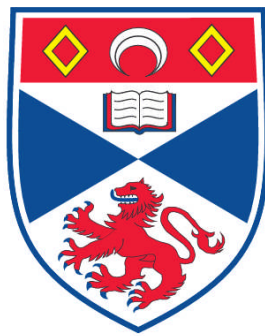


**THE EFFECT OF FEMALE REPRODUCTIVE HORMONES ON THE  
PERCEPTION OF CUTENESS**

**Jennifer Lewis**

**A Thesis Submitted for the Degree of MPhil  
at the  
University of St. Andrews**



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# **The Effect of Female Reproductive Hormones on the Perception of Cuteness**

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Thesis submitted for the degree of MPhil

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## Abstract

*The findings of two recent studies suggest that cuteness sensitivity may be modulated by the female reproductive hormones estrogen and progesterone, with women showing greater sensitivity than men (Sprengelmeyer et al 2009; Lobmaier et al 2010) and women using hormonal contraceptives showing a greater sensitivity than naturally cycling women. Post-menopausal women were found to perform at the same level as men (Sprengelmeyer et al 2009).*

*The present study aimed to extend these findings by determining if an equivalent pattern of differences occurs in the motivation to view pictures of infant faces. To investigate this question, men, naturally cycling women and women using oral contraceptives completed a key-press task in which they were able to increase or decrease the amount of time they spent viewing infant faces that varied in gender, expression and age. Following this, they rated the same set of faces for cuteness. Because levels of estrogen and progesterone fluctuate over the course of the menstrual cycle and over a month of oral contraceptive use, naturally cycling women and women using oral contraceptives completed the experiment at different times of their menstrual cycle or oral contraceptive regimen to determine the effects of cycle phase (menstrual, late follicular, luteal) and pill stage (pill phase, pill-break) on the level of key-pressing.*

*Three key findings were made. First, there is no gender difference in the cuteness judgments of infant faces suggesting that cuteness is a universal construct, perceived in the same way by all. Second, there is a strong correlation between cuteness rating and viewing time, providing evidence that the incentive value of an infant face is modulated by cuteness. And third, there is no evidence that the incentive value of cuteness is hormonally modulated. Regardless of gender, pill phase or cycle phase, the participants showed no difference in their motivation to view the infant faces*

*From these findings it appears that whilst sensitivity to cuteness in infant faces may be modulated by estrogen and progesterone, the motivation to view cute infant faces is not. It was concluded that these different components of cuteness processing evolved separately for different purposes associated with infant care.*

## **1: Theoretical Background**

The following review provides a background to the present study by looking at the morphology of the infant face, reward associated neural activation, fluctuations in hormone levels over the menstrual cycle, pregnancy and during hormonal contraceptive use. Finally, the review will summarise the effect of hormones on maternal behaviour.

The first section starts with a brief introduction to the structural morphology of the infant face, demonstrating how it differs to that of the adult face. Following this, a series of studies are presented that have measured the effects of infant cuteness and attractiveness on adult's behavioural perceptions and judgements of infants as well as their overt behaviours towards them. The chapter then considers three factors that affect the perception of cuteness; the infant's age, gender and expression.

The second section discusses neural activation that has been recorded in response to infant faces, focussing on the activation associated with reward. The 'pay per view' paradigm is then introduced, demonstrating how it can be used to predict reward associated activation and, how it has revealed gender differences in the relationship between aesthetic judgments and motivation .

The third section describes in detail how the levels of estrogen, progesterone, oxytocin, and prolactin vary over the course of the menstrual cycle and in hormonal contraceptive users.

The fourth section of the review chapter starts by discussing how face preferences change over the course of the menstrual cycle in response to changing levels of estrogen and progesterone.

Following this a series of studies that have measured changes in maternal behaviours in relation to changes in hormone levels are presented.

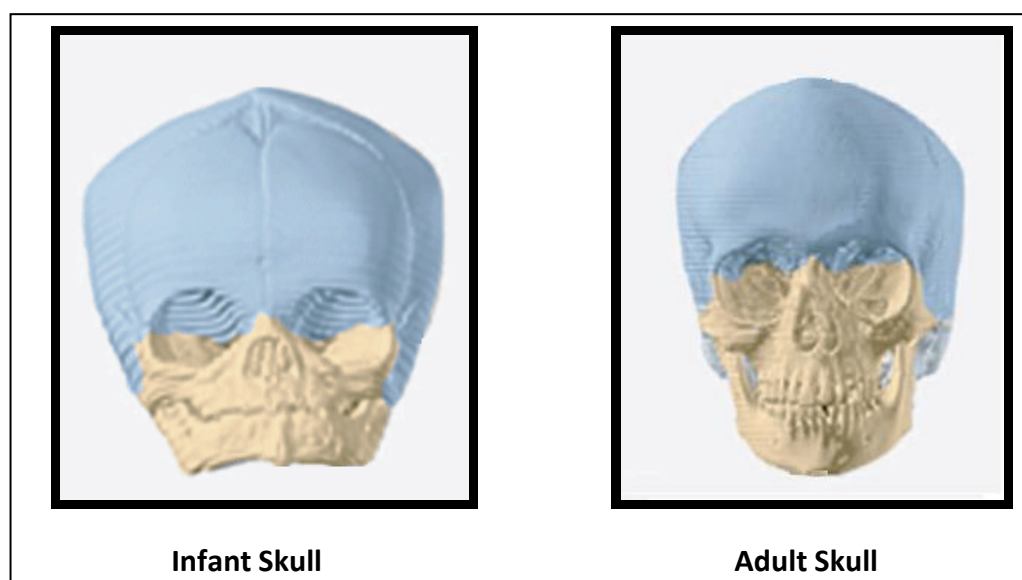


## 1.1 The infant face

### 1.1.1 Morphology of the infant face

Lorenz (1943) pointed out that the typical configuration of an infant face is different to that of an adult, characterized by a high bulbous forehead, large eyes, chubby cheeks and the facial features being set low on the face (Sternglanz et al 1979; Hildebrandt and Fitzgerald 1979; Alley et al 1981; Glocker et al 2008; Glocker et al 2009).

In Figure 1, infant and adult skulls are depicted. In both images the top half of the skull (the cranial vault) is coloured blue, whilst the lower half of the skull (the basicranium) is coloured beige. We can see from Figure 1 that in infancy the top half of the skull is proportionately larger than it is in adulthood (which gives rise to the large bulbous forehead), whilst the lower half of the face is proportionately smaller (resulting in the facial features being spaced closer together and lower down on the face) . In addition to these differences, the eye sockets are their full adult size at birth resulting in the eyes being proportionately larger than they are in adulthood.



**Figure 1: The proportions of the infant and adult skull. Image adapted from Enlow & Hans (1996).**



As the infant develops, the different structures of the face grow at proportionately different rates. In terms of face length, the lower face elongates at a faster rate than the top half of the face during the first year of life (a trend, which is then reversed between the ages of 12 and 24 months). In terms of face width, the top half of the face widens at a faster rate than the bottom half of the face during the year of life (due to neural growth) (Enlow & Hans 1996; Farkas et al 1992; White 2005). It has been observed that cuteness ratings increase over the first year of life, but start to decline by 12 months of age (Hildebrandt & Fitzgerald 1979). This suggests that cuteness is magnified during the first year of life due to the way in which the infant skull grows.

One of the features of the infant face that Lorenz highlighted as contributing to the perception of cuteness was 'chubby cheeks'. Whilst we have focussed on the configuration of the skull, we must also consider how the soft tissue affects the perception of cuteness, in particular adipose or 'fatty' tissue. Very little literature exists documenting the changes in the soft tissues during infancy due to the methods used to obtain such information (e.g. X-Rays, MRI) so instead, studies of body composition will be considered. Humans are born with approximately 15% of their body weight as fat, and in a well nourished environment, will reach a peak of 25% fat at 6-9 months of age. Following this rapid gain the infant then experiences a rapid decline in body fat until the age of 60 months, by which time they are comparatively leaner (Fomon et al 1982; Davies et al 1992). If an increase in facial adiposity (chubbier cheeks) also helps to magnify cuteness, then this would also help explain Hildebrandt & Fitzgerald's (1979) findings that cuteness ratings peak by 12 months before declining.

So far we have considered the development of 'normal' infants, however, it must be noted that some infants may have morphological abnormalities due to either traumatic birth (e.g. forceps delivery or vacuum extraction) or through medical disorders (such as hydrocephalus). In addition, malnourishment due to either famine or disease will result in lower facial adiposity. It is currently unknown as to how dramatically these differences in morphology and/or adiposity affect the level of

cuteness in an infant faces, so to avoid speculation, the present review will focus on the perception of cuteness in 'normal' infant faces.

'Cute' is the term most commonly used to describe the infant face, and infants whose faces represent the typical infant configuration are labelled as being 'more cute' than infants whose faces have a more adult like configuration (Sternglanz et al 1979; Hildebrandt and Fitzgerald 1979; Alley et al 1981; Glocker et al 2009). It is important to note that 'cuteness' is not an analogue construct i.e. cute/not cute. Instead, cuteness can be said to exist on a scale that ranges from 'not very cute' to 'very cute'. Infants described as being 'very cute' are those who have features that conform to the typical infant configuration seen in Figure 1, i.e. those who have a large bulbous forehead and features set low down on the face (Hildebrandt and Fitzgerald 1979a). In contrast, infants described as being 'not very cute' are those who have features that are more like the adult configuration seen in Figure 1, i.e. those who have a proportionately smaller forehead and features that are spaced farther apart on the vertical plane (Hildebrandt and Fitzgerald 1979a). In between the two poles of 'not very cute' and 'very cute' lay infant faces, which neither conform to the prototypical infant configuration nor to a more adult like configuration, but instead possess a configuration that lays somewhere between the two.

When adult participants rate infant faces for cuteness they are very consistent as to what *is* and what *is not* cute, i.e. if one participant rates a face as being very cute, then most of the other participants will give it a similarly high cuteness rating (Alley et al 1981; Hildebrandt and Fitzgerald 1979; Glocker et al 2009). This suggests that cuteness is a universal construct, perceived in the same way by all.

Lorenz (1943) observed that the typical infant facial configuration elicits caretaking behaviours whilst suppressing aggressive behaviours. The exact mechanism behind this response remains unknown, but it is assumed to be an innate, hard wired behavioural sequence, with the infant face

acting as the sign-stimulus that releases the care giving behaviours. Human young are altricial, which means that they are completely dependent on their caregivers for food, warmth and protection. In light of this fact, it is clear how during human evolution, selection could have favoured the evolution of such a response in caregivers and raises the question as to how the level of cuteness in an infant face mediates parental behaviours. To date, no study has directly measured the effect of infant cuteness on parental investment, however several have measured the effect of cuteness on behavioural interactions and judgements and will be discussed further on in this chapter.

We also, less frequently, describe infants in terms of attractiveness. Several of the infant studies that will be presented in this review measure the effect of attractiveness as opposed to cuteness, which is why it is important to consider the difference between the two terms. The Oxford Dictionary defines attractiveness as being 'pleasing or appealing to the senses'. Cute infants fit this description, however, there may be other factors affecting attractiveness judgments of infants. For example, in adult faces, there is a strong positive correlation between symmetry and attractiveness. Despite the fact that authors such as Karraker and Stern (1990) portray infant attractiveness and cuteness as being synonymous, it is likely that the infant attractiveness studies are measuring other than just the level of cuteness, which must be taken into account when considering these studies.

### **1.1.2 Features of the infant face that determine adult-infant interaction**

#### **1.1.2.1 Cuteness and attractiveness**

A number of studies have been conducted to determine the effect of infant cuteness and infant attractiveness on behavioural judgments and perceptions of infants by male and female adults. Stephan and Langlois (1984) and Karraker and Stern (1990) measured the effects of attractiveness and cuteness (respectively) on the behavioural ratings of infants. In these studies the participants

were presented with images of the infants and asked to give behavioural ratings for adjectives including; 'good baby', 'causes parents problems' as well as 'cheerfulness' and 'intelligence'. The studies found that infants with a higher level of attractiveness/cuteness were given more favourable behavioural ratings, which demonstrate that facial attractiveness/cuteness alone can have a significant effect on our behavioural judgements of young infants. The limitation of these two studies is that they only measure bipolar behavioural ratings as opposed to overt behavioural responses (e.g. cuddling or looking at the infants). However, when Power & Hildebrandt (1982) measured the effect of cuteness on the amount of time that adults spent looking at the infant images, they found that the infants that had previously been ranked as being 'more cute' were looked at significantly longer than those ranked as 'less cute', providing evidence that facial cuteness is enough to influence our overt behavioural responses to infants as well as our judgements of them.

It could be argued that the studies of Stephan & Langlois (1984), Karraker & Stern (1990) and Hildebrandt & Fitzgerald (1979) have a low level of ecological validity due to the fact that they were measuring responses to pictures as opposed to real infants. In some respects this may be true, however, by using pictures as opposed to real infants the authors were able to present stimuli that varied on no other factor than the variable that they were measuring, which in this case was cuteness or attractiveness. When using real infants the validity of the experiment is raised, however it becomes impossible to control extraneous variables such as the infant's facial expression or temperament, which could well affect cuteness judgements. As such, there exists a trade off between validity and control over extraneous variables. Both of these factors are critical in determining the effect of cuteness, it is therefore important to compare the results of both approaches.

