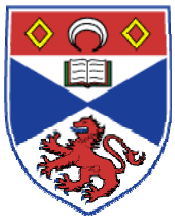
FATHER ABSENCE, ATTRACTION AND DEVELOPMENT

LYNDA BOOTHROYD



University of St Andrews

This thesis was submitted for the degree of Doctor of Philosophy,
in September 2004

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FOREWORD

ABBREVIATIONS

The following abbreviations will be used in this thesis:

ANOVA	Analysis of variance	RHP	Resource holding potential
BMI	Body mass index (weight:height^2)	SES	Socioeconomic status
EPC	Extra-pair copulation	SPSS	Statistical Package for Social Sciences
GLM	General linear model	URL	Universal remote locator (website address)
IBI	Inter-birth interval	WCR	Waist-chest ratio
KS z	Studentised Kolmogirov Smirnov statistic (1 sample test for normality)	WHR	Waist-hip ratio

In chapter 11:

FSEP	Female composite, separated parents
FGR	Female composite, parents had good relationship
FPR	Female composite, parents had poor relationship
MSEP	Male composite, separated parents
MGR	Male composite, parents had good relationship

TERMINOLOGY

Fertility

Use of the word fertility in this thesis will refer exclusively to *biological fertility*, i.e. the ability to conceive. Number of offspring will be referred to as reproductive success. The word fecundity will not be used.

Father absence

Unless specified otherwise, the term father absence will refer to an individual having spent some or all of the years of their childhood (up until puberty or 11 years of age) without a co-resident father. A father absent individual is someone who experienced this background. Similarly, father presence refers to a background in which the biological father was always co-resident with the individual concerned, and a father present individual was always co-resident with their father.

STATISTICS

Use of parametric statistics

Frequently, throughout this thesis, data consists of ordinal scales which are averaged together to produce a single score (usually preference score) for each subject, on a scale which is effectively continuous. Such variables are often considered to be acceptable for parametric analysis. Therefore, these variables were then tested for normal distribution. In relevant results sections, where it was considered desirable to use t-based analysis (either for reasons of power, or in order to carry out factorial analyses) it will be stated whether the averaged scores were normally distributed or not. Where all the variables were normally distributed, parametric statistics will follow. Where the majority of the variables in particular set of ratings is normally distributed, it will be assumed that the underlying population distribution is normal, and because t-based tests are robust to moderate deviations from normality, parametric statistics will again be used. Factorial analyses and 1-way ANOVAs are also all carried out using the General Linear Model in SPSS 10.0 which SPSS claim is more able to withstand nonparametric data than standard ANOVAs. Where at least half the averaged scores are not normally distributed, nonparametric analyses will be used.

In the case of the masculinity preference scores in Part 2 of the thesis, parametric statistics are used. Of the 6 masculinity preference variables in Part 2 and Appendix E[1] preferences for male facial masculinity are always normally distributed ($p>0.05$), while preference for female facial masculinity are normally distributed in Study 5. Only preferences for female facial masculinity in Study 4 differ from normality ($p<0.05$). It was therefore considered acceptable to use t-based statistics on masculinity preference data.

In the case of the family background variables in Parts 2 and 3 of the thesis (Positivity to parents, and quality of parents relationship), the data were never normally distributed so nonparametric statistics are used throughout.

[1] 1. both sexes rating male masculinity for Study 4; 2&3. women rating male masculinity for short term and long term relationships in Study 5; 4. both sexes rating female masculinity for Study 4; 5&6. and men rating female masculinity for short and long term relationships in Study 5

Correction for multiple tests

Throughout this thesis, a single dependant variable is correlated with multiple independent variables, or vice versa. Alternatively, there are instances of two groups being compared on multiple variables. There are also multiple pair-wise comparisons which are not appropriate for standard post-hoc tests (e.g. they utilise repeated measures variables). In all of these instances, error rate is controlled using the Benjamini-Hochberg correction. This is a sequential Bonferroni-like formula, but which unlike Bonferroni does not assume all null hypotheses to be true and has been shown to have much higher power than Bonferroni (Benjamini & Hochberg, 1995).

Where correction renders a particular result nonsignificant, this is stated. In all other cases, it can be assumed that results are significant even after applying correction. Correction is performed within families (i.e. groups of closely theoretically related tests). Benjamini & Hochberg (1995) argue that this is more valid than performing correction across families as it allows for different groups of tests having distinctly different patterns of 'true' results.

ABSTRACT

Since Draper & Harpending (1982) proposed that father absence would be associated with a shift in reproductive strategy, a body of literature has accumulated supporting their claims. This thesis explores further aspects of father absence theory, utilising computergraphic facial processing. It opens with an overview of both father absence theory (Chapter 1) and the Evolutionary Psychology of attraction (Chapter 2).

Part 1

Part 1 explores the meaning of masculinity in partner choice scenarios. Male facial masculinity co-varied with facial age but not apparent facial health both in terms of women's preferences (Study 1) and women's direct perceptions (Study 2). This suggested that masculinity in male faces is not a cue to immunocompetence health status as other authors have suggested. In Study 3, while masculine faces were perceived as more dominant than feminised faces, they were otherwise considered poorer quality partners. It was suggested that masculinity was attractive because of a 'sexy son' mechanism (dominance increasing offspring reproductive success), which was traded off against the anti-social traits associated with masculinity.

Part 2

Studies 4, 5 and 6 found that father absence or poor relationships with the parents generally reduced masculinity preference and age preference (although in Study 5, this effect was moderated by relationship status). This contradicted predictions made from traditional father absence literature (that father absence should be associated with a short term strategy and therefore masculinity preference). Sociological explanations were discounted as family background did not relate to the traits women *said* they desired in a partner (Study 7). Altogether these results raised questions about the attractiveness and self-esteem of father absent females. Part 3 therefore investigated the physical development of these females.

Part 3

Study 8 found that marital difficulties between parents were associated with an increase in perceived facial masculinity in both male and female offspring's faces, a decrease in facial attractiveness and increased weight and waist-hip ratio in women. Study 9 found that levels of progesterone were inversely related to quality of parental relationship.

The overarching conclusions of the thesis were that there appears to be an effect of physical masculinisation which is associated with father absence. This masculinisation may be the predicator for previously observed father absence effects, and the results in Part 2. As such, attachment based explanations of father absence effects (such as Belsky et al, 1991) may be redundant.

1. FATHER ABSENCE AND DEVELOPMENT

1.1. LIFEHISTORY THEORY AND R- VERSUS K-STRATEGY

A key concept within Evolutionary Biology is that of trade-offs. As many desirable circumstances are mutually exclusive, it is necessary to compromise in order to produce the most optimal fitness outcome for a given individual organism. Lifehistory Theory could be a described as the study of how and why species, and individuals within species, vary their reproductive strategies. Ideally, an organism would produce a large number of offspring in whom a great deal of energy is invested to ensure offspring quality and future reproductive success of the offspring. However, the energetic requirements of rearing offspring can be massive. Not only does parental investment drain energy which could be diverted into seeking further copulations by males (see Trivers, 1972, for a discussion of mating versus parenting effort in males), but it drains males and females of energy that could be invested in subsequent offspring (see Trivers, 1974, for a discussion of parent-offspring conflict). Organisms must therefore trade-off number of offspring against quality of offspring. MacArthur (1962; McArthur & Wilson, 1967) introduced the notion of two opposing ecological strategies, r and K[2], which an organism can take to reproduction and rearing of offspring. Although MacArthur proposed that r and K are two different types of selection resulting in two types of reproduction, they can in fact be seen to represent the two ends of a continuum along which there is variation both between and within species.

The r-strategy refers to the rapid production of offspring in whom little or no parental investment is made. R-selected species typically mature rapidly, have short courtships, produce many offspring (sometimes all in one reproductive bout) and die early. Two factors can promote the occurrence of r-strategy. Firstly, in MacArthur & Wilson's (1967) initial argument, 'r' is promoted by an environment in which nutrition does not limit family size, and where there is plenty of room for population expansion. An environment rich in resources has been shown to be associated with reduced inter-birth intervals (IBIs; considered to be an index of parental investment) amongst primates (Dunbar, 1988), which supports this argument. In rich environments, offspring can receive greater nutritional input for a shorter period of time and be viable, allowing their parents to invest in new offspring.

[2] The terms r and K derive from MacArthur's ecological model, where r = rate of population growth (under optimal conditions), and K= carrying capacity of the environment

Secondly, however, r-strategy reproduction is more commonly associated with unstable, dangerous environments in which pathogen levels and predation risk are high. Pathogens and predators are sources of care-independent mortality, in that no amount of extra parental investment can reduce mortality levels. When offspring mortality is largely determined by external forces, selection will favour organisms which invest less in each individual offspring but produce a larger number of offspring, as it is more likely that at least some of those many offspring will go on to reproduce themselves. Extreme forms of an r-strategy are seen more commonly amongst insects and fish, which can produce vast numbers of fertilised eggs many of which are eaten by predators. However, mammals can also be seen to reduce IBIs when care-independent mortality is high. For instance Lycett, Henzi & Barrett (1998) showed that across 9 different baboon populations/data sets, length of IBI was negatively related to predation risk. In the Drakensberg population Lycett et al collected data on, IBIs were very long despite the poor ecological conditions. This, they argued, was because the Drakensberg baboons had almost zero predation risk and the increased parental investment in offspring had a high payoff in long term reproductive success. The low predation therefore meant these baboons did not need to adopt an r-strategy despite the difficult conditions.

A K-strategy is one in which offspring quality is prioritised over offspring number, and organisms will produce a few offspring in whom many months, or even years, are invested. K-selected species are also typically long lived, slow maturers who have their few offspring across several reproductive bouts. This occurs when offspring quality is the driving factor in long term inclusive fitness. MacArthur & Wilson (1967) argued that if an environment was at its 'carrying capacity' (i.e. there were not enough resources to support population expansion) then reproductive success would be based on the competitiveness of offspring, rather than number of offspring. Also, environments promoting a K-strategy will be relatively low in care-independent mortality, and relatively high in care-dependant mortality. If the primary threat facing offspring is starvation, it is in the parents' reproductive interest to invest more in each child in order to prevent this. Similarly, if offspring are unlikely to die of predation or disease, then it is efficient to invest in individual offspring rather than maximising offspring number. Thus reduction in nutritional resources typically leads to longer IBI in primates (Silk, 1990).

Although they do not distinguish here between different sources of mortality, the essence of the relationship between lifehistory and mortality was summarised by Promislow & Harvey (1990) in their Bet-Hedging Theory, a refinement of r-K selection theory.

> *If the chances of survival are good, a mother can afford to make a large neonate, with high competitive ability. If survival is unpredictable (or unlikely) then a large litter of very small neonates will afford the possibility of high fitness in good years, but minimise maternal losses in bad years… It would appear that mortality is a good determinant of which strategy will be pursued.* (Promislow & Harvey, 1990, p 427)

Humans as a species are located overwhelmingly at the K-strategy end of the continuum. Westernised humans in particular, with their typical one to three offspring per couple and very delayed reproduction long past physical maturity, represent an extreme form of the K-strategy. However even amongst modern society there is variation in strategy. For instance, reproducing in one's twenties or thirties and having two children who are both funded through university (a typical middle-class Western strategy) can be described as more of a K-strategy, while reproducing from an earlier age and having five children who leave school at 16 could be described as more of an r-strategy. Figueredo, Vasquez, Brumbach, & Schneider (2004) propose that amongst Western populations, lifehistory traits such as education, initiation of sexual behaviour, first reproduction and impulsiveness all correlate into a 'K-factor' on which individuals vary in an r-K manner.

It has been of great interest and initially consternation to scientists that Western humans (who do not experience much infant mortality) appear to have an inverse relationship between resources (i.e. income) and birth rate with higher socioeconomic status (SES) families typically having fewer children (although the relationship may remain positive *within* income brackets). It has been suggested that those following an r-type strategy may not have high mortality, but do feel they have low economic migration possibilities, i.e. they cannot create high quality, competitive offspring, so their reproductive success is limited by offspring number instead. MacDonald (1997) uses the example of Ashkenazi Jews to show that where Jews were economically constrained from advancement they adopted a strategy of having large numbers of children and not emphasising education. On the other hand, Jews in areas which did not prevent them from advancement had fewer children and strongly emphasised achievement, education and parental investment. Importantly, East European Jews who emigrated to areas which did not persecute them quickly adopted the same small-family, high-investment strategy.

1.2. FATHER ABSENCE THEORY

1.2.1 Draper & Harpending (1982)

An important element in lifehistory theory is that events or conditions during critical periods in an individual's lifetime can affect the trajectory of development and the timing of life-events. Draper & Harpending (1982) proposed that our early childhood represented one of these critical periods as regards development of our reproductive strategies. Specifically, they believed that father-absence/presence cues children into whether it is more adaptive to adopt a strategy relying on stable pair-bonds and high levels of male investment, or to adopt a low-investment strategy. For female offspring, they believed that presence or absence of a father figure (possibly mediated by maternal attitudes to males) signals the amount of paternal investment available in that culture and therefore whether or not it is worth attempting a biparental investment strategy:

> "*In the face of males who will not provide parental effort, females may maximise reproductive success by minimising time loss. They can reproduce early with little or no concern for their mates… [W]here there are males willing to invest … females may delay sexual bonding and refuse any male save one who will be a reliable partner and provisioner."* (Draper & Harpending, 1982, p262)

There is strong evidence that father absence is indeed associated with precocious sexuality in girls. For instance, Ellis, Bates, Dodge, Fergusson, Horwood, Pettit & Woodward (2003) showed in a longitudinal prospective study of two separate groups of girls that absence of the biological father during early childhood was associated with earlier age of first intercourse, and higher rates of teenage pregnancy. This study not only used a prospective design, but also controlled for SES which is an important potential confounding variable. Although Ellis et al used possibly the best methodology thus far, there are several other studies also showing a similar effect of early father absence on first coitus (e.g. Kiernan & Hobcraft, 1997; Jonsson, Njardvik, Olafsdottir, & Gretarsson, 2000; Quinlan, 2003; Grainger, 2004), although some have failed to show an effect (Wu & Thompson, 2001; Dorius, Heaton & Steffen, 1993).

A major flaw within father absence related literature is that researchers are forced to use correlational designs, and no one has yet identified a suitable case for a naturalistic experiment. It is therefore surprising that there has apparently been little work carried out with non-human species, when experimental designs could be used. However, the most applicable animal study, by Wang & Novac (1994), used bi-parental prairie voles and shows

that removing the father from the nest during weaning significantly reduces the alloparenting and parental behaviour displayed by the voles once they reach maturity. This suggests that father absence in a (mostly) bi-parental species such as humans could indeed causally lead to a decrease in parental investment made by offspring once they have children of their own.

1.2.2 Belsky et al (1991)

Belsky, Steinberg & Draper (1991) took Father Absence Theory further and proposed a developmental model by which early circumstances would effect reproductive strategy via the attachment process. They believed that father absence represented simply one of several environmental stressors which could effect development, and that it was this stress which was the key factor. According to the Belsky et al model, a stressful early environment would produce harsh and unresponsive parenting, which should lead to a child developing an insecure attachment to its parents. This insecurity would then transfer to the child's entire approach to life; the individual would operate on a short-term, opportunistic basis, have short term relationships and invest little in their own children, ultimately perhaps leading to a self-perpetuating cycle in many cases. This is essentially an r-strategy in that parents do not seek 'quality' in their offspring, and reproduce on an 'opportunistic' or haphazard basis[3].

Alternatively, a stable and calm environment will promote warm and supportive parenting, leading to secure attachment and a valuing of relationships with others. This should then lead to adoption of a long term strategy, with careful, long term pair bonding and high levels of parental investment in a few offspring (i.e. a K-strategy).

The Belsky et al model can be summarised as in Figure 1.1, and produces three key predictions which can be empirically tested: firstly, early stress and difficult family relationships should have the same effects as those predicted for father absence by Draper & Harpending (1982) – i.e. high stress leads to early coitus; secondly, both early stress and its later effects should relate to attachment; and thirdly, Belsky et al incorporated Barkow's (1984) prediction that the effects of father absence and stress should include not only early coitus, but early *physiological* readiness for reproduction – i.e. early menarche.

[3] Whether father absence actually leads to having more children is uncertain. Bereczkei & Csanaky (1996) found that father absence was associated with more pregnancies, but counteracted by more miscarriages. Otherwise there is very little data on completed family size and family background, and like most measures of reproductive success in Western populations, what exists is perhaps rendered uninformative by modern contraceptive methods.

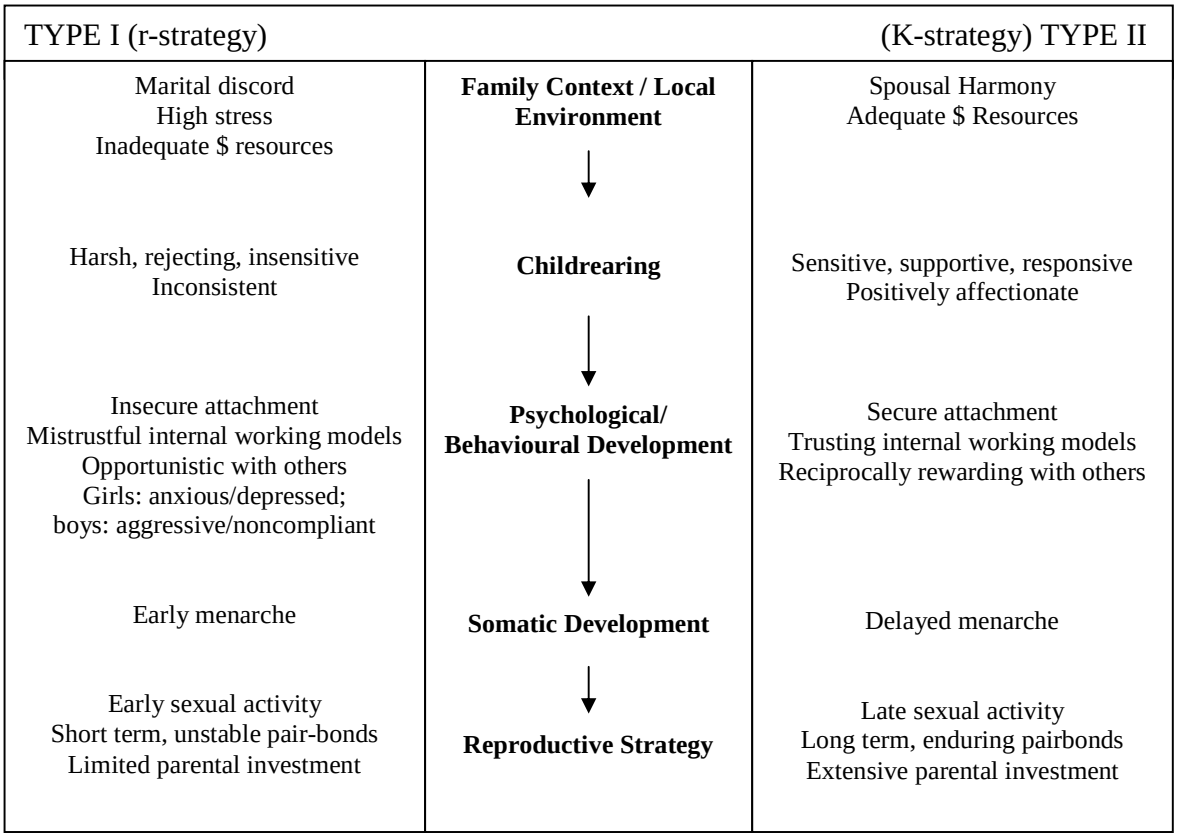

Figure 1.1. Diagram of the ecological developmental model. Adapted from Belsky et al (1991)

In answer to the first prediction, several studies have shown that early stressors other than father absence are associated with precocious sexuality. For instance, Davis & Friel (2001) found that family stress in the form of mother-child relationships and frequency of interaction influenced levels of adolescent sexuality in a way predicted by Belsky et al. Quinlan (2003) showed that as well as parental separation being associated with precocious sexuality, on top of this a greater number of changes in caring situation (i.e. greater disruption of social environment and attachment) was also associated with a decrease in age at first coitus. Furthermore, economic stress (low SES) is well known to be associated with early sexuality and teenage pregnancy. Lammers, Ireland, Resnick & Blum (2000) found that teenagers most likely to postpone first coitus were not only more likely to come from a two-parent household, but also more likely to be of higher SES. Singh, Darroch & Frost (2001) go as far as to cite socioeconomic deprivation as a key factor in cross-cultural differences in teenage sexuality.

There is also evidence that early stress relates to attachment. It is well established that parental sensitivity is essential for the development of secure attachment (e.g. Ainsworth et al, 1971; NICHD, 2001) and that inconsistency on the part of parents (which should create

interpersonal stress for the child) is associated with insecure-resistant attachment (Isabella, 1993) which is characterised by emotionally ambivalent clinginess on the part of the child. Furthermore, environmental stressors have been shown to affect attachment patterns of offspring in both childhood (Vaughn, Egeland, Sroufe, & Waters, 1979) and adulthood (Hill, Young & Nord, 1994). Importantly, Hill et al found that early environmental stress was associated with insecure adult attachment on the Hazen & Shaver (1987) questionnaire (as relates to adult romantic relationships, rather than the Adult Attachment Interview which relates back to parental relationships), suggesting that early stress leads to a reduced ability to form stable, happy and secure partnerships. Although Hill et al used retrospective reporting of parental behaviour by university students, research has shown moderate reliability of retrospective reports based on two different self-report measures (Cournoyer & Rohner, 1996; Finkel & McGue, 1993).

Finally, father absence, early environmental stressors and attachment have been shown to be associated with the age at which an individual reaches puberty. This is particularly important because, unlike sexual activity and attachment, menarche is both an objective measure and represents an actual physiological difference between father absent and present groups. It could therefore be considered to be the strongest evidence for Belsky et al's model. Moffitt, Caspi, Belsky & Silva (1992) found that father absence before the age of six significantly predicted early menarche in girls. Ellis, McFadyan-Ketchum, Dodge, Pettit & Bates (1999) found that, in a prospective longitudinal study, the quality of the father's investment in the family (e.g. his warmth towards the children and his input into the marriage, as rated by observers) significantly predicted pubertal timing in girls. Finally Kim, Smith & Palermiti (1997) found that difficult parent-child relationships in childhood also predicted early puberty in both girls and boys, although this was a retrospective study. In total there are 9 published English-language studies of the effects of early (prior to 11 years of age) father absence on age of menarche, of which 6 found that father absence significantly predicted earlier puberty, while 3 studies found no effect[4] (see Table 1. for a summary of the studies). Given that the nonsignificant results are usually disproportionately under-represented among published results, this suggests there may be further nonsignificant results

[4] Waliszko (1988), Milicerowa (1968) and Panek & Piasecki (1971) are referred to by Hulanicka (1989; as cited by Kim et al, 1997) as showing that father absence is associated with early menarche. However, Waliszko (1988) contains data for complete versus incomplete/broken/unknown family backgrounds in two separate cohorts (and in fact compared the two cohorts within each group, not the two groups), and neither cohort show a significant effect of family group (1966: t_{5857}=1.36; 1976: t_{6026}=0.78). It was not possible to obtain copies of Hulanicka (1989), Milicerowa (1968) or Panek & Piasecki (1971) in order to verify at what age their subjects experienced parental divorce, so they are not included here.

which have not come to light, due to the standard publication bias in favour of significance. This has lead some of those with nonsignificant findings (e.g. Grainger, 2004) to seriously question the validity of the supposed link between father absence and precocious menarche. On the other hand, of 12 known studies of the effects of early stress and poor family relationships on the age of menarche, only 2 have failed to show any effect. Therefore, even if the effect of father absence on menarche can be questioned, the effect of early stress and family disruption in general is a more stable finding. Given that Belsky et al propose that the effect of father absence should be mediated by parenting style and attachment, it may be that some mothers may be better at protecting their children from the stress of divorce than others, which could account for the nonsignificant results.

Table 1. Summary of findings regarding the effect of early (pre-11 years) father absence and childhood stress on age of menarche.

	Father absence	**Early stress/ family conflict**
Jones et al (1972)	E	
Steinberg (1988)		Mixed E/NS
Surbey (1990)	E	E
Moffitt et al (1992)	E	E
Campbell & Udry (1995)	NS	NS
Graber et al (1995)	NS	E
Kim et al (1997)		E
Kim & Smith (1998a)		E
Kim & Smith (1998b)		Mostly NS, some E
Ellis et al (1999)		E
Hulanicka et al (2001)		E
Hoier (2003)	E	E
Quinlan (2003)	E	
Romans et al (2003)	E	
Grainger (2004)	NS	

E= significantly earlier menarche, NS=no significant effect on menarche

A final point to note is that, given the causal direction proposed in the model, unless early puberty is in turn associated with a more short term reproductive strategy, Belsky et al's theory cannot work. Both Kim & Smith (1998a) and Hoier (2003) found that earlier menarche in girls was associated with earlier sexual activity and a greater number of sexual partners. Under conditions of 'natural fertility' (i.e. without modern contraceptive methods) this would lead to a greater number of children in which there was less investment in each individual offspring. Similarly, Jaffee, Caspi, Moffitt, Taylor & Dickson (2001) found that earlier maturing men were likely to have more children and less likely to live with the

children they had; a clear example of high mating effort with low parental effort in males. Additionally, Kim et al (1997) found that earlier maturation was associated with earlier sexual activity and a greater number of sexual partners in both sexes.

1.2.2.1 Alternative mechanisms

Alternative mediating mechanisms, rather than attachment, have been proposed for the father absence effect on age of menarche. For instance, Surbey (1990) found that it was presence/absence of the father that related to menarche, and mother's presence had no effect and so suggested that the pheromones of non-relative males (i.e. the mothers' boyfriends) could trigger earlier maturation, or alternatively presence of the biological father's pheromones suppresses development.

Most importantly however, most researchers in the area acknowledge that the possibility of genetic inheritance has never been satisfactorily dealt with, and may be a more parsimonious approach to take. For instance Moffitt et al (1992) and Ellis et al (2003) acknowledge both the possibility of genetic inheritance, and the inadequacy of current data sets to test the possibility. Bailey, Kirk, Zhu, Dunne, & Martin (2000) found with a twin study that sociosexuality (tendency to engage in short term sexual relationships) is strongly genetically linked but shows very little influence of shared environment. Campbell & Udry (1995) showed in regression analyses including many family and socioeconomic variables that mother's age at menarche was the single strongest predictor of daughter's age at menarche. This is perhaps not surprising if mothers tend to provide their daughters with the same environment in which they grew up (and the tendency in father absent girls to teen pregnancies, Ellis et al, 2003, would support this), but little work on father absence has been carried out controlling for mother's own background. Chasiotis, Scheffer, Restemeier & Keller (1998) did however find that mother-daughter concordance in age of menarche was seen in West Germany, but was not seen in an East German sample where significant changes in living conditions had taken place with the reunification of Germany and the benefits accrued by East Germans at that time. This therefore suggests that mother-daughter comparisons may exaggerate the genetic influence on menarcheal age. Grainger (2004) reported that father absence had no effect on age of menarche when mother's age of marriage was controlled in a multiple regression in an effort to control for mother's reproductive strategy; however, as she found very few effects of father absence on reproductive behaviour

over all and does not report the results of the test on age of menarche *without* controlling for mother's age of marriage, it is hard to be sure what implications her results have for the nature-nurture of age of menarche. The critical test of this issue (does mother-daughter congruence in rearing environment predict mother-daughter congruence in age of menarche) has yet to be published.

In terms of twin-studies, Rowe (2002) found that there was a significant genetic component of age at menarche inasmuch as monozygotic twins had a significantly higher concordance than dizygotic twins (Mz=0.57, Dz=0.32). Dunne et al (1997) also found large genetic components for age of first coitus in a sample of individuals who are currently aged less than 40 (males: 72%; females: 49%). As Mandler (2001) points out, ignoring shared prenatal environment in twins will doubtless lead to heritability estimates from twin studies being over estimated (given that Kaiser et al, 2003, and Sachser & Kaiser, 1996, found effects of prenatal maternal stress, this is a very important point). Therefore adoption studies, and mother-daughter studies would be far more informative if carried out correctly. However, the data on twins suggest there is still at least some genetic influence on sexual development.

Belsky et al (1991) agreed that it was likely that a degree of the covariance between family background and developmental outcomes was genetic. However, they argued that because genetic factors typically account for at most half of variation in any given trait (see Scarr, 1992, for a review) and frequently they account for less than half, it is implausible that genes could account for all the effects of father absence. While this is a valid point, the use of behavioural genetics literature also highlights that in many cases, the remainder of variation between individuals in behavioural traits such as aggression and extraversion (the types of trait Belsky et al appear to have been referring to) are explained by nonshared environmental factors. Scarr (1992) concludes in light of this that since this is the case, parents can in fact have very little influence on their children through rearing and that it is the children's genomes and their experiences outside the home which have the strongest impacts. This perspective does of course assume that parents treat their all children equally, and that difficulties with parents effect all children of a couple in the same way. If father absence is to be treated as a dichotomous variable and expected to effect all individuals in the same way, then the lack of shared environmental effects is a problem. Until this issue is resolved, Belsky's model (and indeed all such models which rely on environmental causation) must be treated cautiously.

1.2.3 Chisholm (1993)

Finally, father absence theory was developed further by Chisholm (1993) who proposed that family stress and parental sensitivity were in fact a cue to mortality levels and that where mortality levels were (cued as being) high, individuals would have a short time-preference (i.e. more immediate costs and benefits would have a greater impact on their behaviour than more distant consequences) and follow short term strategies. Using the concepts discussed in section 1.1: high care-independent mortality is driving an r-strategy. There is evidence that care-independent mortality sources (in these cases disease) can effect reproductive behaviour. For instance, Low (1988) showed that local pathogen levels (i.e. the likelihood of catching serious, if not fatal, diseases) are related to the degree of polygyny. This suggests that when genetic quality is of utmost importance, some women were 'willing' to become secondary wives to high genetically valuable males at the expense of receiving a lower quality male's undivided investment. Transferring this to mate preferences, Gangestad & Buss (1993) reviewed a cross-cultural data-set collected by Buss (1989) and found that people in high pathogen areas also stressed the importance of physical attractiveness to a significantly greater degree than people in geographical areas with lower levels of pathogens.

Neither Low nor Gangestad & Buss propose an actual proximate mechanism for how individuals could respond to local pathogen rates. It is possible that individuals who have lived in high pathogen areas for many generations could evolve to prefer higher gene value mates, just as individuals in malarial areas have evolved a high incidence of the sickle cell trait and have many anti-malarial mythologies (Durham, 1991). However, Chisholm's theory is a conditional one (all individuals posses the same mechanism which responds to the local conditions of that individual), therefore the father absence effect must have evolved as a response to constantly changing pathogen levels, where inter-generational flexibility in behaviour was required. It cannot be due to local microevolution. Similarly, Low and Gangestad & Buss assume that their findings are the result of behavioural flexibility rather than localised adaptation. Should these assumptions be valid, the proposition that mortality rates affect parental stress, which affects the child's developmental trajectory, represents a possible proximate mechanism.

There is evidence that local mortality levels are related to family stress inasmuch as Bereczkei & Csanaky (2001) found that children from stressful families (i.e. those who would be expected to mature early and follow a short-term mating strategy) had more deceased siblings than other children. However, these data could alternatively show that poor/stressful parenting lead to the higher sibling mortality, rather than the other way round.

Chisholm (1999) showed that women's perceptions of mortality risk were negatively associated with sexual caution. Women who expected to live longer had first coitus later than other women, even after controlling for age of menarche and attachment. However, in contrast with this, Hetherington (1972) found that death of the father decreases interest in sexual activity in teenaged girls, even compared to teenagers with married parents, let alone father absent girls.

There is, however, very little research on the effects of mortality on age of menarche. Chisholm (1999) included paternal death in his stressful life events scale, but found no effect of life events on menarche or first coitus (although he did not specify between childhood or adolescence stressors). Surbey (1990) did not find any differences between age of menarche in girls whose parents divorced and girls whose father died. In contrast, Ellison (1981) showed an effect whereby increased mortality in a population was associated with *later* average age of menarche, but he did not distinguish between nutritionally induced mortality and disease or accidents. Although he discusses populations differing in mortality, but *not* calorie intake, having differences in age of menarche, he does not control for energy drains in the environment (such as altitude) and therefore does not control for energy requirements. Since he later argues (Ellison, 1990) for the importance of considering caloric intake:requirements ratios when looking at effects on menarche (as very high energy requirements can induce nutritional stress, which would therefore inhibit fat deposition and therefore inhibit menarche), the lack of this consideration in his earlier paper is a serious flaw.

1.2.4 Hoier (2003)

Hoier (2003) proposed that father absence signalled a shortage of appropriate mates in the local environment, which meant that due to a female biased operational sex ratio, there is increased female competition for mates. She therefore suggests that females in a male-shortage niche needed to start reproducing as early as possible in order to counteract this shortage by finding a mate as soon as they can, and that such women would be less likely to hold out for their 'ideal' partner. However, according to this proposal, one would predict that once a father absent female found a mate she would commit after a very short courtship and then engage in strong mate retention tactics and seek to extend the relationship as much as possible rather than contract it. Given that divorce of parents is a strong predictor of offspring's marital breakdown (Wolfinger, 2003) it seems unlikely that father absent women engage in successful mate retention. Furthermore, if the father absence signals male

shortage, then any cause of male shortage ought to have the same effects. However, there are clear differences between the daughters of absentee fathers and dead fathers, with parental death not resulting in the reduced marital success which is associated with parental divorce (Teachman, 2004) or the increased sexuality (Hetherington, 1972), and divorce and paternal death being associated with very different adult psychological profiles (Mack, 2001). This therefore suggests that there is something about father absence more important than simply male shortage which must be driving the father absence effects. Hoier (2003) supported her theory by presenting data showing that women who experienced early menarche were no more or less interested in provider versus genetic value related personality traits (e.g. reliable, loves children, faithful vs. good looking, sporty, intelligent) than women who had later menarche (suggesting they were just as interested in finding a long term provider), however she did not support this by showing any difference or lack of difference between father absent and father present females. Chapter 9 of this thesis will go on to explore this very issue, of whether father absence effects preferences for partner personality traits.

