the same birth-assigned sex. The term "cross-dresser" will refer to those people who enjoy wearing the clothing that is considered by society to be of the opposite sex. These persons are usually sexually

attracted to the opposite birth-assigned sex. This definition does not include those persons who cross-dress for the purposes of performing.

The term "cross-gender eroticism" refers to sexual arousal in association with cross-dressing or cross-gender fantasy.

The Identity-Defence Model of Gender-Variant Development.

From my experiences I have seen a lot of diversity in the world of gender-variance e.g. cross-dressers, drag artists, and differences in the experiences of transsexuals. Instead of trying to explain the development of these differences separately, as other models have done, this model attempts to account for the diversity. According to the model, the differences occur because of the different ways that the environment effects gender-variant persons, and the ways gender-variant persons react to their environment.

This model is called the Identity-Defence Model of Gender-Variant Development. The model proposes that two factors influence gender-variant outcome: the degree of gender-variant identity developed, and whether defence mechanisms are used to suppress this identity. A number of predisposing factors influence whether a gender-variant identity develops, and whether defence mechanisms are used.

1. Biological Factors.

A number of factors associated with our biology are have been found to be associated with gender-variance. These include left-handedness, birth order, genes, prenatal hormone exposure, and differences in brain structure.

2. Early Childhood Influences.

Some research has found that gender-variant persons report a less warm, more emotionally distant, controlling or rejecting father, and others have found a link between childhood abuse and transsexualism—especially among transmen. However it is unclear whether these are cause or an effect of gender-variance.

3. Degree of Gender-Variant Identity.

These biological and environmental influences in steps 1 and 2 determine the degree of gender-variant identity that is formed in the young child. If a high degree of gender-variant identity is formed then transsexualism is the likely outcome in adulthood. If a lower degree of gender-variant identity is formed then less extreme cross-gender outcomes of transvestism or expressing gender through drag are the result. More commonly, if a gender-variant identity is not formed then the child will develop a gender identity consistent with their birth-assigned sex.

4. & 5. Personality and Environment Factors.

These are factors that influence whether a young child is likely to employ defence mechanisms to protect them from the guilt and anxiety they would feel about their gender-variance. One influence is the environment the child is in. If early expressions of gender non-conforming behaviour are met with scorn and punishment, and the child perceives cross-gender behaviour to be strictly wrong then the young child employ defence mechanisms to repress these feelings. If these behaviours are not always met with scorn and punishment, and if they are not perceived as strictly wrong, then the young child does not form defence mechanisms to repress their gender variant identity.

Cross-dressers, and non-classical transsexuals are less commonly seen among those assigned female at birth than those assigned male at birth. This is accounted for in the Identity-Defence Model because birth-assigned females' early gender-variant expressions are not as likely to receive the same amount of parental and societal intolerance as biological males. As a result they are less likely to repress their gender-variant identity, which the Identity-Defence Model proposes is the antecedent to cross-dresser and non-classical transsexual development.

Personality factors may also play a part as to whether a person uses defence mechanisms to repress their gender-variant identity. An extroverted person would be more likely to openly express their impulses, and less likely to repress them. On the other hand, an introvert would be more concerned with their feelings and thoughts, and more likely to use defence mechanisms to repress these. Another personality characteristic that may logically influence whether a child is likely to use defence mechanisms is agreeableness—the tendency to be polite and accommodating towards others.

6. Defence Mechanisms Used.

The personality and environment factors determine whether defence mechanisms are used to suppress the gender-variant identity. Defence mechanisms are psychological strategies used by an individual to protect themselves from anxiety, and associated feelings of guilt, embarrassment, and shame. In these cases, the gender-variant identity, or sense of self would be repressed from the child's consciousness.

7. Gender-Variant Identity Outcomes.

This part of the model is a two-dimensional continua of possible gender-variant outcomes. If no gender-variant identity develops then an identity consistent with birth-assigned sex is the outcome. If a gender-variant identity develops and defence mechanisms are used to repress this then transvestism or non-classical transsexualism are the outcomes depending on the level of gender-variant identity developed. If defence mechanisms are not used then classical transsexualism or drag artistry are the outcomes, depending on the level of gender variance.