Only two studies to date have measured the effects of infant attractiveness on actual behavioural judgements and interactions. Kurdahi Badr & Abdallah (2001) reported that premature infants given high attractiveness ratings by the nurses caring for them received preferential care on the basis that

they gained weight more rapidly and had shorter hospital stays. However, it must be noted that this study did not measure behavioural interactions between the nurses and the infants, but made its conclusion on the basis of weight gain and hospitalization length alone.

Langlois et al (1995) observed mothers interacting with their infants. They found that mothers of more attractive infants engaged in more 'affectionate' interactions such as vocalising positively towards the baby and patting the baby, whilst the mothers of less attractive infants engaged in more 'routine' care-giving behaviours such as winding the baby and attended more to others in the room compared with mothers of more attractive infants. In addition, when asked to give behavioural judgements of their infants, the mothers of more attractive infants had more positive behavioural judgements of them compared with the mothers of less attractive infants on factors such as how much they perceived the infants to be interfering with their lives.

Together the findings of Kurdahi Badr & Abdallah (2001) and Langlois et al(1995) provide evidence that in *actual* behavioural interactions with infants, the facial attractiveness of the infant influences the behavioural judgements and responses made towards them. As we discussed earlier, these findings may be influenced by variables such as the infant's facial expression and disposition at the time of observation. However, the results support the findings of the studies using infant images (where these variables were controlled for) and together provide evidence that behavioural judgements and responses towards infants are at least partially modulated by the infant's facial attractiveness/cuteness.

#### **1.1.2.2 Facial expression**

Facial expression has been shown to affect several aspects of infant perception. Power & Hildebrandt (1982) found that a positive (cheerful) expression increases looking time. In a forced choice looking-time paradigm (in which two infant faces were presented simultaneously) both male and female participants looked longer at smiling compared with crying infants. However, the pairs

did not consist of the same infant with a varied expression, but two infants matched by age and gender, which meant that the underlying cuteness level of the infant was not controlled for. It is therefore possible that the group of smiling infants shown had a higher underlying level of cuteness (i.e. their cuteness level with a neutral expression) compared with the crying infants and were rated higher as a result of this. Hildebrandt (1983) addressed this problem by presenting participants with three images of each infant; one where the infant had a positive expression, one with a neutral expression and one with a negative expression. The infants depicted received higher cuteness ratings when their facial expression was positive compared to when it was neutral or negative, which provides evidence that infant expression influences cuteness ratings. This same effect of expression was also found by Karakker and Stern (1990) using a similar paradigm to Hildebrandt (1983).

In addition to investigating the effect of infant expression on cuteness ratings, Karakker and Stern (1990) also measured the effect of expression on behavioural judgements. In their experiment three images of each infant were shown, one with a positive expression, one with a neutral expression and one with a negative expression. The infants received more positive behavioural ratings on factors such as 'cheerfulness' and 'intelligence' when they displayed a positive expression compared with when they displayed a negative expression, demonstrating that infant expression can also have an effect on behavioural judgements.

Together these three studies provide evidence that an infant's expression can affect an onlooker's judgement of the behavioural characteristics and cuteness of them as well as affecting the onlooker's visual preferences for them. We have discussed how an infant's cuteness/attractiveness level also affects judgements of behavioural characteristics as well as visual preference, which raises the question as to how these two factors interact with each other. Karakker and Stern (1990) summarised that whilst infant expression does have a significant effect on cuteness ratings, the infants underlying level of cuteness (i.e. its cuteness rating when it is neutral) determines the general level of these ratings on the cuteness spectrum. For example, a less cute infant might

receive a rating of 1 when crying, 2 when neutral and 3 when smiling, whereas a more cute infant might receive a 3 when crying, a four when neutral and a 5 when smiling.

Whilst these three studies support the assumption, that an infant displaying a positive (cheerful) facial expression will elicit positive behavioural responses from onlookers (such as the attribution of more positive behavioural characteristics) it must be noted that these studies only measure the effect of still images. In order to provide validation for the findings of these studies, the same pattern of findings should be observed in actual behavioural interactions with infants.

### **1.1.2.3 Infant gender**

Like infant cuteness and facial expression, infant gender has also been found to have significant effects on the perception of infants. However, unlike the effects of cuteness and facial expression, the findings of the studies measuring the effect of infant gender are conflicting.

Hildebrandt & Fitzgerald (1979) found that cuter infants were more likely to be labelled as female when subjects were asked to guess their gender. In addition, Wiffen & Perrett (in prep) presented participants with interactive infant faces, which could be masculinised or feminised. When asked to make the 'baby look its best' the participants significantly feminised the male infant faces whilst making no significant changes to the female infant faces. Together, the findings of these two studies suggest a significant association between femininity and cuteness. It would therefore be expected that female infants would receive higher cuteness ratings than male infants. However, contrary to this expectation Karraker & Stern (1990) observed that male infants received higher cuteness ratings than female infants whilst Hildebrandt & Fitzgerald (1979) found that infants labelled as male received higher cuteness ratings than infants labelled as female. One possible explanation for the contradicting results is that the ratings reflect the sample of images used. If the females used in the samples were less cute than in an average sample it is possible that this lead to males receiving a higher average cuteness rating than the females.



#### 1.1.2.4 Infant age

To date, only one study has directly measured the effect of infant age on cuteness ratings.

Hildebrandt and Fitzgerald (1979) presented participants with a series of infants ranging between the ages of 3 and 13 months displaying a neutral expression. A significant effect of infant age was found, with the older infants receiving higher cuteness ratings than the younger infants. An interaction between infant age and infant gender was also observed with female infants reaching their peak level of cuteness earlier at around nine months compared with the male infants who reached their peak later at around eleven months of age. It must be noted that the sample size for each age group was only 10 infants, which may not have contained a representative sample of infants in each age group. However, the general finding that older infants are perceived as being cuter supports a morphological trait of the infant skull. In terms of face width, the top half of the face widens at a faster rate than the bottom half of the face during the year of life (due to neural growth) The result of this is that the forehead becomes even larger in proportion to the rest of the face, thus increasing the level of cuteness for a brief period at the end of the first year of life (Enlow & Hans 1996; Farkas et al 1992; White 2005) In addition, the rapid increase in adiposity between birth and 9 months of age will also magnify cuteness by giving the infant chubbier cheeks (Fomon et al 1982; Davies et al 1992).

Lobmaier et al (2010) found a significant effect of cuteness on the perception of an infant's age, with cuter infants being perceived as younger. However, in Lobmaier et al's (2010) study the infants compared were all from the same age group (6.5 months) making it impossible to determine how the perception of cuteness changes as an infant actually ages.

The findings of Wiffen & Perrett (in prep) do not support Hildebrandt & Fitzgerald's (1979) finding that female infants reach their peak level of cuteness earlier than male infants. Wiffen & Perrett (in prep) found that infant faces which had been masculinised were perceived as being older than their

feminised counterparts. As such, it would be expected that male infants would appear older than their female counterparts and therefore reach their peak level of cuteness at a younger age. It is possible that this conflicting finding is the result of Hildebrandt & Fitzgerald's (1979) small sample sizes for each infant group making it necessary for the experiment to be repeated with a larger sample to provide further evidence either for or against their finding.

### **1.1.3 Summary**

In summary, the typical configuration of an infant face is different to that of an adult, characterized by a high bulbous forehead, large eyes, chubby cheeks and the facial features being set low on the face. Infants with a facial configuration that conforms to this description are typically labelled as being 'more cute' than infants with a more adult like configuration who are considered to be 'less cute' (Sternglanz et al 1979; Hildebrandt and Fitzgerald 1979; Alley et al 1981; Glocker et al 2008; Glocker et al 2009). More cute infants have been found to receive more favourable behavioural ratings and longer looking times (Stephan & Langlois 1984; Karraker & Stern 1990; Hildebrandt & Fitzgerald 1979; Kurdahi Badr & Abdallah 2001; Langlois et al 1995). In addition to the effects of cuteness on the perception of infants, Infant expression, gender and age have also been shown to affect behavioural perceptions and visual preferences towards infants (Power & Hildebrandt 1982; Hildebrandt 1983; Karraker & Stern 1990; Hildebrandt & Fitzgerald 1979; Wiffen & Perrett in prep; Lobmaier et al 2010).

## **1.2 Neural activation in response to infant faces**

### **1.2.1 fMRI and passive viewing**

In order to survive and successfully reproduce, a species must carry out certain behaviours including eating, drinking, and copulating. These behaviours are all associated with pleasure or satisfaction and it has been hypothesised that we have evolved what is commonly referred to as the 'reward

system' to regulate these behaviours through reinforcement by inducing pleasurable effects following their performance (Purves et al 2001). Human infants are altricial, meaning that they are completely dependent on their caregivers for sustenance and protection (Purves et al 2001). Care-giving behaviour towards young infants is therefore vital for the survival of the species. Because caring for an infant is often reported by mothers to be a great source of pleasure and satisfaction, recent studies have used fMRI to determine if the pleasure associated with care-giving is also regulated by the reward system.

The first of these studies was conducted by Bartels & Zeki (2004) who aimed to determine if maternal love shares the same pattern of neural activation as 'romantic' love (Bartels & Zeki 2000). To investigate this question Bartels & Zeki (2004) compared neural activation of mothers (in response to images of their infants) with the neural activation observed in individuals in 'deep love' (in response to images of their partner). In the group of mothers, neural activation was observed in dopamine reward processing areas including the striatum, the substantia nigra as well as the ventral tegmental area as well as deactivations in areas associated with negative emotion and social judgement, which included the posterior cingulate gyrus and the amygdala. This spatial distribution of activation overlapped with several areas observed when those in 'deep' love viewed pictures of their partners, who also showed activation in the striatum and the posterior region of the ventral tegmental area as well as deactivations in areas associated with negative emotion and social judgment including the posterior cingulate gyrus and the amygdala. Bartels & Zeki's (2004) study demonstrated two main findings; that maternal love shares core neural correlates with romantic love, and that the activation of reward related areas are at least in part responsible for the affective state of maternal love.

Chapter one reported how an infant's expression can affect both cuteness/attractiveness ratings (Hildebrandt 1983 and Karraker & Stern 1990) and behavioural judgements (Karraker & Stern 1990) as well as visual preference (Power & Hildebrandt 1982). Strathearn et al (2008) measured how

activation of reward associated areas differ in response to infants with different facial expression. The participants in the study (all were mothers) were presented with images of their own infants as well as images of unfamiliar infants. Three pictures of each infant were shown; one with a neutral expression, one with a smiling expression and one with a sad expression. There was found to be an effect of infant identity with own (but not unfamiliar) infants significantly activating areas associated with reward, including the ventral tegmental area, the striatum and regions of the substantia nigra. In addition, it was observed that in these regions of activation, there was a progressive decrease in the percentage signal change from happy, to neutral, to sad facial expressions. Strathearn's (2008) study demonstrates that in mothers, reward activation is only significant in response to her own infant. And, that facial expression can have significant effect on the level of activation in reward associated areas, with happy faces eliciting the highest level of activation.

As well as the effect of infant expression, we also discussed in chapter one how the level of cuteness/attractiveness in an infant face has been shown to affect behavioural judgements (Stephan & Langlois (1984) and Karraker & Stern 1990) as well as visual preference for them (Power & Hildebrandt 1982). In order to determine if the level of cuteness in an infant face also affects the level of activation in reward associated areas, Glocker et al (2009) presented nulliparous females with a series of images varying in the level of cuteness during fMRI scanning. The participants task during scanning was to rate the images for cuteness. Activation in areas associated with reward (specifically, the nucleus accumbens) was found to be significantly higher in response to images depicting cute infants compared to images of less cute infants. Activation was also observed in other regions of interest including the left fusiform gyrus, which is associated with face processing and the pre-nucleus, an area associated with attention. Glocker et al's (2009) study demonstrated two key points, 1) that infant faces can elicit reward activation in nulliparous females, and 2) that the level of cuteness affects the level of activation in reward associated areas.

Together these studies provide evidence that infant faces activate areas associated with reward in both mothers (Bartels & Zeki 2004 and Strathearn et al 2008) and nulliparous females (Glocker et al 2009). In addition they also provide initial evidence that reward associated activation does not happen uniformly in response to an infant face, but is mediated by both the infants expression (Strathearn et al 2008), cuteness (Glocker et al 2009) and in the case of mothers, the identity of the infant (own vs. unfamiliar) (Strathearn et al 2008) .

### **1.2.2 The Key-Press paradigm**

Aharon et al (2001) observed that reward associated neural activation can be predicted using a 'key-press paradigm'. In the key-press paradigm the participant views a series of faces that change automatically after a set period of time (usually around four seconds). The participant has the ability to increase or decrease the set viewing time of the images by pressing buttons. The more rapidly the participant presses the buttons the more they increase/decrease the viewing time of the image. The amount of key presses made is taken as a measure of how motivated the individual is to view, or not view an image.

In Aharon et al's (2001) study, one set of male participants were given a key press task in which adult faces varying in the level of attractiveness (average vs. attractive) were presented. It was found that the participant's key pressed significantly more to view attractive female faces compared with average female faces. No significant difference was found between the levels of key pressing exerted for average vs. attractive male faces, which were both viewed at a similar level to the average female faces. A second set of participants passively viewed the same set of faces during an fMRI scan. A region of interest analysis revealed that the left nucleus accumbens, an area associated with reward, showed a significant effect of beauty, with the highest level of signal change observed in response to beautiful female faces.

