

The Thatcher Illusion:

**What can it tell us about the infants' developing
abilities to distinguish between
facial expressions?**

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The effects of 'The Thatcher illusion': what does it tell us about the infant's ability to distinguish between facial expressions?

Abstract.

This study investigated infants developing abilities in processing facial configurations that are thought to involve different processes from those used in detecting faces per se. The Thatcher illusion (Thompson 1980) is thought to separate the holistic from configurational strategies used in face processing. Consequently, this illusion may allow us to observe infants' abilities in processing facial configurations in isolation from their holistic face processing strategies. For the investigation the Thatcher illusion was used with four different facial expressions (happy, sad, angry and neutral) on adult female faces. They were paired with the equivalent normal face and presented to two groups of infants (6-12 and 12-18 months) as coloured slides in a preferential looking task. Twenty face-pairs were presented separately; all equally distributed among the infants and presented in two orientations (upright and inverted). Half of each group were presented with the Thatcherised face on their left and the normal face on the right; the remaining half saw the opposite arrangement. The infant's preferences for different facial configurations were assessed by measuring the amount of time each infant looked at the Thatcherised and normal face. From these time scores, mixed-design ANOVA's and subsequent paired-samples t-tests revealed that these infant groups share similarities and differences in the duration they looked at different facial configurations. Similarities were evident when the infants looked at some sad and angry faces and differences were apparent when these infants looked at certain happy and angry configurations. The conclusion is that this illusion appears to be an effective way for investigating infants' developing abilities for distinguishing between facial configurations.

1. Introduction

There are two interacting systems involved in face processing; the holistic processes (i.e. those involved in whole face recognition) and, the configurational systems (which pay attention to the spatial interrelationship between the parts of the face for example, the eyes, nose and mouth). This study has a developmental perspective aiming to explore what distinctions infants are able to make between small configurational changes within faces. This was done by replicating the visual illusion created by Thompson (1980) but with four different facial expressions (happy, sad, angry and neutral). This was because previous research has proposed that this illusion can separate the configuration involvement in preferring to look at faces from the visual cues infants use to holistically distinguish between them (Parks, Coss and Coss, 1980: Rock, 1988: Searcy and Bartlett, 1993).

Thompson (1980) created this illusion by cutting out the eyes and mouth from the picture of Margaret Thatcher, who at the time was displaying a pleasant toothy- smile. He removed these features and rotated them by 180 degrees before replacing them in their former position. Immediately, the whole upright picture assumed a very unpleasant appearance. However, when this redesigned picture was inverted by 180 degrees, the unpleasant appearance was hardly noticeable.

The example of this illusion below demonstrates that ones visual attention is drawn to the most significant features involved in any facial expression (eyes, nose and mouth), which Ellis (1982) has identified to be pertinent for interpreting changes in facial configurations associated with expressions (see figure 1).

Figure 1. Thompson's (1980) Illusion.



Many explanations of this illusion have been proposed two of which are noted below. Parks, Coss and Coss (1980) suggest that this effect occurs because all of the features in the face, as well as the face itself are individual forms. Each form has its own identity and each has a top and bottom (i.e. the top and bottom of the head: top and bottom of the eyes: top and bottom of the

mouth, etc). Consequently, when the external top of the head and the internal top of the features become atypically arranged, as happens in the Thatcher illusion, a perceptual oddness stands out. This 'oddness' according to Parks et al is caused by a visual-perceptual conflict between 'what is available to be seen *in* a face', and 'what has previously been learnt to be seen *from* a face' in their normal (upright) orientation. This effect however is significantly reduced when the face itself is turned upside down. Parks et al proposed this is because the strength of the learnt orientation of the face and its features become unfamiliar because, the face is not typically seen this way up with features in the opposite direction hence, the 'oddness' of the inverted features appears perceptually less dramatic.

Rock (1988) explained this illusion in terms of the conflict between the retinal images of the face and the features within it, suggesting that the vertical and horizontal coordinates become disassociated because these retinal images are biologically determined (possibly innate), and because they develop according to environmentally consistent norms. Therefore, anything which is seen that is not consistent with what has been experientially learnt during one's life as normal, immediately stands out as odd, such as, the upside down features in the Thatcherised face when the face is seen in the normal (upright) orientation. Rock's explanation is that the human eyes cannot synchronise these two conflicting perceived forms of information so in order to make sense of them, the horizontal and vertical retinal coordinates tune themselves into what is *most likely* to be environmentally consistent and upon this, a judgment of a holistic form is made, in this case of a face.