I would like to point out here that even though I have only given four "points" on the matrix, I am aware that not every gender-variant person fits neatly into these categories. The model allows for variation between these points. This model does not intend to explain the development of gender-variance in every person who experiences it, rather it attempts to explain a common path of development.

8. Sexuality.

Sexuality is strongly correlated with these outcomes. Those participants not employing defence mechanisms (classical transsexuals and drag artists) are more likely to develop a sexual attraction towards persons of the same birth-assigned sex. Those participants employing defence mechanisms (non-classical transsexuals and transvestites) are more likely to develop a sexual attraction to persons of the opposite birth-assigned sex, and a sexual attraction to themselves as a female. This correlation between sexual orientation and gender-variant outcomes can be accounted for using Daryl Bem's Exotic Becomes Erotic (EBE) developmental theory of sexual orientation (Bem, 1996). Bem's theory suggests that instead of coding for sexual orientation, biological variables code for childhood temperaments, which determine whether a child will favour the activities and company of peers of the same or opposite sex. This results in children feeling different from children of the sex they do not associate with, and perceiving them as exotic. This in turn generates autonomic arousal to the unfamiliar/exotic peers, which later results in erotic arousal to persons of that sex.

Applying this to the Identity-Defence Model, those persons raised as males who do not use defence mechanisms to suppress their gender-variant identity would be more feminine in their childhood, and thus more likely to engage in female activities and to associate with females. Because of this, these biological males are more likely to view males as exotic, and later develop a sexual orientation towards them. In contrast, those birth-assigned males who develop defence mechanisms are more likely to conform to expectations to participate in boy's activities, and associate with other boys. Depending on whether these boys also desire to participate in female activities and associate with

females as well, a sexual attraction towards females or bisexual sexual orientation will be the result. The converse would be the result for birth-assigned female. A weak relationship between sexual orientation and recalled childhood gender-variance has been found previously in studies of transmen and transwomen.

Another sexual attraction that is correlated with the gender-variant outcomes of the Identity-Defence Model is cross-gender eroticism. According to the, this attraction is usually found among those who employ defence mechanisms to cognitively avoid their gender-variant identity in childhood: transvestites and non-classical transsexuals. Bem's theory can also be applied again to give more detail about the possible development of this sexual attraction. Because of the strict boundaries given to gender-variant children in their youth in terms of gender-appropriate behaviour and clothing barriers are placed in the way of expressing gender-variance. This results in an arousal-provoking perception of the forbidden, which, using Bem's theory can result in an erotic component.

The figure below shows Bem's theory applied to the Identity-Defence Model with some modifications to include cross-gender eroticism development. As with the model above, biological and early childhood influences determine whether a gender-variant identity develops, and personality and environment factors determine whether defence mechanisms are used to deny this gender-variant identity. When no gender-variant identity develops, an erotic attraction to peers of the opposite birth-assigned sex will eventuate. If a gender-variant identity develops, and it is repressed in childhood, this will result in erotic attraction to gender-variant stimuli, and/or erotic attraction to peers of the opposite birth-assigned sex. If a gender-variant identity develops that is not repressed in childhood using defence mechanisms, erotic attraction to the same birth-assigned sex will be the outcome.

I am aware of the limitations of this model. For instance, it relies heavily on Bem's theory, which is unproven, and has received serious criticism. Also no previous research has found the differing manifestations of gender-variance occurring on a continuum (or even a matrix as proposed in my model).