The key-press paradigm has also revealed that men and women show differential motivation to view attractive faces of the opposite sex (Aharon et al 2001; Levy et al 2008). In these tasks four categories of face stimuli were presented; attractive females, attractive males, average females and average males. Male participants were found to key press significantly more to view female faces compared with male faces, and significantly more to view attractive female faces than average female faces (Aharon et al 2001; Levy et al 2008).

In contrast, female participants' key pressed significantly longer to view attractive vs. average faces of both sexes, but showed no preference for the faces of the opposite sex. In addition, their overall level of key pressing for the male and female attractive faces was (non-significantly) lower than that observed for males in response to the attractive female faces (Levy et al 2008).

In both of these key-press studies, rating tasks were also administered so that each of the faces presented in the key-press task was rated for attractiveness. Despite the marked differences in motivation between males and female participants, there was found to be no effect of participant gender on the attractiveness ratings of these images. Males assigned high attractiveness ratings to attractive male faces despite showing no motivation to view them and a diminished level of reward system activation in response to them (Aharon et al 2001; Levy et al 2008). This suggests that in men, positive aesthetic judgments of a face do not necessarily lead to an increased level of motivation and reward system activation. It therefore cannot be assumed that the presentation of an infant with a high level of cuteness will elicit a higher level of reward system activation in men in the same manner that it does in women (Glocker et al 2009)

Only one study to date has used a key press paradigm to investigate the motivation to view infant faces, however the comparison was between 'normal' infants and those with facial abnormalities such as cleft palate and foetal alcohol syndrome (Yamamoto et al 2009). As expected, the 'normal' infants were viewed longer and received higher attractiveness ratings than infants with facial

abnormalities. The only gender difference observed was that females viewed images of infants with facial abnormalities significantly less than males, suggesting that males are more tolerant of facial deformities than females.

### **1.3 Female reproductive hormone levels and their effect on maternal and reproductive behaviours**

Sprengelmeyer et al (2009) presented adult participants with pairs of infant images from which they were asked to select the 'more cute' infant. Each pair consisted of two almost identical pictures of the same infant that had been transformed (using a cuteness prototype) to give them a different level of cuteness. The difference in the level of cuteness between each pair of images varied by one of five percentage levels: 0% (the pair of images is identical), 25% (a small difference), 50% (a larger difference) or 100% (the largest difference). Sprengelmeyer et al's (2009) study was designed to measure how sensitive the participants were to differences in the level of cuteness between two images. In this sense 'cuteness sensitivity' can be defined as the ability of an individual to select the 'more cute' image from a pair of infant images. An individual able to select the cuter image from a pair with a small difference in the level of cuteness (i.e. a 25% difference) would be classed as having a high level of cuteness sensitivity. In contrast, an individual who could only select the cuter image when the pair differed by 100% would be classed as having a low level of cuteness sensitivity.

Sprengelmeyer et al (2009) observed that older pre-menopausal women were significantly more sensitive to cuteness (would correctly select the 'more cute' infant from the pair more often at all percentage levels) than post-menopausal women and that young women using hormonal contraceptives were significantly more sensitive to cuteness than young women not using hormonal contraceptives. Men were found to perform at the same level as the post menopausal women.

Because of the differences observed between men and women, pre and post- menopausal women, and women using hormonal contraceptives, Sprengelmeyer et al (2009) suggested that cuteness



sensitivity may be in some part modulated by the female reproductive hormones estrogen and progesterone. This same gender difference in cuteness sensitivity was also observed by Lobmaier et al (2010) using Sprengelmeyer et al's (2009) methodology. However, when asked to select the younger or happier baby from a pair, no sex difference was observed. This suggests that if there is an effect of the hormones estrogen and progesterone on the perception of infants, it is restricted to the realm of cuteness perception.

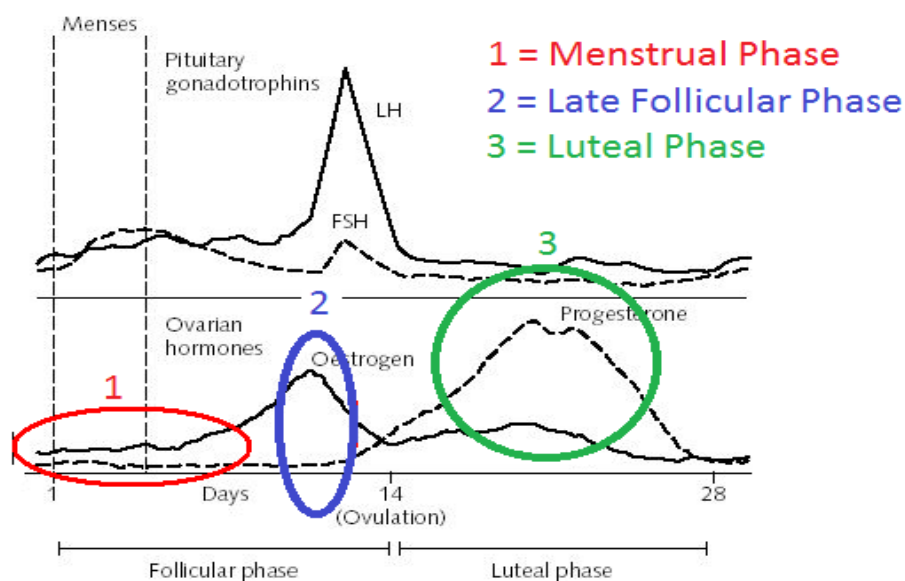
From an evolutionary point of view it is most adaptive for women to be sensitive to infant faces during early infancy, when the infant is most dependent on the mother. Until the recent development of formula milk, all women breastfed until their infant could be weaned on to solid food. Because the process of breastfeeding is mediated by oxytocin and prolactin, these two hormones are present in raised levels in recent mothers and may therefore also play a role in mediating cuteness sensitivity.

In light of these observations, the following section will explain how the female reproductive hormones estrogen and progesterone as well as the peptide hormones oxytocin and prolactin fluctuate over the course of the menstrual cycle, in hormonal contraceptive users and during pregnancy.

### **1.3.1 Hormone levels in naturally cycling women.**

During the first half of the cycle several follicles in one of the ovaries begin to mature and produce high levels of estrogen. The maturation is modulated by the secretion of Follicle Stimulating Hormone (FSH) from the anterior pituitary. It is this rise in estrogen that causes the menstrual bleeding to slow and stop. The same rise in estrogen also triggers a rise in Luteinizing Hormone (LH), following which the most dominant follicle releases an egg in the process known as ovulation. The remains of the dominant follicle in the ovary become what is known as the corpus luteum, a temporary endocrine structure, which releases large amounts of progesterone (and a lower amount

of estrogen) during the second half of the cycle. The progesterone produced by the corpus luteum changes the consistency of the endometrial lining, making it suitable for implantation of a fertilized egg. If implantation of a fertilized egg does not occur within two weeks, the corpus luteum begins to decay, causing a sharp drop in the level of progesterone and estrogen. This drop in progesterone causes the endometrium to shed its lining in the process known as menstruation. In addition, this general drop in the steroid hormones is detected by the hypothalamus and pituitary, which initiates the production of Gonadotrophic Releasing Hormone (GnRH). GnRH is responsible for the release of FSH and LH, which initiates the next cycle (Purves et al 2001). Figure 2 (next page) summarises these changes in hormone levels.



**Figure 2: Changes in the levels of hormones over the 28 day menstrual cycle. The three coloured circles highlight the changes in estrogen to progesterone ratios over the course of the cycle. Image adapted from Jones (1997)**

In addition to the well established fluctuations of estrogen, progesterone, FSH, LH and GnRH over the course of the menstrual cycle, let us now consider the levels of prolactin and oxytocin.

Mitchell et al (1981) observed a peak in the level of oxytocin around the time of the LH surge.

Kumaresan (1983) found that oxytocin levels were significantly higher in the follicular phase of the menstrual cycle compared with the luteal phase, reaching a peak around day 10 of the cycle and

beginning its decline on the day of the LH surge. In a small sample of naturally cycling women (n=4) Suckovski et al (1988) found that oxytocin levels began to rise in the follicular phase reaching a peak just after the LH surge, followed by a decrease in the luteal phase. Together these studies show that levels of oxytocin are higher in the follicular phase than the luteal phase, reaching a peak around the time of the LH surge.

A review on prolactin structure, function and secretion by Freeman et al (2000) identified only one study as having found menstrual fluctuations of prolactin. In this study, prolactin levels were found to increase during the follicular phase of the cycle, peaking at the approximate time of the LH surge (Vekemans et al 1977).

### **1.3.2 Hormone levels in hormonal contraceptive users**

In terms of hormonal contraception, the most common variation is the 'combined oral contraceptive pill', which involves the user taking pills containing a synthetic estrogen and progesterone for a period of 21 days, followed by a 7 day pill-break. During the 21 day pill-taking phase, the high level of synthetic progesterone inhibits the release of Gonadotropic Releasing Hormone or 'GnRH' (which is released by the hypothalamus) through negative feedback. Because GnRH is responsible for the release of LH and FSH, the suppression of GnRH production results in the decrease of the release of FSH by the anterior pituitary. The decreased level of FSH inhibits follicular development, which in turn means that there is no rise in endogenous estrogen. In the natural cycle it is the rise in estrogen that triggers the LH surge and consequently ovulation, however the absence of this rise in pill users

means that ovulation does not occur. The absence of the corpus luteum in pill users means that there is also no rise in endogenous progesterone (Rivera et al 1999)

During the pill-break levels of synthetic hormones drop, triggering bleeding in the same way that the drop in endogenous hormones causes bleeding in a natural cycle. During the pill-break the level of FSH and LH rise significantly as the anterior pituitary is no longer suppressed by the synthetic progesterone. This rise in FSH results in follicular development and consequently a rise in the level of endogenous estrogen (Reiner et al 1998) However, the level of follicular development is limited and ovulation does not occur meaning that the levels of progesterone do not change over the course of the pill-break (Rible et al 2009; Spona et al 1996)

In comparison with naturally cycling women, hormonal contraceptive users have been found to have higher overall levels of oxytocin levels (Sibler et al 1987 Stock et al 1989; Sibler et al 1991). However, it is unclear how the levels of oxytocin change between the pill-taking and pill-break phases.

Mishell et al (1977) found that levels of prolactin were raised in pill users in comparison to non-hormonal contraceptive users. Abu-Fadil et al (1975) found that the levels of prolactin were highest sequential pill users during the estrogen pill-taking phase, indicating that the increased levels of prolactin in pill users are the result of the raised levels of synthetic estrogen.

#### **1.3.4 Summary**

To summarise, the changes in the levels of estrogen and progesterone over the menstrual cycle can be subdivided into three distinct phases; The early follicular phase, which is characterised by low level of both estrogen and progesterone and mid levels of oxytocin and prolactin. The late follicular phase, which is characterised by a high ratio of estrogen to progesterone and peaks in the level of oxytocin and prolactin. The luteal phase is characterised by a high ratio of progesterone to estrogen and the lowest levels of oxytocin and prolactin. The circles in Figure 2 highlight these three phases.

In hormonal contraceptive users there are two distinct phases, the pill-taking phase and the pill-break phase. The pill-taking phase is characterised by high levels of exogenous estrogen and progesterone and low levels of endogenous estrogen and progesterone. In contrast the pill-break phase is characterised by low levels of exogenous estrogen, exogenous and endogenous progesterone and a rising level of endogenous estrogen. It has been established that hormonal contraceptive users have higher levels of oxytocin and prolactin than naturally cycling women, however it remains unknown as to how levels change between the pill and pill-break phases.

In pregnant women, the levels of estrogen and progesterone rise steadily of the course of pregnancy with a higher ratio of progesterone to estrogen. Following birth the elevated levels of estrogen and progesterone rapidly drop back to their pre-pregnancy levels. There is no established pattern for the levels of oxytocin and prolactin over the course of pregnancy.

#### **1.4 The effect of hormones on maternal behaviour and face perception**

The findings of Sprengelmeyer et al (2009) and Lobmaier et al's (2010) studies suggest that the female reproductive hormones estrogen and progesterone modulate cuteness sensitivity, with high levels of these hormones resulting in increased sensitivity. In the previous chapter we discussed how the levels of estrogen and progesterone fluctuate over the course of the menstrual cycle and in hormonal contraceptive users. To date, no studies have investigated whether the perception of infant faces varies over the course of the menstrual cycle or during hormonal contraceptive use as a result of these hormonal fluctuations. A series of studies have investigated the perception of *adult* faces over the course of the menstrual cycle, providing evidence that perception/preferences do change as a result of fluctuating levels of female reproductive hormones. The changes observed in these studies include fluctuations in masculinity preference as well as preferences for health and facial symmetry.