These views are supported by Searcy and Bartlett (1996) who propose that we are skilled at extracting information about the spatial properties of the face when they are upright, but not when they are inverted. Hence, adults immediately notice the 'odd' features in an upright face, but they do not notice the incongruence of spatial information in inverted faces. This study is looking specifically at infants between 6 and 18 months, who have not acquired the level of face processing skills equivalent to adults, so differences between infants aged 6-12 months and 12-18 months, will be explored.

Previous research has identified that there are different ages at which specific expressions in faces are distinguished between during infancy. For example, Oster and Ewy (1980) found, from a preferential looking task, that infants aged four months preferred to look at happy faces with teeth in preference to a sad face when presented upright in orientation, La Barbara et al (1976) found, in a separate preferential looking task, that infants of four months preferred to look a happy face from an angry face. In contrast, Nelson and Dolgin (1985) found that by seven months infants choose to look at a fearful face, in preference to a happy face. Taken together, it can be

inferred from these studies that developmental changes in face processing occur during early infancy and that different face expressions are preferred by infants aged four and seven months.

Johnson et al (1997) suggest a developmental explanation for the changes, proposing that from approximately five months infants look at 'what is a novelty' in preference to 'what is most pleasant' because they are beginning to categorise the information contained within the face. Similarly, De Schonen et al (1993) make a maturational proposal attributing the cause to cortical growth. They claim that face processing by 4 months occurs by encoding local aspects of faces, whereas between seven and nine months, infants develop the ability to process facial configurations, this change being attributed to progressive cortical growth and experiential development.

Ley and Strauss's (1986) research supports and expands on these views. They have observed that infants are quicker and more accurate at detecting configurational information and emotional expressions in face stimuli if they are presented to infants on the right of their central gaze. Hence, it appears that as a process of developmental growth and cortical maturity, infants acquire progressive abilities for processing facial expressions and it seems that this is accompanied with a right-sided bias. This may explain why a novel, fearful, face preference is made by the infants in Nelson et al's (1985) study, as opposed to the happy face in La Barbara et al's (1976) and Oster et al's (1980) experiments. In view of these findings, the first hypotheses in this current study expects that similar developmental differences will be found and that infants will prefer to look at Thatcherised happy faces because they are most novel.

Notwithstanding this, De Schonen et al (1993) found that the infants in their study, who ranged in ages from seven to nine months, showed a significant preference towards the left side when distinguishing between familiar and strange faces. It is possible that a similar bias will be found in this study, when looking at the Thatcher face against a normal face. This is expected in anticipation that the infants in this study may perceive the Thatcherised face as strange. Therefore, it is speculated that the infants may look longer at upright happy faces if they are Thatcherised and presented on their left side and paired with the same un-manipulated face on their right, presuming in this case that the infants were looking for an emotion within the expression presented on their right side.

However, these expectations are drawn with information gained from studies that have concentrated their investigation on infants' preferences for upright faces. In the knowledge that inversion disrupts processes involved in configurational face processing (Valentine 1988, Yin 1969, Chadwick, 2002) it is possible that the preferences these infants make pertaining to the processing of 'strangeness' and 'expressions', may differ when the infants are required to

distinguish between the Thatcherised and normal faces in the inverted orientation.

To date it is known that infants' perceptions of facial expressions are disrupted when perceiving faces upside down. Kestenbaum and Nelson (1990) found infants are not able to categorise the facial expressions of *happy*, *angry*, and *fear*, in inverted faces. However, the infants were able to differentiate between *happy and angry faces* and *happy and fearful faces*, showing a preference for *happy* in both cases. The expectation in this study is that the results gained will conform to these findings and infants will prefer to look at faces that *appear happy* when inverted.

So far, it can be inferred that all of these factors involved in face processing are linked to maturation and occur during periods of time when physical, social and mental development are rapid. Despite this, there is a gap in infant research about the processes involved in the development of infants' perception of facial configurations especially from 6-18 months. Consequently, the mid-infancy period of development is the focus of this study.

To conclude, the main aim in the study is to observe if there are any developmental differences between infants aged 6 to 12 months and 12 to 18 months, in their preferential orientation towards four different facial expressions (neutral, happy, sad and angry), presented in different orientations (upright and inverted) and on opposite sides of their central gaze.

1.1 The main operational hypotheses:

The hypotheses investigated in this study are as follows: 1. The face preferred: it is predicted that all infants will prefer the upright faces that have been Thatcherised as opposed to the upright normal faces. No significant preference is expected between these faces when inverted. 2. The type of emotional expression preferred in upright faces: it is predicted that all infants will prefer the happy face in all expression conditions as opposed to its manipulated partner when upright in orientation. 3. The type of emotional expression preferred in inverted faces: it is predicted that all of the infants will prefer faces that appear *happy* when inverted in orientation. 4. A side preference will be examined with these infant groups: no predictions have been made as to the infants' preferences.