There are also limitations with the definitions and subsequent categorisation applied to groups in the model. For example, there are some persons who could be included in our definitions of drag artists and cross-dressers who do not experience a gender-variant identity, but may have other reasons for their gender-variant expressions, such as employment, fun, rebellion, emotional comfort, or creativity. The Identity-Defence Model does not intend to explain the motivations for gender-variant expression in these cases—it only explains those persons who are expressing a gender-variant identity. The diversity of these groups is substantial, and there are also many gender-variant persons who would not fall under the definitions we have given—for example, persons who identify as androgynous, bi-gendered, or gender-queer. However, the Identity-Defence Model allows for outcomes along a continuum, and I provided definitions for only a limited number of reference points on the continua to keep the explanation of the model relatively concise. I also don't claim that the Identity-Defence Model can explain the development of gender-variance in all persons.

If we are ever able to know for sure, I am aware that my model would at best require modification, and at worst be totally incorrect. However, this model was formulated because it was believed it better explained the development of gender-variance than anything previously proposed. I measured as many of the components in the model as I could using the multiple-choice questionnaire that you would have completed to get to this page. I am aware that this methodology could at best only give tentative conclusions supporting my model.

As well as the questionnaire survey I thought an additional way to assess my model would be to explain it to anyone who was interested and ask for them to comment on it. That is basically what this page is doing; so feel free to rate how feasible you think the model is, and write any comments you have about the model in the box below and then click the "submit" button. Note that your comments here will not be associated with your questionnaire responses.

Please rate how feasible you believe the Identity-Defence Model is on the following scale
Response options: 0 Not at all feasible; 1; 2; 3 Possibly feasible; 4; 5; 6 Very feasible.

Please enter any comments you have about the Identity-Defence Model in the following box.

B.15 Order of randomly presented questions

In this section, the order that the questions outlined in Sections B.6, B.7, B.8, and B.12 were presented to participants is given.

As a child, I would feel little concern for others (*Agreeableness*)
As a child, I felt it was OK if some people didn't like me (*Conformity*)
As a child, I hated to seem pushy (*Cooperativeness*)
How feminine do you act, appear, and come across to others? (*Adult gender-variance*)
How masculine do you act, appear, and come across to others? (*Adult gender-variance*)
I didn't feel the same as other girls my age when I was growing up because they were more feminine than I was. (*Recalled childhood gender-variance*)
As a child, I was easily excited. (*Impulse control*)
When I was growing up, people in my family said hurtful or insulting things to me. (*Emotional abuse*)
I never swear. (*Impression management*)
As a child, I wouldn't care what others thought of me. (*Conformity*)
As a child, I worried what people thought of me. (*Conformity*)
In many ways I feel more similar to (men[5]/women[6]) than to (women[5]/men[6]). (*Adult gender-variance*)
As a child, my favourite toys and games were (masculine/feminine). (*Recalled childhood gender-variance*)
As a child, I loved a good fight. (*Conformity*)
As a child, I often made a fuss. (*Impulse control*)
As a child, I felt (masculine/feminine). (*Adult gender-variance*)
I sometimes drive faster than the speed limit. (*Impression management*)
During my childhood I yelled at people. (*Cooperativeness*)
Since the age of 17, have you wished you had been born a (girl[6]/boy[5]) instead of a (boy[6]/girl[5])? (*Adult gender-variance*)
As a child, I broke rules. (*Cooperativeness*)
As a child, I warmed up quickly to others (*Extraversion*)
As a child, the characters on TV or in the movies that I imitated or admired were (girls or women/boys or men). (*Recalled childhood gender-variance*)
As a child, I was on good terms with nearly everyone. (*Agreeableness*)
I always declare everything at customs. (*Impression management*)