### **1.4.1 Masculinity vs. femininity**

Penton-Voak et al (1999) presented women with male faces varying in the level of masculinity. Women in the fertile phase of their cycle (the time after ovulation during which fertilization of the egg can occur), were found to show a higher preference for masculinity whilst women in the luteal phase showed a preference for femininity. In contrast, women using the hormonal contraceptive pill were found to show no preference for masculine or feminine faces (Penton-Voak et al 1999). A further study by Penton Voak & Perrett (2000) found a similar pattern of findings with women in the follicular phase showing a stronger preference for masculine faces whilst women in the luteal and menstrual phases were found to show a preference for feminine faces. Due to the immunosuppressive effects of testosterone, facial masculinity (which is a result of high levels of testosterone) is considered to be a signal of genetic quality (Folstad and Karter 1990). As such, the preference for facial masculinity during the fertile phase is highly beneficial for mate choice.

### **1.4.2 Perceived health**

In a study by Jones et al (2005) women were presented with pairs of faces that were either raised or lowered in apparent health (i.e. how healthy they looked). The task of the women was to select the face they preferred and indicate the strength of their preference for the face on a Likert scale. An effect of cycle phase was observed, with women in the luteal phase demonstrating a stronger preference for the healthier looking faces than women in the follicular phase. In addition it was found that women on the using the hormonal contraceptive pill showed a stronger preference for the healthier looking faces than naturally cycling women and that pregnant women showed a stronger preference for the healthier looking faces than non-pregnant women. Progesterone has immunosuppressive effects, which function to prevent a woman's immune system from attacking a blasocyst if conception were to occur. A side effect of this immunomodulation in that the immune system is weaker during the luteal phase (as well as pregnancy and hormonal contraceptive use)

when the level of progesterone is at its highest. As such, during this phase it is beneficial for women show a preference for being around healthier looking individuals who theoretically carry less pathogens (Fessler et al 2001)

### **1.4.3 Facial symmetry**

Koehler (2002) presented naturally cycling women with faces varying in the level of symmetry during the early and late follicular phases of their cycle. A second group of women using hormonal contraceptives were also tested. Whilst the women were found to show an overall preference for the symmetrical faces there was no effect of cycle phase or pill use on the ratings. However, the comparison in this study was between the early and late follicular phases of the cycle, where there is a difference in the level of estrogen, but no change in the level of progesterone.

Little et al (2007) found cyclic changes in women's facial preferences in a comparison between women in the late follicular and luteal phases of the cycle, where there is a difference between the level of progesterone (as well as estrogen). When presented with pairs of faces varying in the level of symmetry women showed a significant preference for the symmetrical faces during the late follicular phase (when progesterone levels are low), but not during the luteal phase of the cycle (when progesterone levels are high) suggesting that a preferences for facial symmetry are suppressed by progesterone. There is evidence that facial symmetry is a signal of genetic quality, with more attractive males (who have a higher level of symmetry) showing increased heterozygosity at key loci in the Major Histocompatibility Complex (MHC) (Roberts et al 2005). Heterozygosity in the MHC is associated with increased immune function thus making it highly adaptive to show an increased preference for symmetry during the fertile phase when conception is possible.

Together these studies demonstrate how the fluctuations of hormones across the menstrual cycle affect preferences for various facial characteristics. Penton-Voak et al (1999) and Penton-Voak & Perrett's (2000) studies demonstrated that a high ratio of estrogen to progesterone promotes a



preference for masculinity whilst a high ratio of progesterone to estrogen promotes a preference for femininity. In contrast the hormonal contraceptive pill appeared to suppress preference altogether. Jones et al (2005) found a stronger preference for healthier looking faces in individuals with raised levels of progesterone (women in the luteal phase, pill users and pregnant women) compared with women with a low level of progesterone (women in the follicular phase) suggesting that progesterone strengthens the preference to be around healthy individuals. The pattern of Little et al's (2007) findings suggest that progesterone suppresses the preference for facial symmetry (as opposed to estrogen facilitating it) with women in the luteal phase demonstrating a decreased level of preference in comparison with those in the early or late follicular phases.

The studies discussed demonstrate how the changing ratios of estrogen to progesterone encourage beneficial mate choices during the fertile period (Penton-Voak et al 1999; Penton-Voak & Perrett's 2000; Little et al 2007) as well as protecting females from potential sources of pathogens when the immune system is weakened (Jones et al (2005). It is difficult to predict from these studies how infant face perception may change over the course of the menstrual cycle as it is a 'maternal' behaviour as opposed to one associated with mate choice. In order to predict how the perception of infant faces may change in response to the changing ratios of estrogen to progesterone (or potentially oxytocin and prolactin) we need to determine the hormone ratios associated with maternal behaviours.

#### **1.4.4 Gender differences in parental behaviours**

In this last section we have focussed on how hormone levels differ between naturally cycling women and women using hormonal contraceptives and considered how these differences affect mate choice and maternal behaviour. To conclude, let us now consider the maternal behaviours exhibited by men and women. Both Sprengelmeyer et al (2009) and Lobmaier et al (2010) observed that men have a lower level of cuteness sensitivity than women, which fits in with the theory that cuteness

sensitivity is modulated by the hormones estrogen and progesterone. However, Lobmaier et al's (2010) study revealed that in tasks requiring the judgement of an infant's age and facial expression, men are as capable as women at detecting small differences in infant faces. In the age and expression judgment tasks the participants were presented with the same pairs of infant faces presented in the cuteness judgement task. In the age judgment task the participants were asked to select the 'younger baby' and in the expression judgement task they were asked to select the 'happier baby'. The results of these two tasks revealed no gender difference in the ability to determine the younger or happier baby, which demonstrates that men are as capable as women in detecting subtle differences in infant faces. However, men have a decreased ability to pick up on cues for cuteness, which Sprengelmeyer et al's (2009) study suggests is hormonally modulated. Lorenz (1943) proposed that cuteness elicits caretaking behaviours. If men have a reduced ability to perceive the construct of cuteness then it would be expected that they would exhibit a lower level of maternal related behaviours in general.

In chapter one we discussed a series of studies that observed effects of infant cuteness, expression gender and age on participants' perception of infants. Two of the studies discussed in the chapter also revealed effects of participant gender. Power & Hildebrandt (1982) found significant effects of cuteness level and expression on viewing times. In addition they found a gender difference in heart rate response to the images, with females showing an increase in heart rate in response to crying infants whilst men showed a decreased heart rate, suggesting a gender difference in the emotional response to negative infant emotion. Power & Hildebrandt's (1982) study also revealed that men look longer at infant images compared to women. However, a previous study by Hildebrandt & Fitzgerald's (1978) had demonstrated that men look longer at both infant *and* adult images suggesting that this was a gender difference in response to task demands as opposed to a difference in their actual desire to view infant images.

Karraker & Stern's (1990) study found significant effects of infant cuteness on ratings and of cuteness level on behavioural judgements. In addition, a significant effect of participant gender was found on two of the behavioural judgement scales with female participants rating the infants as being more sociable and easier to care for than the male participants suggesting that women have more positive behavioural perceptions of infants.

In addition to the studies discussed in chapter one, five other studies have measured the effects of participant gender on maternal behaviours. Feldman et al (1977) observed a gender difference in the covertly observed behaviour of participants who were left in a waiting room with an infant. Female participants of all ages were found to be more responsive to the infant, smiling and talking to it more than male participants who were more likely than females to ignore the infant. However, with the negative assumptions that are made about men who approach young children (paedophilia) it is possible that the men in the study avoided contact with the infants out of fear of accusations.

Two further studies by Maestripieri & Pelka (2001) and Volk and Quinsey (2002) have used questionnaires to determine participant's preferences for infants. Maestripieri and Pelka (2001) asked participants a series of questions about their general interest in infants and to what level they would interact with an infant if there was one present at social gathering. The responses to these questions revealed stronger infant interest in females compared with males. With the questionnaires being anonymous it is unlikely that fear of social judgment was responsible for the gender difference observed in this study.

Volk and Quinsey (2002) created a hypothetical adoption situation. Participants were presented with a series of infant images, which they rated on the basis of how willing they would be to (hypothetically) adopt the infants. Following this they rated pictures of infants on four factors; resemblance (as a proxy for kinship), cuteness, happiness and health. All four of the rated factors were found to have a strong correlation with adoption preference, however men were found to

have the strongest correlation between adoption preference and self resemblance whilst women had the strongest correlations between adoption preference and the other three factors of health, happiness and cuteness.

Two further studies have used infant images to measure participants' spontaneous responses to infant images. Hildebrandt and Fitzgerald (1978) measured spontaneous zygomaticus activity (smiling) in response to infant and non-infant faces. There was found to be a significant effect of face type, with infant faces eliciting significantly more zygomaticus activity as well as an effect of participant gender, with females showing more zygomaticus activity than males. Brosch et al (2007) presented participants with pictures of human adults and infants as well as pictures of adult and infant non-human species to determine if infant faces (of either species) capture attention more than adult faces in a dot probe paradigm. There was found to be no effect of participant gender, with infant faces capturing the attention of both males and females significantly more than adult faces (but only for the human species).

#### **1.4.5 Summary**

Together these studies demonstrate that males and females have differential interest in infants. When questioned (Maestriperi and Pelka 2001) and in an actual interaction situation (Feldman et al 1977) men demonstrate a lower interest in infants compared with women. Men also show different emotional responses to infant faces, (Hildebrandt & Fitzgerald 1978; Power & Hildebrandt 1982) which may reflect their different their more negative behavioural judgements of infant images (Karraker & Stern 1990) as well as having different priorities when adopting (Volk & Quincey 2002). Despite these gender differences, Brosch et al (2007) found no difference in attention capture in their dot probe paradigm. This suggests that infant faces *capture* the attention of men as readily as they do in women, the gender difference occurs in the subsequent reaction to the faces.

## 2: Study

### 2.1 Introduction

It has been established that an infant's appearance has an effect on the way it is judged. Cuter infants receive more favourable behavioural ratings (Stephan and Langlois 1984; Karraker and Stern 1990), are looked at significantly longer in a forced choice task (Power & Hildebrandt 1982) and elicit a greater level of reward circuitry activation (Glocker et al 2009.). 'Cuteness', the construct believed to modulate our behaviour towards infants, elicits caretaking behaviours whilst suppressing aggressive behaviours towards infants. Cuteness is not an analogue construct i.e. cute/not cute, but exists on a scale that can be said to range from 'not very cute' to 'very cute'. Hildebrandt & Fitzgerald's (1982) study found that 'more cute' images receive significantly longer viewing times, suggesting that they carry a higher level of incentive value. To date, the direct relationship between the level of cuteness and incentive value has not been measured.

Aharon et al (2001) and Levy et al's (2008) studies have used the key-press paradigm to correlate the level of attractiveness in adult faces with motivation to view them. The current study will present participants with a series of infant faces in a key-press paradigm where they may increase or decrease the viewing time of the faces. Following this, the participants will rate the same set of faces for cuteness on a five point Likert scale. With previous studies showing that cuter infants receive more favourable behavioural ratings (Stephan and Langlois 1984; Karraker and Stern 1990), are looked at significantly longer in a forced choice task (Power & Hildebrandt 1982) and elicit a greater level of reward circuitry activation (Glocker et al 2009), it is expected that cuteness level will be positively correlated with the motivation to view an infant face.

Whilst Sprengelmeyer et al (2009) and Lobmaier et al (2010) observed a gender difference in cuteness *sensitivity*, they did not observe a gender difference in the participants' ratings of the infant faces, which suggests that cuteness is a universal construct, perceived in the same way by all. The

present study will correlate the ratings of the male and female participants in order to test this theory.

Sprenghelmeyer et al (2009) and Lobmaier et al (2009) observed that females are more sensitive to small differences in cuteness than males. In addition, differences observed between the female subjects in Sprenghelmeyer et al's (2009) study suggest that female reproductive hormones may be involved in the modulation of cuteness sensitivity. Women using hormonal contraceptives (who have raised levels of synthetic estrogen & progesterone) were found to have the highest level of accuracy at the task followed by naturally cycling women and then post menopausal women. It was concluded by the authors of both papers that the pattern of findings indicates that cuteness sensitivity may be modulated either directly or indirectly by the female reproductive hormones estrogen and progesterone. We discussed in section 1.3.1 how levels of estrogen and progesterone fluctuate over the course of the menstrual cycle. If reproductive hormone status modulates the incentive value of cuteness then we would expect to see variation in motivation over the course of the cycle in response to these changes.

### **Across-Cycle Experiment (Within-Subjects Design)**

The menstrual cycle can be subdivided into three phases, which represent different levels of estrogen and progesterone; the menstrual phase (low estrogen and progesterone), the late follicular phase (high estrogen, low progesterone) and the luteal phase (mid estrogen, high progesterone). The 'across cycle' study will use a within-subjects design, testing naturally cycling women during each of the three phases of their cycle to determine if the motivation to view infant faces significantly varies across the menstrual cycle. In most species of mammals a high ratio of estrogen to progesterone is associated with increased maternal behaviour/motivation, for example in Rats and Macaques (Fleming et al (1997) and Maestrpeiri and Zehr (1998)). During the follicular phase of the human menstrual cycle, the ratio of estrogen to progesterone is at its highest. So, if estrogen

and progesterone *do* modulate the incentive value of cuteness, it is expected that women will demonstrate a significantly higher level of motivation during the follicular phase of their cycle (see Figure 3b).