1.2.5 An aside on boys

In general, most theories regarding the effects of father absence on boys seem to concur that the primary effect on males of father absence should be a switch to a short term 'cad' reproductive strategy. According to Draper & Harpending (1982) this is because boys pick up on signals that paternal investment is not necessary. According to the Belsky et al model, it is because, like girls, they perceive the social environment as unstable and have an opportunistic approach to relationships. According to Chisholm (1993) boys are facing the same high mortality (and so have the same short time-preference) as girls, and according to Hoier (2003) males should see themselves as the sex in demand, and so operate on a strategy most to their advantage (see Guttentag & Secord, 1983, for further discussion of sex ratio effects on mating strategy in humans). Only Kanazawa's theory should not necessarily predict 'short termism' in males. If father absence signals high levels of polygyny, then father absent males should only lean more towards short term relationships (i.e. temporal polygyny) in societies which do not permit polygamy, because otherwise they can acquire multiple, concurrent long-term partners. Most of these theories would also predict that there would be little or no impact of father absence on the age of boys' puberty. Although according to Chisholm's theory one might expect that males (facing the same high mortality as females) should accelerate their entire lifehistory, all the other theories suggest that father absent boys will feel they need to compete with other males (Berezckei & Csanaky, 1996,

show evidence for this). To compete more successfully, accelerated puberty should not be selected for, as it is better to put energy into growing and strengthening enough to be competitive before entering the mating arena. There has been very little research carried out on the effects of father absence and early stress on age of puberty in boys; Kim et al (1997) cite 4 studies, of which 2 found nonsignificant results, 1 found a significant effect (early puberty, though the same paper showed no effect on age of menarche in girls) and 1 had very mixed results. Kim et al themselves did show some effects of early parent-child and parent-parent relationships on age of spermarche, but far fewer significant results than they found for age of menarche (4/27 vs. 11/27 for female subjects). Waynforth, Hurtado & Hill (1998) on the other hand, found that father absence decelerated first reproduction in South American tribesmen (see Chapter 13 for further discussion).

In general, this thesis will focus on females because it is amongst females where research suggests most effects of father absence are to be found.

1.3. This Thesis

This thesis seeks to further investigate the father absence phenomenon by bringing father absence research together with attraction research, utilising current computergraphic facial imaging techniques. Two principle lines of enquiry can be formed using this approach: firstly one can investigate the effect of father absence on inter-personal attraction, and this will be the focus of Part 2 (Chapters 6 to 10); secondly one can investigate the attractiveness and mate quality (including facial appearance) of individuals from differing backgrounds, which will be the focus of Part 3 (Chapters 11 and 12). Neither of these issues has received much empirical attention before and both should provide greater understanding of the processes associated and involved with the father absence effect. In order to fully understand the choices that participants make regarding facial preferences and the significance of facial differences, Part 1 will investigate further the meaning of facial masculinity in partner choice contexts.

2. EVOLUTIONARY APPROACHES TO ATTRACTION

According to Darwin (1859), acquisition of a sexual partner for the production of offspring is a fundamental part of evolution. He describes 'sexual selection' as depending "not on the struggle for existence, but on a struggle between the males for possession of the females; the result is not death of the unsuccessful competitor, but few or no offspring." This has therefore lead to a great deal of attention amongst evolutionary theorists being directed towards mate choice or attraction. Although these theories have only recently begun to be used by social psychologists, they have become perhaps the most dominant approach to interpersonal attraction at the current time. The various theories and proposals can be divided into two kinds: firstly indirect benefits, or 'good genes' theories, in which it is the potential partner's genetic quality which is key, and secondly direct benefits theories, in which partners render each other direct fitness benefits, without reference to the genetic quality of the offspring.

2.1. INDIRECT BENEFITS THEORIES OF SEXUAL SELECTION

2.1.1 The Handicap principle and honest signalling

Zahavi (1975) proposed that sexually dimorphic features are selected for because they are *honest signals* of fitness; only high quality males can have large ornaments (e.g. peacocks tails) because only high quality males can afford to produce them. This is known as the *handicap principle* and was expanded on in the form of the Hamilton-Zuk Hypothesis (Hamilton & Zuk, 1982) which suggests that many sexually selected traits are direct indicators of parasite loads. One particularly good example of this is male colouration; in many species the males possess brightly coloured areas of their bodies which Darwin suggested would attract females. These include face and rear colour in the Mandrill (a species of monkey), feather colours in ducks and underside colour in male sticklebacks. However, the tails of peacocks, although brightly coloured, seem to attract females on the basis of their visual complexity (rather than brightness or size; Petrie, Halliday & Sher, 1991) and so ornamentation is not limited to colour.

Møller, Christe & Lux (1999) conducted a meta-analysis of non-human sexual selection research and concluded that there was evidence across species for parasite load being related to the expression of male ornaments, and an even stronger relationship between trait

expression and immunity measures. Given that parasites were also negatively related to fitness, choosing males with low parasite loads enables females to have higher quality offspring who will inherit their father's immunity to those parasites (though see Hamilton & Poulin, 1997, for evidence of a lack of these relationships intra-species). It also helps to reduce their own risk of catching parasites (see e.g. Kirkpatrick & Ryan, 1991, for a discussion) although this is a *direct* benefit.

Importantly, there has now been genetic evidence presented for the Hamilton-Zuk Hypothesis. Von Schantz, Wittzell, Goransson, Grahn & Persson (1996) showed that the strength of male ornamentation expression (spur size) in a species of pheasant was positively associated with the possession of genes which promote greater parasite resistance. Males with heterozygous major histocompatibility complex (MHC) alleles should be resistant to a wider range of parasites and pathogens (and should have a wider range of resistance to pass on to offspring), and in pheasants such males showed better viability, and also had the longest spurs. This strongly suggests that ornaments can honestly signal health and viability.

Humans do not possess extreme ornaments like peacocks tails, however it is still possible that features of our faces do give honest signals of mate value. Two particular traits which have been widely considered to be honest signals within humans are immunocompetence cues, and symmetry.

2.1.1.1 The Immunocompetence Hypothesis

Folstad & Karter (1992) proposed the immunocompetence hypothesis as an elaboration of the Hamilton-Zuk Hypothesis. They proposed that secondary sexual characteristics (that is, features arising from sex hormones, which are not directly part of the reproductive system) are honest signals because the hormones producing them are deleterious to the immune systems of the individual. Thus only very parasite-resistant males would be able to withstand the immunosuppressive effects of the hormones needed to produce large ornaments. Work has been carried out by many researchers that suggests testosterone has such an immunosuppressive effect in vertebrates. For example, Messingham, Shirazi, Duffner, Emanuelle & Kovacs (2001) found that injecting mice with testosterone increased their susceptibility to post-trauma infections, and slowed their recovery rates. However, there is also some evidence to the contrary in other species (for example Peters, 2000, found that free-living wrens did not show the same immunosuppression as captive wrens of the same breed). Roberts, Buchanan & Evans (2004) showed in a meta-analysis of experimental

studies, that although there appeared to be a significant effect of testosterone administration on immunity measures (T-cell levels, antibodies etc), this effect was purely driven by multiple studies on the same species. There was a significant effect on parasite loads in reptiles, and marginally in birds, but overall, they found no effect in mammals. In humans, there is a sex difference in post-trauma infection rates, with men much more likely to have septic wounds than women, but actual evidence for immunosuppression in humans is weak (Angele & Faist, 2000) which may be because of the difficulty of carrying out experimental studies of immunosuppression with humans.

While some have proposed that oestrogen too is an immunosuppressor (e.g. Manning, Scutt, Whitehouse & Leinster, 1997; Grammer & Thornhill, 1994). Elevated oestrogen is associated with higher incidence of female-specific cancers (e.g. ovarian: Service, 1998) and Ansar Ahmed, Hissong, Verthelyi, Donner, Becker, and Karpuzoglu-Sahin (1999) did find that oestrogen decreases the performance of white-blood cells. However, it is not clear that oestrogen suppresses the whole immune system. Da Silva (1999) reviewed a wide body of literature showing that despite having a negative impact on 'cell-mediated' immunity (i.e. white-blood cells), oestrogen actually *enhances* the production and action of antibodies (humoural immunity). This is an important point, considering it is antibodies, and not white blood cells, which are passed between mother and child during gestation and in colostrum, and which increase immunity to local pathogens in offspring. It is therefore unsurprising that this type of immunity should be enhanced by female hormones.

Likewise, there are theoretical reasons against applying the Immunocompetence Hypothesis to oestrogen, in that feminisation is believed to be a result of the balance between oestrogens and androgens, with higher relative oestrogen levels producing feminisation, and higher relative androgens producing masculinisation. This is particularly evident in the very feminine, curvaceous appearance of androgen insensitive females, who have only low levels of oestrogen (because they are genetically XY), but have effectively no testosterone at all, making oestrogen the dominant hormone (Gross, 1994). Therefore, if oestrogen and testosterone were both immunosuppressors, it would not necessarily matter whether a female appeared feminine or masculine, since evidence of heightened levels of either of these hormones would signal immunocompetence. Thus oestrogen is not a clear case for the handicap principle.

2.1.1.2 Symmetry

Amongst human honest signalling research, symmetry is a feature which has received extensive attention. Gangestad and Thornhill have frequently suggested that bilateral fluctuating asymmetry cues directly for gene quality (e.g. Thornhill & Gangestad, 1994). They propose that development of bilateral features can be knocked slightly askew by even minor developmental trauma; for example, childhood illness. Therefore, being able to maintain high levels of symmetry proves that the individual has 'good genes' which are not only able to copy with a high degree of fidelity (bearing in mind that mutation in foetal cells can have disastrous consequences for offspring) but they are also able to resist disease, parasites and accidental damage. There is supporting evidence for this in humans; for instance Waynforth (1998) found that high body symmetry in Belizean tribesmen was associated with low morbidity and high reproductive success. Like testosterone therefore, symmetry could be an honest signal of health and gene quality.

There is a great deal of evidence for both sexes preferring symmetrical faces over asymmetric faces (Rhodes, Proffitt, Grady & Sumich, 1998; Perrett, Burt, Penton-Voak, Lee, Rowland & Edwards, 1999; Penton-Voak, Jones, Little, Baker, Tiddeman, Burt & Perrett, 2001a; Rhodes, Yoshikawa, Clark, Lee, McKay, & Akamatsu, 2001). Little & Jones (2003) showed that this preference was restricted to viewing upright faces (and not inverted faces), suggesting that symmetry preference in faces is not due to a simple perceptual preference for symmetry in general. Furthermore, Rhodes, Geddes, Jeffery, Dziurawiec & Clark (2002) and Samuels, Butterworth, Roberts, Graupner & Hole (1994) both found that infants show no preference for symmetric over asymmetric faces and Jones & Cornwell (unpublished data) have found that symmetry preference is not present in prepubertal children and only appears in those who have reached reproductive age, suggesting that it is a sexually relevant trait.

However, Scheib, Gangestad & Thornhill (1999) have shown that highly (naturally) symmetric faces are just as attractive, relative to other faces, even when presented in such a way that viewers would have immense difficulty detecting subtle asymmetries (viewers were shown only one half of the face). Furthermore, Gangestad & Thornhill (1998; Thornhill & Gangestad, 1999; Thornhill, Gangestad, Miller, Scheyd, McCollough & Franklin, 2004) have shown that ovulating women even prefer the *smell* of more symmetric men, as assessed by their ratings of t-shirts which men had worn for 2 nights' sleep. This means that while symmetry may or may not be related to developmental instability, it is related to cues to quality that are already inherently in the body and is not necessarily a quality indicator in itself.

Jones, Little, Penton-Voak, Tiddeman, Burt & Perrett (2001) addressed this problem further asking subjects to rate photographs of symmetric and asymmetric faces on apparent health and attractiveness. They found that more symmetric faces were perceived as healthier, particularly when judging opposite sex faces; however the correlation between symmetry and attractiveness did not remain once the apparent health of faces was partialled out. A later study (Jones, Little, Feinberg, Penton-Voak, Tiddeman & Perrett, 2004) found that facial symmetry was related to skin health (as rated on small patches of the cheeks) and to objective texture and colour in such a way as to mediate the symmetry-attractiveness relationship.

Across the human and animal literature, there has been mixed opinion about the value of fluctuating asymmetry as a sexually selected trait. Kowner (1996) has quite correctly pointed out that we rarely view each other in a way conducive to detecting symmetry (although whether or not we can detect symmetry in natural conditions remains to be tested), which suggests Perrett et al and Rhodes et al's work has an important flaw in its ecological validity. Furthermore, it is possible that some of the asymmetries detected are *directional* (i.e. the same in most individuals) or anti-symmetries, which it has been strongly argued are not related to fitness in the same manner as fluctuating asymmetry (Palmer, 1996). In a meta-analysis of symmetry research across the human and animal literature, Tomkins & Simmons (2003) argue that not only do typical measurements of asymmetry appear to resemble the size and distribution of measurement error, but that as methodologies have improved over the decades, effect sizes in symmetry research have been tending towards zero. As regards the human literature, Tomkins & Simmons conclude that:

'*there is little convincing evidence to suggest that a preference for facial symmetry represents an adaptive preference for the acquisition of healthy partners … [and] the problems outlined for the study of human facial asymmetry are equally relevant to studies of human body asymmetry.*' (Tomkins & Simmons, 2003, p235)

This is a fairly damning conclusion, and many of their criticisms (e.g. measurement error, no control for directionality) appear to be valid ones. However, it remains the case that although symmetry may not be clearly related to health, there is well replicated evidence that it is something which humans prefer in their partner's faces, and which is related to some other factors which are important in partner choice.

2.1.2 Runaway selection and the Sexy Son Hypothesis

However, it has been suggested that indirect benefits can arise without the genes of the male increasing the viability of the offspring. Fisher (1958) was one of the earliest theorists to tackle attraction from an evolutionary perspective, and in particular to address why females should prefer apparently costly traits. He proposed a theory of 'runaway selection', which was based on the assumption that the expression of a particular trait which might (initially) be of slight selective benefit in one sex could be genetically linked to a preference for that trait in the other sex. If this is the case, then a slight bias in the number of females preferring a particular trait should lead to a greater representation of that trait in the males of the subsequent generation, combined with a greater number of females having that preference. Over several generations, more and more females would have a preference for this kind of male, and more and more males would possess increasingly stronger versions of the popular traits. This should lead to a situation where the selection for the popular trait 'runs away' and that trait becomes increasingly exaggerated in the males.

It is also possible that bias in the female preference produces selection for a non-adaptive traits without the preference and trait being linked. It is always reproductively advantageous for a female to mate with a 'popular' male, who other females also want to mate with. If she does so, then her sons may inherit the features which made that male popular, and they will go on to be popular themselves (i.e. be 'sexy sons', see below). Thus any sons she may have by this male, will go on to give her many grandchildren and spread her genes widely throughout the population. Weatherhead & Robertson's (1979) 'Sexy Son' Hypothesis showed that the polygyny threshold model (usually applied to resources) was applicable to male 'sexiness'. Mating with low investing, polygynous males was advantageous to females in that it would increase their long term inclusive fitness despite a reduction in their immediate reproductive success. It is very hard to test this theory amongst nonhuman species (see Alatalo & Rätti, 1995, for a discussion) for methodological reasons (determining paternity, for instance). However, the sexy son hypothesis can be seen quite clearly amongst humans in a comparison between polygamously and monogamously married Mormon women. Josephson (2002) found that although 2nd and 3rd wives in a polygamous marriage had fewer children than monogamous wives, they had the same number of grandchildren. Presumably, 1st wives of polygamous men (with their higher reproductive success than 2nd or 3rd wives) would have the highest inclusive fitness of all.

Although many researchers presuppose that Fisherian or 'sexy son' selection and honest signalling represent completely separate selection models, it has been demonstrated through

modelling by Kokko, Brooks, McNamara & Houston (2002) that in fact they are simply two types of the same selection. Selecting a partner on the basis of the viability that offspring will inherit, has the same impact on long term fitness as selecting a partner on the basis of the sexual competitiveness of offspring. This will be discussed further, with particular reference to humans, in Chapter 3.

2.2. DIRECT BENEFITS THEORIES OF SEXUAL SELECTION

2.2.1 Resource holding potential

2.2.1.1 With female choice: resources

Resource holding potential (RHP) refers to the cues which suggest an individual can acquire and maintain resources. This can include resources such as shelter and nest sites, but is most commonly envisioned as food. Amongst many species, one of the biggest constraints on a female's reproductive success is her and her offspring's supply of food and if males can control food resources, then females can select the males with the best territories or food supply as their mates. Where resources are sufficiently clumped to allow greater monopolisation (e.g. fruit trees), this should ultimately lead to 'Resource Defence Polygyny' (Emlen & Oring, 1977) in which males are able to acquire multiple females by possessing significantly greater resources than other nearby males. Emlen & Oring cite many avian examples of this phenomenon, however it is considerably more rare amongst mammals. Although Smuts (1987) argues that resource defence polygyny is almost never seen amongst primates, there is evidence that it exists amongst humans. For instance, amongst the Kipsigis (an African pastoral group) the size of a man's herd and land is one of the main driving factors in his ability to acquire wives (Borgerhof Mulder, 1988, 1990). Furthermore, Buss (1989) showed that across 37 different populations around the world, women considered a potential partner's resources be significantly more important than men did. Reanalysis of the data presented shows that women cross-culturally rated good job prospects and ambition and industriousness as some of the most important aspects of a partner[5] – traits which are central to human RHP.

Human males may also signal hierarchical dominance (i.e. within-sex competitiveness). For example, Mueller & Mazur (1997) found that amongst a cohort of US military officers, higher levels of facial 'dominance' (associated with masculinity) were associated with

[5] Using each population's mean as a data point, 'good job prospects' and 'ambition and industriousness' were scored as significantly more important than good looks or chastity: all $p<0.001$

attainment of higher military rank. Importantly, these males also had a greater number of (legitimate) children. This suggests it should be possible for females to determine who are more competitive males, who thus possess greater resources (by climbing the hierarchies better) and will give their partners increased reproductive success.

Dabbs, Bernieri, Strong, Campo & Milun (2001) also found that men with higher levels of testosterone were rated as more confident and assertive when video-taped talking to others, suggesting that male hormones are linked to attributes related to resource acquisition in humans.

2.2.1.2 Without female choice: harems

RHP is not strictly limited to food and shelter resources (although these are of paramount importance); amongst a wide range of mammals, RHP can be used to refer to a male's ability to acquire females through competition with other males (e.g. lions, deer, baboons). Thus RHP more broadly refers to a male's ability to access resources and females through his own direct efforts, and also through successfully competing and acquiring dominance amongst conspecifics.

In many species (some would say most polygynous mammals), it is the females who distribute themselves (with regards to the food), while the males then follow the females. Where resources are distributed such that females tend to 'clump' together, males can attempt to monopolise groups of females and thus arises 'Female Defence Polygyny' (Emlen & Oring, 1977). Female Defence Polygyny is characteristic of many mammalian species, for instance lions, hamadryas and gelada baboons, gorillas and elephants. Whether humans show instances of Female Defence Polygyny is debatable. Most salient examples of polygyny are problematic in that although dominant males are more likely to be polygynous (where they are culturally able to), whether this is purely because they are high status or because they have the material benefits of high status in order to practise Resource Defence Polygyny is debatable. For instance, Mealey (1985) showed that amongst Mormons, men would take another wife after being promoted in the church hierarchy. However, this presumably came with further material benefits which meant they could afford another wife.

Even if humans do have Female Defence Polygyny, the lack of female choice implicit in the concept could arguably make it irrelevant to attraction research. Therefore, although the indirect-benefits of male dominance and female monopolisation will be discussed elsewhere, it will not be concentrated on here.

2.2.2 Oestrogen and fertility.

Female fertility is of vital importance in mate value because without a fertile female, males are unable to reproduce and suffer genetic death. Furthermore, since resources are typically not female controlled, males do not need to consider such aspects of females which elevates the relative importance of fertility. Thus, pre-pubertal, post-menopausal and pregnant women should be the least attractive to an adult male. Importantly, Buss (1989) found that men generally prefer younger women (increasingly so as the men aged) which may relate to female fertility declining with age (Zaadstra, Seidell, van Noord, te Velder, Habbema, Vrieswijk & Karbaat, 1993).

It is likely that an oestrogenised face and body signals fertility. Female mice without oestrogen receptors are infertile (Lubahn, Moyer, Golding, Couse, Korach & Smithies, 1993) and Sher & Rahman (2000) found that infertile human women appear to have reduced ability to recycle oestrogen (and thus probably have lower endogenous levels). Singh (1993) proposed that feminine body-shape, namely waist-to-hip ratio (WHR) signalled fertility in that the 'gynoid' fat distribution (small waist and large hips) was only present during certain periods of a woman's life – those when she is most fertile. Women lose their waists very quickly with the burst of progesterone that occurs at the beginning of pregnancy, and Bjorklund, Lissner, Andersson, Lapidus, & Bengtssonthis (1996) showed that WHR increased during the transition from normally cycling to post-menopause (when the ovaries cease production of oestrogen, amongst other hormones). Certainly WHR is related to both conception rate (Bringer, Lefebvre & Renard, 1999; Zaadstra et al, 1993) and to oestrogen levels (Jasienska, Ziomkiewicz, Ellison, Lipson & Thune, 2004; although this study did not control for progesterone levels).

2.3. CURRENT FINDINGS IN HUMAN FACIAL ATTRACTION

2.3.1 … what women want

According to Trivers' (1972) Parental Investment Theory, when one sex of a species is the higher investing of the two in their offspring, that sex will be selected to be more choosy than the other, while selection will favour behaviour which maximises the number of conceptions in the lower investing sex. For the sex with the larger 'minimum time out' (i.e. who takes the longest minimum time to the return to the mating market following reproduction), each reproductive bout represents a larger proportion of their inclusive fitness

than it would for a member of the opposite sex. Thus they should be more careful about whom they enact that bout with. Alternatively, Kokko & Monaghan (2001; see also Kokko & Johnstone, 2002) argue that it is the sex for whom each reproductive bout has the highest cost that should be the most choosy because it is members of this sex who incur the greatest risk.

In humans, like most mammals, females make a bigger contribution to parental investment. While males are in principle able to desert a female immediately after a copulation leading to conception and find another partner, females have a minimum time out of at least 2 or 3 months (if they manage to abort a pregnancy), or a year (allowing for a return to normal cycling if they carry the child to term and abandon it) or up to 5 years (with lactation-induced amenorrhoea). In order to successfully raise a child, maternal investment is essential for at least a few years; amongst the hunter-gatherer Ache of Paraguay, infants never survived the death of their mothers, and small children did so only rarely (Hill & Hurtado, 1996). On the other hand, death or desertion of a child's father had a much less pronounced impact on child mortality amongst the Ache. This pattern can also been seen in an early modern population of farmers (Voland, 1988).

Furthermore, pregnancy incurs significant risk for women, both in terms of their ability to bear more children, and their own survival. Until recent times, pregnancy was a major source of adult female mortality and it is still not uncommon for complications in delivery to lead to sterility even with modern medicine.

Finally, as humans are a strongly K-selected species, offspring quality should be important to most prospective parents, in order to ensure their children's future reproductive success[6]. Therefore, bringing together their increased time-out and potential costs of reproduction compared to men, and the general trend towards selecting for offspring quality in humans, women should be highly selective when choosing potential partners.

Because women should be 'choosy', one might predict that they would be particularly attracted to males who possessed honest signals of good genes, as discussed above: immunocompetence (i.e. high testosterone), health and symmetry. Thornhill & Gangestad (1994) showed that women prefer symmetrical men to asymmetric men. However, there is evidence that women do not desire high testosterone (masculine) men. For example, Cunningham, Barbee & Pike (1990) used a facialmetric method to study female preferences.

[6] Mace (1993) argues that rather than a reduction in infant mortality, it is the increase in child rearing costs in the modern world which lead to the demographic transition from large families, to small families.

They took photographs of male faces, had women from both western and nonwestern populations rate them for attractiveness, and then measured the dimensions of the faces. They found positive correlations between rated attractiveness and chin length and cheekbone prominence (masculine traits), but also large eyes and small noses (feminine traits). Similarly Jones (1995) found that women in different, very contrasting, cultures (the Ache, the Hiwi, Brazil, Russia and the USA) preferred line-drawings of male faces that had been warped to give them larger eyes and foreheads and smaller jaws.

Perrett, Lee, Rowland, Yoshikawa, Burt, Henzi, Castles & Akamatsu (1998) used a computer to manipulate male faces along a shape-continuum from androgynous (feminised) to hyper-masculine. Contrary to their expectation, they found that both Caucasian and East Asian women preferred men who were slightly more feminine in their facial shape than average. They then went on to show that men with more feminine faces are perceived as possessing the traits of better long term partners and fathers. Subjects ranked faces which had been masculinised as more dominant but less warm, honest, cooperative, and as poorer quality parents, than faces which had been feminised.

Thus women appear to be sacrificing genetic quality of mate (as indexed by degree of masculinity) for commitment and paternal investment into their offspring. This is concordant with Buss' findings (1989, Buss & Schmitt, 1993) that both westernised and nonwesternised women consider personality, generosity and commitment to be more important than attractiveness in a long term mate. Cunningham et al's findings that women prefer some features to be masculinised (jaws) and some to be feminised (eye and nose size) could possibly be a direct way in which women manage their trade-off (although it was not clear to what degree the jaw varied independently from the nose, mouth and eyes).

However, there is a complication in this view: women's preferences for a mate change as a function of their menstrual cycle. As mentioned above, women have been shown to prefer the scent of symmetrical men when they are in the most fertile part of their cycle (Thornhill & Gangestad, 1999). Similarly, Penton-Voak, Perrett, Castles, Kobayashi, Burt, Murray & Minamisawa (1999) found that ovulating women preferred *less* feminised (more masculine) men for short term relationships than at other times in their cycle. During non fertile parts of their cycle (luteal and early follicular) they preferred feminised male faces, as in Perrett et al's (1998) data; during their fertile phase (late follicular: days 6 to 14 of the cycle) they preferred male faces closer to average. This suggests that although seeking a long term mate requires women to compromise on gene quality in favour of males most likely to engage in a committed relationship, women who are seeking short term partners (be they exclusive, or

extrapair matings) select higher gene quality partners at the time when they are most likely to conceive. This allows women to prioritise either gene quality, or paternal investment depending on circumstances.

2.3.2 … what men want

According to Parental Investment Theory, men (who have a very minimal time-out) should be much less concerned with the quality of their partners as it is much easier for them to mate with multiple females. However, it has been argued that male choosiness is not purely governed by their negligible minimum investment (i.e. their ability to desert immediately after copulation). Kokko & Johnstone (2002) showed that male choosiness could arise where paternal investment was important for offspring viability. Additionally, where the primary sex ratio of a species is roughly equal, it may not always be in a male's interest to desert his mate since he may not find another easily (Kokko & Jennions, 2003). Therefore, unless male mate competition reduces the number of sexually active males such that a few males dominate all the females, males too may be choosy in selecting the mate they are likely to be unable to desert.

As discussed above, although desertion or death of a child's father is not as devastating as death of the mother, paternal investment is beneficial to human child rearing (Hill & Hurtado, 1996). Furthermore, humans only show mild polygyny. Although in the west, many people practise serial monogamy (or 'temporal polygyny') with males being more likely to remarry than females[7] (Buckle et al, 1996), in cultures which allow polygamy, it is still only a minority of the population which engages in polygyny (e.g. Mormons: Josephson, 2002; Mealey, 1985). Furthermore, when comparing against other primate species, the mild sexual dimorphism seen in humans suggests that humans have an evolutionary history of only mild polygyny in that males are somewhat, but not hugely, bigger than females and should therefore have faced moderately greater sexual competition than females (see e.g. Campbell, 1999 for discussion). Therefore, although (due to an element of polygyny in humans) we would not expect men to be as choosy as women, the fact that in many populations biparental care is the norm and is essential in the west for producing competitive children (i.e. highly educated, according to Mace, 1993 & Rogers, 1990) means men should show some selectivity as regards their potential partners.

[7] Presumably leaving an excess of single older females and with some males never marrying, as the UK is only slightly female biased (Census 2001 figures show that age brackets between 20 and 50 are about 48 to 49% male; http://www.statistics.gov.uk/census2001/implications.asp).

Cunningham, Druen & Barbee (1997) used the facialmetric method to investigate men's preferences and found that men like women with large eyes, full lips, small noses and small jaws (sizes of all features correlated significantly with attractiveness of photographed faces). Cunningham et al believed that the preference for large eyes and small jaws represented a preference for neoteny – i.e. youthfulness. It is certainly true that men prefer young women, and younger women have a much greater reproductive value than older women. However, given that women prefer older men (Buss, 1989), and yet still prefer large eyes (Cunningham et al, 1990), it seems unlikely that preference for large eyes indicate a preference for youth. Rather it may be more plausible that a preference for 'neoteny' (in both sexes) is simply a by-product of a preference for femininity. Chapters 3 and 5 will go on to investigate this possibility further.

Perrett et al (1998) found that men prefer female faces which have been manipulated to be more feminine. If, as discussed above, femininity is a cue for oestrogen levels, and therefore fertility, it would appear that men have evolved a preference for fertile women. This is supported by men's preferences for low WHR (Singh, 1993), which, as discussed above is related to conception rate (although see e.g. Wetsman & Marlow, 1999, for cross-cultural problems with WHR, and Tovée & Cornelissen, 2001, for the problems of viewing-direction in judging WHR).

2.3.4 Intrasexual variation in mate preferences

Although it has been possible to identify certain broad trends in men and women's facial preferences, there is still a great deal of intrasexual variation (something Feingold, 1994, accuses many evolutionists of ignoring). Work on facial preferences has currently used two main explanations of this variation. The first is the role of biological markets in mating strategies, and the second is the role of imprinting during perceptual development.

2.3.4.1 Biological markets and condition dependence

Gangestad & Simpson (2000) stressed the role of an individual's own value in determining their strategy and mate preferences. Given that a woman's 'ideal' strategy is to have a high quality mate who will invest heavily in her offspring, while a man's 'ideal' strategy is to have as many copulations as possible with as many women (preferably high quality) as possible, there has to be some level of trade-off between the sexes. Individuals are faced with the situation of needing to use their own 'value' to get the best deal they can – a principle known in Zoology as 'biological markets' (e.g. Noë & Hammerstein, 1995). This

leads to individuals' mate choices being 'condition dependant', i.e. decisions are dependant on the individual's 'condition' or quality. Males who have high quality genes and the phenotypic cues to them, can 'offer' women their genes without necessarily needing to offer investment in order to gain copulations. Less attractive men on the other hand must play a female-friendly strategy and trade long-term investment for sexual access. For example, Gangestad & Thornhill (1999) gave male subjects the Relationship-Specific Investment Inventory and found that more symmetrical men (i.e. higher quality men) invested significantly less in their relationships than less symmetrical men.

Similarly, higher value, more attractive women can demand more resources, or a combination of good genes and some paternal investment in return for copulation, while lower quality women must either accept a low quality mate, or else play a male-friendly strategy and not demand resources or long term commitment. The classic stereotype of this inter-sex conflict of interests is the belief that beautiful women marry rich, successful men. Pawlowski & Dunbar (1999) have shown how biological markets operate in mate choice through the medium of explicit mate advertisements (lonely hearts ads). As women age and their mate value declines, they tend to make fewer requests/demands for particular qualities in their potential suitors, suggesting they are willing to accept a wider (and presumably therefore, lower quality) range of options.

The theory has also been successfully applied to facial attraction. For example, Little, Burt, Penton-Voak & Perrett (2001) found that a woman's conscious, self-rated attractiveness (which significantly correlates with attractiveness as perceived by others) also affected their preferences. Women who considered themselves more attractive tended to prefer less feminised men for both long and short term relationships than women who considered themselves less attractive, who compromised in long term relationships and looked for more feminised men. Essentially, the attractive women are preferring men of higher gene value because their own value means that they can be more demanding (i.e. they can expect both good quality genes *and* paternal investment). Similarly, Penton-Voak, Little, Jones, Burt, Tiddeman & Perrett (2002) looked at the facial preferences of women with high and low WHR. As mentioned above, low WHR ratio is a secondary sexual characteristic of women and it is believed that it cues for fertility. Thus women with a low WHR *appear* to be more fertile than women with a high WHR and thus have a higher mate value. Penton-Voak et al found that women with a high WHR (low quality women) preferred feminine men in long term relationships, while women with a low WHR (high quality women) preferred masculine men for both short and long term relationships.

Thus, for women at least, there is evidence that individual variation in conditions relates to both competitiveness within the biological market and facial preference for type and quality of male.

2.3.4.2 Perceptual development

Work by Perrett, Penton-Voak, Little, Tiddeman, Burt, Schmidt, Oxley, Kinloch & Barrett (2002) has also suggested a more simple explanation for why some people's facial preferences are different to others: that our prototype of what a face should be is based on the faces we see most when we are very young - such as our parents' faces. It is a common idea in the study of perceptual development that our senses are steadily tuned in to the objects, colours and world around us. There is argument over the degree of modularity and genetic proscription involved in this process, but there must be some degree of tuning in because brain regions associated with facial processing can also be used for other tasks (e.g. bird recognition: Gauthier, Skudlarski, Gore, & Anderson, 2000). Therefore, if there is no precise innate concept of a face but rather a tendency to attend to faces, then our prototype of a face will necessarily be influenced by those we see most during our early childhood. Thus, in Perrett et al's study, those with older parents preferred older looking faces than women with younger parents; particularly in the case of opposite sex parents and faces. Similarly, Little, Penton-Voak, Burt, & Perrett, (2003) found that the eye and hair colour of subjects' partner was significantly predicted by the eye and hair colour of their opposite sex parent. There is also marriage data showing that children of inter-racial marriages are more likely to marry someone of the same race as their opposite sex parent, rather than the race of their same sex parent (Jedlicka, 1980).