As a child, I talked even when I knew I shouldn't. (*Impulse control*)
As a child, I had little to say. (Extraversion)
As a child, I felt comfortable around people. (*Extraversion*)
During my childhood, I couldn't stand confrontations. (*Cooperativeness*)
I sometimes tell lies if I have to. (*Impression management*)
As a child, I had a sharp tongue (*Cooperativeness*)
I sometimes lose out on things because I can't make up my mind soon enough. (*Self-deception*)
Were you considered a "good" child or did you get in trouble and get a "bad" label? (*Agreeableness*)
I never regret my decisions. (*Self-deception*)
As a child, I didn't mind being the center of attention. (*Extraversion*)
As a child, I kept in the background. (*Extraversion*)
As a child, I would follow through with my plans. (*Impulse control*)
I am very confident of my judgments. (*Self-deception*)
As a child, I made friends easily. (*Extraversion*)
I always know why I like things. (*Self-deception*)
As a child, I was easy to satisfy (*Co-operativeness*)
I am a completely rational person. (*Self-deception*)
If it were possible, I'd choose to live my life as a (woman[6]/man[5]) (or I now do so). (*Adult gender-variance*)
As a child, I resisted authority. (*Cooperativeness*)
When I was growing up, people in my family hit me so hard that it left me with bruises or marks. (*Physical abuse*)
I didn't feel the same as other girls my age when I was growing up because they were more feminine than I was. (*Recalled childhood gender-variance*)
When I was growing up, I believe that I was sexually abused. (*Sexual abuse*)
As a child, I demanded attention. (*Impulse control*)
As a child, I would shoot my mouth off. (*Impulse control*)
As a child, I felt different from other boys my age because I was (more masculine/feminine). (*Recalled childhood gender-variance*)
As a child, I would choose my words with care. (*Impulse control*)
As a child, I had a good word for everyone. (*Agreeableness*)
As a child, I had the reputation of a "tomboy."[5]/ As a child, I put on or used cosmetics (make-up) and girls' or women's jewellery[6]. (*Recalled childhood gender-variance*)
As a child, I kept my emotions under control. (*Impulse control*)
As a child, I was quiet around strangers. (*Extraversion*)
As a child, I would blurt out whatever came into my mind. (*Impulse control*)
I don't feel very (masculine[6]/feminine[5]). (*Adult gender-variance*)
I never take things that don't belong to me. (*Impression management*)
As a child, I would start conversations. (*Extraversion*)
As a child, I did what others did. (*Conformity*)
As a child, I wanted to be different from others (*Conformity*)
My first impressions of people usually turn out to be right. (*Self-deception*)
In dress-up play, I would (Wear boys' or men's/girls' or women's clothing). (*Recalled childhood gender-variance*)
As a child, I would let others finish what they were saying. (*Impulse control*)
I have not always been honest with myself. (*Self-deception*)
I have sometimes doubted my ability as a lover. (*Self-deception*)

When I was growing up, someone in my family yelled or screamed at me. (*Emotional abuse*)

As a child, I found it difficult to approach others. (*Extraversion*)

As a child, I didn't like to draw a lot of attention to myself. (*Extraversion*)

As a child, I didn't talk a lot. (*Extraversion*)

As a child, I was not concerned with making a good impression (*Conformity*)

[1] Question only displayed to participants self-identifying as homosexual or bisexual males.

[2] Question only displayed to participants self-identifying as homosexual or bisexual females.

[3] Question only displayed to participants self-identifying as homosexual or bisexual.

[4] Question only displayed to birth-assigned male participants reporting sexual fantasies about women

[5] Question only displayed to birth-assigned female participants

[6] Question only displayed to birth-assigned male participants

[7] Question only displayed to birth-assigned female participants self-identifying as a gender-variant identity.

[8] Question only displayed to birth-assigned male participants self-identifying as a gender-variant identity.

[9] Question only displayed to participants self-identifying as a gender-variant identity.

[10] Question only displayed to participants self-identifying as a gender-variant identity who became aware that their gender was different at a later age than my earliest memories

[11] Question only displayed to all birth-assigned male participants and birth-assigned female participants self-identifying as a gender-variant identity.

[12] Question only displayed to all birth-assigned male participants and birth-assigned female participants self-identifying as a gender-variant identity.