#### **Pill-taking vs. Pill-break Study (Within-Subjects Design)**

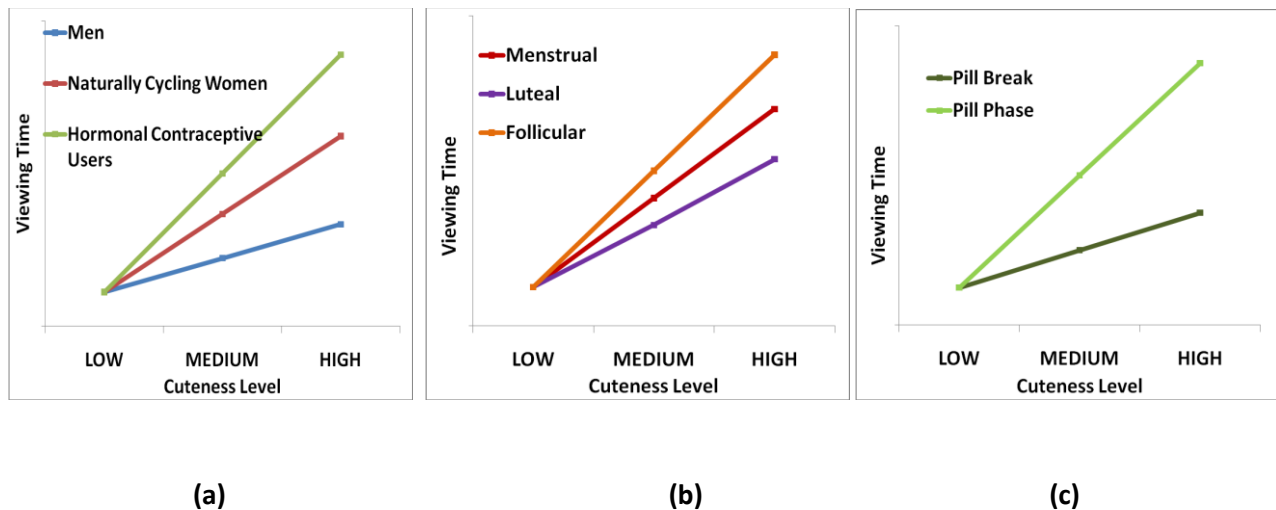
We also discussed in chapter three how estrogen and progesterone fluctuate over the course of a month of hormonal contraceptive use. During the pill-taking phase, levels of exogenous estrogen and progesterone are high whilst levels of endogenous estrogen and progesterone are low. In contrast, during the pill-break phase, levels of exogenous estrogen and progesterone are low, whilst levels of endogenous estrogen begin to rise. If these two hormones modulate the incentive value of cuteness, then we would also expect to see a difference in the level of motivation in hormonal contraceptive users between the pill-taking and pill-break phases. Sprengelmeyer et al (2009) and Lobmaier et al (2010) concluded that the high levels of estrogen and progesterone in pill users may be responsible for the increased sensitivity in hormonal contraceptive users. The Pill-taking vs. Pill-break study will use a within-subjects design, testing each woman once during the pill-taking phase and once during the pill-break phase of their hormonal contraceptive cycle. If there is an effect of estrogen and progesterone on the incentive value of cuteness then it is predicted that motivation will be higher during the pill-taking phase compared with the pill-break phase.

#### **Cross sectional Study (Between-Subjects Design)**

In order to provide a full cross sectional study we will also test male participants. Sprengelmeyer et al's (2009) and Lobmaier et al's (2009) studies found that men had the lowest level of cuteness sensitivity, which was concluded to be due to their having the lowest levels of estrogen and progesterone. If estrogen and progesterone modulate the incentive value of cuteness, then it is



expected that compared with naturally cycling women and women using hormonal contraceptives, men will demonstrate the lowest level of motivation to view the infant faces (see Figure 3a)



**Figure 3. Graphs representing the predictions for (a) The effect of hormone profile on viewing time (b) the effect of cycle phase on viewing time (c) the effect of pill use on viewing time.**

#### **Within Subjects Factors (for the three proposed studies)**

In terms of within subjects factors, we discussed in the first section how three factors have been shown to affect the perception of cuteness in infants; expression, age and gender. Infants with a positive facial expression receive more favourable behavioural ratings (Stephan and Langlois' 1984; Karraker and Stern 1990) and are looked at significantly longer than infants with a negative facial expression. In terms of age, Hildebrandt & Fitzgerald (1979) found that cuteness peaks between 9 and 11 months before declining again. It is therefore expected that the infants within the 9-11 month age group will receive significantly higher ratings and longer looking times than the younger infants between 6-8 months of age. The effect of gender is less clear, it has been observed that cuter infants are more likely to be labelled as female Hildebrandt & Fitzgerald (1979) and that male babies are feminized in order to make them look their best (Wiffen & Perrett, in prep). Conversely,

infants labelled as male (Hildebrandt & Fitzgerald 1979) and actual male infants (Karraker & Stern 1990) have been found to receive higher cuteness ratings than their female counterparts.

In order to determine the effects of infant expression, gender and age in the current experiment, the images presented will be half male, half female; half neutral, half smiling and aged between 6 and 12 months. In light of the findings of Stephan and Langlois' 1984; Karraker and Stern 1990; Hildebrandt & Fitzgerald 1979 it is expected that participants will look longer at and give higher ratings to smiling infants, and infants aged between 9 and 11 months. The effect of gender on motivation in the present study is unpredictable due to the conflicting evidence of Hildebrandt & Fitzgerald (1979), Karraker & Stern (1990) and Wiffen & Perrett (in prep).

## **2.2 Participants, materials and methods**

### **2.2.1 Participants**

A total of 71 participants were tested, consisting of 24 men (mean age = 20.6 yrs), 25 women using the hormonal contraceptive pill (mean age = 19.6 yrs) and 22 naturally cycling women (mean age = 20.8 yrs). All were students of the University of St Andrews and took part for either course credit or payment. The groups did not differ in respect to age (one-way ANOVA,  $F=1.93$ , 2,69,  $p=.15$ ). The male participants completed the experiment once whilst the women completed the experiment up to three times. Data from a trial where the participant made an average of less than one key press per image was excluded on the basis that the participant was not actively participating in the task ( $n=10$  trials).

#### **2.2.1.1 Cross-sectional comparison**

22 naturally cycling women, 25 women who were taking oral contraceptives (tested between day 2 and 21 of their oral contraceptive regimen, while taking the hormonal substitute) and 24 young men took part in the study. The naturally cycling women were asked to return two more

times for the across-cycle study (see 2.2.1.2) and the women using hormonal contraceptives were asked to return once more for the pill-taking vs. pill-break comparison (see 2.2.1.3). However, because testing had to take place during strict time intervals, there was a high dropout rate.

#### **2.2.1.2 Across-cycle comparison (naturally cycling women)**

Out of the group of 22 naturally cycling women, 11 participants (mean age 20.5 years, SD 1.4) were tested three times; once during the menstrual phase of their cycle, once during the follicular phase and once during the luteal phase. The remaining 11 participants dropped out of the study after the either the first or second round of testing. Testing in the menstrual phase took place between days 1 and 5 of the cycle, as confirmed by the onset of their period. To determine the follicular phase, ovulation prediction kits were given to the participants to use at home. These kits detect the surge in Luteinizing Hormone (LH) that takes place immediately preceding ovulation. Once this surge had been detected participants were asked to come in as soon as possible (no later than 72 hours after detection). Time of testing was between days 12 and 16, depending on the average length of the participant's cycle. The luteal session was scheduled between days 19 and 28 of the cycle, based on the last menstruation and results from the ovulation prediction kits. The women were recruited at different phases of their menstrual cycle in order to counterbalance the order of tests.

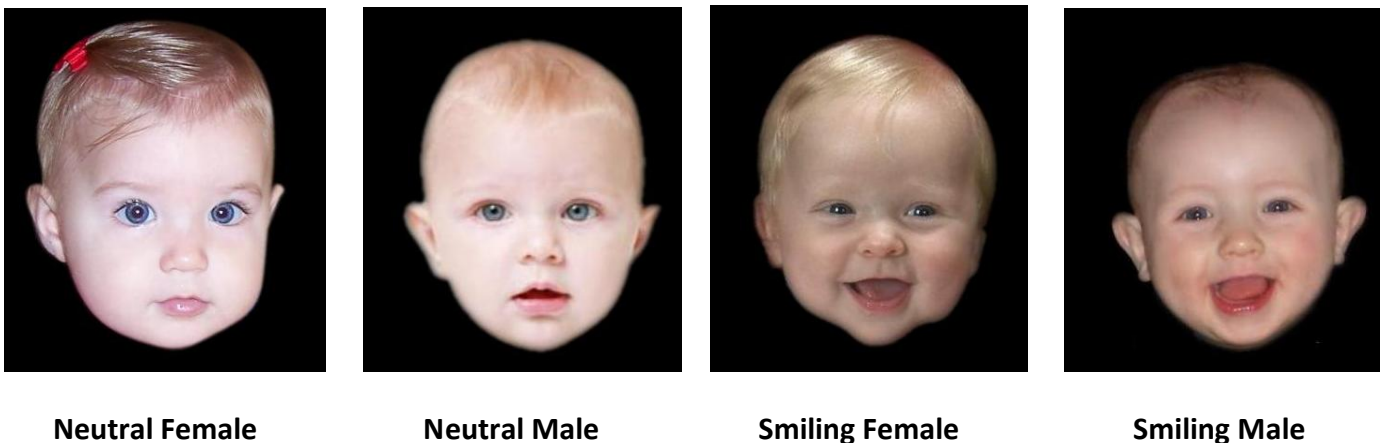
#### **2.2.1.3 Pill-taking vs. pill-break comparison (hormonal contraceptive users)**

Out of the group of the 25 women using hormonal contraceptives, 6 women (average age 18.5, SD 0.8) using hormonal contraceptives were tested twice; while taking oral contraceptives (any time between the 2nd and 21<sup>st</sup> day of pill use) and during their 7 day pill free interval. The remaining 19 participants dropped out of the study after the first round of testing. The women were recruited at different phases of their contraceptive cycle in order to counterbalance the order of tests.

### 2.2.2 Stimuli

The images were obtained from the internet. Only images that provided both the infants gender and age were used. A total of 56 images were selected from a larger cache. These images were selected on the basis of their pixel quality and the clarity of the infant's expression (either neutral or smiling). The images were split in to four main categories on the basis of gender and expression; neutral male, neutral female, smiling male and smiling female. There were 14 images in each of these categories. Each of the four categories contained images of infants between 6 and 12 months of age (two from each month of age).

The 56 faces were delineated and masked using PsychoMorph 8.4.1.0. The delineation process involves defining 160 feature points on each face, these feature points define the outlines and inner details of the main features of the face such as the nose (including the nostrils) and the eyes (including the pupils) as well as the general outline of the face. The first step in this process is to upload an individual picture in to PsychoMorph 8.4.1.0. A template containing the 160 facial landmarks is uploaded in to the programme and aligned over the top of the uploaded picture. Each feature point on the template is then manually aligned to the corresponding area on the uploaded image. Within the same programme, the images were masked with a black background and aligned. Each image, including the masked background was 539 pixels high by 541 pixels wide. These images were presented in the centre of the screen against a white background. Examples of each of the four categories of image are presented in Figure 4 below.



**Figure 4: Examples of each of the four categories of face stimuli**

### **2.2.3 Procedure**

#### **2.2.3.1 Questionnaires**

Each group of participants answered a series of questions in order to determine their childcare experience and relationship status by assessing their experience with children and infants and their desire to have children in the future as well as their romantic relationship status. In addition, the two female groups answered questions to help determine their hormonal status e.g. what day of their cycle they were on. See Appendix 1 for questionnaires.

#### **2.2.3.2 Key-press task**

56 images were presented individually in a random order on a computer screen, if no action was taken, the images would change automatically every four seconds until each had been presented once. The length of time the images stayed on the screen could be either increased or decreased through key-pressing. The maximum length of time the image could be viewed was 16 seconds, which could be achieved through alternately pressing the N & M keys. Alternatively, the minimum length of time the image could be viewed was 2 seconds, which could be achieved by pressing the Z & X keys. The effect of key-pressing on increasing/decreasing viewing time was proportional to the speed at which the keys were pressed; faster pressing elicited a greater effect. As a visual aid for the participants, a vertical green bar was situated to the left of the image, which decreased in length as the amount of viewing time left decreased. This bar enabled participants to see how much time they had left to view the image, thus allowing them to make an online judgment of whether or not they wanted to increase or decrease the viewing time of a given image.

A second key-press task was also created as a 'practice' task for the participants. The parameters of the task were identical to those described above, except for the images presented. The images in the practice task were images that the participants would generally find either aversive (e.g. an extremely ugly dog) neutral (e.g. a light bulb) or salient (e.g. chocolate). This choice of images was

to demonstrate to the participants how they could increase or decrease the viewing time of images they did or did not want to view.

### **2.2.3.3 Rating task**

In the rating task each of the 56 images presented in the main key-press task were presented individually in a random order. Underneath each of the images was a Likert scale ranging from 1 ('Not very cute') to 5 ('Very cute'). Following each rating made on the Likert scale the image would automatically change. There was no time limit on how long participants could take to rate each image.

### **2.2.3.4 Debriefing**

Following the completion of the test session, participants were either scheduled in for their next test session or debriefed (if they had completed all test sessions).