However, there is evidence for face preference being effected by the type of relationship being contemplated (for instance, 'low quality' women prefer more feminine men in long term relationships than in short term relationships in Little et al's 2001 study). Furthermore, according to the Belsky et al model of development, the reproductive strategy of the parents is likely to lead to their children adopting a similar strategy (e.g. father absent women are more likely to have teen pregnancies, Ellis et al, 2003, and thus have father absent daughters). Therefore, it is also possible that the subjects in Perrett et al's study were in fact attracted to the same type of person as their *opposite* sex parent because they are following the same sexual strategy as their *same sex* parent, and the effect may actually be a result of trans-generational similarity in strategy.

PART 1:

THE MEANING OF MASCULINITY

3. THE MEANING OF MASCULINITY: IMMUNOCOMPETENCE OR MATURITY?

3.1 SUMMARY

Variation among women in their preferences for male faces with masculine proportions may reflect variation in attraction to immunocompetence or to maturity. This chapter reports 4 studies that investigated the inter-relationships between women's preferences for masculinity, apparent health and age in male faces (Studies 1a and 1b) and the extent to which manipulations of apparent health, masculinity of proportions and age in male faces influence women's attributions of these characteristics to male faces (e.g. does increasing masculinity in male faces also increase attributions of age and health? Studies 2a and 2b). In studies 1a and b it was found that masculinity and age preferences were positively related, but that masculinity preference was not associated with preference for apparent health. In Studies 2a and b there was a positive relationship between perceived age and perceived masculinity, but evidence for a link between perceptions of masculinity and health was equivocal. Collectively these findings suggest that variation in women's preferences for masculine proportions in male faces reflect variation in attraction to male age and do not support a strict immunocompetence explanation of preferences for facial masculinity.

3.2 INTRODUCTION

Facial masculinity is due to the sexual dimorphism in facial features which emerges at puberty when boys' cranial bones grow, producing heavier brow-ridges and larger jaws, while girls' faces grow less and retain small brows (leading to a perception of larger eyes), jaws and noses (Enlow & Hans, 1996). Penton-Voak et al (2001) measured 49 female and 66 male faces and found that women have significantly larger eyes (compared to face size), larger foreheads, higher cheekbones, wider faces and higher eyebrows than men.

Research has shown varying preferences for masculinity in male faces, with some studies finding a female preference for feminine looking males (e.g. Perrett et al, 1998; Rhodes, Hickford & Jeffery, 2000) and some a preference for masculine looking males (e.g. Johnston, Hagel, Franklin, Fink, & Grammer, 2001). As discussed in section 2.3, women's preferences for masculinity in male faces also vary systematically as a result of their own attractiveness (Little et al, 2001; Penton-Voak et al, 2003), the phase of their menstrual cycle (Penton-Voak et al, 1999; Johnston et al, 2001) and whether or not they have a partner (Little, Jones,

Penton-Voak, Burt & Perrett, 2002).

This variation in preferences strongly suggests that masculinity has both good and bad connotations which must be traded off against each other. Under some circumstances, the drawbacks are greater than the benefits and a female will opt for a less masculine/more feminine male; under other circumstances, the benefits will be stronger (or the drawbacks less important) and the female will opt for a masculine male. Two different explanations for the possible benefits of masculinity and femininity in male faces have been proposed. One, the 'immunocompetence' explanation, rests on a possible direct link between sex hormones and facial features, while the 'neoteny' explanation rests upon the link between facial growth and age.

Folstad & Karter's (1992) Immunocompetence Hypothesis proposes that secondary sexual features (those resulting from sex hormones) are honest signals of gene quality (see Section 2.1.3 for further discussion). There is evidence that testosterone injections do lead to increased cranio-facial growth (Verdonck, Gaethofs, Carels & de Zegher, 1999) and that jaw size and apparent facial masculinity are associated with circulating testosterone levels in adult males (Chen, 2002; Penton-Voak & Chen, 2004). Therefore, this would suggest that facial masculinity could be attractive because it is an honest signal of underlying health. The Immunocompetence explanation has been widely adopted within facial attraction research (e.g. Thornhill & Gangestad, 1999b; Rhodes et al, 2000; Penton-Voak et al, 1999).

In contrast to the Immunocompetence explanation's focus on the testosterone-masculinity link, several researchers have referred to facial manipulations such as increasing eye size, as affecting the neoteny or 'baby-facedness', rather than femininity of the faces (e.g. Jones, 1995; Berry & McArthur, 1985). Since feminine faces do retain more child-like features, this may seem like a semantic dispute. However, Cunningham and various co-workers (Cunningham et al, 1990; Cunningham et al, 1997) have suggested that these 'neotenous' features denote characteristics associated with youth versus maturity; they do not discuss neotenous features in terms of characteristics associated with femininity. In their 'Multiple Fitness Model' Cunningham et al (1997) suggest that women prefer men with neotenous features because these men have the vigour needed to raise children and that they evoke feelings of nurturance from the female partner (i.e. their childlike faces tap into women's desire to care for children). If Cunningham et al are correct, it could be inferred that variation in preferences for masculinity/femininity is simply a by-product of variation in

preferences for facial cues to maturity.

The purpose of this study was to investigate the possible links between facial masculinity, age and health in male faces and female preferences. Several studies have found that exaggerating the shape difference between an average male face and an average female face increases the perceived age of the male face (e.g. Perrett et al, 1998). Similarly, Berry & McArthur (1985) found that increasing eye size in photo-fit faces reduced perceived age in both male and female faces. However, evidence of a relationship between age and sexual dimorphism does not mean that facial age and facial masculinity serve the same purpose in mate choice.

Perceived facial health has been shown to reflect genotypic profiles which affect pathogen resistance (Roberts, Petrie, Gosling, Perrett, Little, Jones, Penton-Voak, & Carter, 2003). There are also currently two studies reporting a positive link between facial masculinity and perceived facial health (Rhodes, Chan, Zebrowitz & Simmons, 2003; Johnston et al, 2001), which would seem to support an immunocompetence explanation. However, Folstad and Karter's (1992) hypothesis does not predict that this link should necessarily exist. Whether greater testosterone should be associated with greater apparent health or reduced parasite load across individuals is a matter of debate amongst evolutionary biologists and findings are mixed (see Getty, 2002, for a review and possible reasons for this).

Whatever the relationship between testosterone and health, in order to understand the basis of mate choice, it is important to assess the functional similarity between masculinity and health (i.e. are they used in the same way for mate choice decisions). This was the purpose of Study 1, which compared women's preferences for apparent healthiness in male faces and their preference for facial masculinity. Study 2 directly assessed the perceptual relationships between masculinity, health and age in facial stimuli by examining the effects of manipulating one variable on perceptions of the others.

3.3 STUDY 1

This study investigated how female variation in preference for facial masculinity relates to variation in preferences for health and age. There are systematic differences between women in their preferences for masculinity (e.g. Little et al, 2001) therefore if masculinity cues for immunocompetence, then masculinity preferences should covary with

preferences for apparent health since they are both cues to gene quality. However, the immunocompetence explanation does not predict a link between masculinity preference and age preference.

By contrast, the neoteny explanation predicts that masculinity preference will covary with age preference, as they are physiognomically equivalent, but does not predict a link between masculinity preference and health preference.

3.3.1 Study 1a

3.3.1.1 Subjects

There were 645 heterosexual female subjects (mean age=26.7, s.d.=6.7 years, range=16-45), who were recruited through the laboratory website and the media. The majority of subjects reported being of Western origin (42.0% British, 25.5% European, 22.2% North American) and 84.7% reported being Caucasian.

3.3.1.2 Stimuli

Subjects viewed the Set 1 male stimuli (see Appendix A for details of stimulus creation and validation, and Appendix B for all stimuli). These consisted of three base faces manipulated using specially designed software to look more or less sexually dimorphic (i.e. masculine in terms of facial shape), more or less apparently healthy, and to have greater or lesser apparent age. Thus there were 9 face pairs (3 masculinity, 3 health and 3 age pairs), all of which had been validated to ensure that they maintained the apparent change in appearance they were supposed to (i.e. the masculinity pairs were rated significantly different on masculinity, etc. See Appendix A).

3.3.1.3 Face Preference Test

Subjects responded to advertisements for the laboratory website and then followed a link to the experiment start page. Pairs were presented side by side in the same java applet. Results were recorded on an 8 point scale where 0 represents a preference for feminine/young/unhealthy faces and 7 represents a preference for masculine/old/healthy faces. In the initial instructions subjects were told first to decide which of each pair "you find more attractive" and then to indicate the strength of that preference on the points below the faces. The reminder 'Please indicate which face you prefer and how much you prefer it,

by clicking a point below' ran at the top of the screen throughout the test. Figure 3.3 below shows an image of the java applet test.

3.3.1.4 Results

Mean scores were calculated for the subjects' rated preference (0-7) averaged across all three pairs within each transform set (overall preference means: health mean=5.03, s.d.=1.08; age mean=3.82, s.d.=1.42; masculinity mean=3.24, s.d.=1.25). Mean rated facial age preferences correlated significantly with masculinity preferences (r_s=0.226, n=645, p<0.001), but there was no significant correlation between masculinity preference and health preference (r_s=0.024, n=645)[8]. There was no effect of subject's age on their preferences (masculinity r=0.021, age r=-0.054, health r=0.037, n=645).

Figure 3.1. Sample of the java applet face test used in this study. Masculinised face (left) and feminised face (right)

[8] Correlations between preferences for masculinity, health, and age were equivalent when participant's age was partialled out.

3.3.2 Study 1b

Study 1b used an independent set of stimuli and an independent subject group to replicate Study 1a. It had the same design as Study 1a, but was carried out within the University of St Andrews, rather than with the public.

3.3.2.1 Subjects

There were 160 heterosexual female subjects (mean age=20.73, s.d.=1.97 years, range=17-30), who were undergraduate students.

3.3.2.2 Stimuli

Subjects judged the Set 2 male stimuli (see Appendices A and B). These consisted of 18 base faces, of which 6 were manipulated on masculinity, 6 were manipulated on apparent health, and 6 were manipulated on apparent age, creating a total of 18 validated face pairs.

3.3.2.3 Face Preference Test

The face preference test was the same as used in Study 1a. However, this time subjects were given the test twice: once with the instruction to make the attractiveness judgement based on a potential long term partner, and once based on a potential short term partner. Order of long and short term judgements was randomised.

3.3.2.4 Results

Masculinity preference correlated significantly with age preference for short term preferences (r_s=0.22, n=160, p=0.005) but not for long term (r_s=0.05). There was no correlation between masculinity and health preferences (short term: r_s=0.03; long term: r_s=0.004)[9]. Own age did not correlate with any short term preferences, or with long term masculinity preferences (all r_s<0.13), although younger women preferred younger (r_s=0.18, p<0.05) and healthier (r_s=0.18, p<0.05) long term partners than older women did.

3.3.3 Discussion

Studies 1a and 1b found a link between preference for masculinity and preference for age in male faces, but no link between preference for masculinity and preference for health in

[9] Correlations between preferences for masculinity, health, and age were equivalent when participant's age was partialled out.

male faces. The absence of a link between preference for health and masculinity in male faces suggests that facial masculinity is not utilised in female mate choice as a proxy for health. This contrasts with Johnston et al's (2001) and Rhodes et al's (2003) findings regarding the perceptual similarity of health and masculinity. It is, however, concordant with Rhodes et al's observation that the link they found between perceived masculinity and perceived health did not explain the correlation between attractiveness and masculinity. On the other hand, the link between masculinity preference and age preference supports Cunningham et al's (1997) discussion of youth- and maturity-related traits as a basis for attractiveness of adult male features.

3.4 STUDY 2

In order to investigate further the relationship between masculinity, health and age, the stimuli from Studies 1a and b were cross-rated on masculinity, health and age in Studies 2a and 2b respectively. That is, the masculinity stimuli were assessed for apparent age and health, and the health and age stimuli were assessed for apparent masculinity. This was particularly important given that the results of Study 1 do not fit with Johnston et al's (2001) finding that masculinised faces were perceived as healthy.

Given that the results of Study 1 support the neoteny explanation of female preferences for masculinity, it can be predicted that manipulating masculinity would have an effect on perceived age and manipulating age would have an effect on perceived masculinity, but that manipulating masculinity would not have an effect on perceived health, and manipulating perceived health would not affect perceived masculinity.

By contrast, the Immunocompetence explanation would predict that increasing masculinity should not necessarily have an effect on perceived age, but should increase perceived health, and vice versa.

3.4.1 Study 2a

3.4.1.1 Subjects

There was a volunteer sample of 47 females (mean age=28.4 years, s.d.=10.2, range 18-46).

3.4.1.2 Stimuli

The same stimuli were used as in Study 1a: 3 bases transformed to create 3 masculinity pairs, 3 age pairs and 3 health pairs.

3.4.1.3 Procedure

Subjects completed the experiment on their own computers. They were asked to estimate the ages of the 6 health and 6 masculinity stimuli in the same way as the subjects in Study 1. They were then asked to decide which face of each age and health pair looked the most masculine, and which of each masculinity pair looked the healthiest using the same 8-point scale as in Study 1. All subjects judged age, followed by masculinity and then health. Inter-rater agreement was high for both masculinity and health ratings, and for age estimates (all Cronbach's alphas >0.85).

3.4.1.4 Results

Each subject's age estimates were averaged together for the 3 high masculinity and 3 low masculinity faces separately. Similarly, pairs of age estimates were derived for the 3 high health and the 3 low health faces. Masculinity and health ratings for the 3 pairs were averaged into single composite scores separately for each judgement. Health ratings of masculinity pairs and masculinity ratings of health pairs were normally distributed (health ratings: KS z=1.00; masculinity ratings KS z=0.99). Only masculinity ratings of the age pairs differed (just) significantly from the normal distribution (KS z=1.38, p=0.045). Therefore parametric tests follow.

3.4.1.4.1 Age and Masculinisation

A repeated measures t-test showed that masculinised faces were perceived as significantly older than feminised faces (t_{46}=4.00, p<0.001). One-sample t-tests showed that there was also a significant effect of manipulating facial age on perception of masculinity. Mean scores were compared against a theoretical 'indifference' midpoint of 3.5, which would indicate no perceived difference in masculinity between the two faces. Mean scores for the age pairs were significantly above 3.5 (t_{46}=9.94, p<0.001) showing that subjects perceived the older faces as being more masculine.

3.4.1.4.2 Health and Masculinisation

There was a significant effect of manipulating facial health on perception of masculinity and also an effect of manipulating masculinity on perception of health. Mean scores for masculinity ratings of health pairs were significantly above the indifference point of 3.5 (t_{46}=5.82, p<0.001). This shows that subjects perceived the healthier males as more masculine. Mean scores for health ratings of masculinity pairs were significantly below 3.5 (t_{46}=4.26, p<0.001) showing that subjects perceived the more feminine shaped faces as being healthier than the masculine faces.

3.4.2 Study 2b

3.4.2.1 Subjects

There were 30 female undergraduate mature students who completed the test (age range 21 to 50).

3.4.2.2 Stimuli

The same stimuli were used as in Study 1b: 6 masculinity pairs, 6 health pairs and 6 age pairs.

3.4.2.3 Procedure

The subjects completed the task on computers in departmental laboratories. They rated the masculinity and health of the stimuli as in Study 2a. However, rather than guessing the ages of the stimuli, they instead compared each pair and rated which face appeared older, using the same java applet as for the masculinity and health ratings. Order of rating health, masculinity and age was randomised. All ratings were normally distributed (all KS z<1.1)

3.4.2.4 Results

3.4.2.4.1 Age and Masculinisation

Mean scores for the age ratings of the masculinity pairs did not differ significantly from 3.5 (t_{29}=1.01) showing that subjects perceived neither face as being older. Mean scores for the masculinity ratings of the age pairs were significantly above 3.5 (t_{29}=11.12, p<0.001) showing that subjects perceived the older faces as being more masculine.

3.4.2.4.2 Health and Masculinisation

Mean scores for masculinity ratings of health pairs were significantly above the indifference point of 3.5 (t_{29}=2.24, $p<0.05$) showing that subjects perceived the healthier males as more masculine. Mean scores for health ratings of masculinity pairs did not differ from 3.5 (t_{29}=0.06) showing that neither feminine nor masculine face shapes appeared healthier.

3.4.3 Discussion

The purpose of Study 2 was to assess the degree to which masculinity is associated with perceptions of age and health. It was found that masculinity and age in faces are very much related in that artificially 'aging' a face led to an increase in perceived masculinity in both stimuli sets. Importantly, the composites used in the masculinity transformation were of males and females of the same age showing that masculinisation has an effect on perceived age independent of actual age. Masculinising the shape of a face led to an increase in perceived age in one set. The absence of an effect in Study 2b could be due to the different rating method used, however. In Study 2b participants rated which face within each pair looked oldest, while in Study 2a they estimated the ages of each face separately. Alternatively, Set 2 male stimuli were transformed using two faces relatively close in age, while Set 1 were transformed using a pre-pubertal boy's face and an old man's face. This may have also contributed to the lack of effect in Study 2b as the 'younger' faces had not been moved directly towards a pre-pubertal face.

Increasing the masculinity of a face shape either decreased perceptions of health (Study 2a) or had no effect at all (Study 2b), while in contrast, increasing perceived health increased perceived masculinity in both Studies 2a and 2b. While this ambiguous result does not necessarily contradict the Immunocompetence Hypothesis it does contrast with the findings of Rhodes et al's (2003) correlational study and Johnston et al's (2001) computer graphic study. This contradiction and the ambiguity of the current results may be because the health transforms involved manipulation of shape, colour and texture, while the masculinity transform changed only the shape of the faces and features. Thus healthy, toned skin might suggest muscularity and therefore masculinity, while the lack of change in skin texture in masculinity transforms could obscure an apparent health difference. However, in previous

work suggesting that masculinity is linked to gene quality (e.g. Penton-Voak et al, 1999) researchers also manipulated only sexual dimorphism of face shape. Therefore, while the masculinity stimuli may lack a degree of ecological validity, the current result (that masculinisation of face shape has no clear effect on perceived health) is still important when considering previous mate choice studies.

3.5 General Discussion: Immunocompetence or maturity?

These studies were intended to address the proposal that attraction to facial masculinity could be due to either an attraction to advertised immunocompetence or a by-product of attraction to maturity. Study 1 showed with two independent stimulus sets that masculinity and age have a similar impact on attraction, but that facial health affects attraction independently of facial masculinity. Thus attraction to masculinity is most closely linked to attraction to maturity. While the association between masculinity and age preferences does not mean that facial age and facial masculinity are the same, Study 2 suggests that the two traits have similarity in terms of facial structure and appearance.

There is little evidence in this study to support an Immunocompetence explanation of female attraction to facial masculinity. Neither stimulus set showed any correlation between masculinity preferences and preferences for apparent health, and increasing facial masculinity did not increase perceived health (though healthier faces did look more masculine). Although this does not rule out a link between masculinity and *real* or *underlying* health, these results suggest *apparent* health is of limited importance in facial preferences for masculine facial shape.

Given these results, the question is then raised as to the validity of theories relying on 'good-genes' explanations of attraction to facial masculinity. Cunningham et al (1997) did not rely on 'good-genes' in that they suggested that women trade-off the virility, strength and status of mature males with the fact that neotenous faces trigger the 'nurturance instinct'. This does not, however, explain why women who consider themselves to be unattractive would be more drawn to neoteny than women who consider themselves to be more attractive (Little et al, 2001) or why women would require a stronger partner at peak fertility points in their menstrual cycle (Penton-Voak et al, 1999). It may be that maturity and/or masculinity is associated with some other feature which is both heritable and associated with greater

reproductive success in offspring possessing that feature. For instance, age and masculinity are both associated with dominance (e.g. Swaddle & Reierson, 2002: testosterone and perceived dominance; Perrett et al, 1998: masculinity and perceived dominance; Bailey, 1991: age and actual dominance). Dominant/high status males are less likely to settle into a long term relationship and tend to have a greater number of sexual partners and higher potential reproductive success than less dominant/lower status males (e.g. Perusse, 1993). If these high status males pass on their ability to obtain status to their sons they would become attractive in short term contexts because of these 'sexy-sons' and the higher inclusive fitness that the mothers would achieve. In long term contexts, more masculine men would remain unattractive to most women because they would be less likely to invest in offspring or commit to a long term relationship.

Thus we would expect only very high quality women (e.g. attractive, with low WHR) to prefer dominant males (with both their resources and their 'sexy-sons') in long term contexts because only high quality women could extract paternal investment from these males. Lower quality women we would expect to show a preference for more dominant males in short term contexts (or when high conception risk) but a preference for less dominant males in long term (or low conception risk) contexts. This could explain previous findings regarding relative masculinity preference (Penton-Voak et al, 1999; Johnston et al, 2001; Little et al, 2001) without reference to immunocompetence.

4. THE MEANING OF MASCULINITY: PARTNER CHARACTERISTICS

4.1 SUMMARY

Chapter 3 showed that male masculinity was not associated with health in mate choice contexts. The purpose of this chapter was to address what possible partner characteristics could be signalled by masculinity, and how these characteristics compare to those perceived in mature or healthy faces. Study 3 finds that masculinity was perceived as reflecting heightened dominance, but reduced faithfulness and quality as a parent. This supports the suggestion made in Chapter 3 that masculinity preference could depend on dominance rather than immunocompetence. However, increased age and health in faces was perceived as increasing dominance, wealth and all prosocial traits (faithfulness, commitment, parenting etc) which weakens that supposition made in Chapter 3 that maturity and masculinity are closely related in facial attraction.

4.2 STUDY 3

Important traits individuals look for in a partner depend on the context in which the partner is being sought. Buss & Schmitt (1993) found that women were more concerned with traits relating to RHP for a potential long term partner than a potential short term partner (e.g. promising career, good financial prospects, likely to earn a lot of money), and also traits which show willingness to impart resources (spends money on me, has extravagant lifestyle). Given that women tend to want to wait longer than men before engaging in sexual intercourse with a partner (Buss & Schmitt, 1993; Buss, 1989), women should be more interested in signs of commitment in potential partners. For men, it is of paramount importance that a female partner is faithful in order to preserve paternity certainty; men rate faithfulness as much more important in long term partners than in short term partners, while for short term partners, attractiveness is of most importance (Buss & Schmitt, 1993).

Perrett et al (1998) found that masculinised male and female faces were perceived as more dominant, but less warm, emotional, honest and cooperative, and as poorer quality parents than average and feminised faces. This was consistent across both Caucasian and Japanese faces. This was interpreted as suggesting that masculine faces signal dominance, but that dominance comes with the drawback of a less pleasant personality, and lower suitability as a parent.

Similarly, Cunningham et al (1997) argued that 'mature' faces signal sexual maturity, '*forcefulness and readiness for competition, and strength for parenting*.' Forcefulness and 'readiness for competition' seem to refer to the male traits important in dominance and RHP. Keating, Mazur & Segall (1981) also found that sexually mature faces of both sexes were perceived as more dominant, stronger and higher status than less sexually mature faces.

There would therefore seem to be good evidence that older and more masculine faces convey greater levels of status and dominance than other faces. However, there has been little work addressing whether this increased dominance is accompanied by other less pleasant traits in older faces. Furthermore, the impact of increased apparent facial health on perceived partner characteristics has received little attention.

This study compares masculinised vs. feminised, old vs. young, and unhealthy vs. healthy transformed face pairs on several characteristics important in potential partners. It can be predicted that masculine faces will be seen as more dominant and therefore having more resources than feminine faces, but less likely to commit to and remain faithful in a relationship, less good as parents, and less warm. If masculinity and facial maturity are physiognomically the same/similar (as suggested by Study 2), then older faces should also look more dominant, but less faithful and committed, less good parents and less warm. At present there is no clear set of predictions to be made regarding the characteristics which will be assigned to healthy versus unhealthy faces. As faces perceived as healthy tend to smile more than those perceived as unhealthy, they should be perceived as warmer and better parents. Futhermore, Jones (2004) found that female preferences for healthy males are increased during the luteal phase of the menstrual cycle, suggesting that healthy individuals may have good features for a long term partner, such as faithfulness and commitment. It is not clear how healthiness will effect perceptions of dominance.

4.2.1 Method

4.2.1.1 Subjects

Subjects were recruited via an opportunity sample of those passing through the laboratory website. All were of reproductive age (16 to 45 years).

4.2.1.1.1 Set 1 males

94 males and 76 females judged the Set 1 male faces. Mean age was 29.37 years (s.d.=8.00).

4.2.1.1.2 Set 2 males

96 males and 69 females judged the Set 2 male faces.

4.2.1.2 Stimuli

4.2.1.2.1 Set 1 males

Three male base faces, transformed on masculinity, health and age to create 9 pairs of faces (as used in Studies 1a and 2a).

4.2.1.2.2 Set 2 males

18 male base faces. 6 transformed on masculinity, 6 were transformed on health, and 6 were transformed on age, to create 18 pairs in total (as used in Studies 1b and 2b).

4.2.1.3 Procedure

Subjects completed the experiment via a web-based test. Stimuli pairs were presented in the java applet described in Chapter 3, with a scale underneath running from strongly prefer left, to strongly prefer right. Subjects judged which of each pair of faces looked:

1. the most dominant (further elaboration: "Someone who is socially dominant is able to strongly influence others and is someone others defer to.")
2. the most likely to be faithful to a long term partner
3. the most likely to be committed to a long term partner ("How committed would these faces be to a long term partner? Would they stay with their partner if they had one?")
4. the most ambitious
5. the most (potentially) wealthy ("How much money do you think they have or are likely to earn?")
6. the better parent/carer of children ("How good a parent would these men be? If they were raising your children or your nieces/nephews, do you think they would do a good job?")
7. the warmest.

All pairs were judged together for each trait. Pairs were presented in a random order within each trait, and subjects judged each trait in a random order.

4.2.2 Results

Within each set of results, ratings for the 3 or 6 face pairs were collapsed for each trait rating. For the ratings of Set 1 males, most of the ratings differed significantly from a normal distribution, and so each subject's ratings were compared using Wilcoxon tests against a dummy variable in which all subjects were assigned a score of 3.5, representing the indifference point where neither face was preferred. For the Set 2 ratings, the vast majority (17/21) did not differ significantly from the normal distribution, and so these ratings were compared against 3.5 using 1 sample t-tests.

4.2.2.1 Set 1 males

There were no significant differences between the ratings of men and women (all $z<1$[10]). N for all tests is 170. Results are given as z-score of U.

Older faces were rated as significantly wealthier ($Z=4.69$, $p<0.001$), less warm ($Z=2.09$, $p<0.05$), more ambitious ($Z=3.08$, $p<0.01$), more committed ($Z=3.00$, $p<0.01$), more dominant ($Z=7.56$, $p<0.001$) and better parents ($Z=2.86$, $p<0.01$) than younger male faces.

Healthy male faces were rated as significantly wealthier ($Z=7.11$, $p<0.001$), warmer ($Z=8.04$, $p<0.001$), more ambitious ($Z=6.96$, $p<0.001$), more committed ($Z=5.43$, $p<0.001$), more dominant ($Z=4.78$, $p<0.001$), more faithful ($Z=5.77$, $p<0.001$) and better parents ($Z=7.59$, $p<0.001$) than unhealthy male faces.

Masculine male faces were rated as significantly less warm ($Z=5.21$, $p<0.001$), more dominant ($Z=6.28$, $p<0.001$), and less faithful ($Z=4.39$, $p<0.001$) than feminine male faces. They were also rated as worse parents ($Z=2.02$, $p=0.044$) but this became nonsignificant once Benjamini-Hochberg's correction was applied (adjusted alpha=0.021)

4.2.2.2 Set 2 males

After Benjamini-Hochberg correction there were no significant differences between the ratings of men and women (all $t<1.5$)[11].

[10] Except 3 (out of 21) results which without correction, would have been significant with $p=0.009$, $p=0.023$ and $p=0.050$ respectively. Males and females in these two cases did not differ in direction of ratings, merely in extremity.

Older male faces were rated as significantly wealthier (t_{164}=6.44, p<0.001), warmer (t_{164}=5.60, p<0.001), more ambitious (t_{164}=7.24, p<0.001), more committed (t_{164}=3.83, p<0.001), more dominant (t_{164}=7.33, p<0.001), more faithful (t_{164}=5.04, p<0.001) and better parents (t_{164}=7.89, p<0.001) than younger male faces.

Healthy male faces were rated as significantly wealthier (t_{164}=10.92, p<0.001), warmer (t_{164}=13.41, p<0.001), more ambitious (t_{164}=6.99, p<0.001), more committed (t_{164}=6.79, p<0.001), more dominant (t_{164}=3.04, p<0.01), more faithful (t_{164}=6.78, p<0.001) and better parents (t_{164}=13.93, p<0.001) than unhealthy male faces.

Masculine male faces were rated as significantly less wealthy (t_{164}=2.43, p<0.05), less warm (t_{164}=8.18, p<0.001), more dominant (t_{164}=4.97, p<0.001), less faithful (t_{164}=5.29, p<0.001) and worse parents (t_{164}=7.58, p<0.001) than feminine male faces. They were also rated as less committed (t_{164}=1.98, p=0.049), but this become nonsignificant once Benjamini-Hochberg's correction was applied (adjusted alpha=0.036).

4.2.2.3 Overall

The results of the three studies can be summarised in Table 4.1 below. In general, manipulations increasing apparent health lead to an increase in perceptions of all seven traits. Increasing apparent age lead to an increase in perceptions of wealth, ambition, commitment, dominance, faithfulness and parenting skill, but had a mixed effect on warmth. Increasing apparent masculinity decreased apparent warmth, faithfulness and parenting skill and increased perceived dominance. There was an effect of decreased perceived commitment in one face set.

Table 4.1 Summary of results of Study 3

	Wealth	Warmth	Ambition	Commitment	Dominance	Faithfulness	Parenting skill
Masculinity	-[$]	-			+	-	-[$]
Age	+	+/-	+	+	+	+[$]	+
Health	+	+	+	+	+	+	+

[$]Set 2 males only.

[11] Without correction, 2 results would have been significant with p=0.030 and p=0.02 respectively. Males and females in these two cases did not differ in direction of ratings, merely in extremity.

4.2.3 Discussion

In general, the results of this study suggest that despite their visual similarity (as shown in the previous chapter) facial age and masculinity are not perceived as signalling the same partner characteristics (perhaps because despite similarities in shape, the colour changes involved in aging faces are not associated with the same negative traits as masculine shape). Although both are perceived as signalling dominance, increased facial masculinity and increased age have the opposite effects on perceived commitment, faithfulness and parenting skill. Furthermore, while facial aging increases perceptions of both wealth and ambition, masculinity has no effect on perceived RHP traits.

As predicted, masculinisation of a face is associated with higher levels of dominance, but that this greater dominance is accompanied by less likelihood of entering and being faithful within a long term relationship and poorer suitability as a parent. This supports Perrett et al's (1998) findings regarding perceived dominance, warmth and parenting quality in masculine vs. feminine faces. It is also concordant with Perusse's (1993) behavioural data showing that high status men are less likely to settle into a long term relationship and have more sexual partners, and Mazur & Michalek's (1998) data showing high testosterone in males is associated with marital problems.

These data therefore lend more weight to the idea suggested in Chapter 3, that masculinity can best be viewed in the context of dominance as a 'sexy son' trait. Weatherhead & Robertson (1979) argue that if a male can produce sons who will go on to have high reproductive success, then females will be more likely to engage in polygynous relationships with such a male. Thus, with this strategy, females sacrifice full paternal investment for increased inclusive fitness through their male offspring. In a legally monogamous society, this polygyny threshold model can be seen as women's willingness to engage in short term relationships or risk serial monogamy (since far more men remarry than women, serial monogamy is the riskier option for the female; Buckle et al, 1996).

This proposal of masculinity being a 'sexy son' trait can be further tested by assessing whether facial masculinity, dominance, number of potential conceptions and number of *sons'* potential conceptions are all positively related in men. Although there is evidence for many of these stages (e.g. Mueller & Mazur, 1997; Perusse, 1998; Perrett et al, 1998) data is lacking linking them all together, and there is also little or no evidence looking at sons' reproductive success.

5. FEMALE FACIAL ATTRACTIVENESS

5.1 SUMMARY

Chapters 3 and 4 have concentrated on male masculinity in order to understand the nature of the choice to be presented to female subjects in the following section. However, because Part 3 of the thesis also goes on to consider the attractiveness of father absent women, it is important to clarify the function of femininity within female attractiveness. Furthermore, it is useful to determine whether masculinity/femininity are the same in both men and women. Analysing data collected on judgements of women's faces which parallels the male facial data in Chapters 3 and 4 shows that female femininity, health and youthfulness are all closely related both in terms of men's partner preferences and their perceptions of each trait. It is hypothesised that all three traits relate to fertility. As in men, facial masculinity in women is perceived as signalling increased dominance and decreased prosocial traits. It is suggested that since dominance is not a trait men desire in women, there is no trade-off to be made in the manner women must trade-off dominance against pro-sociality.

5.2 INTRODUCTION

Male masculinity has commonly been conceived as showing genetic quality (via immunocompetence) and/or more direct benefits such as status and RHP. Thus far this thesis has argued the possibility that masculinity signals dominance and ensuing genetic quality via a sexy son mechanism. Amongst women, however, femininity is generally viewed as relating primarily to fertility. As discussed in section 2.2.2, hormone-related aspects of female body-shape (WHR) are related to ability to conceive (Bringer et al, 1999). Therefore, a feminised face (which is associated with high oestrogen: Law Smith, unpublished data) may also be related to increased fertility. Femininity has also been argued to signal health via an immunocompetence mechanism (Manning et al, 1997). However, as discussed in section 2.1.1.1, oestrogen is not clearly immunosuppressive and is not an entirely appropriate hormone for the Immunocompetence Hypothesis. The fact that oestrogen increases levels of antibodies, which are important for providing foetuses and newborn infants with immunity to

local pathogens, does in fact suggest that high oestrogen contributes to a female's ability to successfully bear healthy, surviving children.