APPENDIX C - USE OF "ONLINE RULER" TO SELF-MEASURE 2D:4D

2D:4D has been proposed to be negatively correlated to prenatal testosterone exposure in humans (see Section 3.1.2). Initial studies that assessed 2D:4D used photocopies of the hand that were subsequently measured by researchers. More recently, attention has been given to participant self-reported 2D:4D. Caswell and Manning (2009) found moderate correlations between participant self-reported and experimenter measured 2D:4D from photocopies when outlier self-reported values were excluded. From a large Internet study using self-reported 2D:4D, Manning et al. (2007) also found significant sex differences in 2D:4D, but with a smaller effect size than in previous studies. These studies show that self-reported ratios are an acceptable measure of 2D:4D when large samples are used to compensate for the increased error resulting from using non-trained measurers. Furthermore, Manning et al. concluded that direct measurement of finger length is preferable to using photocopies which may not approximate actual 2D:4D as well as first thought. However, this view is not universal (e.g., Voracek & Offenmuller, 2007).

When completing an online questionnaire that assessed 2D:4D as well as a number of other gender- and sexuality-related variables, many participants would not have access to a ruler to measure finger lengths. It was decided give them the option of using an *online ruler* which is simply the image of a ruler in a pop-up browser window. This ruler can not accurately measure finger lengths because the size of the picture, and thus the scale of the ruler varies across different computers depending on the size of the screen and the resolution settings of the computer. However, provided both fingers are measured on the same ruler, 2D:4D—a ratio between two measurements—should be the same as if the fingers were measured veridically.

C.1 Method

This analysis was conducted using the first 811 participants described in Chapter 2.

In measuring their finger lengths, participants were informed that if they don't have a "physical" ruler or a tape measure, they could use an online ruler, with the proviso that "This online ruler is more difficult to use, and not as accurate, so it is preferable for you to use a physical ruler if you can". Participants using both the online ruler and physical ruler were given the same instructions and response options given by

Manning et al. (2007). Those using the online ruler were also told not to be concerned that the measurement may not be accurate because it was the *ratio* of the finger lengths that was of interest. Participants also were asked to report whether they used an online or a physical ruler. A total of 811 participants responded to these questions and were used in this analysis.

C.2 Results

Initial analysis sought to determine whether participants using the online ruler were more likely to report an outlier 2D:4D. Caswell and Manning (2009) and Manning et al. (2007) excluded 2D:4Ds less than 0.8 or greater than 1.2 as outliers. Of 503 participants using an online ruler, 6 (1%) reported an outlying 2D:4D. Of 759 participants using a physical ruler, 3 (0%) reported an outlying 2D:4D. This difference was not statistically significant, (p = .168, Fisher's exact test). These nine participants were excluded from the remaining analysis.

Also for the remaining analysis, only the 1158 participants who identified their ethnicity as "White/Caucasian/European" were included because of previous findings that 2D:4D is related to ethnicity (Loehlin, McFadden, Medland, & Martin, 2006; Manning et al., 2007). A two-way ANOVA was conducted with 2D:4D as the dependent variable, and type of ruler used (online or physical), birth-assigned gender, degree of gender-variant identity, and age as independent variables. Participant birth-assigned gender and degree of gender-variant identity group average 2D:4Ds are outlined in Table C.1. There was no significant main effect for participant group—birth-assigned gender X degree of gender-variant identity, $F(2, 690) = 2.04$, $p = .131$, type of measurement ruler used, $F(1, 690) = 0.04$, $p = .948$, group X type of ruler interaction effect, $F(2, 690) = 0.68$, $p = .934$, or age X birth-assigned gender effect, $F(43, 690) = 1.17$, $p = .213$. A Levene's Test found that the standard deviation for the online ruler group (.066) was significantly higher than for the physical ruler group (.048), $F(1, 690) = 53.79$, $p < .001$.