### **2.2.3.5 Ethical statement**

This study was performed in accordance with the policy and procedures for ethical research practice set out by the University of St Andrews. The protocol for this study was approved by the University Teaching and Research Ethics Committee of the University of St Andrews (Approval numbers: PS9548 and PS6311). See Appendix 2 for full copies of the ethical approvals.

### 3 Results

#### 3.1 Questionnaire data

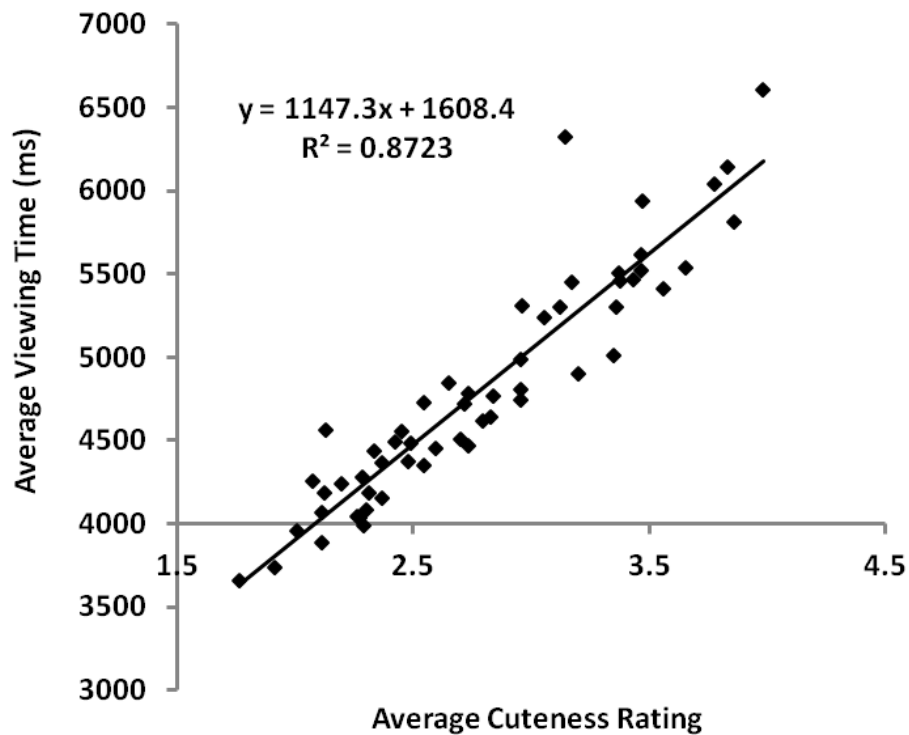
The relationship status and childcare questionnaire revealed that 42 % of males, 40% of hormonal contraceptive users and 32% of naturally cycling women were in a relationship .77% of men, 88% of hormonal contraceptive users and 72% of naturally cycling women reported that they wanted to have children in the future. 42% of males, 24% of hormonal contraceptive users and 31% of naturally cycling women regularly spent time with children each week. All participants reported some experience of children, which was typically from babysitting, from younger family members or from volunteer work. No participant reported having children of their own.

#### 3.2 Inter-rater reliability

In order to determine the level of inter-rater reliability for the 56 images shown CRONBACH's alpha was calculated using the rating data from all three participant groups on their first test. The level of inter-rater reliability across all participants was high, CRONBACH's alpha = 0.95. Cuteness ratings between men and women taking oral contraceptives were significantly correlated ( $r=.85, p <.001$ ), as was the rating between men and regularly cycling women ( $r=.87, p <.001$ ). Cuteness ratings between women taking oral contraceptives and regularly cycling women correlated significantly ( $r=.75, p <.001$ ).

#### 3.3 Correlation between cuteness rating and viewing time

In order to determine the level of correlation between cuteness and viewing time, the average cuteness rating and viewing time for each of the 56 images were calculated and plotted against each other. A strong positive correlation between cuteness rating and viewing time was found ( $R = 0.87$ ), see Figure 5 below.



**Figure 5: The correlation between the average cuteness rating and viewing time for each of the 56 images**

### 3.4 Categorisation of cuteness Levels

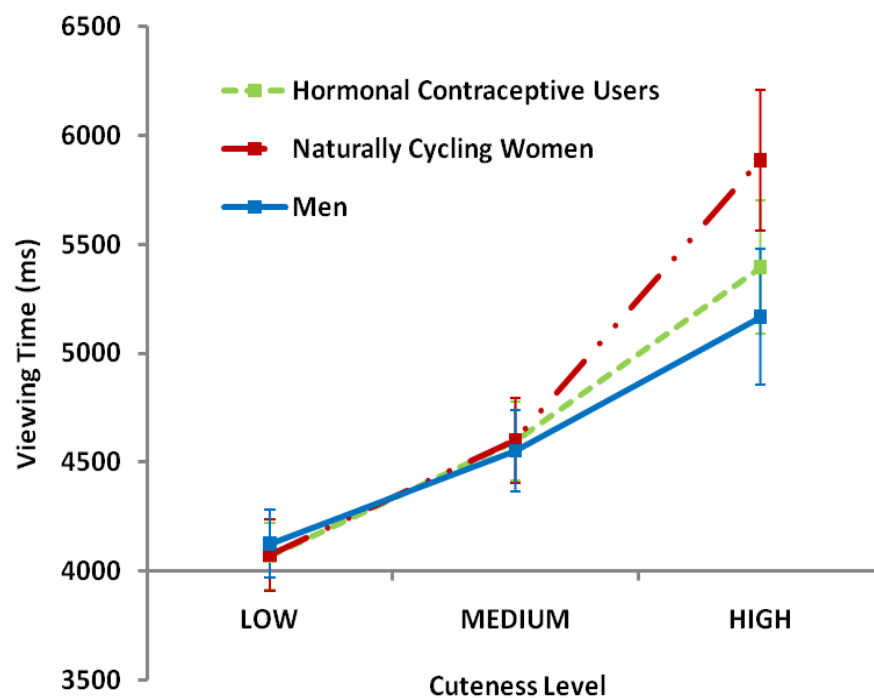
Using the cuteness ratings collected from the 71 participants, the 56 infant images were ranked on the basis of their average cuteness level. The images were then subdivided into three groups; the lowest fifteen ranked images were divided into the 'low' cuteness group, the middle fifteen images into the 'medium' cuteness group and the top fifteen images into the 'high' cuteness group. Only the data collected from these three groups of images were used in the subsequent analyses.



### 3.5 Key-press task

#### 3.5.1 Effects of hormone profile and cuteness level on viewing times

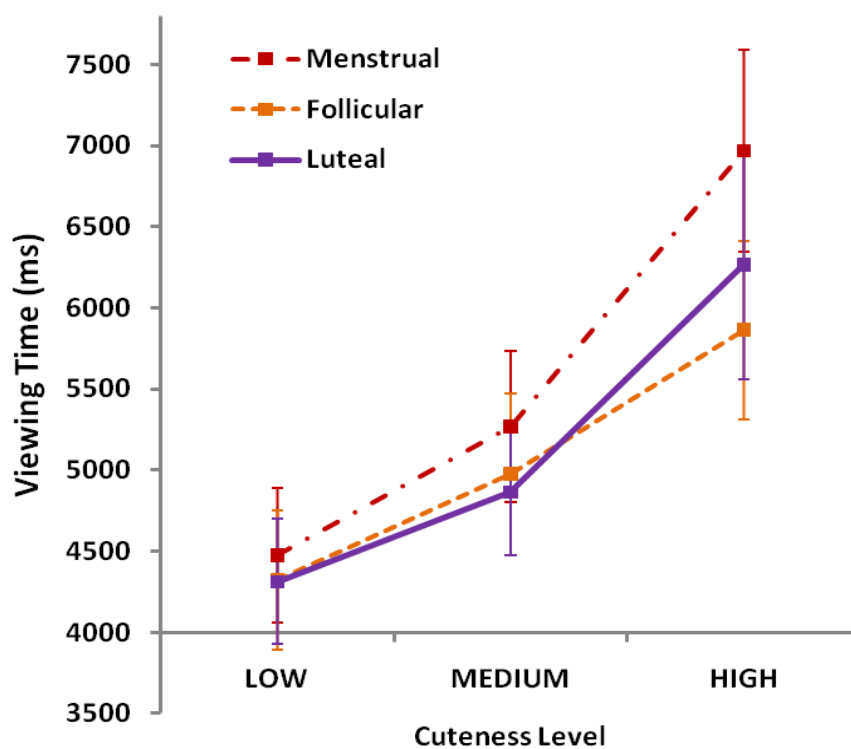
A repeated measures ANOVA was performed with hormone profile (naturally cycling, hormonal contraceptive user, male) as a between subjects factor and cuteness level (low, medium, high) as a within subjects factor to determine the effects of hormone profile and cuteness level on viewing times. There was found to be a significant effect of cuteness level on viewing times  $F(2,136) = 60.12$ ,  $p < 0.001$ ) with viewing time increasing as cuteness level increased (see Fig 6 below). However, there was found to be no significant effect of hormone profile on viewing times  $F(2,68) = 0.398$ ,  $p = 0.673$ ) and no interaction between hormone profile and cuteness level  $F(4) = 1.79$ ,  $p = 0.135$ ). Fig 6 below demonstrates these findings.



**Figure 6: The effect of Cuteness Level on Viewing Times for each of the three groups**  
(Error bars represent S.E.M)

### 3.5.2 Effect of cycle phase on viewing times

To determine the effect of cycle phase and cuteness ratings on viewing times for the nine naturally cycling women who completed the task in all three cycle phases an ANOVA with Cycle Phase (follicular, menstrual, luteal) and cuteness level (low, medium, high) as within subjects factors was conducted. An effect of cuteness level on viewing times was found  $F(2,16) = 14.90, p < 0.001$  but no effect of cycle phase  $F(2,16) = 1.61, p = 0.231$  and no interaction between cycle phase and cuteness rating  $F(4,32) = 0.84, p = 0.51$ . Figure 7 below demonstrates these findings.

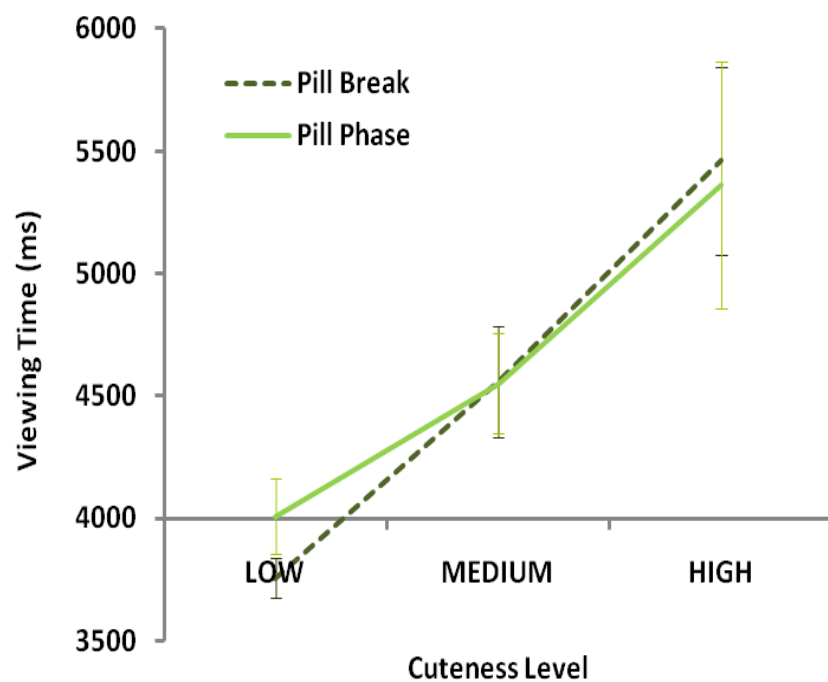


**Fig 7: The effect of Cuteness Level on Viewing Times for each of the three cycle phases**  
(Error bars represent S.E.M)

### 3.5.3 Effect of pill use on viewing times

To determine the effect of pill use and cuteness ratings on viewing times for the six hormonal contraceptive users who completed the task in both phases an ANOVA with Pill Use (pill Phase, pill-break) and cuteness level (low, medium, high) as within subjects factors was conducted. An effect of cuteness level on viewing times was found  $F(2, 10) = 20.28, p < 0.001$  but no effect of pill use  $F(1, 5) = 0.18, p = 0.90$  and no interaction between pill use and cuteness level  $F(2, 10) = 0.616, p = 0.56$ .

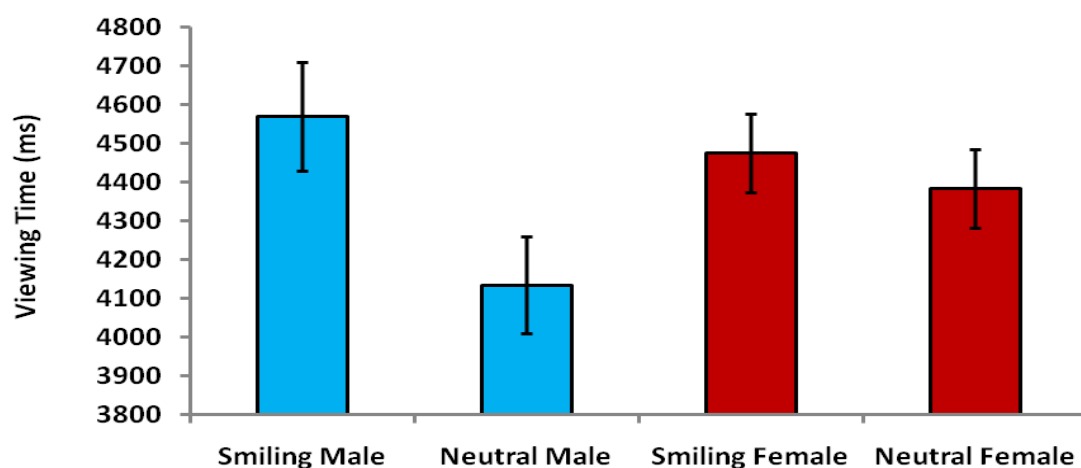
Figure 8 below demonstrates these findings.