The attractiveness of femininity can also be explained by attraction to fertility via youthfulness. A neotenous appearance compared to males is the essence of feminine facial structure (e.g. large eyes and full lips), although females do have their own sexual maturity features (high cheekbones, reddening of lips etc, see Cunningham et al, 1995, 1997, for further discussion). Feminised female faces are generally perceived as younger than masculinised female faces, even if the male and female composites used for the transform are of the same age (Perrett et al, 1998). Although the theoretical case for the importance of youth in men was weak, there is a much stronger case for its importance among women. Female biological fertility is at its peak in the late teens and early twenties, with increasing age decreasing the likelihood of conception (Zaadstra et al, 1993: using IVF patients). Not only are the ova of better quality in younger women (as evidenced by the lower rate of congenital disorders such as Downs syndrome), but young women are more likely to carry infants to term, with the incidence of miscarriage rising from 30 years of age onwards (Coste, Jobspira & Fernandez, 1991). Thus males seeking a mate should prefer young, sexually mature women. In support of this, Buss (1989) found that men across 37 different cultures all preferred spouses younger than themselves. Furthermore, Buckle et al (1996) showed that across serial marriages, the age gap between men and their wives increased with each consecutive wife. This suggests these men are trying to obtain partners of a given age bracket, no matter what the male's own age.

Finally, although it is not clear how health and femininity should relate (since oestrogen has mixed effects on the immune system), apparent health should also be associated with successful childbearing. As mentioned above, maternal immunity is passed on to offspring both through the placenta and shortly after birth in colostrum. Therefore a healthy appearance is likely to be associated with higher levels of antibodies, which in turn will result in healthier children. Furthermore, a generally healthy woman will be less likely to become ill during pregnancy than a woman prone to illness. The damaging effects of some maternal illness on foetuses is well known (for instance, rubella during pregnancy is associated with serious congenital problems, and the delivery of the old rubella vaccine in the UK – for girls only at puberty – reflects this). Therefore, if male preferences for females is in a large part driven by a desire for a suitable woman to impregnate (which Buss, 1989, would strongly argue that it is), then health should also play a large part in men's facial preferences.

Thus, it is anticipated that repeating the work of the previous two chapters for males looking at female faces, would show a strong link between femininity preference and youth preference, and also between femininity preference and health preference. Furthermore, feminine faces should look younger than masculine female faces, although it is not clear if they would look any healthier.

5.3 STUDIES 1 & 2: MALES JUDGING FEMALE FACES

Two sets of female faces (one set of 9 pairs, one set of 18 pairs) varying in health, masculinity and age were constructed in exactly the same fashion as the male faces (see Appendix A for details) and shown to male raters at the same time as the female raters judged the male faces.

5.3.1 Study 1a Male results

Method was identical to that reported for women in Study 1a. Men judged the Set 1 female stimuli (as described in Appendix A), consisting of 3 base faces, all transformed on masculinity, apparent health and age, to create 9 stimuli pairs in total.

5.3.1.1 Subjects

There were 463 males between the ages of 16 and 45 (mean=27.46, s.d.=7.34). 42.8% were British, and a further 47.8% were from other Western countries (North America, Europe and Australia). 85.1% were Caucasian.

5.3.1.2 Results

There were significant correlations between both masculinity preference and age preference (r_s=0.150, $p<0.01$, n=463) and masculinity preference and health preference (r_s=-0.258, $p<0.001$, n=463). Thus men who preferred more feminine females also preferred younger and healthier looking females.

5.3.2 Study 1b Male results

Method was identical to that reported for women in Study 1b. Men judged the Set 2 female stimuli (as described in Appendix A), consisting of 18 base faces, 6 different bases being transformed per trait, to create 18 stimuli pairs in total.

5.3.2.1 Subjects

There were 356 males between the ages of 16 and 45 (mean=27.42, s.d.=6.66). 46.9% were British, and a further 43.3% were from other Western countries. 87.9 % were Caucasian.

5.3.2.2 Results

There were significant correlations between both masculinity preference and age preference and masculinity preference and health preference, in both the short and long term contexts (see Table 5.1 below; all r_s>0.3). Thus men who preferred more feminine females also preferred younger and healthier looking females, no matter whether this preference was for short or long term relationships.

Table 5.1 Results of correlation analyses between masculinity and age/health in short and long term contexts. All p<0.001.

		Long term relationship	Short term relationship
Masculinity/Age Correlations	r_s	0.321	0.325
	n	322	356
Masculinity/Health Correlations	r_s	-0.379	-0.466
	n	322	356

5.3.3 Study 2a Male results

5.3.3.1 Subjects

There were 48 males aged 17 to 55 (mean=30.79, s.d.=8.94). They completed the same test as females in Study 2a, and judged the Set 1 female faces.

5.3.3.2 Results

Masculinity ratings of age and health pairs, and health ratings of masculinity were all normally distributed (all K-S z<1), so parametric statistics follow.

5.3.3.2.1 Age and Masculinisation

A repeated measures t-test showed that masculinised faces were perceived as significantly older than feminised faces (t_{46}=4.47, p<0.001, mean difference=1.99 years). One-sample t-tests showed that there was also a significant effect of manipulating facial age on perception of masculinity. As before, mean scores were compared against a theoretical indifference point of 3.5, which would indicate no perceived difference between the two faces. Mean scores for the age pairs were marginally above 3.5 (t_{46}=1.73, p=0.09) showing that subjects *may have* perceived the older female faces as being slightly more masculine/less feminine.

5.3.3.2.1 Health and masculinisation

There was a significant effect of manipulating facial health on perception of masculinity and also an effect of manipulating masculinity on perception of health. Mean scores for masculinity ratings of health pairs were significantly below the indifference point of 3.5 (t_{46}=4.85, p<0.001). This shows that subjects perceived the unhealthy females as more masculine and the healthy females as more feminine. Mean scores for health ratings of masculinity pairs were significantly below 3.5 (t_{46}=4.50, p<0.001) showing that subjects perceived the more feminine female faces as being healthier than the masculine faces.

5.3.4 Study 2b Male results

5.3.4.1 Subjects

There were 12 males aged 20 to 36 (mean=26.42, s.d.=5.71). They completed the same test as females in Study 2b, and judged the Set 2 female faces.

5.3.4.2 Results

Masculinity ratings of age and health pairs, and health ratings of masculinity were all normally distributed (all K-S z<1), so parametric statistics follow.

5.3.4.2.1 Age and Masculinisation

One-sample t-tests showed that there was also a significant effect of manipulating facial age on perception of masculinity. As before, mean scores were compared against a theoretical indifference point of 3.5, which would indicate no perceived difference between the two faces. Mean scores for the age pairs were significantly above 3.5 (t_{11}=3.07, p<0.05) showing that subjects perceived the older female faces as being slightly more masculine/less feminine.

5.3.4.2.2 Health and masculinisation

There was a significant effect of manipulating facial health on perception of masculinity and also an effect of manipulating masculinity on perception of health. Mean scores for masculinity ratings of health pairs were significantly below the indifference point of 3.5 (t_{11}=5.04, p<0.001). This shows that subjects perceived the unhealthy females as more

masculine and the healthy females as more feminine. Mean scores for health ratings of masculinity pairs were significantly below 3.5 (t_{11}=2.90, p<0.001) showing that subjects perceived the more feminine female faces as being healthier than the masculine faces.

5.3.5 Discussion

As predicted, preference for femininity was associated with preference for youth, and for health in both face sets. Thus it appears that femininity, youth and health are all important aspects of female mate value, which are selected by males along the same basis. When the faces were rated on masculinity, health and age, feminine faces looked both younger and healthier than masculine female faces, while younger faces and healthier faces looked more feminine than older and unhealthy female faces. This suggests that health, age and femininity are all related in female facial appearance.

5.4 Study 3: Ratings of female faces

5.4.1 Subjects

38 males and 35 females judged the Set 1 female faces. Mean age was 27.23 years (s.d.=7.22). They rated the Set 1 female stimuli on the same traits as the male stimuli were rated on in Study 3.

5.4.2 Results

All ratings scores were normally distributed so parametric statistics follow. There were no differences between the ratings of men and women (all t<1.66)[12].

Older faces were rated as significantly wealthier (t_{72}=3.70, p<0.001), less warm (t_{72}=2.35, p<0.05), more ambitious (t_{72}=2.41, p<0.05) and more dominant (t_{72}=4.98, p<0.001) than younger female faces.

Healthy faces were rated as significantly wealthier (t_{72}=3.97, p<0.001), warmer (t_{72}=5.30, p<0.001), more ambitious (t_{72}=4.93, p<0.001), more committed (t_{72}=2.53, p<0.05), more

[12] Without correction, 3 out of 21 results would have been significant with p=0.050 or p=0.02. Males and females in these two cases did not differ in direction of ratings, merely in extremity.

dominant (t_{72}=4.41, p<0.001), more faithful (t_{72}=4.27, p<0.001) and better mothers (t_{72}=5.52, p<0.001) than unhealthy female faces.

Masculine female faces were rated as significantly less warm (t_{72}=4.32, p<0.001), more dominant (t_{72}=5.10, p<0.001) and less faithful (t_{72}=2.63, p<0.05) than younger female faces.

The results are summarised in Table 5.2 below.

Table 5.2 Direction of significant relationships between transforms and perceived characteristics.

	Wealth	Warmth	Ambition	Commitment	Dominance	Faithfulness	Parenting skill
Masculinity		-			+	-	
Age	+	-	+	+	+		+
Health	+	+	+	+	+	+	+

5.4.3 Discussion

When the faces were rated for personality traits, masculinised female faces were rated as more dominant but less warm and less faithful than feminised female faces. Older female faces were rated as less warm, but more dominant, more ambitious, more committed, more wealthy and as better mothers than younger females. Healthy female faces were rated as significantly more wealthy, warm, ambitious, committed, dominant, faithful, and as better mothers than unhealthy female faces. These results suggest that in terms of femininity, there is no trade-off for males to make in the way women must trade-off dominance versus prosociality and commitment in male partners. Not only should feminine women be more fertile, but according to these results, they are perceived as better partners in that they are warmer and more committed. Because men are not the primary carers of offspring, and still tend to be higher earners in the West, dominance in a female partner should not be necessary. Therefore there are no advantages to having a masculine female partner. Similarly, there are no advantages to having an unhealthy female partner, as all positive attributes were associated with the healthier faces, rather than the unhealthy faces.

The only anomaly in the personality ratings, was that of the age pairs. Although, like the male age transforms, the older faces were rated higher on most of the items, but rated as less warm, this does not entirely match with men's strong preference for youth in females. The fact that younger faces were seen as less likely to commit to a relationship and as less good mothers should seem to make them less attractive. The most obvious explanation for this is

that when males are judging a potential female partner, fertility considerations are more important than how committed to the relationship, or how motherly a woman is. Notably, perception of the one trait men ought to value most in a long term female partner, faithfulness (according to Buss, 1989, Buss & Schmitt, 1993), was not affected by facial age.

To summarise, therefore: femininity, youth and healthiness are all features of female mate value and men may well make their choices for facial cues to these traits based on their implications for fertility.

PART 2:

FAMILY BACKGROUND AND FACIAL ATTRACTION

6. FATHER ABSENCE AND ATTRACTION TO MASCULINITY 1

6.1 SUMMARY

The purpose of Part 2 was to determine whether or not the father absence literature can be successfully used to predict patterns of female partner preference in young adulthood. Study 4 was designed to look specifically at the relationship between family background and masculinity preference. Predictions were made based on three perspectives: first the effect father absence may have on reproductive strategy (classic Father Absence Theory); second, the effect that it may have on female 'condition' (condition dependency); and finally, the effect it may have on parental imprinting. Father absence reduced preferred masculinity in potential long-term partners' faces, but increased masculinity preferred for short-term partners. Reduced warmth towards parents decreased masculinity preference. These results predominantly support the condition dependence predictions and are discussed in the context of current father absence research.

6.2 STUDY 4

Although Draper & Harpending (1982) and Belsky et al (1991) do not mention how father absence might affect partner choice, it is possible to extrapolate from the theory to make predictions regarding facial preferences. This can be done based on three different perspectives: first: the differences in sexual and reproductive strategy that one would expect to see between women with and without early father absence; second: the differences in physical condition one might expect to see between women with and without early father absence; and third: the differences in opportunities for sexual imprinting one would expect to find between women with and without early father absence.

Sexual strategy

If a woman is following a short term strategy and not emphasising parental investment, it can be predicted that she would primarily be concerned with the genetic benefits of a partner. Men may trade-off their looks/genetic quality against paternal investment, with the most genetically desirable males not offering much (if any) long term commitment (see Gangestad & Simpson, 2000 for a discussion). Furthermore, as discussed in Part 1, masculine males

may be high genetic quality *because* of a tendency not to commit to relationships. Therefore a woman who is not interested in giving her children high levels of parental investment is free to pursue high quality men without concern for their low levels of parenting effort. There is evidence that when seeking a short term partnership, women are more concerned with looks than when seeking a long term partnership (Buss & Schmitt, 1993). Furthermore, women most likely to be seeking genetic quality in a mate (women who are in the late follicular phase of their menstrual cycle) prefer more masculine males (Penton-Voak et al, 1999). On the other hand, if a woman is following a long term strategy and investing in her offspring, then one might expect her to be much more concerned with acquiring a partner who will provide long term investment himself. Therefore, she should avoid very masculine men (who are perceived as having poorer parenting skills: Perrett et al, 1998; Chapter 4) and opt instead for more feminine males who will be more committed to her.

Therefore, given that father absence and/or early psychosocial stress are believed to promote a low-investment reproductive strategy in females, it can be predicted that father absent females or those who experienced poor family relationships during childhood, should prefer more masculine men than father present females or those who had a warm relationship with their parents. It is not clear how proscribing a long or short term relationship context would affect masculinity preferences according to this hypothesis. Menstrual cycle research shows that when subjects are asked to judge preferences in long/short term relationship contexts, the increase in masculinity preference in the late follicular phase (believed to be because women are taking a short term view when high conception risk) is seen more in short term judgements than long term judgements (e.g. Penton-Voak et al, 1999; Gangestad, Simpson, Cousins, Garver-Apgar & Christensen, 2004). Therefore, it may be that the preference for masculinity amongst father absent women should be evident when they are asked to make short term judgements, but less clear when they are asked to make long term judgements. Importantly however, because the difference in preference between father absent and father present women is expected to be the result of a difference in reproductive and sexual strategy, it should be evident when women are asked to state a preference *when no relationship context is specified*.

Condition

There is evidence that girls growing up in a father absent household or who have difficult/insecure relationship with their parents may be of relatively lower quality than other girls due to poor health. For instance, Flinn & England (1997) assessed the living conditions

of children and adolescents living in a village in Dominica and took regular saliva samples (several times a day for multiple days) to assess their levels of cortisol (a stress-related hormone). Although the society they studied was matrilocal and the parenting conditions were very varied, the majority of children (approx. 54%, averaging the means from all 4 study seasons) were living with their mother and their biological or step-father, while a further 12% lived alone with a single parent. The remainder of the children lived with mother and kin, grandparents, distant kin or nonrelatives. Thus about two thirds of the children lived in circumstances common in the West. Flinn & England found that children living without their biological father had significantly higher cortisol levels than those living with both parents (even if their father was often absent from the home, e.g. for work or after rows). The same differences were also found for number of days of illness experienced by the children, and furthermore, were present irrespective of the socioeconomic conditions of the children. There is strong evidence for stress negatively effecting health via the impacts of cortisol on the immune system; for instance, in this study Flinn & England found a moderate positive correlation (0.35) between levels of cortisol and self-reported days of illness. There are also studies showing a relationship between stressful life events and susceptibility to illness under controlled conditions (e.g. Cohen, Tyrrel & Smith, 1992).

Furthermore, in a review of literature using western samples, Feeney (2000) proposed that there was good evidence for insecure attachment in childhood being associated with poorer health later in life (see e.g. Kotler, Buzwell, Romeo & Bowland, 1994, for empirical data). Given that apparent health is very strongly associated with attractiveness in faces (Jones et al, 2001; see Chapter 2 for further discussion) Flinn et al's and Feeney's data suggest that individuals from high stress, father absent or poor attachment backgrounds are likely to be considered less attractive in adulthood. Furthermore, Epel, McEwan, Seeman, Matthews, Castellazzo, Brownell, Bell & Ickovics (2000) found that increased cortisol reactivity (cortisol increasing to a greater than average degree in response to stress) is associated with increased levels of trunk fat in girls (i.e. higher WHR; see Chapter 2 for a discussion of WHR). Unusually highly reactive cortisol is one of the 2 profiles Flinn & England found in highly stressed children, suggesting childhood stress could lead to women being bodily less attractive.

Finally, the precocious physical development linked with father absence may be associated with stress-induced features of low quality status (e.g. Ghirri, Bernardini, Vuerich, Cuttano, Coccoli, Merusi, Ciulli, D'Accavio, Bottone & Boldrini, 2001: low birth weight; Bjorkeland, Lissner, Andersson, Lapidus & Bengtsson, 1996: body-fat distribution).

As discussed in Chapter 2, evidence suggests that 'condition' or attractiveness of a female affects the type of male she prefers, such that high quality women (Little et al, 2001: high self-rated attractiveness; Penton-Voak et al, 2003: low waist-hip ratio), prefer more masculine male faces than other women when contemplating a long term relationship. One could therefore predict that women who have grown up without cohabiting fathers and those with poor attachment should prefer less masculine males due to their possible 'low condition' status. By contrast, those females with resident fathers and those with secure attachment (i.e. 'high condition females') should consistently prefer more masculine men. This difference should be particularly evident in long term contexts – such as when asked to choose a potential long term partner (as in Little et al, 2001). When not asked to give their preferences in a given context, we might expect lower quality (or father absent) women to show the greatest cyclic shifts in preference and be most different to high quality (or father present) women at a time when they are least likely to opt for short term sexual relationships (i.e. low fertility points of the menstrual cycle; Bellis & Baker, 1990).

Imprinting

The third prediction can be made based on research which suggests exposure to parental faces during the early stages of perceptual development may bias preferences in favour of parental characteristics in potential partners (Perrett et al , 2002: parental age; Little et al, 2003: eye and hair colour). Not only have Perrett et al and Little et al found relatively passive effects of parental characteristics on later partner preferences, but Bereczkei and colleagues have found in both males (Bereczkei, Gyuris, Koves & Bernath, 2002) and females (Bereczkei, Gyuris, & Weisfeld, 2004) that the quality of the relationship between parents and children can influence the degree of imprinting which takes place. The degree to which women's adoptive fathers bore resemblance to their husbands was significantly related to how well the women got on with their adoptive fathers. This effect cannot be genetically mediated as the women were all adopted, and furthermore, cannot be influenced by any similarity between the daughters and adoptive fathers (perhaps brought about through environmental factors) because self-husband similarity was much weaker than father-husband similarity.

Therefore, one can predict that due to reduced paternal contact and poor attachment, father absence is likely to detract from a female's ability/'desire' to imprint on her father's facial characteristics and will leave her only a mother as a model for potential male partners. Like the condition explanation, this explanation would also predict that women with absent

fathers should be more attracted to feminine men than those with co-resident fathers (assuming masculinity of father's face varies randomly between groups). There should, however, be no effect of whether the judgements are carried out in a long or short term context since an impact on facial prototypes ought to be uniform across facial perception.

Thus, Table 6.1 shows how the three explanations make mutually exclusive predictions for facial preferences.

Table 6.1. Predictions made based on sexual strategy, condition dependence and imprinting explanations of mate choice.

Basis for predictions	**Predicted preference in male faces**	
	Father-absent:	*Father-present:*
Sexual strategy	masculine men	feminine men
Condition dependence	feminine men*	masculine men
Imprinting	feminine men	masculine men

**Particularly in long term relationships*

6.2.1 Method

6.2.1.1 Subjects

445 heterosexual women aged 16 to 29 (mean age=23.1 years, s.d.=3.7) were recruited for a 'Background and Facial Attraction' study through the laboratory website. They were told the following before beginning the study:

> First of all you will be asked to fill in five short questionnaires, which will ask you about your background, your attitudes to relationships and your current circumstances. Some of the questions are fairly personal and if you would rather not answer some of them, leave them blank.
>
> After this you will be asked to make some choices between pairs of faces, which will help us to understand which of several kinds of faces you *prefer*. Finally we would like you to manipulate the shape of some faces to help us understand what kinds of face you consider *ideal*.

89.2% of subjects were from Western countries (Europe, North America, Australia) and 83.1% were Caucasian. 30.0% of subjects had separated parents. 52.1% of subjects were undergraduate and postgraduate students, and 5.4% had other jobs within universities and research. 41.3% had jobs unrelated to science.

6.2.1.2 Questionnaire variables[13]

Subjects filled in an electronic questionnaire providing their sexuality and racial background, and the following information:

Menstrual cycle. Subjects were asked when their last menstrual cycle had started. Those who had started between 6 and 14 days previously (follicular phase) were coded as high conception risk. Those who started less than 6 days (menstrual phase) or between 14 and 30 days (luteal phase) previously were coded as low conception risk. Women taking hormonal contraceptives and those reporting unusually long (last period more than 30 days ago) or irregular cycles, pregnancy or amenorrhoea were excluded, leaving 245 women (mean age=22.9 years, s.d.=3.6) for analyses involving menstrual cycle.

Sexual development. Subjects were asked at what age they a. started their periods, and b. first had sexual intercourse. They were also asked how many sexual partners they had ever had.

Parental separation. Subjects were asked whether or not their parents were separated and when any separation occurred. Parental separation was then coded as prior to puberty (menarche), after puberty, or not at all.

Relationship with parents. Subjects rated warmth with which mother/father remembered (*With how much warmth do you remember your parents during these periods in your life*?) on 9-point Likert scales for both before the age of 6 (roughly pre-school) and between the age of 6 and when the individual reached puberty (roughly primary/elementary school). The two ratings were averaged together for each parent separately, producing two variables: *Positivity to Father* and *Positivity to Mother*. These two variables had previously been validated using the Adult Attachment Questionnaire (see Appendix D).

[13] The questionnaire also included a measure of SES (bedrooms per capita), but this related to neither father absence nor facial preferences, so was not included in the analyses. See Appendix F for further details.

6.2.1.3 Facial preference tasks

Rated masculinity preference. Subjects rated preference on male and female pairs of faces varying in masculinity. These pairs were the opposite ends of the 6 masculinity-continuums of each sex, used in previous tests (Perrett et al, 1998: 1 Caucasian, 1 Japanese; Penton-Voak, et al 1999: 3 additional Caucasian; Penton-Voak, 2001: 1 Afro-Caribbean). Each pair consisted of a face which had been given a 50% masculinisation shape transform, and the same face given a 50% feminisation shape transform. Face pairs were presented side by side in the java applet used in Studies 1, 2, and 3, which recorded an 8-point 0-7 preference scale where 0 = strong preference for the feminine face and 7 = strong preference for the masculine face (such that 3.5 represented no preference). Masculinity preference was taken as the mean of the ratings for all 6 face pairs in each sex separately.

Subjects were told to first decide which of each pair they preferred and then to indicate the strength of that preference on the points below the faces. For opposite sex (male) faces they were asked to decide which one was more attractive. For same sex (female) faces they were asked which one they preferred to look at.

Pairs were randomised on order of presentation and left-right positioning. All subjects were presented with all male face pairs first and all female face pairs second.

Degree of masculinity preferred. 262 females went on to complete an interactive masculinity test used in previous experiments (e.g. Penton-Voak et al, 1999). They were given a display which morphed under the subject's control from 50% masculinisation to 50% feminisation and asked to pick the point at which they found the face most attractive. All subjects were asked to judge opposite sex faces separately for a short term context (e.g. one night stand) and a long term context (e.g. marriage) and same sex faces for general attractiveness; order of judgement context was randomised.

6.2.2 Results

6.2.2.1 Parental Separation

Father absence had a significant effect on timing of first coitus ($F_{2,352}=5.93$, $p<0.01$) such that those whose parents separated before puberty had sex at a younger age than those whose

parents did not separate at all (early separation: mean 16.48 years, no separation, mean 17.62 years, $p<0.01$; those whose parents separated later had first coitus at mean age 17.20 years and did not differ from either other group). Those whose parents had separated before puberty also had a greater number of sexual partners, even after controlling for age ($F_{2,389}=4.15$, $p<0.05$). However, there were no differences between the groups on timing of puberty ($F_{2,425}=0.024$).

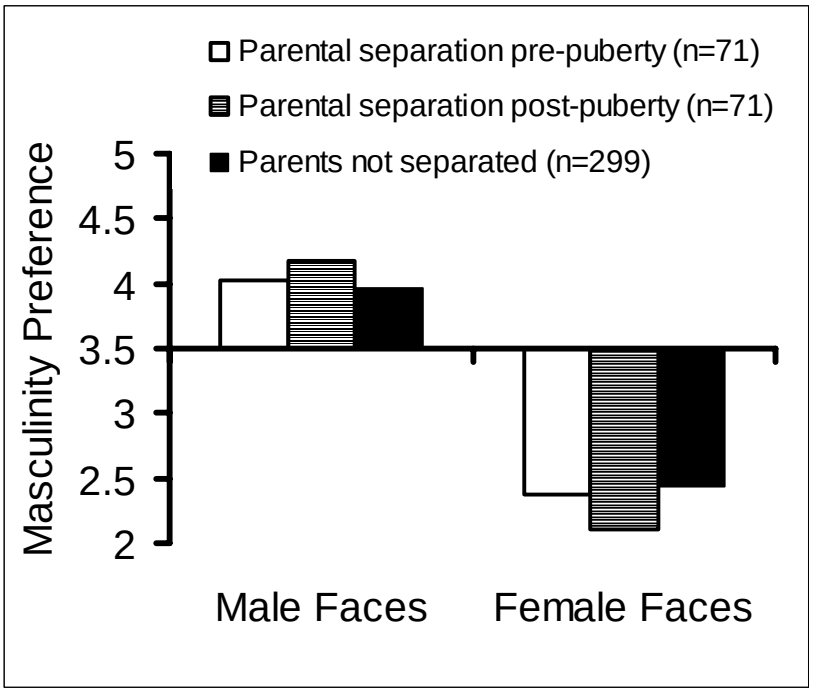

Figure 6.1. Mean preferences for women judging male and female faces (where 0 = strongly prefer feminine face & 7 = strongly prefer masculine face), split by timing of parental separation.

Figure 6.1 shows the effect of parental separation on female masculinity preference. There were no significant differences in preferences for male facial masculinity between women whose parents were never separated and those whose parents had separated, whether that separation took place before or after puberty ($F_{2,438}=1.14$). There was an effect on preferences for female faces ($F_{2,438}=2.66$, $p<0.05$) with those women whose parents separated after puberty showing the strongest preference for the feminine female.

When the subjects were split by conception risk (excluding those using hormonal contraceptives), a General Linear Model found a significant interaction between conception risk and parental separation on masculinity preference ($F_{2,220}=4.74$, $p<0.05$). Women whose parents separated before they reached puberty had a significantly higher masculinity preference in the high risk phase ($F_{2,69}=4.71$, $p<0.05$) than other women. They had a lower mean masculinity preference in the low risk phase, but this difference did not reach

significance ($F_{2,151}$=1.02). Planned comparisons within groups showed that women whose parents had separated before puberty preferred the masculinised male faces significantly more if they were high conception risk compared to those who were low conception risk (t_{33}=3.42, p<0.005; see Figure 6.2). There was no difference in masculinity preference between the high and low risk groups amongst women whose parents had separated after puberty (t_{34}=0.53) and those whose parents were unseparated (t_{153}=0.62). There was also no interaction between conception risk and parental separation for femininity preference in female faces ($F_{2,220}$=0.62).

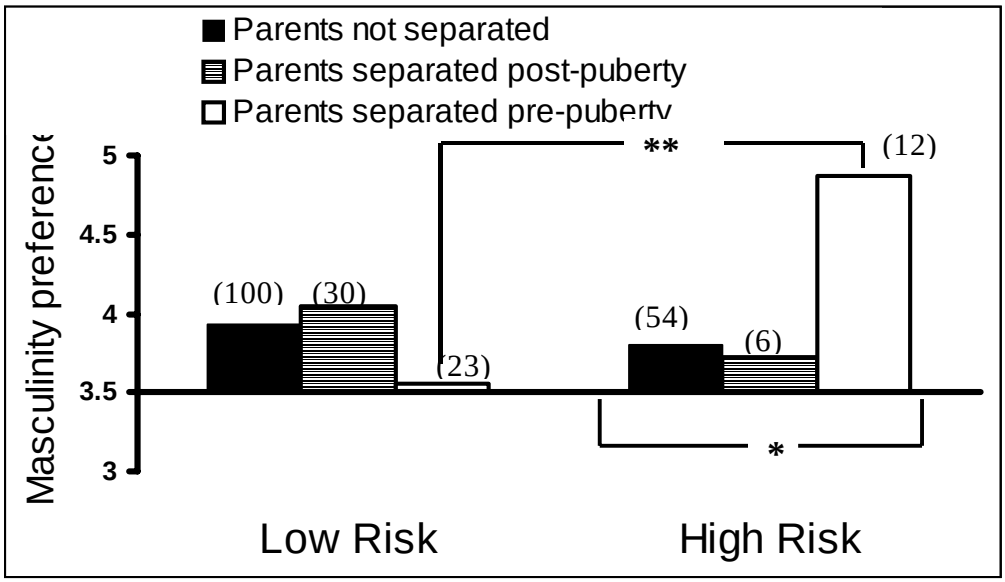

Figure 6.2. Mean rated preference for masculine faces (where 0 = strongly prefer masculine & 3.5 = no preference) split by conception risk and parental separation. Sample sizes given in brackets. * p<0.05, **p<0.005

Subjects were then compared on the degree of masculinisation preferred. There was a marginally significant main effect of relationship type considered, such that individuals preferred more masculine men for short term relationships ($F_{1,246}$=3.78, p=0.053), and a significant interaction between relationship type and parental separation ($F_{2,246}$=3.19, p<0.05). Women whose parents separated before they reach puberty preferred marginally significantly more masculine male faces than other women for short term relationships ($F_{2,246}$=2.94, p=0.055). There was no significant difference for long term relationships ($F_{2,246}$=0.04). Within groups, those whose parents separated early preferred significantly more masculine men for short term relationships than they did for long term relationships (t_{40}=2.63, p<0.05; see Figure 6.3). Women in the other two groups showed no significant differences between long and short term (parents unseparated: t_{160}=0.25; parents separated

after puberty: t_{47}=0.79). There was no effect of parental separation on same sex face preferences ($F_{2,213}$=1.87).

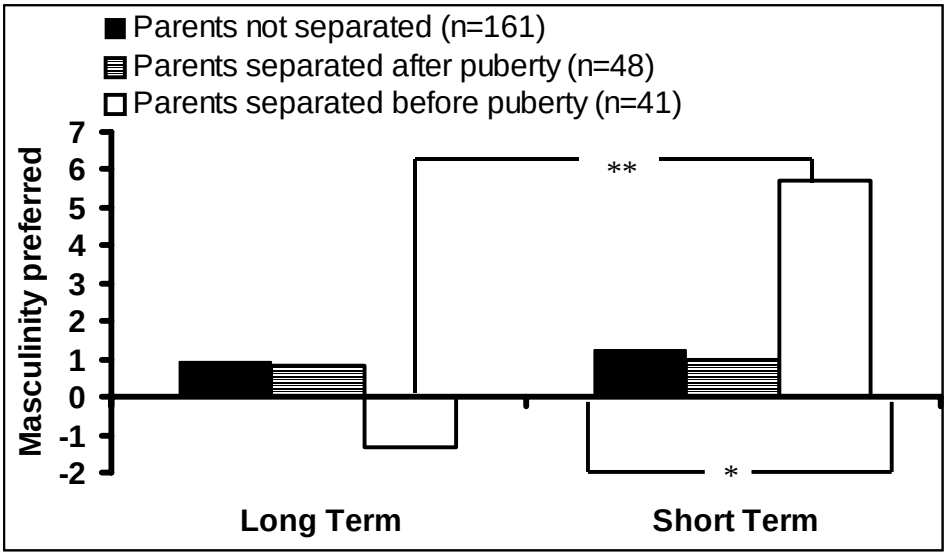

Figure 6.3. Mean degree of masculinity preferred in male face shape (in percentage change from average), split by timing of parental separation and type of relationship judged. * p=0.055, **p<0.05

6.2.2.2 Relationship With Parents

Correlation coefficients showed a significant association between masculinity preference and both Positivity to Father (r_{s426}=0.146, p<0.01) and Positivity to Mother (r_{s426}=0.106, p<0.05) such that the higher a woman's 'Positivity' scores, the more she preferred masculine faces. However, there was no relationship between 'Positivity' and degree of masculinisation preferred in the interactive test for short or long term judgements. There were also no same-sex preference effects (see Table 6.2 for r_s values).

When the subjects were split by parental separation, daughters of unseparated parents still showed a significant correlation between positivity to parents and masculinity preference (Positivity to Father: r_{s285}=0.227, p<0.01; Positivity to Mother: r_{s285}=0.141, p<0.01). There was also a significant correlation between Positivity to Father and degree of masculinity selected in long term judgements (r_{s168}=0.217, p<0.01).

There was no correlation between subject's age and their facial preferences (Male face preference: r_{s441}=0.02; male interactive long term: r_{s262}=0.061; male interactive short term: r_{s262}=0.042; female face preference: r_{s441}=0.017; female interactive: r_{s262}=-0.041).

Table 6.2. Results of correlations between women's masculinity preference/degree of masculinity selected and Positivity to Father and Positivity to Mother scores for all women, and those with unseparated parents. (Sample sizes in brackets; subjects excluded if not completing relevant items on questionnaire.)