2. Method.

2.1. Subjects.

Twenty-five subjects aged between six and eighteen months took part in a preferential looking task. The mean ages of the infants in the youngest group were 286 days: mean ages of the infants in the older group were 469 days. In total there were 13 males and 12 female participants of which there were, 5 females and 8 males in the younger group and, 7 females and 5 males in the older group. All of the participants were naive to the experimental task and accompanied by their parent(s) who signed a consent form allowing the infants to participate in study (see appendix 1).

This sample was selected from the local community by way of a personal invitation to the parents at clinic visits or from telephone contact attained from a pool of infant parents who had previously visited the Infant Study Unit at Sussex University for a separate study and had volunteered to return.

2.2. Stimuli.

Pairs of colour slides produced of three adult female faces posing four different expressions (neutral, happy, sad and angry) were used as stimuli. Half of these were manipulated on a computer to produce the Thatcher illusion. The rest remained unmanipulated (see figure 2 for examples).

Figure 2. The Thatcher Illusion.



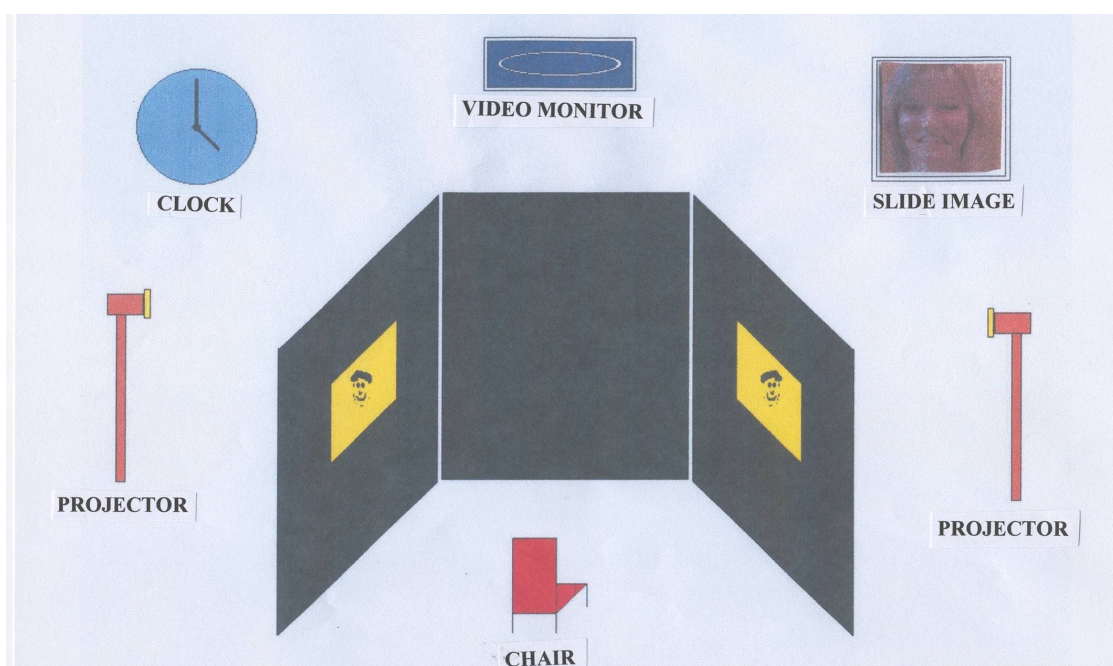
The computer manipulated faces were produced using photographs of adult female faces which were taken on a Canon Power shot S 20 digital camera. These face images shared similar skin colour (pale), hairstyles (short and blonde) and age range (from 22 to 40 years with a mean age 30 years). All paraphernalia were omitted (hats, glasses, Jewellery etc). Each face profile was a full frontal - face view. These photographs were judged by ten independent adults to confirm the reliability of the expressions posed; there was 100% agreement of the expressions.

These photographs were then transformed into computer images and manipulated on a Home Performance 550MHZ personal computer by rotating and reinserting the eyes and mouth within the faces, causing the faces to assume the Thatcher Illusion (Thompson 1980). These images were then made into 35mm slides comparable in quality, size, lighting and background by Sussex University Media Centre. In total 40 faces were produced and used as stimuli (6 x happy, 10 x angry, 14 x sad and 10 x neutral facial expressions).