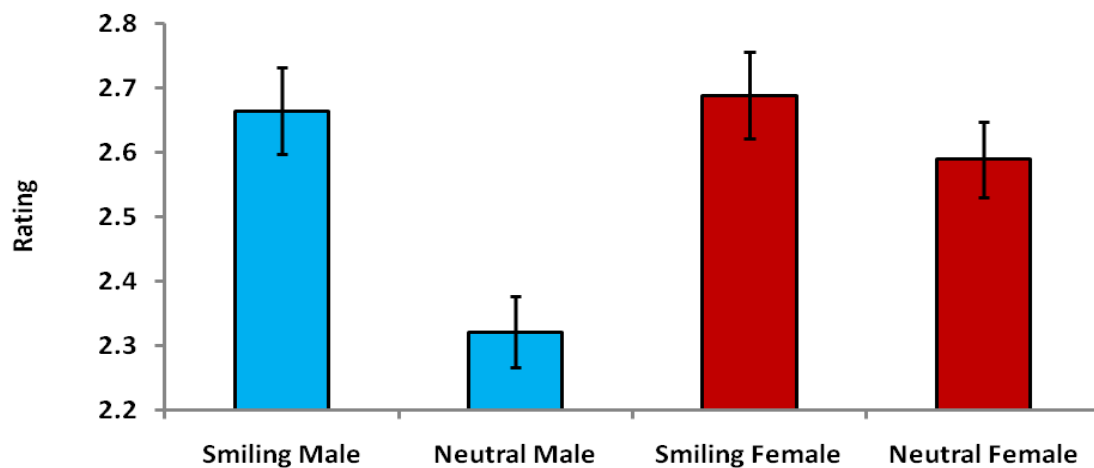


**Fig 8: The effect of Cuteness Level on Viewing Times during the Pill-break and Pill Phase**  
(Error bars represent S.E.M)

### 3.5.4 Effects of infant gender and expression

In order to measure the effect of infant expression and infant gender on cuteness ratings and viewing times two repeated measures ANOVA's were conducted with infant expression (neutral vs smiling) and infant gender (male vs female) as within subjects factors. Data from all 56 images were used in these analyses. There was found to be a significant effect of infant expression on both cuteness ratings  $F(1,70) = 10.87, p < 0.005$  and viewing times  $F(1,70) = 15.87, p < 0.005$  with smiling infants rated higher and viewed longer than neutral infants. There was no effect of infant gender on viewing times  $F(1, 70) = 1.73, p = 0.19$  but a significant effect on cuteness ratings  $F(1,70) = 18.04, p < 0.001$ , with female infants receiving higher cuteness ratings than male infants. There was also a significant interaction between infant gender and infant expression for both cuteness ratings  $F(1,70) = 22.46, p < 0.005$  and viewing times  $F(1,70) = 7.07, p < 0.001$ . Post hoc t- tests (using the Bonferroni correction) revealed that the effect of expression was only significant for male infants, with smiling male infants receiving significantly higher ratings  $t(70) = 5.52, p < 0.001$  and viewing times  $t(70) = 3.67, p < 0.005$  than neutral male infants whilst there was no significant difference between ratings  $t(70) = 1.65, p = 0.10$  or viewing times  $t(70) = 1.11, p = 0.27$  of neutral female and smiling female infants. Figure 9 demonstrates these findings.





**Fig 9. The effects of infant expression and gender on cuteness ratings (top graph) and viewing times (bottom graph). Error bars represent S.E.M.**

### 3.5.5 Effects of infant age on cuteness ratings and viewing time

In order to determine the effect of infant age on cuteness ratings and viewing times the 6-8 month old infants were combined to form the 'young infants' category and the 9-11 month old infants were combined in to the 'older infants' group. Paired samples t-tests were conducted on both the Cuteness rating data and the Viewing Time data. There was found to be a significant effect of infant age on cuteness ratings  $t(70)=5.77, p<0.001$  with younger infants receiving a higher average rating (mean=2.89) than older infants (mean=2.66). There was also found to be a significant effect of infant age on viewing time  $t(70)=3.82, p<0.001$  with younger infants being viewed significantly longer (mean= 4905 ms) than older infants (mean= 4615 ms).

## 4: Discussion

The findings of Sprengelmeyer et al (2009) and Lobmaier et al (2010) suggest that there may be a hormonally modulated effect of gender on the ability to detect small differences in infant faces.

The present study aimed to extend these findings 1) by investigating to see whether there is a gender difference in cuteness judgments, 2) whether the incentive value of an infant face (i.e. how much we want to see it) is determined by its cuteness, and 3) whether the incentive value of cuteness is hormonally modulated. We also looked at the effect of facial expression, gender, and age on cuteness rating and incentive value. The following section will discuss each of these questions in turn, and will conclude by integrating the findings in to a broader context.

### 4.1 Gender differences in cuteness judgement

In order to determine if there was a gender difference in cuteness judgements, participants were presented with pictures of infant faces, which they rated for cuteness on a five point Likert scale. In order to measure the incentive value of the faces presented, a 'key-press paradigm' was used. This paradigm was developed by Aharon et al (2001) and allows participants to either increase or decrease the viewing time of faces that are sequentially presented on a computer screen. This paradigm has been successfully used to determine the incentive value of adult faces varying in attractiveness, and the effect of facial abnormalities on the incentive value of children's faces.

However, to date, the paradigm has never been used to determine the incentive value of cuteness.

The present study first compared the cuteness ratings given by male and female participants. There was found to be no significant differences between the cuteness ratings given by men and women.

In addition Cronbach's  $\alpha$  revealed that both groups had a high level of internal consistency. These findings are similar to those of Sprengelmeyer et al (2009), who found that whilst men and women differ in their sensitivity to small differences in infant faces, there is no significant difference in their judgments of cuteness in un-manipulated faces.

This reflects the findings of Aharon et al (2001) and Levy et al (2008) who found no gender difference in the judgments of attractiveness in adult faces. However, despite finding no gender difference in the *judgements* of attractiveness they did see differences in the *incentive value* of attractiveness. The women in Aharon et al's (2001) and Levy et al's (2008) studies key-pressed significantly more to view attractive vs. unattractive faces of either gender, whilst the men only showed a significant increase in key-pressing to view attractive faces of the opposite sex. It therefore could not be assumed (in men at least) that infants judged as being more cute would elicit a higher level of motivation to be viewed.

#### **4.2 Aesthetic judgement and incentive value**

We then went on to determine the correlation between cuteness rating and viewing time across all participants. Previous research has shown that cuter infants receive more favourable behavioural ratings (Stephan and Langlois 1984; Karraker and Stern 1990), elicit a greater level of reward circuitry activation (Glocker et al 2009) and, most relevantly, are viewed significantly longer in a forced choice task (Power & Hildebrandt 1982). It was therefore expected that cuteness would be positively correlated with viewing time. In order to determine the level of correlation, the average cuteness rating and viewing times were plotted against each other. There was a strong positive correlation between cuteness rating and viewing time demonstrating that the cuter an infant face is, the stronger it's incentive value. One of the functions of having a cute face appears to be that of capturing attention. Young human infants are completely helpless and require constant attention in order to survive, it is therefore crucial for them to be able to both draw and maintain positive attention from potential caregivers. The present study demonstrates that the level of cuteness in an infant face determines how long an individual will view an infant face for, before moving on to the next one. Together with the studies of Stephan and Langlois (1984) and Karraker and Stern (1990)

the present study provides further evidence that cuteness modulates our behaviour towards infants, with cuter infants receiving more favourable responses from their caregivers.

#### **4.3 Hormonal modulation of incentive value**

Sprengelmeyer et al (2009) and Lobmaier et al's (2010) studies observed that females are more sensitive to cuteness than males. Sprengelmeyer et al (2009) also observed that older pre-menopausal women were significantly more sensitive to cuteness than post-menopausal women and that young women using hormonal contraceptives were significantly more sensitive to cuteness than young women not using hormonal contraceptives.

Because of the differences observed between men and women, pre and post- menopausal women, and women using hormonal contraceptives, the authors concluded that the pattern of findings suggest that hormones may play a role in the modulation of cuteness sensitivity. The reproductive hormones estrogen and progesterone were considered to be the most likely candidates for this modulation, with high levels of these hormones being associated with an increased level of cuteness sensitivity.

This raises the question as to whether the levels of these hormones also affect the incentive value of cuteness i.e. how much effort people will exert to view infant images. Relatively few studies have measured the effects of estrogen and progesterone on maternal behaviours in humans. Although the evidence is limited, together it suggests that in pregnant and postpartum women, a higher ratio of estrogen to progesterone is associated with an increase or the onset of maternal behaviours in members of both the lower primates (suborder Strepsirhini) (Pryce et al 1993) and the higher primates (suborder Haplorhini) (Fleming 1997 and Maestri & Zehr 1998).

In order to explore the possibility that estrogen and progesterone may affect the incentive value of cuteness, three comparisons were made. The first was a between subjects comparison of men, women using hormonal contraceptives and naturally cycling women. The second was a within subjects comparison of naturally cycling women in the luteal, follicular and menstrual phases of the



cycle. The third was a within subjects comparison of hormonal contraceptive users in the pill vs. the pill-break phase.

It was predicted that if the incentive value of cuteness is hormonally modulated, then individuals with artificially raised levels of estrogen and progesterone and women with a higher ratio of estrogen to progesterone would exhibit higher levels of effort to view the infant faces (see Figures 3a – 3c for more detailed predictions).

All three comparisons revealed no significant effect of hormone levels on viewing times, which strongly suggests that the incentive value of cuteness is *not* hormonally modulated. The findings also demonstrate that cuteness has a similar incentive value for both men and women, a result that may seem surprising given that from an evolutionary point of view women are the main caregivers of infants.

So, why might cuteness elicit a similar incentive for both men and women? Lorenz (1943) proposed that the particular configuration of infant faces not only elicits caretaking behaviours but also suppresses aggressive behaviours towards infants, thus protecting them from physical abuse. As humans have always lived in groups containing both men and women, such a mechanism potentially protects against abuse or infanticide by not only the females, but also the males in the group. In addition, whilst the infant face elicits close one to one contact with females, the sight of it may signal to males that extra protection and resources are needed for the females carrying the infants. This extra protection re-allocation of resources would serve to increase the reproductive success of the group.

It must be noted that the present study measured reactions to a series infant images only. If other biologically relevant stimuli were presented, such as attractive faces of the opposite sex, it is possible that we would see a gender difference. For example, men may show a higher level of incentive value for the opposite sex faces whilst women may show a higher or equal level of value for infant faces.

#### 4.4 Infant expression and gender

The present study also investigated the effects of infant gender and facial expression on cuteness ratings and viewing times. Infants with a positive facial expression have been shown to receive more positive behavioural ratings (Stephan and Langlois 1984; Karraker and Stern 1990) and are looked at significantly longer than infants with negative facial expressions. It was therefore expected that that smiling infants would be rated higher and looked at longer than neutral infants.

The effect of infant gender on participant behaviour is unclear. It has been observed that cuter infants are more likely to be labelled as female Hildebrandt & Fitzgerald (1979) and that male babies are feminized in order to make them look their best (Wiffen & Perrett, in prep). Conversely, infants labelled as male (Hildebrandt & Fitzgerald 1979) and actual male infants (Karraker & Stern 1990) have been found to receive higher cuteness ratings than their female counterparts. From this conflicting evidence, a prediction could not be made.

The present study found there to be a significant effect of infant expression on cuteness ratings (but not on viewing times), with smiling infants receiving higher cuteness ratings than neutral infants. However, there was also found to be a significant interaction between infant expression and infant gender, which revealed that the effect of infant expression was significant only for male infants. Smiling male infants received significantly higher ratings than neutral male infants, which reflect the findings that infants with a positive facial expression receive more positive behavioural ratings (Stephan and Langlois' (1984); Karraker and Stern 1990) and are looked at significantly longer than infants with a negative facial expression (Power and Hildebrandt 1982). However, these previous findings do not explain why the effect of smiling is greater for male infants than it is for female infants.

A potential explanation for the interaction between infant expression and gender comes from the finding that there was found to be a trend towards an effect of infant gender on cuteness rating (but

not on viewing times) with female infants receiving higher cuteness ratings than male infants. It is therefore possible that due to the lower level of cuteness in male infants, the infant's expression becomes a more salient feature resulting in a stronger bias of expression on cuteness ratings for male infants compared with female infants. The effect of infant gender in the present study also reflects the finding that cuter infants are more likely to be labelled as female Hildebrandt & Fitzgerald (1979) and that male babies are feminized in order to make them look their best (Wiffen & Perrett, in prep). It also suggests that the previous findings that male infants receive higher cuteness ratings (Hildebrandt & Fitzgerald 1979; Karraker & Stern 1990) reflect the sample of images used in these studies as opposed to providing evidence that male infants are cuter than female infants.