		Positivity to Father			Positivity to Mother		
	Face sex	*Preference*	*Degree (long term)*	*Degree (short term)*	*Preference*	*Degree (long term)*	*Degree (short term)*
All females	M	0.146** (426)	0.088 (262)	0.022 (254)	0.106* (371)	0.105 (236)	0.013 (226)
	F	0.025 (421)	0.030 (210)		-0.004 (371)	0.014 (188)	
Parents not separated	M	0.227** (285)	0.217** (168)	-0.119 (140)	0.141** (248)	0.140 (150)	0.036 (145)
	F	0.066 (248)	0.119 (140)		-0.007 (248)	0.041 (124)	

*p<0.05, **p<0.01

6.2.3 Discussion

The results of this study contribute to the large bank of literature showing that father absence and early family relationships are associated with precocious sexuality and increased number of sexual partners. They failed to show family effects on age of menarche, which contrasts with some of the literature cited in Chapter 1. This lack of an effect on menarche could be due to the coding of parental separation as pre- or post-puberty, rather than pre- or post an earlier age, such as 5 to 7 years. However, other studies have found effects of father absence on age of menarche when using the same split as this study (e.g. Surbey, 1990). Therefore, it is more likely that the lack of an effect in this study is due to sample size (studies reporting effects tend to be very large – e.g. Quinlan, 2004, had over 1000 subjects) and possibly analysing age of menarche in years rather than months.

This study shows support for family background affecting face preferences in adulthood. Early father absence was associated with a significant increase in masculinity preference in short term/high fertility contexts and a nonsignificant decrease in masculinity preference in long term/low fertility contexts. Poor parent-daughter (particularly father-daughter) relationships were associated with a decrease in masculinity preference in the java applet test. The results do not necessarily fit with the short term reproductive strategy that Belsky et al (1991) argued was associated with father absence and stressful childhoods. The sexual strategies explanation predicted that father absence would be associated with a short term strategy leading to increased masculinity preference *even when relationship context was not specified*, which was not the case. Father absence did increase masculinity preference

amongst high conception risk females, and those judging a short term context. One might suggest that the preference for masculinity might *only* manifest itself when a short term relationship was specified (see e.g. Penton-Voak et al, 1999; though cf Rhodes et al, 2001), which could explain why an effect was only seen once relationship context/conception risk was taken into account. The correlations between Positivity to Father/Mother and masculinity preference, however, directly contradict the strategy predictions.

It is also likely that the effect of father absence on face preferences is not mediated by parental imprinting because while father absence was associated with a preference for femininity in male faces, as the imprinting explanation predicted, the effect was mediated by relationship context. A perceptual bias in representations of faces resulting from reduced early exposure, or poor quality early contact, should bias attraction to masculinity in male faces independently of context.

Women's preferences followed most closely the predictions made by the quality or 'condition dependent' explanation, with women whose parents separated during their early childhood, or who perceived their parents very negatively, exhibiting the preferences associated with low-quality women; i.e. a preference for more feminine men in long term contexts and more masculine men in short term contexts (Little et al, 2001; Penton-Voak et al, 2002). This finding fits with Flinn & England's (1997) work showing that father absent children have higher cortisol than father present children. Although Flinn, Quinlan, Turner, Decker & England (1996) found that this difference became negligible in adult women, different childhood hormonal profiles in father-absent children may have deleterious effects on their *developing* appearance, leading to decisions similar to those of 'low-quality' women. It is important however, to note that these females' preferences do not completely follow the low condition explanation, as the difference between the groups of women was significant in short term contexts, rather than long term contexts as Little et al (2001) found.

The finding that Positivity to Father had an effect on facial preferences amongst those whose parents were *not* separated supports the Belsky et al's (1991) model in that it suggests that it is the poor attachment and psychosocial stress associated with father absence, rather than father absence per se, which affects development. It is also of interest that parental separation had an effect only when it occurred pre-puberty, which is exactly what the causality implied in Belsky et al's model would suggest. However, the fact that the women in this study show patterns of face preferences that are not entirely concordant with the

reproductive strategy that Draper & Harpending's Father Absence Theory predicts they follow is somewhat problematic for the theory as a whole.

Even if females from 'father absent' backgrounds *do* engage in short term reproductive strategies, do they only do so because they are 'low quality'? According to the condition dependency explanation, a low quality female should be able to secure a long term mate only by accepting a low quality male, or else she must opt for short term relationships. Therefore, the greater tendency for short term relationships in father-absent females may be a product of this lower attractiveness.

Finally, in this study the cyclic shift in masculinity preferences was driven entirely by father absent women. It could therefore be that the shifts seen in previous studies have also been driven by such women and further research may help to clarify this. However, Penton-Voak et al (1999) used a St Andrews student sample and given that father absence is very low amongst St Andrews students (c. 5-10%, Boothroyd, unpublished data) it is unlikely there could have been sufficient in their sample to create this effect. On the other hand, all published studies on the menstrual cycle and preferences (be they olfactory or facial preferences) have thus far used student samples and it may be that cyclic shifts are therefore more an idiosyncrasy of upper/middle class 18-22 year old women, rather than a feature of the wider population.

7. FATHER ABSENCE AND ATTRACTION TO MASCULINITY 2

7.1 SUMMARY

This chapter investigated whether being in a relationship could mediate the relationship between family background and partner choice seen in Study 4. Using a similar methodology to the previous study, Study 5 found that father absence or a poor father-daughter relationship were associated with femininity preference in both short and long term contexts, but only amongst those who were single or in unhappy/uncommitted relationships. It was therefore concluded that rather than mediating the link between family background and partner choice, being in a relationship had a moderating effect (or was related to some other moderating factor, since women in good relationships also did not show the classic father absence effect of early menarche). The results of this study were also in contradiction with the sexual strategies explanation, and were more concordant with the imprinting or condition explanations.

7.2 STUDY 5

Chapter 6 presented evidence that father absence and a poor parent-daughter relationship during early childhood, was associated with a pattern of facial preferences which suggested that women from such backgrounds regarded themselves as having low quality mate value. Although father absent women favoured masculine men for short term relationships, preference for femininity increased as warmth towards parents decreased.

The aim of this study was two-fold. Firstly, it was to replicate the results of Study 4, and secondly, it was to include a further variable of interest: relationship status. Little et al (2002) found that being in a relationship increased women's masculinity preference. They suggested that this was because women in relationships already have a long term, investing partner and thus can only view potential male partners in a short term (i.e. extra-pair) context. This leads to them seeking good genes and therefore having a preference for masculinity. Conversely, women not in relationships may be biased towards considering potential partners as long term mates and thus being drawn to more feminine men.

According to previous research, women from father absent backgrounds are less likely to be in stable long term relationships as adults (see Chapter 1 for discussion of this). If women

in relationships have a higher masculinity preference, then one would expect father-present women (more likely to be in relationships) to also have a higher masculinity preference. Thus being in/out of a relationship could be the mediating factor in the results of Study 4.

If relationship status does indeed mediate the effect of father absence on facial attraction, one would expect the effects of father absence to disappear once relationship status is entered into a model. If relationship status is not a mediating factor, then the two factors should have separate effects on masculinity preference. Thus, if relationship status is not a mediating factor, there should be an equal effect of father absence on facial preferences amongst both those in and those out of relationships.

7.2.1 Method

7.2.1.1 Subjects

563 heterosexual women aged 16 to 29 (mean age=22.92 years, s.d.=3.64) took part in this study. 90.9% of subjects were from Western countries (Europe, North America, Australia) and 85.8% were Caucasian. 15.9% of subjects had separated parents. Replicates were excluded on the basis of IP address. 62.6% of subjects were undergraduate and postgraduate students, and a further 10.5% working in teaching and research.

7.2.1.2 Questionnaire variables

Subjects filled in an electronic questionnaire providing their sexuality and racial background, and the following information:

Sexual development. Age of first menstruation and first coitus were reported in years.

Family background. Parental separation was measured and coded as in Study 4. Positivity to Father and Positivity to Mother were again rated on 1-9 Likert scales, although for this study subjects rated the entirety of their childhood up until puberty on one scale.

Current relationship status. Subjects reported whether or not they were currently in a relationship, and if they were, they rated on 1-5 Likert scales the happiness and commitment in the relationship. In their analyses, Little et al discarded all those who rated their relationships as unhappy or uncommitted (since these women may well have been open to

new *long term* relationships and look at men as mate replacements as well as EPCs). Following from this, but in order to preserve sample size, in this study subjects were divided into those who were in a happy and committed relationship (rated 3 to 5 on both the happiness and commitment scales; 47.2% of subjects), and those who were in an unhappy relationship or single (52.8%).

7.2.1.3 Facial preference tasks

Subjects rated preference on male pairs of faces varying in masculinity. Stimuli were the 6 pairs of masculinity stimuli used in Study 4, and the 6 pairs used in Study 1b. The testing applet was identical to that used previously.

Rather than splitting subjects on conception risk, or losing subjects by using the difficult to download interactive test, subjects rated the faces based on both attractiveness as a long term partner, and attractiveness as a short term partner. This maximised sample size, while still including the short/long variable. Order of testing short and long term preferences was counterbalanced. Within each choice context, pairs were randomised on order of presentation and left-right positioning.

7.2.2 Results

Parental separation was not associated with age of menarche (t_{563}=0.47) or of first coitus (t_{447}=0.87). When parental separation and relationship status were entered into a GLM, there was a significant interaction between the two predictors on age of menarche ($F_{1,445}$=9.42, $p<0.01$) and age of first coitus ($F_{1,445}$=6.22, $p<0.05$). The interaction plots (see Figure 7.1 below) showed that parental separation only reduced age of menarche amongst women who were single or in bad relationships. Precocious sexuality was associated with being in a good relationship amongst father absent women, and a lack of good relationships amongst father present women. Positivity to Mother was positively correlated with age of first coitus (r_s=0.094, n=454, $p<0.05$), however it did not relate to age of menarche (r_s=-0.025, n=579), and Positivity to Father related to neither measure (menarche: r_s=0.008, n=579; first coitus: r_s=0.047, n=455).

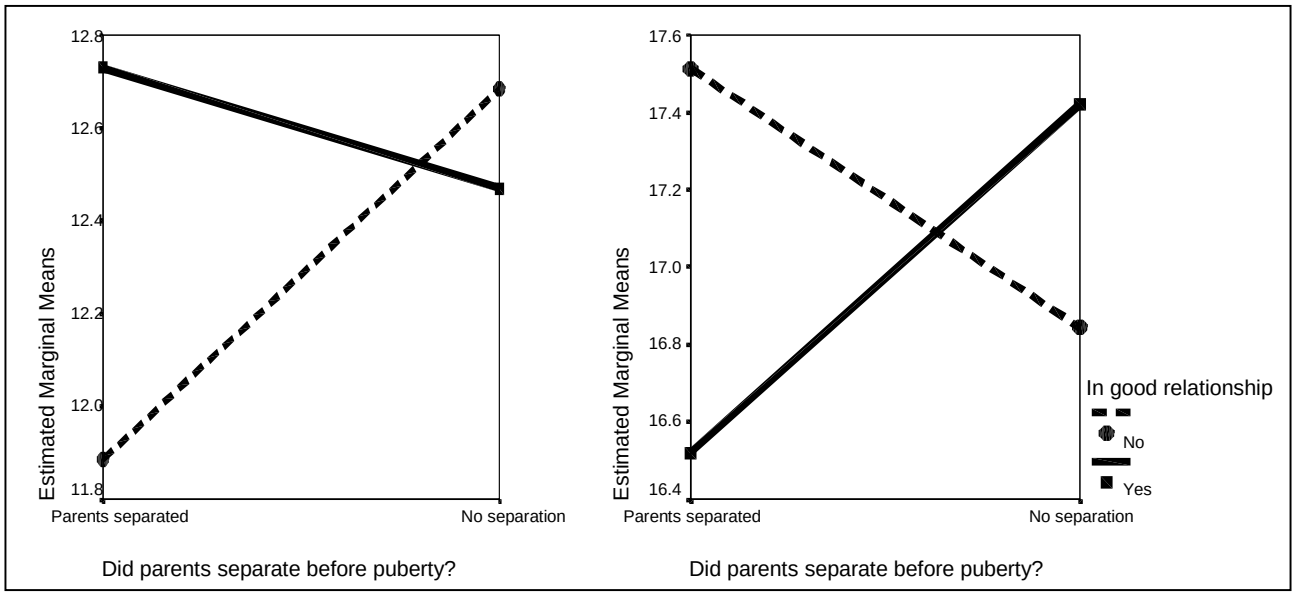

Figure 7.1 Interaction plots for effects of relationship status and father absence (parental separation) on age of menarche (left) and age of first coitus (right). Graphs show estimated marginal means (i.e. means controlling for other variables in the ANOVA).

Parental separation was not associated with relationship status (χ^2=0.32, 1df). Multiple logistic regression showed that Positivity to Mother could predict being in a good relationship versus being in a bad relationship or single (B=0.095, 1df, $p<0.05$, R^2=0.022) but Positivity to Father could not (B=0.040). For *all* those who were in relationships, early father absence was associated with decreased self-reported happiness and commitment (happiness: $t_{341}=2.50$, $p<0.05$; commitment: $t_{335}=2.18$, $p<0.05$). Furthermore, warmth towards parents correlated positively with happiness of relationship (Positivity to Father: $r_s=0.211$, $p<0.001$; Positivity to Mother: $r_s=0.183$, $p=0.001$; n=348) and commitment of relationship (Positivity to Father: $r_s=0.176$, $p<0.01$; Positivity to Mother: $r_s=0.157$, $p=0.001$; n=343).

Masculinity preference was averaged for all 12 stimuli pairs, to create a single short term masculinity preference score, and a single long term score. A GLM was run with term (short versus long) as a within groups factor and relationship status and father absence pre-puberty as between groups factors. There was a main effect of father absence ($F_{1,337}=4.29$, $p<0.05$) and a marginal interaction between father absence and relationship status ($F_{1,337}=4.76$, $p=0.053$). Planned comparisons showed that while father absence pre-puberty was associated with a decrease in masculinity preference amongst single women (short term: $t_{23.87}=2.00$, $p=0.057$; long term: $t_{143}=2.16$, $p<0.05$), it had no effect amongst women in

relationships (short term: t_{231}=0.75; long term: t_{218}=0.36). There were no further main effects or interactions in the GLM (all F<1).

Across all subjects, Positivity to Father was found to relate to short term masculinity preference (r_s=0.114, n=397, p<0.05) but only related marginally to long term preference (r_s=0.093, n=348, p=0.067). Positivity to Mother did not effect masculinity preference at all (short term: r_s=0.057, n=395; long term r_s=0.004, n=421). When subjects were divided by relationship status, Positivity to Father correlated with masculinity preference for both long and short term amongst single women and those in uncommitted relationships (long term: r_s=0.182, n=171, p<0.05; short term: r_s=0.182, n=172, p<0.05)[14], but not amongst women in good relationships (short term: r_s=0.077, n=225; long term: r_s=0.036, n=216). There was no effect of Positivity to Mother in single women and those in bad relationships (short term: r_s=0.085, n=172; long term: r_s=-0.048, n=171), or women in good relationships (short term: r_s=0.040, n=223; long term: r_s=0.033, n=211).

7.2.3 Discussion

The results of this study show that father absence and poor father-daughter relationships are associated with a decrease in masculinity preference in both short and long term relationships, amongst women who were single or in relationships in which they were unhappy and felt uncommitted to their partners. There were no effects of family background in women who were in happy and committed relationships. The aims of this study had been firstly, to replicate Study 4, and secondly, to investigate the effects of controlling for relationship status. As regards to the first aim, the results did indeed partly replicate Study 4 in that there was evidence that poor relationships with fathers were associated with a preference for femininity rather than masculinity in male faces. Contrary to expectation, however, there was no interaction between relationship context and father absence such as had been seen in Study 4.

The lack of a term interaction effect in Study 5 could be because the testing applet was not sensitive enough. In Study 4, the applet was used to collect only general preferences, without proscribing short or long-term relationships. The short-long difference was tested using the much more sensitive (essentially 100-point scale) interactive test. Therefore, the

[14] These correlations remained, albeit not quite significantly, when only father present women were analysed (long term: r_s=0.156, n=132, p=0.078; short term: r_s=0.169, n=134, p=0.051)

applet test used here may not be sensitive enough to detect a term effect. This is particularly likely since these results did not even show a main effect of short- versus long-term relationships on masculinity preference.

Alternatively, subjects in Study 5 had a somewhat different demographic distribution to those in Study 4. While Study 4 subjects were predominantly employed outside education/research ("other") or undergraduate students, this study contained twice the proportion of postgraduates and researchers and teachers[15]. If academics and teachers have a slightly different view on short versus long-term relationships, this could have contributed to the lack of a term interaction effect in Study 5.

The second aim of Study 5, to investigate the effects of controlling for relationship status on the father absence relationship with masculinity preference, also proved fruitful. Relationship status did not mediate the effects of father absence. In this sample, relationship status did not predict masculinity preference, and the main effect of father absence on masculinity preference existed even with relationship status in the model. However, the effects of father absence appear to be *moderated* by being in a good relationship. Although single women and those in unhappy/uncommitted relationships showed the expected pattern, with low Positivity to Father scores and father absence predicting lower masculinity preference, women who were in happy relationships showed no effects of father absence or warmth to parents on their masculinity preferences.

There are two possible explanations for why a happy relationship would remove family effects on partner preference. Firstly, it could be that achieving a happy and stable relationship helps women to overcome the problems of having separated parents, and adjusts their preferences accordingly. For example, it might argued that a preference for feminine men amongst women from divorced households represents an increased desire by these women for a partner who can give them the stability they lacked as children (since feminine men are perceived as more faithful and committed, this is plausible; see Chapter 9 for further discussion of this possibility). Alternatively, being in a relationship could elevate the self esteem of these women and thus they would cease to behave as if they considered themselves low quality.

However, there is a second possibility which is perhaps more likely. It was also shown in this study that father absence only predicted precocious menarche amongst single women

[15] Study 4: 40.8% undergraduates, 10.7% postgraduates, 5.4% teachers & researchers, 43.0% other; Study 5: 34.8% undergraduates, 27.8% postgraduates, 10.4% teachers & researchers, 27.1% other

and those in unhappy relationships. Women in happy relationships did not show any father absence effect on age of menarche. Since age of menarche is an objective measure, and moreover took place long before the current relationship, the causal relationship (if any) can only be that father absence *and* early menarche predict more difficulty in attaining a happy relationship in adulthood. It could therefore be that there are two groups of father absent women: those for whom the absence/poor relationships are stressful, who experience precocious development, and as adults find it hard to have relationships and are in some way low quality, leading to decreased masculinity preference; and those who are protected in some way during childhood from the effects of father absence, who do not go on to develop along a 'father absent' trajectory, but in fact resemble more closely father present women. Thus rather than being a direct moderator of father absence, being in a good relationship with a partner could reflect that there had been some previous moderation of the father absence effect.

8. FATHER ABSENCE AND AGE PREFERENCE

8.1 SUMMARY

Previous chapters have shown a pattern of female preferences for male facial masculinity which suggests that father absence or bad parent-daughter relationships lead to low quality status. However, because the second study in this section failed to find an interaction between father absence and relationship context (short versus long term) on masculinity preference, it could not rule out the possibility of parental imprinting effects. The aim of this chapter is to use preferences for facial age to further clarify which hypothesis is correctly predicting women's preferences. It was found that father absence was associated with a preference for a more youthful face, while father presence was associated with older facial preferences. Importantly parents' ages did not relate to facial preferences or father absence, and so these results could not be due to imprinting. The results were therefore taken as further supporting the condition explanation.

8.2 STUDY 6

As discussed in Part 1 of this thesis, facial age is closely related to facial masculinity. Therefore one might suppose that there would be no difference between effects of father absence on age preference and effects on masculinity preference. However, there are two important points which count against this opinion. Firstly, as demonstrated in Study 3, despite their visual similarity, facial age and facial masculinity are not perceived to convey the same partner characteristics. Although masculinity and age are both associated with dominance, facial age is also associated with mostly positive attributes, such as ambition, parenting skill, commitment and faithfulness. Masculinity on the other hand, is mostly associated with negative traits such as lack of faithfulness and commitment, and poor quality parenting. Because of these differences, we would predict that factors effecting women's reproductive strategies may therefore affect facial age preferences differently to how they affect facial masculinity preferences. Secondly, studying facial age preferences allows the use of parents' age as an important control variable in teasing apart effects of imprinting versus condition dependence.

It is anticipated that for the age group tested, older males represent a higher quality partner. Firstly, age is associated with masculinity and dominance (Part 1) which may lead

women to associate apparent maturity with 'sexy sons' even though age is not in itself heritable. Secondly, living to a greater age implies better survival ability (which may be heritable). Thirdly, age is associated with increased financial resources in women's perceptions (Study 3). Given the importance of resources in child rearing, increased wealth should make older males more attractive than younger males. Finally, older males are also perceived as being better long term partners. In Study 3, women considered older males to be more faithful and committed, and to be better fathers. Therefore, women perceive facial age as not only suggesting status, but also increased resources for child rearing and increased willingness to engage in paternal investment. Thus, up until the onset of age-induced health problems, older males should be generally preferred to younger males. There is empirical evidence that women desire older partners than themselves, both when asked by researchers (Buss, 1989) and when seeking a partner (lonely hearts ads: Waynforth & Dunbar, 1995; Pawlowski & Dunbar, 1999).

Because older males are of greater quality as partners (particularly long term partners), there should be competition amongst women to mate with older males. Therefore, extrapolating from the condition dependence literature (e.g. Little et al, 2001) would suggest that higher quality women will prefer older males, while lower quality women will settle for younger males. Thus, applying this prediction to father absence, the condition dependence explanation would predict that father absence and/or difficulty in parent-child relationships should be associated with decreased preference for facial age.

One could argue that the imprinting explanation would also predict this pattern of results, in that young age of marriage is an important predictor of divorce (O'Connor, Pickering, Dunn & Golding, 1999), and thus father absent women should generally have younger parents and therefore develop a younger facial prototype and prefer younger faces (as suggested by Perrett et al's, 2002, findings). Even if absent fathers are not around for their daughters to imprint on, the same-sex parent's age also somewhat affects preferred partner age (Perrett et al, 2002), so the prediction that father absence should be associated with youth preferences should hold. However, unlike the quality explanation, the imprinting explanation would predict that the relationship between father absence and age preference should be mediated by parents' age, and thus not exist once parents' age is controlled for. The imprinting explanation would also predict an effect of father absence on same sex faces, although the current data could not test this prediction.

It is not clear what prediction can be made from the sexual strategies explanation. Although older males do represent a good choice for a long term relationship, because of

their apparent masculinity and perceived dominance (and survival ability), they are probably also a good choice for a female more concerned with genetic quality as they have demonstrated their ability to survive to an older age. Thus a difference in sexual strategies should not necessarily effect age preference.

The predictions regarding age preference are summarised in table 8.1 below.

Table 8.1. Predictions of each explanation for female age preferences.

Basis for predictions	**Predicted preference in male partners**	
	Father absent:	*Father present :*
Sexual strategies	No predicted difference	
Condition	Prefer younger	Prefer older
Imprinting	Prefer younger*	Prefer older*

*assuming separated parents are younger than unseparated parents

This study used a pre-collected, but previously un-analysed, data set to assess these predictions.

8.2.1 Method

8.2.1.1 Subjects

There were 275 female volunteers aged 16 to 29 (mean =23.82 years, s.d.=3.33).

8.2.1.2 Stimuli

There were two male facial composites (see Appendix B). One consisted of 15 males aged 20 to 24, the other consisted of 15 males aged 25 to 29. Both composites were displayed in colour with hair, neck and shoulders visible. For previous use of these stimuli, see Burt & Perrett (1995) and Perrett et al (2002).

8.2.1.3 Questionnaire variables

Relationship with father/mother – subjects indicated whether their relationship with each parent had been high quality, medium quality, low quality, or nonexistent.

Parents' personality – subjects rated how warm and caring each parent was on 1-7 Likert scales.

Ideal age of partner – subjects indicated the ideal age (in years) of any potential partner.

8.2.1.4 Procedure

Subjects completed a questionnaire and were shown the two faces individually on a computer screen. They rated how attractive they found each face on a 1-7 Likert scale. Preference for the younger composite was subtracted from preference for the older composite to produce a facial age preference variable. Thus a positive score indicates a preference for the older face over the younger face, while a negative score indicates a preference for the younger face.

8.2.2 Results

Facial age preference did not correlate with own age (r_s=0.014, n=275), nor with age of mother or father at time of subjects' birth (mother: r_s=0.075, n=275; father: r_s=0.066, n=275). Ideal age preference was negatively related to age of mother at the time of subject's birth (r=-0.131, n=273, p<0.05) but not to age of father at time of subject's birth (r=0.044, n=273). Ideal age preference was also strongly positively related to own age (r=0.767, n=273, p<0.001). Therefore, all analyses involving ideal age preference also controlled for own age and where relevant, mother's age. Importantly, contrary to expectation, parents' ages at the time of subject's birth were not associated with father absence (mother's age: $t_{11.478}$=0.54; father's age: $t_{11.198}$=1.13) although father's age was positively related to quality of relationship with father (r_s=0.142, n=261, p<0.05) and with father's caring (r_s=0.144, n=271, p<0.05) such that men who were older when their daughters were born had a better relationship with them and were perceived by their daughters as more caring.

Subjects were split into those who had had a relationship with their father (whether it be good or bad; n=261) and those who had not (n=12). Those with absent fathers had a significantly stronger preference for the younger face than those with present fathers (U=1033.0, z=-2.05, n=273, p<0.05) and reported a significantly younger ideal partner age ($F_{1,265}$=10.21, p<0.005, R^2=0.6; controlling for own age and father's age at time of birth).

For those who had relationships with their parents, quality of relationship with neither father nor mother correlated with facial age preference (fathers: r_s=0.061, n=261; mothers: r_s=-0.025, n=272). Warmth of mother and caring of mother both correlated with facial age preference (warmth: r_s=0.145, n=275, p<0.05; caring: r_s=0.136, n=275, p<0.05), such that those with warmer and more caring mothers preferred the older face more than those with cold and uncaring mothers. However, these relationships become marginal when Benjamini-

Hochberg's correction is applied (adjusted alphas: 0.008 and 0.025 respectively). There was no effect of father's warmth or caring (warmth: r_s=0.053, n=270; caring: r_s=0.031, n=271).

Table 8.2. Correlation coefficients between ratings of parents' personalities /parent child relationships, and ideal partner's age.

		Spearman's correlation	Own age partialled out	Age of parent and own age partialled out
Relationship with mother	r	-0.155	-0.0719	-0.0717
	p	0.011	0.240	0.242
	n/df	270	267	266
Mother's rated warmth	r	0.062	0.1441	0.146
	p	0.309	0.018	0.016
	n/df	273	267	266
Mother's rated caring	r	0.046	0.1024	0.105
	p	0.445	0.094	0.087
	n/df	273	267	266
Relationship with father	r	-0.091	-0.0470	-0.0497
	p	0.143	0.454	0.429
	n/df	259	255	254
Father's rated warmth	r	-0.026	-0.1098	-0.1137
	p	0.670	0.079	0.069
	n/df	268	255	254
Father's rated caring	r	-0.033	-0.1014	-0.1058
	p	0.587	0.105	0.091
	n/df	269	255	254

Ideal partner's age correlated negatively with relationship with mother (r_s=-0.155, n=270, $p<0.05$), but this relationship became both nonsignificant once own age and mother's age were controlled (see table 8.2 below) and once Benjamini-Hochberg's correction was applied (adjusted alpha=0.0083). Once own age and mother's age were controlled there was a significant relationship between ideal partner's age and warmth of mother (r_{266}=0.146, $p<0.05$) and a marginal relationship with mother's caring (r_{266}=0.105, p=0.087) such that warmer and/or more caring mothers were associated with a desire for an older partner. However, both of these were also nonsignificant after applying Benjamini-Hochberg correction (adjusted alpha=0.0083 in both cases) and neither of these relationships existed in zero-order nonparametric correlations, which are the more appropriate tests for the rated parent variables (see Table 8.2). There were no zero-order relationships between ideal partner's age and relationship with father or father's warmth or caring, although there were marginal negative relationships between father's warmth/caring and ideal partner's age in the partial correlations (see Table 8.2).

8.2.3 Discussion

This study showed that father absence was associated with a decrease in age preference – both in terms of facial age preference, and ideal partner's age. Parents' ages did not mediate this effect. Therefore the results support the condition dependence explanation of the impact of father absence on partner preferences.

Combined with Studies 4 and 5, this strongly supports the notion that girls from father absent backgrounds somehow are, or perceive themselves as being, low mate quality compared to father present females and thus adjust their partner aspirations accordingly.

Unlike the previous studies, these data showed no effect of father warmth or parent-daughter relationships. This could be because of the use of different predictor variables and a different style of stimulus presentation. Where Studies 4 and 5 used a 9-point scale for parent-child relationship (in order to maximise variation and sensitivity), this study used a 3-point scale, which could have obscured an effect of parent-child relationship. Furthermore, this study includes parental personality (warmth and caring) rather than specifically the child's retrospective warmth towards the parent.

Importantly, these results did not show a relationship between parents' age and age preference, in contrast to Perrett et al (2002). There are two key possible reasons for this. Firstly, this study used a slightly wider range of subject ages in order to make the subjects' ages match those of the preceding chapters' samples (Perrett et al's subjects were aged 18 to 27, rather than 16 to 29). Therefore this could have taken too wide a section to replicate Perrett et al's results. Secondly, the data have been analysed in a different way. Where Perrett et al looked at women's preferences across several male stimuli (which ranged from 18 to 55 years) this study only used the two stimuli which were of an appropriate age for the subjects to consider a potential partner. Furthermore, rather than comparing the preferences for the two different stimuli, calculating a single difference score may have further obscured the parental age effect. Essentially, Perrett et al looked at tolerance for increasing age and found increased tolerance for age (i.e. less extreme aversion) in those with older parents, whereas this study looked specifically at a direct preference between two faces.

9. FATHER ABSENCE, PERCEPTIONS OF MASCULINITY AND DESIRED PARTNER TRAITS

9.1 SUMMARY

In order to address possible sociological explanations of the effects seen thus far in Part 2, Study 7 investigated whether family background was related to perceptions of masculinity (which could in turn effect preferences) or to the traits women believed they desired in a partner. It was found that father absence and warmth to parents related to neither of these, and therefore father absent women could not be attracted to more feminine and younger faces than their father present peers because of an explicit desire for a more stable, pro-social partner than their father, nor because of any effect their father may have had on their perceptions of masculinity. It was therefore concluded that the condition explanation remained a reasonable theory for the relationship between family background and face preferences in women.

9.2 STUDY 7

Thus far, this section has demonstrated in three different studies that family background can affect partner preference in young adulthood. Women from father absent backgrounds, or who did not feel warm to their parents (or considered their parents less warm in Study 6) preferred more feminine, younger male faces than women from father present backgrounds who had a positive with their parents. Such evidence appears to point towards father absence or early conflict with parents leading to reduced 'condition' or attractiveness (or self-perceived attractiveness) later in life.

Two critical questions must be addressed regarding the condition dependence explanation. First, could it be that the difference in facial preferences actually reflects a difference in other aspects of partner choice, rather than a compromise based on mate quality? In particular (and as mentioned in section 7.2.3), it could be suggested that women coming from families which were lacking in paternal warmth and care might select feminine male faces *in reaction to* their fathers. Their own poor experiences of parenting may have heightened their desire for emotional stability as adults, and as such lead them to select partners who are more likely to provide long term emotional investment: i.e. feminised males, who are rated as more cooperative, warm and faithful (Perrett et al, 1998, Study 3).

This sociological explanation would make the same predictions as the condition dependence explanation when it comes to facial preferences: women with absent fathers or who were not close to their fathers, should select feminised male faces, particularly for long term relationships were stability is even more important.

If father absent women were seeking a more emotionally secure partnership (rather than simply 'compromising' in their choice due to low condition) one could also predict that this would be evident in their explicit preferences for related partner characteristics such as faithfulness and commitment. On the other had, if the condition dependant explanation is correct, there should be no differences in what father absent vs. father present women want from their partners; there should only be a difference in the type of partner they choose with which to fulfil those desires.

Second, it is important to establish whether when choosing male faces, women from less harmonious backgrounds have differing views about what a given face signals. For instance, do father absent women fail to associate masculinity with dominance (perhaps through lack of a father figure) and thus make their facial preference choices on an alternative basis? Children form sex-role stereotypes very rapidly and have an appreciation of even quite abstract associations (women=heart/pink/round, men=tree/angular) by 18 months of age (Eichstedt, Serbin, Poulin-Dubois & Sen, 2002). Therefore the behaviour/presence of fathers as salient role models during early childhood is likely to have a profound impact on children's developing concept of what masculinity means. For instance, fathers who are more involved in their children's upbringing had children who are less likely to ascribe strict gender stereotypes, both when young and when teenagers (see e.g. Rohner & Veneziano, 2001, for discussion). It is therefore entirely plausible that women whose fathers were absent or distant could either have exaggerated views of masculinity (perhaps stressing the bad features if they were lacking a caring father), or have very little concept of it at all (if they had no role models whatsoever). This in turn may well affect their partner choice by either androgynising it (if they have no concept of masculinity) or by putting them off masculinity and biasing them towards femininity (if they have excessively negative stereotypes of masculinity). According to the condition dependence explanation on the other hand, women from different backgrounds should have exactly the same views of what masculinity means, and simply be forced to compromise if they are lower quality.

The purpose of Study 7 was to address these issues. The latter question was addressed by repeating the mate characteristics study (Study 3) and comparing the results of father absent

and father present women. The former question was addressed by asking the same women to rate how important different characteristics were to them in choosing a partner.

9.2.1 Method

9.2.1.1 Subjects

Subjects were recruited via an opportunity sample of those passing through the laboratory website. There were 82 females aged 17 to 39 (mean=24.76 years, s.d.=5.81). 82.9% were Caucasian and all subjects were from western countries (67.1% Britain, 26.8 % North American, and 6.1% mainland European). 59.8% were undergraduate and postgraduate students, 14.6% were involved in research and teaching and 2.4% were unemployed.

9.2.1.2 Stimuli

Subjects rated the six male masculinity pairs used in Chapters 6 and 7.