Table C.1 *Mean and confidence intervals of 2D:4D for participants using an online or physical ruler grouped by gender identity/sexual orientation type.*

Group	Online ruler			Physical ruler		
	n	2D:4D	99% CIs	*n*	2D:4D	99% CIs
MF transsexuals	117	0.989	0.976-1.002	191	0.992	0.988-1.008
Birth-assigned males with other gender-variant identities	113	0.977	0.963-0.990	154	0.982	0.970-0.994
Males with gender-typical identities	42	0.997	0.974-1.019	90	0.984	0.969-0.999
FM transsexuals	38	0.981	0.957-1.005	41	0.992	0.969-1.014
Birth-assigned females with other gender-variant identities	59	0.985	0.966-1.004	75	0.983	0.966-1.000
Females with gender-typical identities	84	0.999	0.984-1.015	154	0.992	0.980-1.003
Total	453	0.987	0.980-0.994	705	0.988	0.982-0.993

C.3 Discussion

Although there was a small difference in the percentage of participants reporting an outlying 2D:4D value using an online ruler (1% versus 0%) this difference was not statistically significant. Also, the 1% of outliers in this research is comparable to Manning et al.'s (2007) level of 1%. In addition, once the outliers were removed, 2D:4D did not differ significantly between participants who used an online ruler and those who used a physical ruler, and the 2D:4D patterns were similar across a variety of participant groups. Therefore, it is concluded that an online ruler is an acceptable alternative to a physical ruler in 2D:4D measurement. Giving participants the option of using an online ruler is likely to increase response rates by allowing participants who do not have access to a physical ruler the ability to respond. However, while the standard deviation of the 2D:4D for participants using a physical ruler was similar to that reported by Manning et al., the standard deviation for participants using an online ruler was significantly higher indicating a larger amount of measurement error using this method.

In the present study it was only possible to check the *variability*, not the *accuracy* of the responses using an online ruler. More informative research would test

within-subjects differences between measurement procedures for finger length ratios (e.g. differences between photocopies, physical ruler, and online ruler).

APPENDIX D - ADDITIONAL STATISTICS FOR CONFIRMATORY FACTOR ANALYSES

Table D.1 *Correlation matrix for the Edinburgh handedness scale items (Table 6.1) with proportion of variance accounted for (R^2) on the negative diagonal*

Item	1	2	3	4	5	6
1. Hand1	.84					
2. Hand2	.79	.76				
3. Hand3	.80	.78	.77			
4. Hand4	.86	.78	.82	.85		
5. Hand5	.87	.81	.81	.87	.88	
6. Hand6	.80	.82	.79	.82	.84	.81

Table D.2 *Correlation matrix for the emotional abuse scale (Table 6.5) with proportion of variance accounted for (R^2) on the negative diagonal*

Item	1	2	3	4
1. AbusEm1	.53			
2. AbusEm2	.58	.62		
3. AbusEm3	.65	.57	.54	
4. AbusEm4	.54	.59	.56	.57

Table D.3 *Correlation matrix for the mental rotation scale (Table 6.7) with proportion of variance accounted for (R^2) on the negative diagonal*

Item	1	2	3
1. Mental rotation parcel 1	.53		
2. Mental rotation parcel 2	.61	.71	
3. Mental rotation parcel 3	.61	.73	.74

Table D.4 *Correlation matrix for the systematising quotient (Table 6.10) with proportion of variance accounted for (R^2) on the negative diagonal*

Item	1	2	3	4	5	6	7
1. Sys1	.50						
2. Sys2	.30	.24					
3. Sys3	.30	.21	.38				
4. Sys4	.27	.23	.35	.31			
5. Sys6	.54	.27	.24	.23	.57		
6. Sys7	.39	.30	.32	.25	.47	.70	
7. Sys8	.30	.30	.43	.28	.34	.59	.50

Table D.5 *Correlation matrix for the adult gender-variant identity scale (Table 6.13) with proportion of variance accounted for (R^2) on the negative diagonal*

Item	1	2	3	4
1. AGV1	.51			
2. AGV2	.66	.86		
3. AGV3	.67	.87	.87	
4. AGV4	.61	.62	.62	.44

Table D.6 *Correlation matrix for the recalled childhood gender-variance scale (Table 6.15) with proportion of variance accounted for (R^2) on the negative diagonal*