2.3. Apparatus.

The apparatus used for this experiment consisted of a Panasonic HiFi stereo MS4 video camera, two matching Elmo slide projectors with Elmo 1: 3: 5 f= 70/120mm zoom lenses, a large clock with a clearly visible second hand, a video monitor, a chair, a squeaky toy and a wooden framed screen with a black cloth covering. These were set up in a quiet experimental laboratory with all visual distractions removed or screened off (see figure 3 for diagram).

Figure 3. The Apparatus used in this preferential looking task.



The screen measured 2 metres in width by 2 metres in height and had two forward facing side wings in which two slides screens were incorporated, these measures 35 cm by 35 cm. The slide projectors stood at a height of 120 cm and were positioned symmetrically on the left and the right, behind the screen, so that the slides could be projected to the left and right of the infant. The clock and video monitor were also positioned behind the screen, positioned next to the experimenter's seat, so that the time and the participants face could be seen together throughout the task.

2.4. Design.

A mixed design method was used with repeated measures on facial orientation, expression and presentation side, and independent measures on the age of infant. The dependent variable was the participant's visual fixation time to the stimuli. This was determined by observational measures of the participants' looking time taken from the video recordings. These were coded by the amount of time (in seconds) the participants looked to the left stimulus and / or to the right stimulus. Two independent observers repeated the coding process for 50% of the material. The results revealed an inter-reliability match of 98%.

All of the stimuli were presented simultaneously in pairs to the participants who sat on the parent's lap facing the front screen. Their parents were seated on a chair that was pre-positioned 87.5 cm away from the front, left and right side of the screens.

2.5. Procedure.

Participants entered the laboratory with their parents who were shown the chair for them to sit on with their infant. Example pair of slides were displayed for two reasons, firstly to provide light in order to focus the camera on the participants face and secondly to give the parents an idea of what they and their infant would be seeing. Following this, the video recorder was turned on and the task commenced as soon as the participants were settled into the environment. This began with a squeaky toy which was operated from behind the screen by the experimenter to attract the participant's attention and to centralise their gaze. When this happened, the 20 experimental slide-pairs were presented.

Each face-pair was displayed for 15 seconds. Between slide presentations there was a five second break in which the squeaky toy was used to orient the participants' gaze to their centre. Then, the next slide-pair was presented. This procedure continued until the face pair trials had been completed, which took approximately seven minutes in total. If any of the participants

became upset or inattentive to the stimuli, the experiment was halted until the participants were settled enough to carry on or, it was abandoned.

The slide pairs consisted of a manipulated face (happy, sad, angry or neutral in expression) paired with the same facial expression but in an unmanipulated face. Both slides shared the same orientation (upright or inverted), and showed the same female. The slide pairs were presented in a random order to the participants, and each pair was seen once. Half of the participants saw the face pairs with the manipulated face on their left and the unmanipulated face on their right; the remaining half saw the reverse. The independent variables were the expressions (happy, sad, angry, neutral), the manipulations (Thatcherised or not Thatcherised), and orientation (upright or inverted) between age of infants (6-12 and 12-18 months) and the dependent variable was the looking time.

2.6. Ethical issues.

Informed consent was obtained from the parent(s) of the participants before the experiment commenced. Each parent signed a consent form willingly offering his or her infant's participation in this study. This information will remain confidential and the infant's identity will be concealed (see appendix 3 for Ethics Practice Checklist; as per British Psychological Society requirements).

3. Results.

3.1. The effect of the Thatcher Illusion: the type of upright and inverted face preferred by infants' aged 6-12 and 12-18 months.