9.2.1.3 Procedure

Subjects completed the experiment via a web-based test. Initially subjects completed a short questionnaire, giving demographic information, details of parental separation (and timing of that separation), positivity to parents, rated quality of the relationship between the parents (whether they lived together or not, on a 1-9 Likert scale), and self-rated attractiveness (1-7 Likert scale). They then completed the same personality perception test as conducted in Chapter 4, rating the perceived dominance, faithfulness, commitment, ambition, wealth, warmth and parenting quality of the male masculinity stimuli. Finally, they rated on 1-7 Likert scales how important the following characteristics were to them when choosing a partner:

Ambition*	Good sense of humour	Sex appeal
Attractiveness	Good with children*	Social dominance*
Commitment*	Intelligence	Warmth*
Faithfulness*	Maturity	
Financial prospects*	Physical strength	

The asterisked terms are the same traits on which the masculinity pairs were rated (with wealth becoming financial prospects and good father becoming good with children to reduce the obvious link to the perception ratings they had just completed). Sex appeal, sense of humour, maturity, physical strength and attractiveness were added to give a broader view of their preferences. Other than maturity, these traits were all used by Buss (1989; Buss & Schmitt, 1993) in his studies of cross-cultural patterns in mate choice.

9.2.2 Results

Subjects were divided into those whose fathers had left before they reached the age of 11 (n=17), and those whose parents never separated (n=44). Those experiencing mother absence (1 subject) or other early disruption such as parental death (6 subjects), those whose fathers left the family home later (6 subjects), and those not reporting the age at which their parents separated, were excluded from father absence analyses. Father absent and father present women did not differ in their age (t_{59}=0.57). Age also did not correlate with positivity to parents, parents' relationship quality, nor self-rated attractiveness. Self-rated attractiveness did not correlate with positivity to parents or parents' relationship quality but father absent women did have marginally lower self-rated attractiveness than father present women (studentised Mann-Whitney U=1.88, n=61, p=0.062).

9.2.2.1 Face perception

Ratings for the 6 faces were collapsed for each trait rating. All ratings were normally distributed (all K-S z<1.1) so parametric statistics follow. Overall, masculine male faces were rated as significantly more wealthy (t_{81}=4.27, p<0.001), less warm (t_{81}=5.72, p<0.001), more ambitious (t_{81}=4.25, p<0.001), more dominant (t_{81}=10.46, p<0.001), and less faithful (t_{81}=5.71, p<0.001) than feminine male faces. There was no effect of masculinity on perceived commitment (t_{81}=1.44) or parenting quality (t_{81}=1.36).

Father absent women were more likely to perceive masculinity as signalling wealth than father present women (t_{59}=2.213, p<0.05). However, this became nonsignificant when Benjamini-Hochberg's correction was applied (adjusted alpha =0.007) and there were no

other differences between the two groups as regards their perceptions of the stimuli (all $t_{59}<1.3$).

There were no significant correlations between perceived characteristics of the stimuli and positivity scores or parental marital quality (all $|r_s|<0.2$) except for a significant positive correlation between perceived ambition on masculine faces and positivity to mother ($r_s=0.230$, n=81, $p<0.05$). However, as this represents one significant correlation amongst 21 (below chance), it is almost certainly a case of Type I error and it does not remain significant after correction (adjusted alpha=0.0023).

9.2.2.2 Partner preferences

9.2.2.2.1 Zero-order correlations

All rated partner preferences differed significantly from normal, so nonparametric statistics follow. There were no significant differences between father absent and father present women on preferences for any of the characteristics (all Mann-Whitney $z<1.3$).

There was no effect of parents' relationship quality, or positivity scores on subjects' partner preferences (all $r_s<0.21$) except for a positive relationship between positivity to father and desired faithfulness of partner ($r_s=0.225$, $p<0.05$, n=79), and a negative relationship between positivity to mother and interest in financial prospects ($r_s=-0.229$, $p<0.05$, n=81). Again, these two significant relationships out of 39 correlations are highly likely to be Type I error and also do not remain significant after correction (adjusted alphas=0.0026 and 0.0013 respectively).

9.2.2.2.2 Factor analysis

Factor analysis of the partner preferences (using Varimax rotation and suppressing correlations below 0.4, as recommended by Field, 2000) produced 3 factors which are shown in Table 9.1 below. Factor 1 has been labelled 'Good genes' in that the factors loading onto it are all those associated with status/dominance (ambition, financial prospects, intelligence and dominance), those associated with looks (attractiveness and sex appeal) and physical strength. Factor 2 has been labelled 'Good father' and consists of the characteristics of a

good long term partner (commitment, faithfulness and warmth) and of a good parent (mature and good with children). Finally, Factor 3 consists of good sense of humour and sex appeal and has been labelled Good personality.

Scores for all three factors were calculated for each subject. There were no differences between father absent and father present women on any of the three factors (Factor 1: t_{59}=0.82; Factor 2: t_{59}=0.16; Factor 3: t_{59}=1.35) and no correlations between any of the family background ratings and any of the three factors (all r_s<0.16, all p>0.15).

Table 9.1 Rotated solution for factor analysis of partner trait preferences.

	1 Good genes	**2 Good father**	**3 Good personality**
Ambition	.425		
Attractiveness	.741		
Commitment		.819	
Faithfulness		.769	
Financial Prospects	.712		
Good Sense of Humour			.873
Good with children		.464	
Intelligence	.510		
Maturity		.421	
Physical strength	.807		
Sex appeal	.680		.470
Social Dominance	.675		
Warmth		.702	
Eigenvalue	3.248	2.479	1.379
Variance explained	24.98	17.53	10.61

9.2.3 Discussion

The results of this study showed that neither father absence nor retrospective warmth towards parents were associated with the characteristics women desire in a partner or the characteristics they perceive masculinity as signalling (other than a difference in perceived wealth of masculine males). As regards the aims of this study, this has two key implications. First, it was suggested in the introduction that women with absent or less warm relationships with their fathers could react to this by desiring warmer, more committed husbands than their fathers had been, thus leading them to have a preference for feminine male faces. However, since there was no relationship between family background and desired partner traits (other than a possible effect of warmth to father on desired faithfulness which did not survive

Benjamini-Hochberg correction nor appeared in the analysis of the Factors), it cannot be the case that father absent women were seeking more committed, caring partners than their peers. Second, it was suggested that father absent women or those with early family conflict might have difference perceptions of what masculinity signals compared to other women, and thus might not choose on the same basis. However, there was little effect of the family variables on perceptions, therefore the effects of family background on partner choice cannot be due to different perceptions of masculinity. Even the result that father absent women were more likely to perceive masculine male faces as wealthy cannot explain why father absent women (who are no less interested in financial prospects than other women) should choose feminine male faces.

Taken together, these lack of effects further support the notion that childhood familial stress and father absence could effect partner preferences via a condition dependence mechanism. If father absent women want the same things as other women, and have the same perceptions of men's characteristics as other women, but still choose differently, it could be that they are unable to compete for the highest quality males and so choosing a lower gene-quality male instead. The condition explanation is further supported by the marginal relationship between father absence and self perceived attractiveness. Importantly, although the results of the previous chapters might suggest father absent women are indifferent regarding male masculinity (in that their choices tend not to significantly differ from the mid-point of 3.5), they are equally as interested in physical attractiveness, sexiness and physical strength as other women in this study. Therefore the apparent 'indifference' is more likely to be a preference for average males (rather than masculinised or feminised), rather than indifference per se.

There is one methodological point which should be considered regarding the use of rated preferences for partner characteristics, and that is that these ratings are possibly being made completely independently of each other and reality. While in real life subjects may have to compromise between their desire for genetic quality of a partner and their desire for commitment, in rating scenarios such as these there is no compromise enforced. Subjects may make the compromise themselves when making their ratings, but there is no need for them to do so. The fact that 'Good genes' and 'Good father' factors could be extracted as independent variables (i.e. 'Good genes' traits and 'Good father' traits did no load onto the same factor in opposite directions) suggests that no compromise is being made. A similar scenario to rated preferences is the lonely hearts advertisement, in which individuals

advertise for the kind of partner they *want*. This may or may not lead to them obtaining such a partner through the dating process. Lonely hearts advertisements have been described as human sexual selection in its purest form (Waynforth & Dunbar, 1995; Pawlowski & Dunbar, 1999) in that they are nothing but self-advertisement and partner demands, and despite the fact that they do not give information on the end results of the partner selection, the ads are treated as highly ecologically valid data regarding mate choice. Therefore, the lack of inverse variation between good genes preferences and good father preferences does not invalidate the results of the current study. They should however be strictly viewed as the subjects' ideal partner choices, rather than actual choices. A further study of interest would be to create vignettes of different males which embody the different traits in different proportions and study mate choice under conditions of enforced compromise.

10. FAMILY BACKGROUND AND MALE PREFERENCES FOR FEMALE FACES.

Section 2 of this thesis has concentrated on the effects of family background on female partner preferences. The concentration on females had two primary motivations: first, previous father absence literature has suggested that there are more effects to be found in females than males. Second, most research into facial preferences (on which the predictions from father absence were based) has been concerned with women judging male attractiveness. Therefore, there were few predictions which could be made regarding males judging female attractiveness. Those that could be made are detailed below:

Sexual strategies explanation

Although there is mixed evidence regarding the effects of father absence on puberty in boys, most theories of father absence and/or childhood disruption, would predict that parental separation and family conflict should lead to a tendency towards short term relationships in males (e.g. Draper & Harpending, 1982; Belsky et al, 1991). However, although there is a great deal of published data regarding women's short term versus long term facial preferences, there is no such literature regarding men's choices. Buss & Schmitt (1993) found that, when asked to consider a short term relationship, men were significantly more interested in looks than when considering a long term relationship (when factors such as chastity were more important). They argued that this was because men engaged in a short term strategy were trying to choose the women most likely to be fertile at that current moment. Given the links between attractiveness and femininity (i.e. supposed fertility), and that women are considered most attractive at the most fertile points of the menstrual cycle (Roberts, Havlicek, Flegr, Hruskova, Little, Jones, Perrett & Petrie, 2004), it seems reasonable to suppose that a preference for attractiveness in short term partnerships is indeed a preference for immediate fertility. It could therefore be predicted that men from backgrounds including parental separation and family conflict would prefer younger, more feminine women than men from more harmonious backgrounds.

Condition explanation

Although again, there is little published regarding condition dependence in human males, there is evidence from the zoological literature that with species which have elements of mutual mate choice (as humans have) males also adjust their partner choices to match their

own quality. For instance, brighter coloured male sticklebacks select higher quality female mates (Kraak & Bakker, 1998). Burley, Parker & Lundy (1996) also showed that when researchers increased a male zebra finch's quality by attaching an ankle-band of a colour females preferred, these males became less likely to provide paternal investment and mated with a larger number of females. Therefore, given the supposed detrimental effects of early stress on later health and development, one could predict that males from father absent or equivalent backgrounds would have a weaker preference for femininity and youth than males from father present backgrounds.

Imprinting

Male imprinting is unlikely to be directly influenced by father absence since males should use predominantly maternal characteristics to form their prototype female face (see Perrett et al, 2002, for evidence). However, Bereczkei et al (2002) showed that a male's preferences for his mother's facial characteristics in a potential mate, depends on his relationship with his mother. Following from this, because they will have developed positive associations with the female face, men who are emotionally warm towards their mothers (to paraphrase the Positivity to Mother question), should prefer feminine features more than men who are not. This does, however, presuppose that colder mothers are not more masculine, which would perhaps push their sons to prefer more feminine women. Thus predictions made based upon imprinting are also very tenuous.

During data collection for previous chapters, males also took part and their data were analysed separately. In general, there were few effects (see Appendix E for subject information and results). Parental separation (at any age) seemed to be associated with earlier age of first coitus but not first shave. However, there were no effects of parental separation on face preference at all in Studies 4 and 5, and there were no significant correlations between positivity to parents and femininity preference in either study. Finally, there were no effects on age preference in Study 6.

Overall, these results show 4 instances of nonsignificant differences between father absent and father present males' face preferences, and 15 nonsignificant correlation coefficients. This strongly suggests that either family background does not effect males' partner choices, or that it does so in ways which counteract each other.

The explanation which made the strongest predictions for male preferences was that of condition dependence. Therefore, the fact that its predictions have not been supported seems

problematic for the argument put forward throughout the rest of this section: that low quality status is the likely reason for father absent women's different preferences. There are two possibilities which could explain this anomaly. Firstly, males could be somehow protected from the effects which reduce quality in women. For instance, there is evidence that female children are more likely to play and be in the vicinity of adults than male children (Martin & Fabes, 2001) and thus girls may be more subject to the negativities of their parents' relationship. Alternatively, family problems may have the same effect on boys and girls, but while such an effect may have negative consequences for girls, the effect may be a neutral, or positive consequence for boys' mate quality. For instance, amongst males, testosterone is a stress hormone. Therefore, family stress may increase masculinisation in males, which will possibly increase mate quality (or at least balance out cortisol effects). Girls would remain negatively effected by high cortisol levels.

It is unlikely however that males are less effected by father absence, as Flinn et al (1996) in fact showed that amongst Dominican villagers, father absence increased cortisol levels more in boys than in girls, and furthermore, that father absence decreased boys' testosterone levels in later life (although it was elevated in early childhood; see Chapter 13 for further discussion of Flinn et al, 1996). Therefore it seems unlikely that boys' condition should remain unaffected by early parental separation or conflict. This complete lack of effect in males does therefore present a challenge to the condition dependant explanation.

SUMMARY OF PART 2

The aim of Part 2 was to investigate how father absence or poor parent-daughter relationships in childhood could affect women's partner choice in adulthood. Three different routes through which family background could have such an effect were put forward: a shift in sexual strategy, a difference in condition, and sexual imprinting. The findings regarding the effects of father absence on male facial masculinity preference were somewhat mixed. Study 4 found father absent females showing an increase in masculinity preference (which the sexual strategy explanation would predict as an effect on general preferences) during the fertile phase of their menstrual cycle/in their short term judgements, and a nonsignificant decrease in masculinity preference during the unfertile phase of their cycle and in their long term judgements (which the condition explanation would predict). Study 5 on the other hand showed father absent females to have a decreased masculinity preference in both long and

short term judgements (which the imprinting, and to a lesser extent, the condition explanations would predict).

However, the correlational analyses in Studies 4 and 5 were more consistent. In both studies, retrospective warmth of the subjects' relationships with their parents was positively associated with masculinity preference. This was predicted by both the condition and the imprinting explanations. However, the imprinting explanation did not predict that warmth towards mother should relate to preferences for male faces, but not female faces. Therefore the condition explanation emerged as strongest for masculinity preferences.

Likewise, condition seems a more likely explanation for the relationship between family background and facial age preferences. Women from father absent backgrounds had a stronger preference for the younger face of a pair than women from father present backgrounds. These results supported the condition explanation. The fact that parents' ages did not mediate the preference (as would be predicted by the imprinting literature) was strong evidence against the sexual imprinting explanation.

Therefore, of the three explanations presented in the introduction of Chapter 6, condition dependence emerges as the overall strongest explanation for women's preferences. The findings of Study 7 that family background is not related to attributions to masculinity or explicit partner preferences further strengthens the evidence for condition explanation.

The complete lack of effects in men on the other hand, seems to count against the condition dependence explanation, unless there is an as-yet undiscovered reason why only females should be effected by early psychological stress in this way.

Section 3 of the thesis will go on to investigate the condition explanation further by attempting to assess physical aspects of condition in individuals from different backgrounds.

PART 3

FAMILY BACKGROUND AND PHYSICAL AND HORMONAL OUTCOMES

11. FACIAL AND BODILY CORRELATES OF FATHER ABSENCE.

11.1 SUMMARY

Father absence theory suggests that absence of the father during early childhood has long reaching effects on reproductive strategy and development. This chapter reports two studies designed to investigate the possible physical correlates of father absence. Studies 8a and 8b compared family background with facial and bodily appearance, and found that father absence or a poor quality relationship between parents is associated with increased facial and bodily masculinity, and decreased apparent health. These results highlight the possibility of physical masculinisation being involved in the father absence effect. They also show that the general tendency for poor family relationships and father absence to be associated with facial femininity preference in women (Part 2), could indeed be because such women are low condition.

11.2 STUDY 8

As discussed in Chapter 1, it has been argued that father absence (Draper & Harpending, 1982) and/or a stressful family environment (Belsky et al, 1991; Chisholm, 1999) cues female children to adopt a low-investment (i.e. short term) reproductive strategy in which paternal investment is not expected and offspring quantity is maximised. Alternatively, father presence and a stable early environment should cue children to adopt a reproductive strategy relying on stable pair-bonds and high levels of paternal investment (i.e. a long term strategy), and maximising quality of offspring. That father absent females seem to operate on a short term reproductive and sexual strategy, would suggest they should show a preference for more masculine male faces, in order to maximise the genetic quality of their partners (see Part 1 for a discussion of masculinity and gene quality). However, the results of Part 2 of this thesis have shown that father absent females prefer more feminine and younger looking males than father present females. This pattern of results seems to suggest that these father absent females have lower mate value, as women with lower self-rated attractiveness and higher (less curvy) waist-to-hip ratios show a stronger femininity preference in male faces compared to more attractive females (Little et al, 2001; Penton-Voak et al, 2003).

As discussed in Chapter 6, there is real reason to believe that father absence or early family stress may be associated with lower quality status, particularly in terms of health. Early stress and father absence are associated with higher cortisol levels and greater levels of illness in a rural Dominican sample (Flinn & England, 1997) and parental divorce and poor attachment have both been shown to be associated with poorer health outcomes in Western samples (e.g. Maier & Lachman, 2000; Feeney, 2000). Given these associations between early parental/parent-child relationships and later health, it can be predicted that women from father absent backgrounds should appear less healthy, which should in turn reduce their attractiveness and produce 'lower mate value'. Similarly, Epel et al (2000) showed that high cortisol reactivity is associated with high (i.e. low quality) WHR. Given that having high cortisol reactivity (cortisol levels rising rapidly in response to a stressor) combined with unusually low day to day cortisol levels is very much one of the profiles that Flinn & England (1997) found to be associated with childhood stress, it may also be that father absence is associated with a difference in WHR.

Father absence and early stress may also be associated with masculinisation. Kaiser, Kruijver, Swaab, & Sachser (2003) found that unstable, stressful environments during gestation and lactation lead to behavioural and endocrine masculinisation in female guinea pigs. Female offspring of mothers who were moved between groups every 15 days showed higher levels of testosterone and a greater number of androgen receptors. They also showed greater levels of usually exclusively male courtship behaviours and predominantly male play behaviours (which replicates Sachser & Kaiser, 1996). Although the guinea pigs in Kaiser et al's study were exposed to maternal stress hormones in the womb, given that Belsky et al's theory posits that father absence is one amongst many environmental stressors and that parental separation is often preceded by a long period of marital stress, it may be reasonable to suppose that father absent women are also exposed to maternal stress hormones in this way.

If father absent females have higher levels of testosterone and/or greater testosterone receptivity, then this may cause a degree of masculinisation which might lower attractiveness and therefore lead to the preferences seen in Part 2. Masculinisation would not however, necessarily be expected to affect male offspring in a way deleterious to attractiveness, as higher testosterone is not a mating handicap to males. This may explain the lack of an effect of father absence on male partner preferences (Chapter 10). Similarly, father absent females may have a higher incidence of a gene coding for more androgen receptors, which is

associated with early menarche in women and absenteeism in fathers (Comings, Muhleman, Johnson, & MacMurray, 2002; although see section 13.2 for criticisms of this study).

Although there is at present very little research assessing the relationships between early experience and later appearance, Waynforth (2002) did find that amongst the Mayan people of Belize, father absence was associated with increased craniofacial masculinity (cheekbone prominance and chin/jaw length, both relative to face height) in males. This supports the hypothesis that father absence may be associated with changed facial appearance in females and males.

The purpose of this study was to assess aspects of mate value which may be linked to father absence. Study 8a looked at facial correlates of parental separation, while Study 8b assessed bodily appearance.

11.2.1 Initial data and stimuli collection

Two independent cohorts of St Andrews students (Batch 1: 134 female and 58 males, mean age=21.62 years; Batch 2: 95 females and 31 males, mean age=20.83 years) had standardised head-and-neck photographs taken and at the same time, completed questionnaires detailing background information. Subjects reported whether or not their parents had separated, and when this separation took place relative to their own development (i.e. before or after they started menses if female, or started shaving if male). They were then given a 1-9 Likert scale and asked "Whether they lived together or not, how good was the quality of your biological parents' relationship during your childhood (up until you reached puberty)?"

11.2.2 Study 8a

11.2.2.1 Stimuli

Separate stimuli were created from the two batches of females. Composites were made of 15 Caucasian individuals reporting parental separation before they hit puberty (FSEP), the individuals in the top 15 for parental relationship (i.e. those whose parents had a very high quality relationship; FGR) and the bottom 15 individuals (those whose parents had stayed together but had a very low quality relationship; FPR).

Due to much smaller numbers of males it was only possible to combine the two cohorts and construct two composites: those whose parents were divorced pre-puberty (MSEP), and those whose parents had a good relationship (MGR). Smiling and neutral versions of each were made. There were no significant differences between the ages of those whose parents were separated and those whose parents were not.

Table 11.1. Summaries of images used in stimuli. There were no significant differences between the parental status groups' ages (females: $F_{2,86}$=1.62; males: t_{25}=1.59). There was also no difference in bedrooms per capita of their childhood homes (females: $F_{2,83}$=0.39; males: t_{29}=0.53).

SEX	PARENTAL STATUS	BATCH	N	MEAN AGE
FEMALE	**Separated** (FSEP)	*1*	15	22.5
		2	15	20.5
	Good relationship (FGR)	*1*	15	21.3
		2	15	19.3
	Poor relationship (FPR)	*1*	15	21.6
		2	15	20.7
MALE	**Separated** (MSEP)		15	22.7
	Good relationship (MGR)		15	20.1

Composites were made using the computer package Psychomorph, based on 179-point delineation. Texture was added using intensity wavelet analysis (Tiddeman, Burt & Perrett, 2001). All images were standardised to a size of 400x515 pixels. An example of the final composites can be seen in Figure 1 below (for all composites, see Appendix C).

Figure 11.1 Batch 1 female composites. From left to right: FSEP, FPR, FGR

11.2.2.2 Procedure

Judges followed a URL to the test site. Stimuli were presented singly using a java applet embedded into the html page. A Likert scale was beneath the images, running from 1 (very feminine/unattractive/unhealthy) to 7 (very masculine/attractive /healthy). Judges were asked to click on the point of their choice; this then triggered the presentation of the next face. Images were randomised on presentation order. 28 females (mean age=26.0 years) and 18 males (mean age=25.9 years) rated all the stimuli for masculinity/femininity followed by rating them all for health. 23 females (mean age=24.65) and 15 males (mean age=24.87 years) rated the female stimuli for attractiveness. 15 females (mean age=26.8) and 10 males (mean age=26.1 years) rated the male stimuli for attractiveness.

11.2.2.3 Results

Ratings were averaged together for all images within each parental separation category, producing one score per variable for females with divorced parents (FSEP), males with divorced parents (MSEP), females whose parents had a good relationship (FGR), males whose parents had a good relationship (MGR), and females whose parents had a poor quality relationship (FPR). All ratings were normally distributed (All KS z <1.1).

There was a significant effect of parental separation category on subjects' ratings of composite attractiveness. Planned comparisons between all three female image-groups showed that subjects rated the FGR images as significantly more attractive than the FSEP images (t_{37}=2.026, p=0.05), which were in turn rated as significantly more attractive than FPR (t_{37}=3.304, p<0.01). There was no difference between the attractiveness scores of the male composites, MSEP and MGR (t_{24}=0.98).

FSEP and FGR were rated as significantly healthier than FPR (t_{42}=3.93, p<0.001; t_{42}=5.87, p<0.001; respectively) but did not differ from each other (t_{42}=1.52). There was also no difference between judges' health ratings of MSEP and MGR (t_{42}=0.84).

FGR were rated as significantly more feminine than both FPR (t_{42}=7.36, p<0.001) and FSEP (t_{42}=7.13, p<0.001). FSEP and FPR did not differ from each other (t_{42}=1.26). Similarly MSEP were rated significantly more masculine than MGR (t_{42}=7.16, p<0.001).

Judge gender had no effect on the magnitude of the ratings given and did not interact with parental separation (all F<1).

Table 11.2. Summary of comparisons between composites.

	Female composites	**Male composites**
Attractiveness	FGR > FSEP > FPR	MGR=MSEP
Health	FGR=FSEP > FPR	MGR=MSEP
Masculinity	FGR < FSEP=FPR	MGR<MSEP

11.2.2.4 Discussion

These data showed that separation of an individual's parents during their early childhood is associated with increased facial masculinity/decreased femininity in the composites of those individual's faces, and with reduced in attractiveness in the female composites (see Table 11.2 for a summary). Poor marital relations of the parents during early childhood (without divorce) is also associated with an increase in masculinity, and with a reduction in apparent health and attractiveness in female composites.

This pattern of results suggests that the stress of poor family relationships may have a negative impact on health of offspring, but that this impact is only relevant if the stress continues into the teenage years (which is why those whose parents separated were spared this problem). On the other hand, the effects of early stress on later masculinisation may be more immediate and less reversible (explaining why both FSEP/MSEP and FPR images were more masculine than FGR and MGR images). These results are concordant with Waynforth's (2002) data regarding craniofacial masculinity in Mayan men.

11.2.3 Study 8b

11.2.3.1 Method

88 females (mean age=20.07 years) from Batch 2 had further physical measurements made at the time of the photograph being taken. The subjects' height, waists, hips and chests (*not* breasts) were measured using a measuring tape. Weight and 'impedance' (a measure of percentage body fat, estimated by passing a mild current through the body) were measured using electronic scales. The dependant variables calculated were waist-hip-ratio (WHR), waist-chest-ratio (WCR) and body-mass index (BMI: kg/m^2). Impedance was also used as a dependant variable.

11.2.3.2 Results

Those whose parents separated before they reached puberty had a higher impedance score (i.e. had a greater proportion of body-fat) and higher BMI than those whose parents separated later, or did not separate at all (impedance: $F_{2,85}=3.09$, $p=0.05$; BMI: $F_{2,85}=4.52$, $p<0.05$). Although mean scores for WHR and WCR suggested daughters of separated parents had the largest waists, neither of these differences reached significance (WHR: $F_{2,85}=0.78$;WCR: $F_{2,85}=2.17$).

Across all subjects, the rated quality of parents' relationship was significantly negatively related to WHR ($r_s=-0.259$, $p<0.05$), WCR ($r_s=-0.238$, $p<0.05$), BMI ($r_s=-0.242$, $p<0.05$) and impedance ($r_s=-0.236$, $p<0.05$).

11.2.3.3 Discussion

These results show that differences in physique are also associated with childhood background. Coming from a family with separated parents was associated with increased adiposity and weight. Quality of parents' relationship (whether married or not) was associated with physique in that the higher the quality of the parents' relationship, the smaller the waist in relation to both hips and torso, the lower the weight relative to height, and the lower the level of adiposity.

Waist size is a sexually dimorphic trait such that women have smaller WHRs than men, and it is believed that a small WHR may be a sign of fertility and is related to oestrogen levels (e.g. Singh, 1993). Therefore, an increase in WHR can be regarded as a reduction in femininity of the body. Importantly, Ibanez, Ong, de Zegher, Marcos, del Rio & Dunger (2003) found that amongst girls with precocious puberty and controls, greater levels of trunk fat (i.e. having a larger waist), was positively related to their levels of testosterone. Similarly, Elbers, Asscheman, Seidell, Megens & Gooren (1997) found that long term administration of testosterone to female-to-male transsexuals resulted in increased levels of abdominal fat. The results of Study 8b are therefore concordant with the data in Study 8a, and show that poor quality of parents' marriage and/or parental separation is associated with bodily masculinity (which may well be testosterone mediated) as well as facial masculinity.

The increase in BMI and adiposity seen in those whose parents had poor quality relationships and/or were separated is also concordant with the data in Study 8a showing a decrease in perceived health of facial composites of these individuals, since high BMI and increased body-fat are generally signs of poor health in western society.

11.2.4 General Discussion, Study 8

Overall, Study 8 strongly suggests that parental relationship status and quality is associated with later physical development of offspring. Parental separation and/or poor parental relationships are associated with increased facial and bodily masculinity and decreased facial health. These results are concordant with previously published data, which found links between early attachment and health (Feeney, 2000) and emphasise the importance of early social harmony in later health outcomes. The results also suggest that it is not the parental separation *per se* which is important in this association, but the general nature of the relationship between the parents and between the parents and offspring. Such findings are concordant with theorists such as Belsky et al (1991) and Chisholm (1993) who suggest it is environmental stress that is the key to the father absence effect.

Furthermore, the results are concordant with previous data showing a link between facial masculinity and father absence in men (Waynforth, 2002) and with research suggesting father absence is related to greater androgen receptivity (Comings et al, 2002).

Overall, the current results strongly suggest that a maritally disharmonious background is associated with physical masculinisation. However, this study cannot distinguish between the possible environmental and hereditary influences, and of the little research which has been carried out on this issue, evidence points in either direction (e.g. Kaiser et al, 2003, vs Coming et al, 2002; see Chapter 13 for a broader discussion of heredity versus environment in these effects). However, given that in Study 8a, the composites of those whose parents had separated did not suffer any reduction in visible health, it is likely that the health effects are *not* hereditary and are in fact a result of early stress. The effects of family stress on health and masculinity in offspring may therefore be separate.

Previous research into father absence has concentrated on reproductive and social behaviour, and investigated only one physical effect (age of puberty). This research has highlighted the importance of considering the possible effects of father absence on other aspects of physical development. Chapter 13 will go on to consider the relationships between the results of the present study and the results of Part 2 of the thesis.

12. HORMONAL CORRELATES OF FAMILY BACKGROUND

12.1 SUMMARY

Having shown in Study 8 that family background related to physical features, this chapter reports a study designed to investigate the possible endocrinal correlates of family background. Study 9 found that the quality of the parents' relationship was associated with urine progesterone level, though not with oestrogen levels. These results highlight the possibility of hormonal mediation of the father absence effect and suggest the results of Study 8 could indeed be due to hormonal masculinisation.

12.2 STUDY 9

Physical attractiveness and physical masculinity have been shown in Study 8 to relate to family background. The mechanism believed most likely to be responsible for this association is a hormonal one: either in terms of levels of hormones, or in terms of hormone receptor frequency. This evidence currently favours the former of these two types of hormonal mechanisms as Study 8b found differences in aspects of the female body shape thought to relate directly to hormone levels (WHR: Jasienska et al, 2004).

The purpose of Study 9 therefore, was to look for a relationship between family background and hormone levels in an opportunistic study. In the current study, a subset of a group of young women taking part in a menstrual cycle study agreed to answer further questions on their family background, allowing an assessment of whether background impact on hormone profiles. Given Kaiser et al's (2003) finding that unstable environments lead to hormonal masculinisation in guinea pigs, we would predict that women from less harmonious backgrounds would have lower oestrogen levels. It is not clear what the effects on progesterone levels would be.

12.2.1 Method

12.2.1.1 Subjects

There were 53 female students aged 18 to 22. Only 4 subjects' parents had separated before they reached puberty (another 5 subjects' parents had separated during the subject's teens), and so no father absence analyses could be performed. 2 subjects did not manage to provide a sample within their late follicular phase and a further 2 subjects' late follicular samples

failed to produce an oestrogen reading. The data from these subjects are excluded from the relevant analyses.

12.2.1.2 Procedure

Subjects provided morning urine samples once a week for 4-6 weeks. They also completed a family background questionnaire. They reported the quality of their parents' marriage prior to puberty, and with how much warmth they remembered each parent during their childhood (Positivity to parents, as assessed in Study 5). All questions were answered using a 1-9 Likert scale.

Urine samples were analysed for oestrone (a metabolite of oestrogen) and pregnanediol (a metabolite of progesterone). Hormone levels (relative to creatinine, in order to control for varying sample sizes) were averaged together across early luteal and late luteal measurements to give a 'non fertile phase' measurement. Late follicular was taken as the fertile phase. For further details of hormone analysis methods see Jones et al (in print).

12.2.2 Results

Reported quality of the parents marriage significantly negatively correlated with pregnanediol levels (non-fertile phase: r_s=-0.408, n=54, p<0.01; fertile phase: r_s=-0.333, n=52, p<0.05), such that greater quality of parents' marriage was associated with reduced pregnanediol. Quality of parents' marriage did not correlate with oestrone levels (fertile phase: r_s=-0.141, n=50; nonfertile phase: r_s=-0.214, n=54).

Warmth with which the subjects remembered their fathers was significantly negatively correlated with pregnanediol levels (nonfertile phase: r_s=-0.332, n=54, p<0.05; fertile phase: r_s=-0.468, n=52, p<0.001), as was warmth with which they remembered their mothers during the fertile phase of the cycle (r_s=-0.457, n=51, p=0.001). The more warmth with which the subjects remembered their parents, the lower their pregnanediol levels. Warmth towards the mother did not correlate with nonfertile phase pregnanediol, although the correlation was in the same direction (r_s=-0.167, p=0.231, n=53). Levels of oestrone correlated with neither warmth towards father (fertile phase: r_s=-0.088, n=50; nonfertile phase: r_s=-0.186, n=54), nor warmth towards mother (fertile phase: r_s=0.062, n=49; nonfertile phase: r_s=-0.097, n=53).

Levels of oestrone and pregnanediol correlated significantly in the nonfertile phase (r_{54}=0.382, $p<0.05$) but were not related during the fertile phase (r_{50}=0.089).

12.2.3 Discussion

Study 9 had been designed to assess whether the differences in physical appearance seen in Study 8 were reflected in hormonal profiles. While the data do not show any effects of background on levels of oestrogens, there were clear effects on levels of progesterone as indexed by the presence of its metabolite in urine.