Item	1	2	3	4	5	6	7	8	9
1. RGI1	.65								
2. RGI2	.69	.77							
3. RGI3	.58	.69	.85						
4. RGI4	.73	.76	.61	.78					
5. RGI5	.66	.73	.53	.74	.67				
6. RGI6	.47	.54	.35	.50	.49	.52			
7. RGI7	.30	.30	.43	.28	.34	.37	.38		
8. RGI8	.41	.52	.60	.41	.36	.28	.32	.43	
9. RGI9	.42	.45	.35	.49	.42	.47	.31	.12	.42

Table D.7 *Correlation matrix for the balanced inventory of desirable responding (Table 6.18) with proportion of variance accounted for (R^2) on the negative diagonal*

Item	1	2	3	4	5	6	7	8	9	10	11	12	13
1. IM1	.13												
2. IM3	.17	.14											
3. IM4	.21	.18	.35										
4. IM5	.20	.18	.26	.20									
5. IM6	.19	.25	.34	.22	.32								
6. SD1	-.01	.03	.18	.11	.09	.23							
7. SD2	.08	.00	.08	.04	.05	.18	.18						
8. SD3	-.01	-.03	.07	.00	.08	.31	.30	.38					
9. SD4	.07	.05	.07	.07	.11	.19	.20	.30	.28				
10. SD5	.12	.10	.12	.09	.15	.14	.16	.28	.31	.22			
11. SD8	.10	.03	.19	.10	.07	.19	.17	.18	.21	.19	.23		
12. SD9	.00	-.02	.10	.02	.04	.21	.16	.24	.20	.13	.23	.17	
13. SD10	.06	.09	.18	.15	.15	.33	.17	.26	.37	.25	.37	.27	.44

APPENDIX E - CORRELATION MATRICES AND REGRESSION COEFFICIENTS FOR STRUCTURAL EQUATION MODELS

Table E.1 *Correlation matrix for all latent variables used in this thesis.*

Variable	1	2	3	4	5	6	7	8
1. Systemising								
2. Emotional abuse	-.16							
3. Adult gender-variance	-.19	.26						
4. Mental rotation	.38	-.08	-.01					
5. Recalled childhood gender-variance	-.57	.13	.15	-.10				
6. Edinburgh handedness scale	-.06	-.11	-.09	.07	.02			
7. Impression management	-.07	-.12	.11	-.04	.16	.01		
8. Denial of negative	.27	-.31	-.26	.02	-.04	.01	.39	
9. Over-confident rigidity	.55	-.22	.12	.01	-.12	-.02	.26	.78

Table E.2 *Correlation matrix for biological and psychosocial predictor variables of structural equation model regression in Figure 7.10.*

Variable	1	2	3	4	5
1. Systemising					
2. Emotional abuse	-.22				
3. Mental rotation	.41	-.04			
4. Mother age at birth	-.03	-.02	-.05		
5. Proportion of gender-variant relatives	-.06	.04	-.01	.02	
6. Number of years living with father	-.02	-.06	-.05	.16	-.03

Table E.3 *Unstandardised maximum likelihood path regression coefficients and* p *values for biological and psychosocial factors predicting adult gender-variance (SEM in Figure 7.10)*

Regression path	Unstandardised regression coefficient	*p*
Emotional abuse → Adult gender-variance	0.08	< .001
Mother's age → Adult gender-variance (BA male)	0.00	.932
Mother's age → Adult gender-variance (BA female)	0.04	< .001
Proportion of gender-variant relatives → Adult gender-variance	2.32	.003
Mental rotation → Adult gender-variance (BA male)	0.12	< .001
Mental rotation → Adult gender-variance (BA female)	-0.01	.889
Number of years living with father → Adult gender-variance	-0.02	.005
Systematising → Adult gender-variance (BA male)	-0.63	< .001
Systematising → Adult gender-variance (BA female)	0.85	< .001

Note: BA = birth-assigned

Table E.4 *Correlation matrix for biological and psychosocial predictor variables of structural equation model regression in Figure 7.11.*