#### **4.5 Infant age**

Lastly, we investigated the effects of infant age on cuteness ratings and viewing times. To date, only one study to date has directly measured the effect of infant age on cuteness ratings (Hildebrandt and Fitzgerald, 1979). In their study a significant effect of infant age was found with the older infants receiving higher cuteness ratings than the younger infants. Although the sample size of the study was small, the results reflect the observation that cuteness is 'magnified' during the first year of life due to the forehead increasing in size (Enlow & Hans 1996) and may also reflect an increase in facial adiposity (Fomon et al 1982; Davies et al 1992). The present study also found there to be a significant effect of infant age on cuteness ratings with younger infants (6-8 months) receiving higher cuteness ratings and viewing times than older infants (9-11 months). This finding reflects that of Hildebrandt and Fitzgerald (1979) and provides further evidence for the theory that cuteness is magnified during the first year of life due to the way in which the infant skull grows, as well as an increase in facial adiposity.

#### 4.6 Theoretical integration of findings

In conclusion, the present study adds three key findings to the literature. Firstly, there is no gender difference in the cuteness judgments of infant faces suggesting that cuteness is a universal construct, perceived in the same way by all. Secondly, there is a strong correlation between cuteness rating and viewing time, providing evidence that the incentive value of an infant face is modulated by cuteness. And thirdly, there is no evidence that the incentive value of cuteness is hormonally modulated. Regardless of gender, pill phase or cycle phase, the participants showed no difference in their motivation to view the infant faces. This third finding went against the predictions of the present study, so let us now consider its implications in more detail.

Sprenghelmeyer et al (2009) and Lobmaier et al's (2010) studies demonstrated that during their reproductive years, women show an increased sensitivity to cuteness in infant faces. The pattern of findings from the two studies suggested that this heightened sensitivity may be modulated by the reproductive hormones estrogen and progesterone. In contrast, the present study found no evidence of hormonal modulation of either cuteness judgments or the incentive value of infant faces. This indicates that whilst some components of cuteness processing may be modulated by reproductive hormones, other components are not, suggesting they may have evolved separately for different purposes associated with infant care.

Human childrearing does not just involve the mother and her young, but rather a whole entourage of alloparents as well as the father. This type of shared caretaking is common among the primate species and increases long term reproductive success by reducing the physical burden that the mother faces. Within these social groups there are often several young being cared for at any given time. Whilst all young require continuous care, infants require the *most* care of any age group in order to survive. As such, it is crucial for infants to be able to elicit preferential treatment from their

caregivers. Cuteness is believed to elicit precisely this type of preferential treatment, therefore making it necessary for *all* potential alloparents to be able to perceive and be motivated by cuteness, not just the mother.

However, if all parents and alloparents are able to universally perceive and be motivated by the level of cuteness in the infant face, what function does the increased sensitivity to cuteness observed by Sprengelmeyer (2009) and Lobmaier (2010) serve? In terms of direct mother-infant interactions, an infant's appearance can affect the *type* of care given to the infant and the behavioural judgements made about it. For example, in Langlois et al's (1995) study, mothers of more attractive/cute infants were found to engage in more 'affectionate' interactions whilst the mothers of less attractive/cute infants engaged in more 'routine' care-giving behaviours. In addition, when asked to give behavioural judgements of their infants, the mothers of more attractive/cute infants had more positive behavioural attitudes towards them on factors such as how much they perceive the infants as interfering with their lives. This study supports the earlier findings of Stephan and Langlois (1984) and Karraker and Stern (1990) who found that pictures of infants with a higher level of attractiveness/cuteness were judged as having more favourable behavioural characteristics by unrelated non-parents on factors such as 'good baby' and 'causes parents problems'.

A good mother-infant relationship is vital for the emotional development and future reproductive success of an infant. It is therefore possible that one function of the heightened cuteness sensitivity exhibited by women of reproductive age is that it serves to facilitate the development of the mother-infant bond by eliciting more affectionate interactions with the infants and causing them to perceive the infants behaviour in a more positive manner.

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## **Appendix 1**

### **Questionnaire given to male participants**

We need to ask you a few questions about your relationship status and childcare experience. Because we are studying hormonal variations, lifestyle and past experience this information is key to our study. Please answer all questions as accurately as possible. Participation in this study is completely voluntary. You are free to withdraw participation at any point, or to skip answering any questions that make you uncomfortable. All data collected will be stored completely anonymously and confidentially.

- 1) Are you currently in a relationship? Yes/No
- 2) If yes, how long have you been in the relationship for months/years?
- 3) Do you want to have children in the future? Yes/No
- 4) If yes, how soon? i.e. in how many months/years time? \_\_\_\_\_
- 5) How many children would you like to have? \_\_\_\_\_
- 6) Approximately how many hours of contact do you have with children per week? \_\_\_\_\_
- 7) Briefly describe how much experience you have with childcare, e.g. through babysitting or having younger siblings? \_\_\_\_\_

### **Questionnaire given to women using the hormonal contraceptive pill**

We need to ask you a few questions about your menstrual cycle, relationship status and childcare experience. Because we are studying hormonal variations, lifestyle and past experience this information is key to our study. Please answer all questions as accurately as possible. Participation in this study is completely voluntary. You are free to withdraw participation at any point, or to skip answering any questions that make you uncomfortable. All data collected will be stored completely anonymously and confidentially.

- 1) What is your date of birth? (dd/mm/yy)
- 2) Are you; Male/ Female
- 3) Are you currently using HORMONAL contraceptives (pill, patch, depo, etc?); Yes/ No
- 4) If yes, please indicate the type of contraceptive used; Pill/depo shot/ other
- 5) What is the brand name and dosage of the pill that you use? For example a common brand in the UK is 'Mycrogynon 30' ('Mycrogynon' is the brand name and '30' indicates that the dose is 30mg)
- 6) If no, have you used hormonal contraceptives in the last 3 months?; Yes/No
- 7) If yes, please indicate the type of contraceptive used; Pill/depo shot/ other

- 8) have your hormonal contraceptives caused you to cease menstruating? ; Yes/ No
- 9) Are you currently pregnant or breastfeeding? ; Yes/No
- 10) Have you been pregnant or breastfed in the past 6 months? ; Yes/No
- 11) What day of your pill are you on? (Day 1 is the first day that you started taking your current pack of pills); \_\_\_\_\_
- 12) What time did you take your last pill e.g. '9am this morning' or '10pm last night' (please be as accurate as possible); \_\_\_\_\_
- 13) How sure are you of this date?: Absolutely certain/Fairly sure/Not very sure
- 14) When was the first day of your last period (dd/mm) (please be as accurate as possible); \_\_\_\_\_
- 13) How sure are you of this date?; Absolutely certain/Fairly sure/Not very sure
- 15) When do you expect the first day of your NEXT period (dd/mm)? \_\_\_\_\_
- 16) How long are your menstrual cycles typically? (Please give full details. Eg: "always 28 days", "between 25-30 days", "not very regular", "no period due to contraception", etc.) \_\_\_\_\_
- 17) Are you currently in a relationship? Yes/No
- 18) If yes, how long have you been in the relationship for months/years?
- 19) Do you want to have children in the future? Yes/No
- 20) If yes, how soon? i.e. in how many months/years time? \_\_\_\_\_
- 21) How many children would you like to have? \_\_\_\_\_
- 22) Approximately how many hours of contact do you have with children per week? \_\_\_\_\_
- 23) Briefly describe how much experience you have with childcare, e.g. through babysitting or having younger siblings? \_\_\_\_\_

**Questionnaire given to naturally cycling women**

Go to: <http://138.251.154.88/expt/Amanda/Page1.html>

## **Appendix 2**





23 October 2009

<b>Ethics Reference No:</b> <i>Please quote this ref on all correspondence</i>	PS5948
<b>Project Title:</b>	Hormonal influences on the perception of infant faces
<b>Researchers Name(s):</b>	Jennifer Lewis
<b>Supervisor(s):</b>	Professor David Perrett and Dr Reiner Sprengelmeyer

Thank you for submitting your application which was considered at the School Ethics Committee meeting on the 21<sup>st</sup> October 2009. The following documents were reviewed:

- |                                  |          |
|----------------------------------|----------|
| 1. Ethical Application Form      | 21.10.09 |
| 2. Participant Information Sheet | 21.10.09 |
| 3. Consent Form                  | 21.10.09 |
| 4. Debriefing Form               | 21.10.09 |
| 5. Questionnaires                | 21.10.09 |
| 6. Advertisement                 | 21.10.09 |

The University Teaching and Research Ethics Committee (UTREC) approves this study from an ethical point of view. Please note that where approval is given by a School Ethics Committee that committee is part of UTREC and is delegated to act for UTREC.

Approval is given for three years. Projects, which have not commenced within two years of original approval, must be re-submitted to your School Ethics Committee.

You must inform your School Ethics Committee when the research has been completed. If you are unable to complete your research within the 3 three year validation period, you will be required to write to your School Ethics Committee and to UTREC (where approval was given by UTREC) to request an extension or you will need to re-apply.

Any serious adverse events or significant change which occurs in connection with this study and/or which may alter its ethical consideration, must be reported immediately to the School Ethics Committee, and an Ethical Amendment Form submitted where appropriate.

Approval is given on the understanding that the 'Guidelines for Ethical Research Practice' (<http://www.st-andrews.ac.uk/media/UTRECguidelines%20Feb%2008.pdf>) are adhered to.

Yours sincerely

Convenor of the School Ethics Committee

OR

Convener of UTREC

Ccs Professor David Perrett  
Dr Reiner Sprengelmeyer  
School Ethics Committee



12 April 2010

<b>Ethics Reference No:</b> <i>Please quote this ref on all correspondence</i>	PS6311
<b>Project Title:</b>	Hormonal influences on the sensitivity to infant faces
<b>Researchers Name(s):</b>	Jennifer Lewis, Amanda Hahn, Janek Lobmaier
<b>Supervisor(s):</b>	Professor Dave Perrett, Dr Reiner Sprengelmeyer

Thank you for submitting your application which was considered at the Psychology School Ethics Committee meeting on the 7<sup>th</sup> April 2010. The following documents were reviewed:

- |                                  |            |
|----------------------------------|------------|
| 1. Ethical Application Form      | 08/04/2010 |
| 2. Participant Information Sheet | 08/04/2010 |
| 3. Consent Form                  | 08/04/2010 |
| 4. Debriefing Form               | 08/04/2010 |
| 5. Questionnaires                | 08/04/2010 |
| 6. Advertisement                 | 08/04/2010 |

The University Teaching and Research Ethics Committee (UTREC) approves this study from an ethical point of view. Please note that where approval is given by a School Ethics Committee that committee is part of UTREC and is delegated to act for UTREC.

Approval is given for three years. Projects, which have not commenced within two years of original approval, must be re-submitted to your School Ethics Committee.

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Approval is given on the understanding that the 'Guidelines for Ethical Research Practice' (<http://www.st-andrews.ac.uk/media/UTRECguidelines%20Feb%2008.pdf>) are adhered to.

Yours sincerely

Convenor of the School Ethics Committee

OR

Convener of UTREC

Ccs Professor Dave Perrett (Supervisor)  
Dr Reiner Sprengelmeyer (Supervisor)  
School Ethics Committee



## **Appendix 3**

### 1. Candidate's declarations:

I, Jennifer Lewis, hereby certify that this thesis, which is approximately 17,000 words in length, has been written by me, that it is the record of work carried out by me and that it has not been submitted in any previous application for a higher degree.

I was admitted as a research student in September 2009 and as a candidate for the degree of MPhil in September 2010; the higher study for which this is a record was carried out in the University of St Andrews between 2009 and 2010.

Date 25/10/11    signature of candidate .....

### 2. Supervisor's declaration:

I hereby certify that the candidate has fulfilled the conditions of the Resolution and Regulations appropriate for the degree of ..... in the University of St Andrews and that the candidate is qualified to submit this thesis in application for that degree.

Date 20/11/11    signature of supervisor .....

### 3. Permission for electronic publication: *(to be signed by both candidate and supervisor)*

In submitting this thesis to the University of St Andrews I understand that I am giving permission for it to be made available for use in accordance with the regulations of the University Library for the time being in force, subject to any copyright vested in the work not being affected thereby. I also understand that the title and the abstract will be published, and that a copy of the work may be made and supplied to any bona fide library or research worker, that my thesis will be electronically accessible for personal or research use unless exempt by award of an embargo as requested below, and that the library has the right to migrate my thesis into new electronic forms as required to ensure continued access to the thesis. I have obtained any third-party copyright permissions that may be required in order to allow such access and migration, or have requested the appropriate embargo below.

The following is an agreed request by candidate and supervisor regarding the electronic publication of this thesis:

*Add **one** of the following options:*

(i) Access to printed copy and electronic publication of thesis through the University of St Andrews.

Date 25/10/11    signature of candidate .....

signature of supervisor .....

*A supporting statement for a request for an embargo must be included with the submission of the draft copy of the thesis. Where part of a thesis is to be embargoed, please specify the part and the reasons.*