Progesterone is an important hormone in female reproductive systems, and is highest during the luteal phase of the menstrual cycle and during pregnancy. High progesterone is associated with an increase in eating and adipose weight gain in ovariectomised rodents (Schwartz & Wade, 1981; Bhatia & Wade, 1989) and may therefore explain the increase in weight and adiposity seen amongst women from less harmonious backgrounds in Study 8b. Contrary to what Schwartz & Wade's results might suggest, Jasienska et al (2004) found that progesterone levels in women were negatively related to WHR, such that the higher the women's progesterone levels tended to be, the smaller their waists. This would seem to be incongruous with the combined results of Studies 9 and 8b, since the present data show both WHR and progesterone have negative relationships with parents' marital quality (and would therefore be expected to have positive relationships to each other). However, in their study Jasienska et al found that both oestrogen and progesterone were negatively related to WHR and did not control oestrogen levels when assessing the relationship between progesterone and WHR or vice versa. Given that in the current data, oestrogen was not related to family background, it may be more relevant to assess the effects of progesterone on WHR when not allowing oestrogen to vary.

The lack of an effect on oestrogen is surprising given that it has been described as an 'anti-testosterone' in that the body converts a certain amount of testosterone into oestrogen. Furthermore, oestrogen is considered to be important in femininity and female mate quality (as discussed before, as well as its organising effects on females during gestation and puberty, it is related to WHR and fertility). However, Kaiser et al (2002) also found very few effects of early stress on oestrogen in guinea pigs, despite finding effects on androgen receptors and androgen levels. Therefore, it may not be expected to be effected in humans either.

The differences seen here in progesterone levels suggest that further research into the relationships between hormone levels and childhood background in women are worthy of further study. Flinn et al (1997) concluded in their Dominican sample that family background had limited effects on female cortisol levels compared to males'. While this may yet be the case in Western samples as well, it is important to note that in Kaiser et al's study, early stress masculinised the endocrine profiles of the female guinea pigs without having a lasting effect on cortisol levels. Therefore, the results in the current study suggest that cortisol may not be the only, or even most appropriate, hormone for study. At present there is little research however, on any other hormones as they related to early experience. Flinn et al (1997) looked at testosterone levels, but only did so in males (for further discussion of their results, see Chapter 13). It may however be appropriate to look at testosterone in females as well as males.

13. General Discussion: Family background, attraction and development.

13.1 Results of this thesis

The overarching aim of this thesis was to bring together the father absence research and facial attraction research. This predominantly involved investigating the relationship between family background and facial preferences in adulthood.

The results of Part 2 of the thesis in general seem to point towards an equivalence between being father absent or from a less harmonious family, and being 'low quality' in classic attraction research. As discussed in Chapter 10, the results of Part 2 are not entirely consistent and are taken as pointing towards a low quality explanation only inasmuch as this explanation makes predictions most concordant with the data.

The sexual strategies explanation predicted that father absent females and those who did not get on with their parents should prefer more masculine male faces than other females and that this preference should exist *without relationship context being specified*. In Study 4 this condition was violated in that an effect of father absence on partner choice could only be found when short- or long-term context was specified, or when the women were split by conception risk. In Study 5, women from father absent backgrounds who were not in good relationships preferred more feminine male faces than other women for both short and long term relationships, which contradicted the sexual strategies explanation. Furthermore, positivity to parents was positively correlated with masculinity preference in both studies.

The imprinting explanation predicted that father absence and/or poor parent-daughter relationships would be associated with a reduced masculinity preference compared to other women, also irrespective of short or long term relationship context. While the results of Study 4 do not match the imprinting explanation, the results of Study 5 do. However, there are two important points against the imprinting explanation. Firstly, the correlational analyses in Studies 4 and 5 both show an effect of positivity to mother on face preferences as well as positivity to father (higher Positivity to Mother ratings being associated with higher masculinity preference), while in Study 4, Positivity to Mother shows no effect on female face preferences. If the effects of imprinting were generalised outside the mating context, then why relationship with mother should effect partner choice but not preferences for female

faces is baffling. Similarly, if the effects of imprinting are restricted to mating behaviours, relationship with mother should not necessarily be expected to effect partner choice and if it did, because women are more feminine than men, one could argue that the effect should run in the opposite direction (i.e. warmth to mother should be negatively related to women's masculinity preference, not positively). The second important point against the imprinting explanation is the results of Study 6, which using pre-collected data, found that father absence is associated with a preference for younger male faces. However, these results also show that parents' ages do not mediate the effect of father absence on facial age preference, in that parents' ages neither correlate with age preference nor with the family background variables.

The condition dependence explanation predicted that early stress would be associated with a decrease in health in adulthood, and therefore lower mate condition. It was therefore predicted that father absence or not getting on with one's parents would be associated with a decrease in facial masculinity preference, particularly in long term contexts, and with a decreased facial age preference. This was partially the case, in that all the correlations between positivity to parents and masculinity preference were negative (if significant at all) and mother's warmth and caring in Study 6 were positively associated with age preference. However, there was no interaction between relationship context and father absence in Study 5, with father absent women (not in good relationships) preferring more feminine male faces in both short and long term contexts. While this could have been due to a slight change in methodology (assessing long and short term preferences in the java applet, rather than the original interactive test) the result is a contradiction to the condition dependence explanation. Overall, however, the condition dependence explanation is the only explanation which could account for the results of studies 4 and 6 and as such is the most supported set of predictions.

Part 3 of the thesis took the overall conclusion of Part 2 of the thesis (that father absent women should be 'low quality') and sought to investigate the possibility further. In support of the condition dependence explanation, Study 8 found that father absence and/or poor quality of parents' relationship was associated with masculinisation of facial and bodily appearance, and with increased weight and adiposity. As was seen in Chapter 5, femininity in female faces was closely associated perceptually with youth and healthiness and male preferences for female facial femininity, youth and healthiness were all significantly related. Furthermore, femininity in female faces is preferred in women by both men (Chapter 5) and women (Chapter 6). It can therefore be concluded that the masculinity in the composites of

father absent women and those whose parents had difficult relationships does indeed represent a reduction in mate quality.

It is less clear what the results of Study 9 imply for the condition dependence explanation. Although Jasienska et al (2004) found that progesterone levels were negatively related to waist size, this study did not control for oestrogen levels in their analysis and thus do not have clear implications for the results of Study 9 in which progesterone levels varied with family background, but oestrogen levels did not. The finding that progesterone levels increase eating and weight gain in mice (Schwartz & Wade, 1981) suggests that increased progesterone may mediate the relationship between family background and weight seen in Study 8b. However, this is purely speculative. The primary importance of Study 9 is that it shows that family background can be related to hormone levels in young adult females. Flinn et al (1996) found much less of an effect in women than men in terms of the impact of family background on adult cortisol levels, therefore Study 9 suggests that females' hormones may yet be worthy of further investigation in relation to family background.

Bringing together the results of Parts 2 and 3 of the thesis, it can be proposed that early family difficulties are associated with some level of physical masculinisation (perhaps through hormonal differences) which leads to women from these backgrounds having a lower mate value (e.g. being less attractive, having a less curvaceous body shape) and making their partner choices in a facultative manner to maximise their chances of successfully finding a partner who will commit to them – i.e. choosing less masculine men. The fact that masculinisation is relatively neutral to a man's attractiveness (since it entails a trade-off between pro-social personality and perhaps dominance, see Part 1) may explain the lack of effects of family background on facial preferences in the men reported in Chapter 10.

Alternatively, hormonal masculinisation may independently predict physical masculinisation and different partner preferences. It has been observed in female dark-eyed juncos (*Junco hyemalis*) that artificial elevation of testosterone levels in adult females is associated with less choosiness in their selection of breeding partner for that season (McGlothlin, Neudorf, Casto, Nolan & Ketterson, 2004). While control females systematically preferred control males with normal testosterone levels (contrary to McGlothlin et al's prediction), high-testosterone females were indiscriminate in their choice of a control male or a male whose testosterone levels had also been artificially increased. Furthermore, no matter which male they chose to mate with, high-testosterone females were more likely to waver between their two potential mates than control females, as judged by the amount of time spent with each potential mate. Being anthropomorphic: the high-

testosterone females did not seem able to make up their minds when choosing a mate. Since testosterone was administered in adulthood and testing took place only a week after hormonal implants were put in place, the effects on mate choice can not have been mediated by a long term phenotypic effect of testosterone treatment. Either it must have a direct effect on choosiness, or, the authors suggest, it may be that the increase in corticosterone (an equivalent to cortisol) seen in the high-testosterone females leads them to act as if they were in a high stress environment where perhaps choosiness in mate choice is more costly.

In humans, Jones (2004) has argued that progesterone levels could drive female preferences for healthiness in partners. He found that the luteal phase of the cycle, taking hormonal contraception and being pregnant were all associated with increasing health preference. Given that each of these states is associated with increasingly high progesterone levels, it was suggested that progesterone was driving a preference for apparent health in faces, with the ultimate function of helping pregnant women avoid infection.

It is therefore possible that the results of Part 2 of this thesis are in fact due directly to hormonal differences between groups rather than differences in quality resulting from hormonal differences. However this possibility is at present untested.

13.2 HORMONAL MASCULINISATION AS A MEDIATOR FOR THE FATHER ABSENCE EFFECTS

As discussed above, masculinisation may be able to explain the results of Parts 2 and 3 of this thesis. Not only this, but it may be possible that there are endocrine factors which play a role in mediating the wider effects of father absence. As mentioned previously, Kaiser et al (2003) found that unstable environments lead to a greater number of testosterone receptors and higher levels of testosterone in female guinea pigs (notably without changing the cortisol system). Similarly, Comings et al (2002) found that genomes associated with greater testosterone receptivity were associated with absenteeism in fathers (although see below for criticisms of this work). An increase in testosterone following parental divorce or marital disharmony, or a hyper-sensitivity to testosterone which correlated with father absence, would be expected to have four significant effects on individuals, as detailed below (see Figure 13.1 for a summary).

Fig 13.1. Summary of expected impact of increased testosterone levels on development.

1. A reduction in fear-based inhibition and impulsivity
   - ⇨ greater (sexual?) risk-taking and aggression
   - ⇨ 'behavioural problems' in children
2. Masculinisation of physical features
   - ⇨ greater success at a short term mating strategy in males
   - ⇨ reduced success at a long term mating strategy in females
3. Increased likelihood of infidelity/marital problems/divorce in adult males

1. **A reduction in fear-based inhibition.** It is hypothesised that the relationship between aggression, dominance and testosterone may be mediated by fear (e.g. Campbell, 1999; Archer, Pers comm.) and that testosterone levels may control this inhibition, rather than promote aggression per se. Wilson et al (2002) have suggested that testosterone mediates time-frame considerations, such that the higher the testosterone levels, the more likely an individual is to discount future consequences of their actions, and engage in immediately satisfactory behaviours. This should ultimately lead to greater levels of risk taking and aggression in all individuals. In children, this could manifest itself in the behavioural problems (e.g. conduct disorder) which tend to be seen amongst boys from disrupted family backgrounds (Cherlin, Furstenberg, Chase-Lansdale, Kiernan, Robins, Morrison & Teitler, 1991). In adolescents and adults this could manifest itself in sexual risk taking and may partly explain the association between father absence and teen pregnancy.

2. **Physical masculinisation.** There is evidence that higher levels of testosterone during childhood lead to greater cranio-facial growth (Verdonck et al, 1998) and body shape in women is associated with oestrogen levels (Jaskienska et al, 2004). Therefore, an increase in testosterone levels should lead to masculinisation of physical appearance. In men this should be beneficial in that facial masculinity is associated with apparent dominance (Penton-Voak et al, 1999; Study 3) and dominance in turn is associated with greater reproductive success (Mueller & Mazur, 1996; Perusse, 1993; Mealey, 1985). In females, however, reduced femininity and greater masculinity is unlikely to be beneficial, and should lead to lower mate value and thus a poorer position when attempting a long term strategy. This would then produce lower partner aspirations (as seen in Part 2) and perhaps force females into short term relationships in order to achieve conceptions with high gene-quality males.

3. **Increased likelihood of marital problems in adult males**. Finally, there is evidence that higher levels of testosterone are associated with greater levels of infidelity, marital problems and divorce in males (Mazur & Michalek, 1998; Booth & Dabbs, 1993). This should lead therefore, to greater levels of absenteeism amongst fathers with elevated testosterone levels, just as men whose own parents separated are more likely to be absent fathers themselves (Jaffee et al, 2001) and the increased likelihood of divorce in children of divorcees (Wolfinger, 2003).

Thus, an endocrinal model can be seen to explain many of the features seen in father absent individuals (short term strategy, different partner preferences, behavioural problems) without the need to invoke a child's developing representation of interpersonal relationships and attachment theory in the manner of Belsky et al (1991). While it may not be incorrect to use such concepts, a hormonal explanation is more parsimonious and therefore increases plausibility. A hormonal explanation also has the advantage of being more objectively verifiable via hormone assays and genetic screening.

13.3 GENETIC VERSUS ENVIRONMENTAL CAUSATION

A key question remains which this thesis has not investigated, and which (as discussed in Chapter 1) has been acknowledged as an important caveat in the vast majority of research into the 'effects' of father absence: is father absence a causal factor in the relationships found, or is it a correlate of some other genetic difference between father absent and father present individuals? It has been repeatedly suggested that a genetic explanation of the father absence findings may be more parsimonious than the theories presented by Draper & Harpending (1982) or Belsky et al (1991). The same may apply to the masculinisation model presented above, as there is very little evidence which can be used to determine whether such masculinisation would be an environmental or genetic phenomenon.

Comings et al (2002) provided evidence for a heritable androgen receptivity (homozygotic possession of the 16-repeat GGC gene) being associated with early menarche in women and absenteeism in fathers. A problem with this research is that the evidence shows that having homozygous possession of the GGC repeats was associated with early menarche, but this means that *both* the parents possessed this genotype. Comings et al do not give the differences (if any) between those who are heterozygous and those who do not

possess the gene at all. Furthermore they do not look at the relationship between androgen receptor genes and divorce or single parenthood in *women*, nor whether the women with the androgen receptor gene experienced absent fathers themselves. Therefore their data provides only part of the argument. Jorm, Christensen, Rodgers, Jacomb & Easteal (2004) attempted to correct this latter problem and used several community samples to assess the relationships between childhood background, current reproductive development and the androgen receptor gene. While, like others, they did find that parental divorce and childhood family stress were related to age of menarche, they did not find any greater incidence of childhood adversity in women with homozygous possession of the 16 GGC repeats. Additionally, women with these genes did not show any greater incidence of marital problems themselves. While again, Jorm et al did not assess whether being a single parent was associated with the androgen receptor gene and they were unable to assess whether genotype was related to relationship duration, their large community sample probably provides a more representative population than Comings et al's opportunistic clinical groups of substance abusers (male subjects) and those with weight problems (female subjects). Therefore, although there may be other genotypes which may mediate the father absence effect and have possible masculinising effects (e.g. the CAG androgen gene repeats), it is not clear whether the GGC androgen receptor gene is the correct candidate.

On the other hand, Kaiser et al's (2003) guinea pig research provides an animal model of a process that cannot be experimentally tested in humans, and does strongly suggest that early social experiences (particularly stressful ones) can have real, lasting impacts on physical development in the manner suggested by the masculinisation model given above. Although there is no research looking at family background and testosterone levels in women, Flinn et al (1996) did assess testosterone levels in men from different backgrounds. In contrast to the apparent masculinisation seen in men and women in this thesis, Flinn et al found that in their Dominican sample early father absence was associated with elevated testosterone levels in very young boys but *reduced* levels of testosterone in adult males and significantly elevated cortisol at all ages. The same was true of males who reported having difficult relationships with their fathers during childhood. If the masculinisation seen in this thesis is due to increased susceptibility via the androgen receptor gene then Flinn's findings have limited relevance to the interpretation of this thesis' results. However, should it be due to differences in hormone levels, then Flinn's findings are more relevant. It could be that Dominican families are sufficiently different to middle class Western families that the same form of disruption has very different effects. For instance, Flinn & England (1997) describe

the Dominican study group as having frequent absences by adult males who often work elsewhere and just over a third of the subjects in the 1997 study lived in extended families or with distant relatives only. Although not unheard of, such living arrangements are uncommon in the West. Parental separation within the Dominican sample may represent a different form of stressor than parental separation in Western, Caucasian culture (see below for further discussion of possible cultural differences in father absence effects). Certainly, Flinn's research should be repeated with a sample more akin to those in which father absence research has been traditionally carried out.

In order to assess whether the facial masculinisation seen in Study 8 reflects a genetic or environmental difference between the groups, it will be informative to look at facial images of parents and children at different ages. If the relationship is a genetic one, it can be predicted that parents who have/had a poor relationship with each other will also appear more masculine, and that their children should appear more masculine than their peers from infancy onwards. There are strong correlations between apparent masculinity in parents and children, even when the children are at young ages (below 12 months: Perrett et al, unpublished), suggesting it is heritable.

If the relationship between appearance and childhood background is due to the effects of childhood stress, then it can be predicted that it is very unlikely that infants' faces will reflect their parents' later (or current) relationship problems. Facial differences should appear at the time of the difficulties, and/or shortly afterwards. Furthermore, it is much less likely that the parents will also show the same differences. If the parents do show increased masculinity, it should be because their own background is the same as that of their child.

Until such data are collected, it remains purely speculative whether the masculinisation believed to be seen in Part 3 of this thesis is inherited or a response to early childhood stress. However, there is a third, slightly more complex possibility, which is raised by the results of Study 5. In Study 5 there appeared to be two 'types' of father absent/high stress females. Those who went on to be in happy, committed relationships did not show early menarche compared to their peers and did not prefer less masculinised faces. On the other hand, those father absent women who did *not* go on to be in good relationships did show early menarche and reduced masculinity preference compared to their peers. Similarly, within clinical psychology it is widely accepted that many psychological disorders such as depression and schizophrenia can be due to a combination of genetic and environmental factors. Diathesis-stress models of psychological disorders are based on the idea that some individuals will carry a genetic predisposition or weakness to a particular disorder which will then be

triggered by environmental stress in some of these individuals. Therefore those experiencing the same stressors but without the predisposition will not develop the disorder, just as those with the same predisposition who are not exposed to stressors will not develop the disorder.

It may therefore be that the processes involved in the father absence effect and the relationship between early childhood and partner choice are also subject to a diathesis-stress form of causality. Whether or not this would be an adaptive process (or previously adaptive in ancestral environments) versus a by-product with no function is a matter for debate. Belsky (1997) has argued that it is adaptive for offspring to vary in how easily their genotypes are expressed because:

> *'it would seem to make sense for evolution to have created parents to produce offspring that vary in terms of the ecological niches in which they could flourish and successfully reproduce.'* (Belsky, 1997, p185)

Applying this to reproductive behaviour, it could be evolutionarily advantageous for some individuals to be inflexible in their reproductive strategy, while for others it may be advantageous to be flexible. Therefore, if this supposition is correct, there should be variance in to what degree individuals' reproductive strategies are effected by their early environment.

However, it is also possible that a masculinisation effect on females could be a by-product of selection for masculinisation in sons of adults who engage in shorter term partnerships (or have less success at long term partnerships). For instance, in the data collected for Study 4, a greater proportion of males than females reported parents having separated before they reached puberty (χ^2=5.997, 2df, $p<0.05$). Similarly, Simpson & Gangestad (1992) cite data from the Kinsey Reports (Kinsey et al, 1953) which shows that women who had a greater number of premarital partners (i.e. were more likely to engage in short term relationships) had more sons than women with fewer premarital partners. As discussed in Part 1 of this thesis, masculinisation may be related to dominance which in turn may be related to reproductive success in males. Therefore, if an individual has a genetic tendency towards a short term reproductive strategy, sons will benefit more from inheriting this strategy than daughters, and furthermore, would benefit from masculinisation. The negative effects of masculinity on daughters could be considered 'collateral damage' which is not bad enough, compared to the benefit of masculine sons, to be selected against. Thus, while daughters from 'short term strategists' lineages may have absent fathers and be masculinised, producing the results seen in this thesis, daughters from other lineages in which father absence is the exception rather than the norm, will not show any of the 'effects'

of father absence seen in other father absent women. However, this explanation would depend on the sons of absent fathers also being more masculine, which at the present there is only minimal evidence for (Study 8; Waynforth, 2002) and some evidence against (Flinn et al, 1996). It would also depend on masculine father absent males having higher inclusive fitness (including their brothers' and sisters' children) than feminine father absent males.

13.4 Father absence across cultures

A key feature of this thesis is that is has focussed almost exclusively on Western samples. Although some of the subjects in the online data collection reported being from non-Western regions such as Asia and Africa, the vast majority of subjects were British, mainland European or North American. In these cultures, monogamy (or at least serial monogamy) is enforced by legislation and, in many countries, confers material benefits such as tax allowances (e.g. in Britain: the married couples allowance). Futhermore, until recently, the social stigma attached to divorce and premarital childbearing meant that father absence was considered exceptional. The fact that the 'norm' of children being brought up by two co-resident, heterosexual parents is still firmly entrenched in the psyche of British and American policy-makers, researchers, and public alike is made clear by the sheer volume of research and government literature seeking to understand and help children suffering the adverse effects of parental divorce, the scale of the arguments over homosexual couples' rights to marry and adopt, and the ongoing debate regarding benefits for single mothers. The fact that parental divorce (or parental marital conflict) is associated with higher incidence of behavioural problems and lower academic achievement (see e.g. Rodgers & Pryor, 1998 for a review) is considered to be a social problem and most research into these phenomena are aimed at trying to understand how to prevent these outcomes (e.g. Cherlin et al, 1991; Fustenberg & Kiernan, 2001).

However, when Draper & Harpending (1982) first proposed their theory of father absence, they suggested that rather than be seen as problematic, the outcomes associated with father absence were simply those which best suited the circumstances in which the individuals found themselves. By this way of thinking, the idea that such behaviours represented 'maladjustment' is an entirely arbitrary view based on western middle class ideals of education, late reproduction and the nuclear family.

While in no way should the psychological distress suffered by those with disrupted childhoods be ignored, it is important to consider that their distress may be a result of the

wider pattern of western parenting trends as much as their own parents' behaviour. As mentioned before, amongst many non-western cultures, family contacts make a significantly larger proportion of social networks and extended families may be much more likely to live together. Just as Rogers (1990) has suggested that the demographic transition from large families to small families may be due to a reduction in family support (urbanisation having broken up family-oriented communities), so Rossi (1997) has suggested that the loss of extended family networks makes father absence a more serious issue, and may have elevated the 'need' for fathers to remain co-resident with their offspring.

This creates two key questions: first, what can be predicted about 'father absence effects' or their equivalent in cultures with a tradition of extreme sex-segregation or matrilocality and avuncular parental investment rather than paternal investment. Secondly, in such cultures, what role would masculinisation play in father absence effects?

In answer to the first question, there are two possibilities. One is that in societies with a tradition of avuncular investment and short term pair bonding, *all* offspring might tend to show 'father absent' characteristics, and as such the average age of puberty should be lower than equally developed patrilineal societies with patrilocal marriage. There should also be higher levels of male aggression and reduced closeness between parents and offspring. The second possibility is that in societies with avuncular investment and matrilocality, lack of an appropriate carer (be it an uncle or grandparent) might have the same effect in that society as parental separation has in western cultures. Certainly, according to Belsky et al's (1992) model, any early stress will disrupt the attachment process and as such should produce early puberty and a short term reproductive strategy. Therefore it may not matter who the 'parents' are, as long as they are a stable and positive presence in the child's life.

Although there is limited cross-cultural research into father absence compared to research in western populations, Ember & Ember (2001) did show that across a range of pre-industrial societies, lower levels of father involvement (indexed by father-infant sleeping distance) was associated with higher levels of aggression in males (indexed by homicide and assault rates). However, this was only the case once matrilocal and peaceful societies were excluded from the analysis, which suggests that in matrilocal societies, the role of the father is less relevant than in patrilocal societies. Mother-infant sleeping distance was never related to aggression but Ember & Ember did not assess the role of other principle carers (such as maternal uncles and grandmothers) in predicting aggressive behaviour. Waynforth (2002; Waynforth, Hurtado & Hill, 1998) found that amongst the Ache of Paraguay, father absence (as indexed by the proportion of children an individual's same-sex parent had had with someone other

than the individual's biological opposite-sex parent) was associated with *later*, rather than earlier, reproduction in females. Males showed the same pattern, although it was not significant. Although the Ache tend to have monogamous marriages, divorce is commonplace and both polygyny and polyandry have been reported (Hill & Hurtado, 1996), therefore the Ache mating system makes them a relevant contrast against western populations. However, the Ache believe in partible paternity and secondary fathers do sometimes invest in their putative offspring (see e.g. Hrdy, 2000, for a discussion of the benefits of secondary fathers). Therefore it may be that these secondary fathers can compensate for the desertion of primary fathers, and it is unclear how Waynforth et al controlled for any secondary fathers. Furthermore, divorce approximately doubles child mortality and Waynforth et al (1998) observed that father absent males were under-represented in their sample.

As regards the second question, what role masculinisation would play in matrilocal cultures, it was suggested above that masculinisation in father absent women could well be a result of having a masculinised absentee father, or a less feminine short-term strategist mother. However, in societies in which father absence is the norm, it seems unlikely that having masculinised parents would be the case. Alternatively, if masculinisation is a response to stress in the individual then it should be associated with any disruption of childhood care. Therefore, if father absence is the norm and the culture is matrilocal with childcare being the domain of the mother and her family, father absence should be expected to have less of an effect on offspring, whereas desertion by the mother and/or her relatives should produce the masculinisation effects seen here. On the other hand, if the society is patrilocal, no matter how common father absence is, one would expect it to be associated with masculinisation in the offspring as it would be a disruption to the caring patterns of the child and the mother would not have relatives to support the child in its father's stead.

At the present time it does not appear to be possible to fully address any of these predictions with data in the literature.

13.5 Summary and future directions

Overall, the results of this thesis seem to show that despite ostensibly wanting the same types of qualities in a partner, women experiencing childhood father absence or poor parent-child relationships have a reduced preference for facial masculinity and facial age (although these effects may only be present in a certain section of the father absent sample). Secondly,

father absence or poor parental relationships are associated (in a university sample) with physical masculinisation and greater weight and adiposity. This physical masculinity or decrease in condition may be mediating the effects of father absence on facial preferences. The physical differences between the father absent and father present females may be due to hormonal differences, such as elevated progesterone. When choosing masculinity, women appear to be choosing dominance (and perhaps potential reproductive success of sons) over prosocial facial cues, and these perceptions of masculinity do not vary depending on family background. Therefore the effects of family background on preferences do not appear to reflect different norms or attributions to male masculinity, but rather different degrees of preference for male masculinity.

Overall, these results suggest that traditional approaches to father absence research (Draper & Harpending, 1982; Belsky et al, 1991; Chisholm, 1993) may be mistaken in their reliance on parental behaviour, attachment and purely psychological explanations of father absence 'effects'. In fact it may be that hormonal differences between those from stressful families and those from harmonious families (be they genetically or environmentally caused) create differences in phenotype which in turn lead to the different behaviours observed by psychologists.

There are several future directions in which this research could be taken. For instance, it is important to look more closely at the physical differences between father absent and father present individuals. Firstly, are the physical differences visible in a community sample, rather than a university sample? Secondly, are the physical differences apparent earlier in life and are they present in the parents of the individuals? Such research would also help determine the genetic versus environmental causation of the physical correlates. Thirdly, are there any other hormonal differences between father absent and father present populations, and in particular, are there differences in levels of testosterone?

As regards facial preferences, it would be interesting to compare father absent and father present *children* on their face preferences, as this could help further rule out imprinting effects. If the results in Part 2 of this thesis are due to the condition dependence explanation, then they should only be evident at puberty once individuals are looking for potential mates. On the other hand, imprinting may have an effect on facial preferences in children, since poor father-child relationships should bias children against facial masculinity from the time of the relationship difficulties onwards.

Finally, it would be interesting to carry out longitudinal studies in which individuals for whom detailed childhood data exists were followed up and assessed on both facial

preferences and physical development. This would greatly improve the accuracy of the studies and reduce both noise in the data and any effects of retrospective inaccuracy. It would also allow for more detailed analyses of how different levels of father involvement were related to outcomes.

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APPENDIX A: STIMULI CREATION AND VALIDATION

A.1 STIMULI SET 1

Three male and three female textured composite base faces, to which all transforms were applied, were created using the face processing package Psychomorph. All base faces were created by averaging the faces of St Andrews University students. The students' full-face colour photographs were taken with a digital camera (resolution set at 1200x1000 pixels) and under standardised diffuse lighting conditions. Background was constant in all photographs. Facial expression was neutral and hair pulled back from the face. Key points and lines on faces were semi-automatically defined to create line-drawings ('templates') of each face. The dimensions of these templates were averaged across all faces to produce an average face shape. Each face was then warped into that average shape and the RGB colour at each pixel point in the final shape was calculated from averaging the colour profiles of the warped faces. Wavelet intensity analysis was used to apply texture to the base faces (for explanation of texture processing, see Tiddeman, Burt & Perrett, 2001). The base faces may be summarised as in Table A.1 below and are depicted in Figure A.1 below.

Table A.1 Summary of faces used to construct base faces

Base Face	Sample taken from	n	Mean age	sd
Male 1	St Andrews students, 1999	66	21.3	3.4
Male 2	St Andrews students, 2000	12	21.2	1.6
Male 3	St Andrews students, 2000	12	22.0	4.8
Female 1	St Andrews students, 1999	85	20.2	2.6
Female 2	St Andrews students, 2000	40	20.7	2.9
Female 3	St Andrews students, 2000	40	19.7	2.1

Transforms were then applied to the base faces to alter apparent masculinity, age and health. The transformation process involved calculating the differences in skin colour, face shape and skin texture between a prototype 'source' face (e.g. a younger face) and a prototype 'destination' face (e.g. an older face) and applying a proportion of that difference to the base face. The difference could both be 'added' to the base face (a positive transform, e.g. aging the face), or 'subtracted from' the base face (a negative transform, e.g. making the face look younger). After transformation, all images were masked so that only the faces were visible (i.e. hair, neck and ears were excluded) and were standardised to a size of 400x533 pixels, with inter-pupillary distance being approximately 150 pixels.

Figure A.1. Base faces made by combining facial images of Caucasian adults. Top row, left-right: Male 1, Male 2, Male 3. Bottom row, left-right: Female 1, Female 2, Female 3

Age The prototype faces used for the age transforms were a composite of 19 boys aged 8-12 versus a composite of 15 men aged 45-55, and a composite of 13 girls aged 8-12 versus a composite of 14 women aged 45-55. All faces used in the transform composites were Caucasian with no facial hair or glasses. The base faces were transformed by adding and subtracting 15% (theoretically 6 years) of the difference between the 2 prototypes (see Figure 3 for an example). Colour, shape and texture were all transformed.

Masculinity The prototypes used for the masculinity transform were a composite of 40 Caucasian females and a composite of 21 Caucasian males. Both prototypes consisted of individuals of the same age (mean 21.0 years) in order to manipulate masculinity without affecting apparent age. The shape of the faces was transformed 50% in each direction (see Figure 3). Colour and texture were not changed as this produces unrealistic changes to feminised images such as abnormally light skin in the place of beards (Rowland & Perrett, 1995).

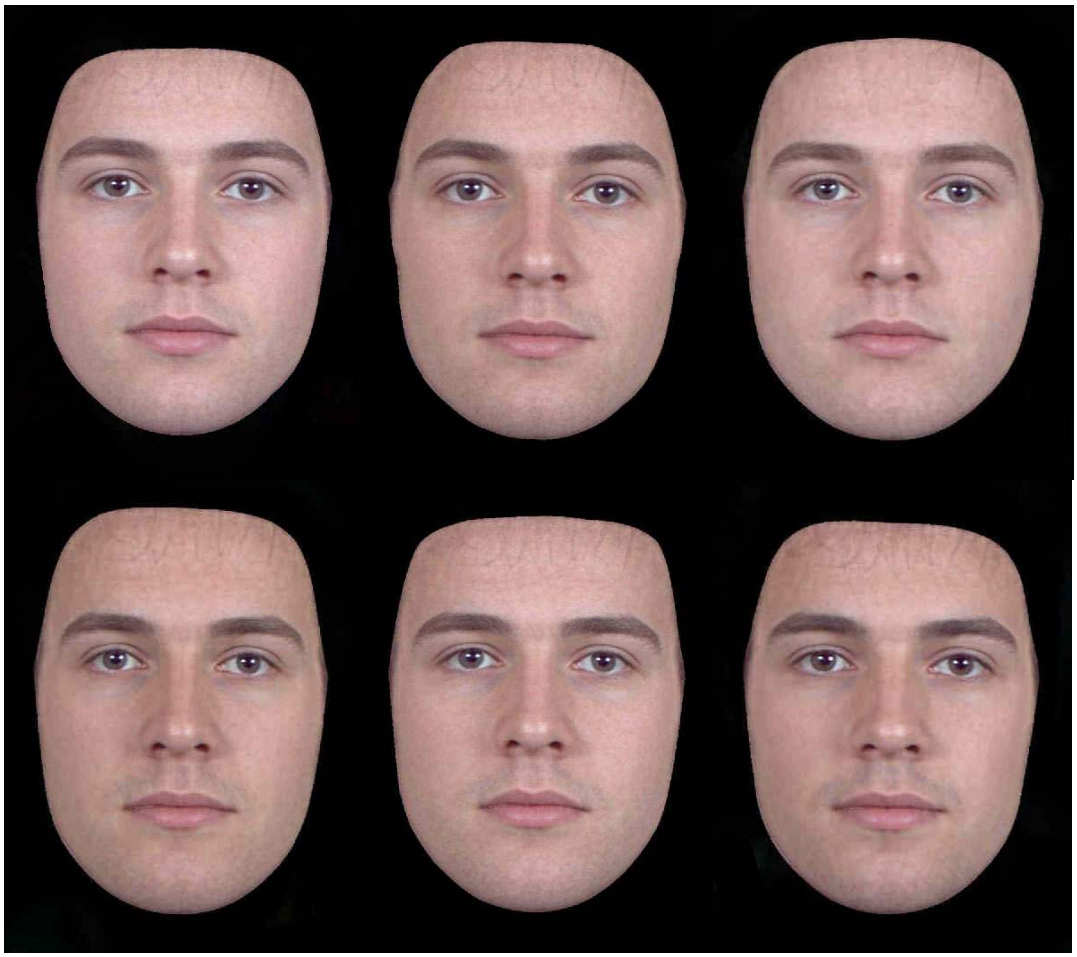


Figure A.2. Male1 transformed to decrease and increase apparent age, masculinity and health (Top row, left-right: young, feminine, unhealthy. Bottom row: old, masculine, healthy).