Variable	1	2	3	4	5	6
1. Emotional abuse						
2. Mental rotation	.02					
3. Edinburgh handedness	-.03	.07				
4. Number of older brothers	.01	-.09	-.01			
5. Proportion of gender-variant relatives	.02	-.03	-.12	-.04		
6. Mother age at birth	.01	.03	.03	.27	-.03	
7. Number of years living with father	-.24	-.08	.06	.08	-.12	.21

Table E.5 *Unstandardised maximum likelihood path regression coefficients and* p *values for biological and psychosocial factors predicting adult gender-variance (SEM in Figure 7.11)*

Regression path	Unstandardised regression coefficient	*p*
Emotional abuse → Adult gender-variance	0.06	.001
Mother's age → Adult gender-variance (BA male)	-0.01	.167
Mother's age → Adult gender-variance (BA female)	0.03	.002
Proportion of gender-variant relatives → Adult gender-variance	2.66	< .001
Mental rotation → Adult gender-variance (BA male)	-0.05	.099
Mental rotation → Adult gender-variance (BA female)	0.12	.004
Number of older brothers → Adult gender-variance	0.12	.001
Number of years living with father → Adult gender-variance	-0.03	< .001
Handedness → Adult gender-variance (BA male)	-0.01	.167
Handedness → Adult gender-variance (BA female)	-0.04	< .001

Note: BA = birth-assigned

Table E.6 *Maximum likelihood path estimates biological and psychosocial factors predicting adult gender-variance (SEM in Figure 7.10) including BIDR predictors.*

Regression path	Standardised regression coefficient	99% confidence interval
Emotional abuse → Adult gender-variance	.07	.01, .12
Mother's age → Adult gender-variance (BA male)	.03	-.06, .11
Mother's age → Adult gender-variance (BA female)	.14	.05, .23
Proportion of gender-variant relatives → Adult gender-variance	.03	-.02, .09
Mental rotation → Adult gender-variance (BA male)	.21	.08, .33
Mental rotation → Adult gender-variance (BA female)	-.05	-.17, .08
Cohabitation with father → Adult gender-variance	-.10	-.19, -.02
Systematising → Adult gender-variance (BA male)	-.60	-.82, -.38
Systematising → Adult gender-variance (BA female)	.40	.08, .71
Impression management → Adult gender-variance	.18	.05, .31
Denial of negative → Adult gender-variance	-.48	-.78, -.17
Over-confident rigidity → Adult gender-variance	.51	.13, .90

Note: BA = birth-assigned

APPENDIX F - CALCULATION OF PROPORTION OF MEASUREMENT ERROR VARIANCE FOR DIGIT RATIO (2D:4D)

The amount of measurement error variance for the ratio between the second to fourth finger (2D:4D) was calculated as the difference between the variance in the present study (this is the only study known to have self-measured 2D:4D) and an estimate of true variance obtained from studies using similar samples with experimenter measured 2D:4D that have assessed the reliability of this measure.

Three other studies have assessed 2D:4D in samples with gender-variant participants. One of these studies (Schneider et al., 2006) did not give variance details. Wallien et al. (2008) assessed 96 MF transsexuals, 51 FM transsexuals, 90 males with gender-typical identities, and 112 females with gender-typical identities. Their sample had a variance of the ratio of 2D:4D of 0.00143, with inter-experimenter reliability of *r* = .98, suggesting the true variance was 0.00143 * .98, equalling 0.00140. Kraemer et al. (2009) assessed 39 MF transsexuals, 17 FM transsexuals, 176 males with gender-typical identities, and 190 females with gender-typical identities. Their sample had a variance of 2D:4D of 0.00106, with inter-experimenter reliability of *r* .89, suggesting the true variance was 0.00106 * .89, equalling 0.00094. Out of the total 771 participants, there is an estimated true variance of 0.00115.

The variance of 2D:4D in the sample used in this thesis is .00295. From this, it can be estimated that the amount of error variance in the present study is a 2D:4D ratio of 0.00180 (0.00295 - 0.00115). As a proportion, this is .61 (0.00180 / 0.00295).