Health The prototypes used for the health transforms were composites of the faces judged most and least healthy from a set of 96 Caucasian male faces (healthy: n=15, mean rated health=5.0, mean age=20.5; unhealthy, n=15, mean rated health=3.2, mean age=22.2) and 85 female faces (healthy: n=15, mean rated health=5.3, mean age=19.6; unhealthy: n=14, mean rated health=3.1, mean age=19.5), all of whom had been rated by 8 males and 7 females for apparent general health on a Likert scale from 1 to 7 (where 1= very unhealthy and 7=very healthy). The 3 base faces were transformed 50% in each direction (see Figure 3). Colour, shape and texture were all transformed.

A.1.1 Stimuli Validation

32 women (mean age=21.2 years) and 22 men (mean age=22.3 years) compared the masculinity stimuli on masculinity and the health stimuli on health. Approximately half of these subjects, 14 women (mean age=21.9 years) and 11 men (mean age=23.4 years), estimated the ages of the age stimuli. They were recruited by distribution of an advertisement over email. All subjects were postgraduates and undergraduates at UK universities.

Using their own computers, subjects followed a URL to the test site. After being asked their age, occupation and sex, they began the test. A pair of faces was presented using a java script applet, taking up most of the screen. Subjects were asked to indicate which face was more masculine (when judging the masculinity pairs) / healthy (when judging the health pairs). A scale underneath had the points 'much more (left), 'more', 'slightly more', 'guess (left)', 'guess (right)', 'slightly more', 'more', much more (right)', thus allowing the results to be recorded as an 8-point scale in which 3.5 represented no difference between the faces, while 0 represents a choice for the incorrect face and 7 for the correct.

During presentation, order of face pairs and left-right position of each face within the pairs were both randomised. Subjects were always asked to judge health and then masculinity. Some subjects then went on to estimate the ages of the age stimuli. All faces were presented on one html form in male-female pairs. Above each face was a box in which they were asked to type the age they estimated that face to be.

The mean rated health and masculinity scores were calculated for male and female pairs separately. Kolmogirov-Smirnov tests showed that none of the ratings showed any significant difference from normality (All KS $z<1.4$) except the male health scores (KS $z=1.82$, $p=0.003$; $n=61$). Therefore parametric statistics were used. T-tests showed that subjects correctly identified the more masculine/healthy faces in that mean scores were significantly above 3.5 in both sex faces, on both traits (Male masculinity: mean=4.58, $t_{52}=7.64$, $p<0.001$; Female masculinity: mean=4.17, $t_{52}=4.84$, $p<0.001$; Male health: mean=5.01, $t_{60}=11.33$, $p<0.001$; Female health: mean=5.28, $t_{60}=13.42$, $p<0.001$).

Estimated ages of age stimuli were also compared using t-tests. 'Older' faces were judged to be significantly older than the 'younger' faces for each pair at $p<0.01$ (for results see Table 2 below).

A.2 STIMULI SET 2

36 base faces (18 male, 18 female) representing different fictional 'individuals' were constructed by averaging 10 randomly chosen faces together. The average ages of the faces used for each base face was 21 years and all faces were without glasses or facial hair. 6 faces of each sex were then transformed along the dimension of masculinity (sexual dimorphism), 6 of each sex were transformed on apparent health and 6 of each sex were transformed on age using the same methodology as in Stimuli Set 1. This meant that although there were 3 sets of 6 male and 6 female face transforms, subjects never saw the same 'individual' more than once. After transformation, all images were masked so that only the faces were visible (i.e. hair, neck and ears were excluded) and were standardised to a size of 400x533 pixels, with inter-pupillary distance being approximately 150 pixels.

Masculinity

The prototypes used for the masculinity transform were a composite of 80 Caucasian females (mean age=20.3 years) and a composite of 32 Caucasian males (mean age=20.4 years). The shape of the faces was transformed 50% in each direction. As in Set 1, colour and texture were not changed.

Health

2 sets of prototypes were used for the health transforms. Male and female composites of the most and least healthy looking individuals were created from two different populations (2 years' worth of student photographs were randomly allocated to two groups). 3 male and 3 female bases were transformed using healthy and unhealthy prototypes from population A (all contained 25 individuals, and were rated by 8 men and 5 women on 1-7 Likert scales, Cronbach's alphas for inter-rater agreement all>0.8) and 3 male and 3 female bases were transformed using healthy and unhealthy prototypes from population B (also all containing 25 individuals, and having been rated using identical procedures, Cronbach's alphas>0.8). Colour, shape and texture were all transformed. This resulted in 6 males and 6 female health transform pairs, the two halves of which had been given independent health transforms. For further details of these images see Jones (2004).

Age

Set 1 age transforms had been performed using pre-pubertal and old age end points. It was decided that this lacked ecological validity, and so for Set 2 stimuli, the faces were given a

large transform using a pair of end points closer in age to the base faces. The prototype faces used for the age transforms were a composite of 15 males aged 15-18 versus a composite of 15 males aged 25-29, and a composite of 15 females aged 15-18 versus a composite of 15 females aged 25-29. All faces used in the transform composites were Caucasian with no facial hair. The base faces were transformed by adding and subtracting 30% (theoretically 3 years) of the difference between the 2 prototypes. Colour, shape and texture were all transformed.

A.2.1 Stimuli Validation

Masculinity and Health stimuli

11 women (mean age=23.27 years, s.d.=6.05) and 12 men (mean age=26.42 years, s.d.=5.71) assess the health and masculinity of the health and masculinity stimuli respectively. Testing took place in the laboratory on computers. They were presented with the face pairs and asked, within each pair, which looked more masculine/healthy. Face pairs were presented in a random order within each judgement-block and order of judging masculinity or health was randomised. The computer returned the data as a dichotomous result in which 0 indicated a choice for the feminine or unhealthy face and 1 indicated a choice for the masculine or healthy face. For each subject, proportion of masculine faces chosen versus feminine faces, and proportion of healthy faces chosen versus unhealthy was calculated. If the health and masculinity transforms had been successful, then subjects would select the appropriate faces significantly more often than chance (50%).

Proportion of masculinity and health choices were compared against chance (0.5) using one-sample t-tests. Subjects selected the correct faces significantly more than chance for both masculinity (male faces: $t_{22}=6.31$, $p<0.001$; female faces: $t_{22}=7.11$, $p<0.001$) and health (male faces: $t_{22}=12.05$, $p<0.001$; female faces: $t_{22}=18.57$, $p<0.001$). Although female subjects had significantly higher accuracy than male subjects in classifying the male masculinity pairs ($F_{20,1}=4.41$, $p<0.05$; ANOVA of proportions correct, with age as a covariate) separate t-tests within each sex showed that both sexes still classified the masculine faces as masculine significantly more than chance (male subjects: $t_{11}=2.88$, $p<0.05$; female subjects: $t_{10}=8.48$, $p<0.001$). There were no other effects of rater sex or rater age on proportion of faces correctly classified (all $F_{1,20}<3.5$, all $p>0.096$).

This shows that the masculine transforms looked more masculine than the feminine transforms, while the healthy transforms looked more healthy than the unhealthy transforms across the 6 pairs in each sex and transform category.

Age

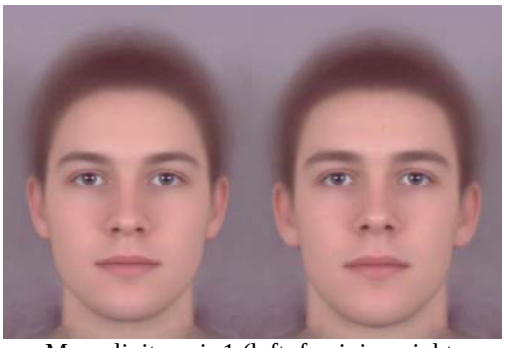
A voluntary sample of 16 female students (mean age=21.9 years, s.d.=2.8) estimated the ages of the age stimuli. Testing took place in the laboratory on computers. The faces were presented individually in a random order. Beside each face was a box in which subjects were asked to type the age they estimated that face to be. 'Older' faces were judged to be significantly older than the 'younger' faces (mean perceived age gap=2.28 years, $t_{15}=4.54$, $p<0.001$).

APPENDIX B: ALL STIMULI USED IN FACIAL PREFERENCE TESTS

All images shown 25% of real size.

ORIGINAL MASCULINITY STIMULI
(as used by Perrett et al, 1998; Penton-Voak et al, 1999; Penton-Voak et al, 2001; Cornwell et al, 2004)

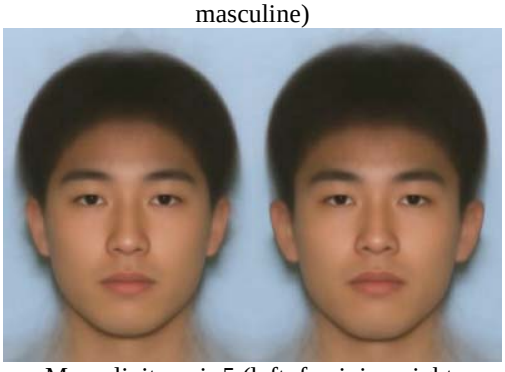
Male stimuli


Masculinity pair 1 (left: feminine, right: masculine)


Masculinity pair 2 (left: feminine, right: masculine)


Masculinity pair 3 (left: feminine, right: masculine)


Masculinity pair 4 (left: feminine, right: masculine)


Masculinity pair 5 (left: feminine, right: masculine)


Masculinity pair 6 (left: feminine, right: masculine)

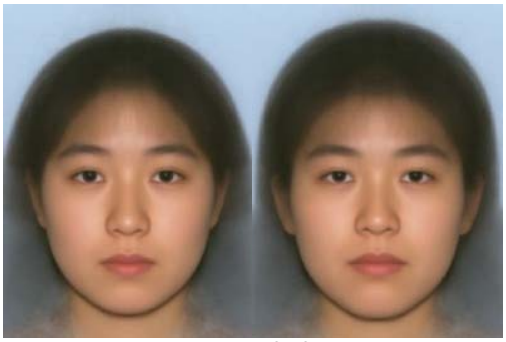
Female stimuli

Masculinity pair 1 (left: feminine, right: masculine)

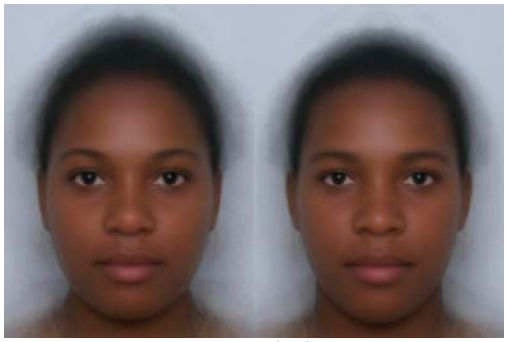
Masculinity pair 2 (left: feminine, right: masculine)

Masculinity pair 3 (left: feminine, right: masculine)

Masculinity pair 4 (left: feminine, right: masculine)



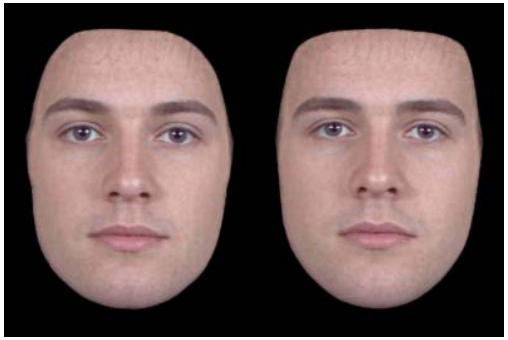
Masculinity pair 5 (left: feminine, right: masculine)



Masculinity pair 6 (left: feminine, right: masculine)

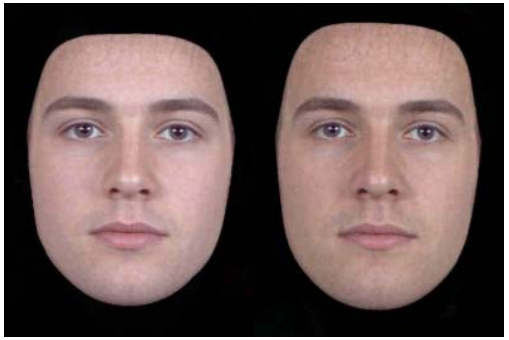
STIMULI SET 1

Male pairs

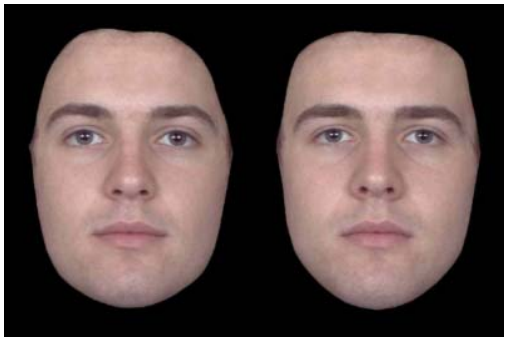


Male 1 Feminised (left) and Masculinised (right)

Male 1 Unhealthy (left) and Healthy (right)



Male 1 Young (left) and Old (right)

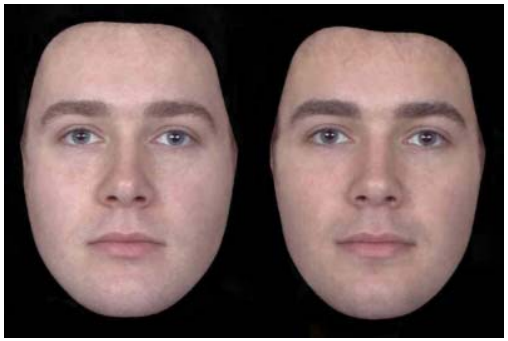


Male 2 Feminised (left) and Masculinised (right)

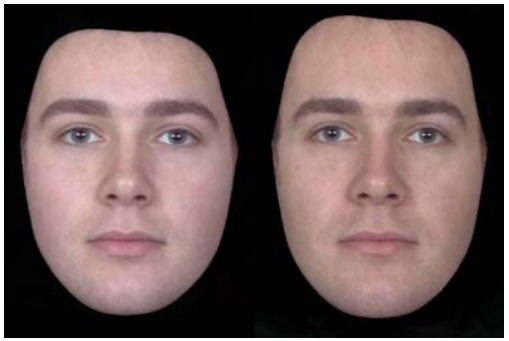
Male 2 Unhealthy (left) and Healthy (right)

Male 3 Young (left) and Old (right)

Male 3 Feminised (left) and Masculinised (right)

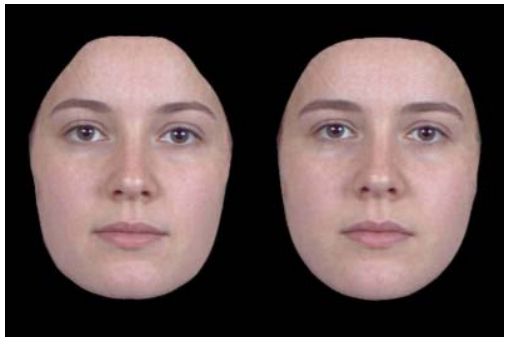


Male 3 Unhealthy (left) and Healthy (right)



Male 3 Young (left) and Old (right)

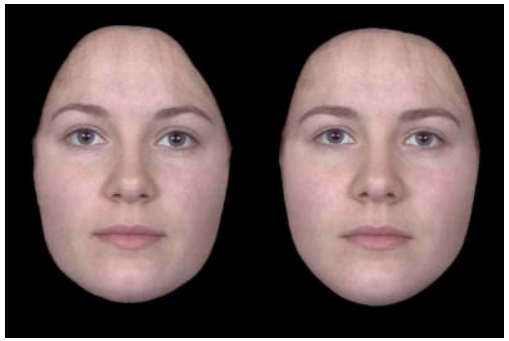
Female pairs



Female 1 Feminised (left) and Masculinised (right)

Female 1 Unhealthy (left) and Healthy (right)

Female 1 Young (left) and Old (right)



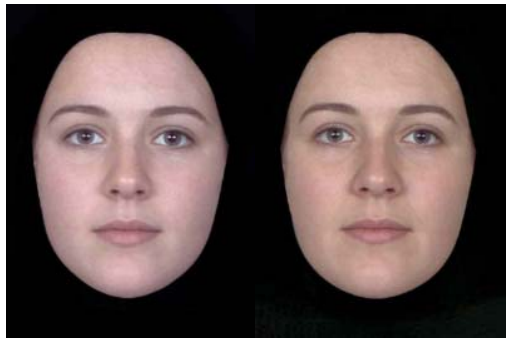
Female 2 Feminised (left) and Masculinised (right)

Female 2 Unhealthy (left) and Healthy (right)

Female 3 Young (left) and Old (right)

Female 3 Feminised (left) and Masculinised (right)

Female 3 Unhealthy (left) and Healthy (right)



Female 3 Young (left) and Old (right)

SET 2 STIMULI

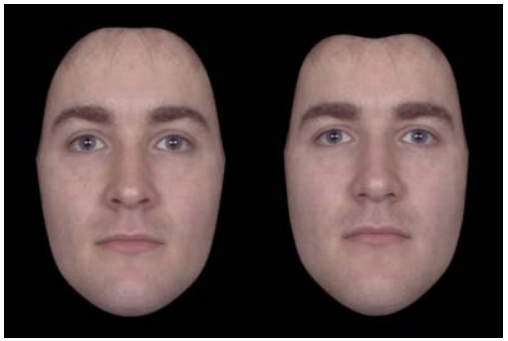
Male stimuli


Masculinity pair 1 (left: feminine, right: masculine)


Masculinity pair 2 (left: feminine, right: masculine)


Masculinity pair 3 (left: feminine, right: masculine)


Masculinity pair 4 (left: feminine, right: masculine)


Masculinity pair 5 (left: feminine, right: masculine)


Masculinity pair 6 (left: feminine, right: masculine)


Health pair 1 (left: unhealthy, right: healthy)


Health pair 2 (left: unhealthy, right: healthy)

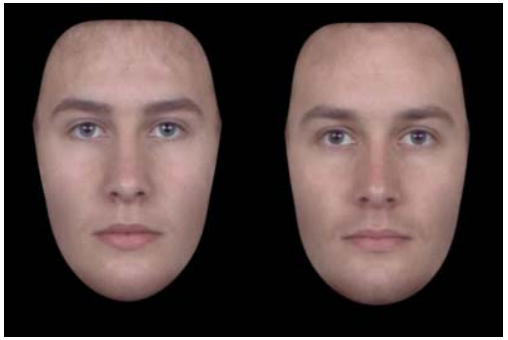

Health pair 3 (left: unhealthy, right: healthy)

Health pair 4 (left: unhealthy, right: healthy)

Health pair 5 (left: unhealthy, right: healthy)

Health pair 6 (left: unhealthy, right: healthy)

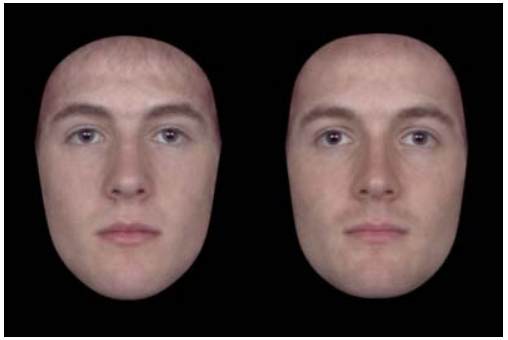
Age pair 1 (left: young, right: old)



Age pair 2 (left: young, right: old)

Age pair 3 (left: young, right: old)

Age pair 4 (left: young, right: old)



Age pair 5 (left: young, right: old)

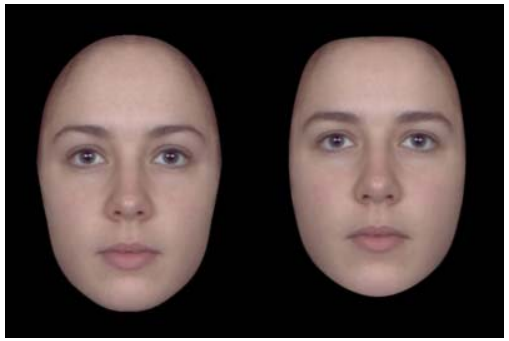
Age pair 6 (left: young, right: old)

Female stimuli

Masculinity pair 1 (left: feminine, right: masculine)

Masculinity pair 2 (left: feminine, right: masculine)

Masculinity pair 3 (left: feminine, right: masculine)



Masculinity pair 4 (left: feminine, right: masculine)

Masculinity pair 5 (left: feminine, right: masculine)

Masculinity pair 6 (left: feminine, right: masculine)

Health pair 1 (left: unhealthy, right: healthy)

Health pair 2 (left: unhealthy, right: healthy)

Health pair 3 (left: unhealthy, right: healthy)

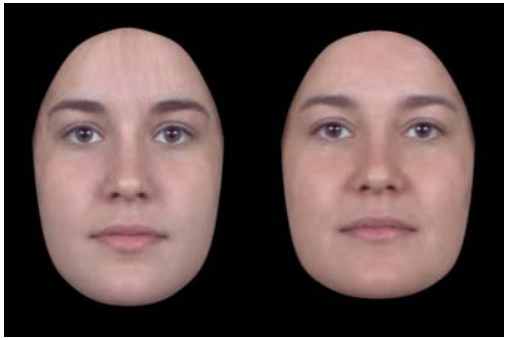
Health pair 4 (left: unhealthy, right: healthy)

Health pair 5 (left: unhealthy, right: healthy)

Health pair 6 (left: unhealthy, right: healthy)

Age pair 1 (left: young, right: old)

Age pair 2 (left: young, right: old)



Age pair 3 (left: young, right: old)

Age pair 4 (left: young, right: old)

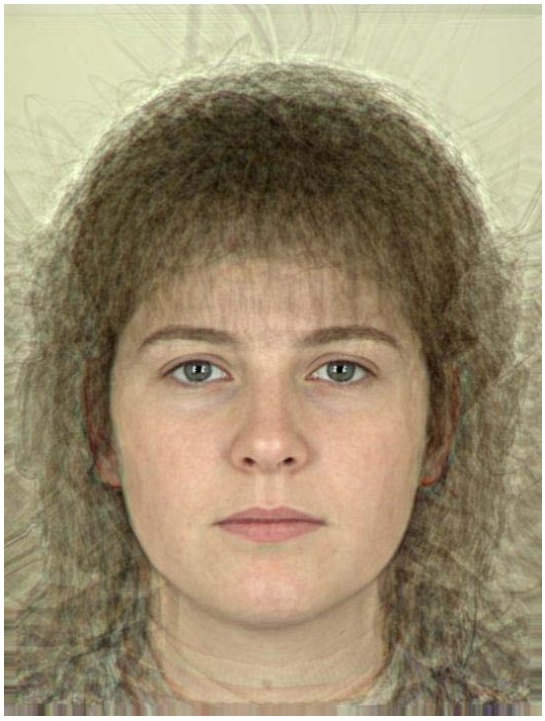
Age pair 5 (left: young, right: old)

Age pair 6 (left: young, right: old)

AGE STIMULI USED IN STUDY 6

Younger male face (20-24)

Older Male face (25-29)



Younger female face (20-24)

Older female face (25-29)

APPENDIX C: PARENTAL SEPARATION COMPOSITES (STUDY 8A)

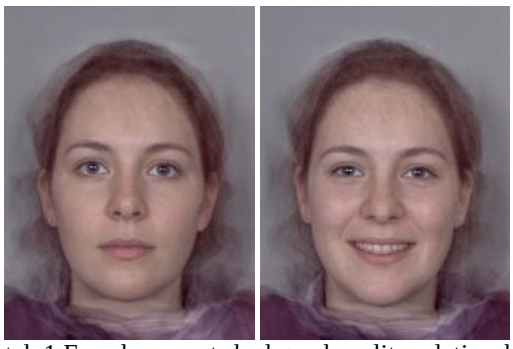
Smiling and neutral versions of each image shown. All images shown 25% of real size.

Batch 1 Female, parents separated prior to puberty

Batch 2 Female, parents separated prior to puberty

Batch 1 Female, parents had poor quality relationship

Batch 2 Female, parents had poor quality relationship



Batch 1 Female, parents had good quality relationship

Batch 2 Female, parents had good quality relationship

Male, parents separated prior to puberty

Male, parents had good quality relationship

APPENDIX D: VALIDATING THE FAMILY BACKGROUND QUESTIONNAIRE

D.1 SUBJECTS

There were 15 men (mean age=20.7, s.d.=3.0) and 43 women (mean age=19.7, s.d.=1.5), all of whom were undergraduates at the University of St Andrews.

D.2 QUESTIONNAIRES.

Subjects completed the Adult Attachment Questionnaire (Hazen & Shaver, 1987), which produced a score for each style of attachment (secure, anxious/preoccupied, avoidant/ dismissive).

A questionnaire was written, aiming to assess quality of family relationships. Subjects were asked to assess the warmth with which they remembered each parent, and the quality of the parents' relationship (whether they lived together or not) on 1-9 Likert scales. Subjects were asked to assess these things at two different age ranges – birth to 6 years (roughly pre-school), and 6 years to puberty (roughly primary/elementary school).

Subjects were also asked whether or not their parents had separated and when any separation occurred.

D.3 PROCEDURE

Subjects completed the questionnaires on a computer in a laboratory setting. All subjects completed the purpose written questionnaire, followed by the Adult Attachment Questionnaire.

D.4 RESULTS

Rated warmth towards parents and quality of parents' relationship at 0-6 years was highly correlated with the same variable at 6-puberty (warmth towards father: $r_s=0.68$, $p<0.001$; warmth towards mother: $r_s=0.62$, $p<0.001$; quality of parents' relationship: $r_s=0.83$, $p<0.001$;

n=58). Therefore ratings from the two time periods were averaged together for each variable.

Rated tendency to Style A (avoidant/dismissive) attachment was significantly negatively correlated with warmth towards father (r_s=0.32, $p<0.05$), warmth towards mother (r_s=0.36, $p<0.01$), and quality of parents' relationship (r_s=0.33, $p<0.05$), such that the more highly subjects rated their relationships with and between their parents, the less likely they were to be insecure-avoidant. Tendency towards Styles B or C (secure and anxious/preoccupied respectively) did not correlate with warmth towards parents, or parents' relationship (all $|r_s|<0.22$).

Individuals whose parents separated during their early childhood (up to 10 years old), had a significantly higher tendency towards avoidant attachment (Mann-Whitney U=93, $p<0.05$) and were less warm towards their fathers (U=83, $p<0.05$). There was no effect on the other variables (warmth towards mother: U=157; quality of parents' relationship: U=171; Style B: U=; Style C: U=140).

APPENDIX E: FATHER ABSENCE AND MALE PREFERENCE FOR FEMALE FACES

E.1 STUDY 4 MALE DATA

E.1.1 Subjects

There were 357 males in total between the ages of 16 and 29 inclusive (mean=23.40, s.d.=3.55). 42.3% were British, and a further 46.7% were from other Western countries (North America, Europe and Australia). 81.4% were Caucasian. 36.2% were undergraduates, 22.2% were postgraduates, researchers and teachers, and 39.3% reported 'other' employment.

Method was identical to that reported for women in Study 4, with the exceptions that a. men did not report menstrual status or pregnancy, and b. instead of age of menarche, males reported the age at which they first shaved.

E.1.2 Results

Parental separation had no effect on age of first shave ($F_{2,208}$=2.32), but did affect age of first coitus, with those whose parents never separated having sex later than those whose parents did separate ($F_{2,208}$=4.42, $p<0.05$). There was also no significant effect on number of sexual partners ($F_{2,205}$=0.73).

Parental separation had no effect on preferences for opposite- or same-sex faces in the applet test (opposite: $F_{2,182}$=0.82; same: $F_{2,182}$=2.11). There was also no effect on femininity preference in the interactive test. A repeated measures ANCOVA found no main effect of parental separation ($F_{2,145}$=0.84) and no interaction between parental separation and relationship context ($F_{2,145}$=0.66). There was also no main effect of relationship context ($F_{1,144}$=0.26). Finally there was no effect of parental separation on same-sex masculinity preference in the interactive test ($F_{2,116}$=1.01).

There were no significant correlations between positivity to parents and any of the masculinity/femininity preference variables (see Table E1 below).

Table E1 Correlations between positivity scores and masculinity preferences.

		Interactive test			Applet test	
		Short term	Long term	Same sex	Female faces	Male faces
Positivity to Mother	r_s	0.021	0.028	-0.003	0.045	-0.076
	p	0.770	0.701	0.969	0.417	0.186
	n	193	188	152	322	301
Positivity to Father	r_s	0.015	0.091	0.011	0.016	-0.081
	p	0.834	0.210	0.894	0.777	0.158
	n	196	192	154	330	308

E.2 STUDY 5 MALE DATA

E.2.1 Subjects

There were 339 males in total between the ages of 16 and 29 inclusive (mean=22.84, s.d.=3.67). 41.6% were British, and a further 43.4% were from other Western countries (North America, Europe and Australia). 83.2% were Caucasian. 34.8% were undergraduates, 29.2% were postgraduates, researchers and teachers, and 31.6% reported 'other' employment.

Method was identical to that reported for women in Study 5, with the exception that instead of age of menarche, males reported the age at which they first shaved.

E.2.2 Results

Parental separation did not effect age of first shave ($F_{1,297}$=1.49). However, it did effect age of first coitus ($F_{1,199}$=10.12, $p<0.005$, controlling for age). There was no significant interaction between parental separation and relationship status for any of the development variables (puberty: $F_{1,297}$=0.19; first coitus: $F_{1,199}$=2.93; number of sexual partners: $F_{1,199}$=1.47).

There was no significant main effect of parental separation on femininity preference ($F_{1,155}$=0.01), nor any interaction between parental separation and relationship status

($F_{1,155}$=0.003). There was also no effect main effect of long or short term context ($F_{1,155}$=1.98), nor interactions between term and any other variables (all F<1).

There were no significant correlations between masculinity/femininity preference and positivity to parents (see Table E2 below).

Table E2. Correlation coefficients between positivity scores and femininity preferences, Study 5

		All males		In good relationship		Single/bad relationship	
		Long term	Short term	Long term	Short term	Long term	Short term
Positivity to Father	r_s	-0.045	-0.094	-0.066	-0.101	-0.037	-0.087
	p	0.535	0.165	0.563	0.342	0.697	0.323
	n	195	222	79	91	116	131
Positivity to Mother	r_s	-0.034	-0.052	0.047	0.003	-0.100	-0.093
	p	0.635	0.439	0.685	0.978	0.284	0.291
	n	195	221	78	89	117	132

E.3 STUDY 6 MALE DATA

E.3.1 Subjects

There were 148 males in total between the ages of 18 and 29 inclusive (mean=24.84, s.d.=3.07). They completed the same questionnaire as the female subjects and rated a composite image of 15 female faces aged 20-24, and a composite image of 15 female faces aged 25-29. Age preference was calculated in the same way as for the female subjects.

Table E3. Correlation coefficients between ratings of parents' personalities /parent child relationships, and age preference, from Study 6.

		Spearman's correlation	Own age partialled out	Age of parent and own age partialled out
Relationship with mother	r	-0.054	-0.0185	-0.0309
	p	0.523	0.829	0.719
	n/df	144	137	136
Mother's rated warmth	r	-0.080	-0.0618	-0.0646
	p	0.335	0.470	0.437
	n/df	148	137	136
Mother's rated caring	r	-0.125	-0.0831	-0.0828
	p	0.130	0.331	0.334
	n/df	148	137	136
Mother's age when child born	r	0.075	0.0924	
	p	0.367	0.279	
	n/df	148	137	
Relationship with father	r	-0.155	-0.1253	-0.1303
	p	0.064	0.142	0.124
	n/df	143	137	139
Father's rated warmth	r	-0.067	-0.0557	-0.0667
	p	0.422	0.515	0.432
	n/df	148	137	139
Father's rated caring	r	-0.094	-0.0732	-0.0804
	p	0.255	0.392	0.343
	n/df	148	137	139
Father's age when child born	r	0.035	0.0387	
	p	0.670	0.651	
	n/df	148	137	

E.3.2 Results

There were only 2 males reporting absent fathers and 3 reporting absent mothers, therefore these variables could not be analysed. There were no significant correlations between age preference and rated quality of relationship with each parent, warmth and caring of each parent, or parents' ages when subject was born; this was the case with or without controlling for own and parent's age (see Table E3 below). There was a marginal relationship between relationship with father and age preference such that those who got on better with their fathers preferred the younger face more (r_s=-0.155, p=0.064, n=143). However, this correlation became nonsignificant when own age was partialled out (r_{142}=-0.125, p=0.14).

APPENDIX F: AGE AND SES DO NOT MEDIATE EFFECTS IN PART 2

F.1 AGE

Father absence had no significant effect on age in Study 4 (females: $F_{2,440}=1.06$; males: $F_{2,339}=0.13$), Study 5 (females: $t_{563}=0.49$; males: $t_{310}=0.25$) or Study 8a (see Table 8.1).

Age did not relate to facial preferences in Studies 4 or 5 (all $|r|<0.1$).

Therefore age was not included in the analyses.

F.2 SES

Subjects were asked to give the number of bedrooms and the number of inhabitants in "the first house you lived in, or the one where you spent most of your childhood, if different". Number of bedrooms was then divided by inhabitants to give rooms per person. This was used as a measure of socioeconomic status (SES).

Father absence had no significant effect on childhood SES scores in Study 4 (females: $F_{2,423}=1.05$; males: $F_{2,325}=0.22$) or Study 5 (females: $t_{365}=0.67$; males: $t_{196}=0.31$).

SES did not relate to facial preferences in Studies 4 or 5 (all $|r|<0.05$).

In Study 8a, individuals in the different image groups (parents separated, parents had good relationship and parents had bad relationship) did not differ in SES (females: $F_{2,83}=0.39$; males: $t_{29}=0.53$).

Therefore the SES variable was not included in the analyses.