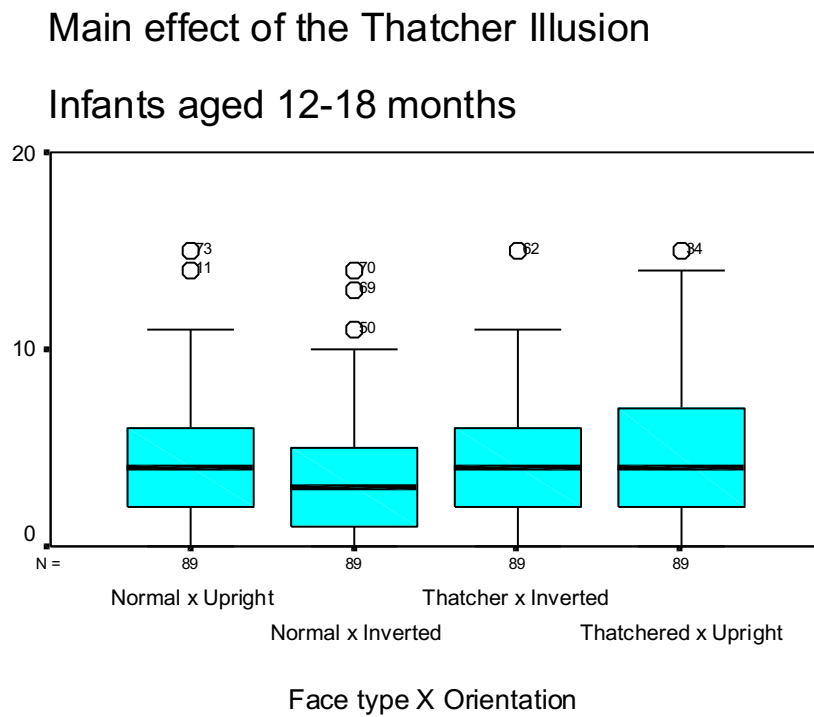
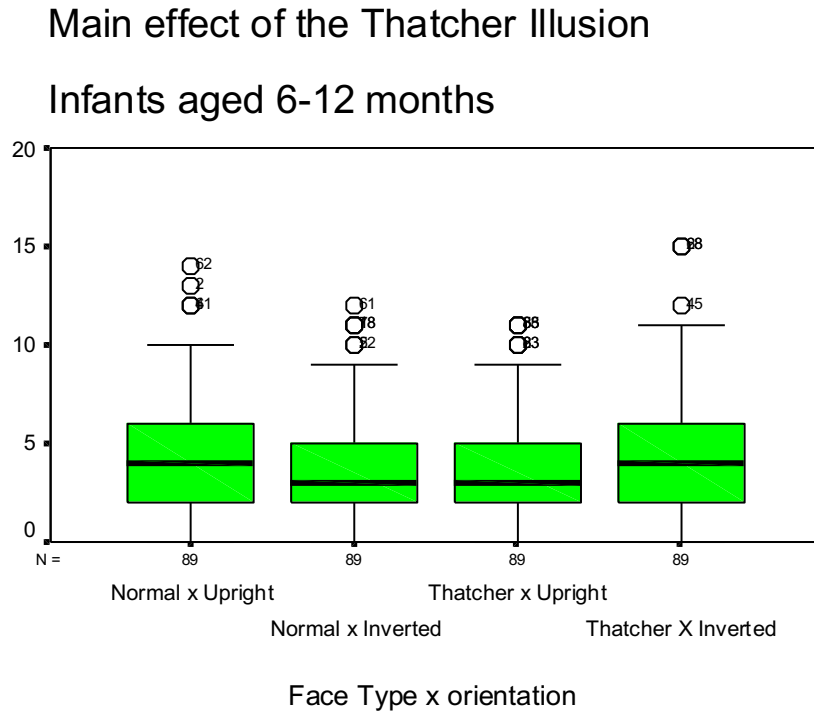
For each subject 40 scores were recorded representing the amount of time in seconds (out of a maximum, of 15 seconds) that infants looked to their left or right sides at the face stimuli. There could have been 1000 scores in total but only 89% were actually recorded. The absent scores represent the infant's inattentiveness to the stimulus (e.g. looking at their parents, around the laboratory or, at only one of the two slides presented the latter happened on 4 occasions).

3.1. The Main Effect of the Thatcher Illusion:

To see if there was a difference between the infants aged 6-12 and 12-18 months in their preferences for Thatcher or normal face-types, in the upright or inverted orientation, a two-way mixed design ANOVA was conducted with repeated measures on face type (2 levels) and orientation (2 levels) and independent measures on age (2 level). This revealed three significant results. Firstly, a significant difference was found between the groups ($F(1, 85); 6.073, p = 0.016$), secondly there was a significant difference in the amount of time these infants look at certain face types (Thatchered or normal. $F(1, 83); 7.83, p=0.006$) and finally, there was a significant difference in these infants' looking time to faces presented in a specific orientation ($F(1, 85); 76.222, p=0.005$). Pair-wise t-tests identified these differences as; Thatchered face types presented in the inverted orientation where, infants 6-12 months looked at these for a longer duration ($t(265); 2.848, p=0.005$). No other significant results were found.

It was predicted that infants would prefer to look at Thatchered happy faces presented in the upright orientation and faces that appeared happy when inverted. These results do not confirm this. Bar charts demonstrating these results are in figure 3.1 and the reasons proposed are explained in section 4.

Figure 3.1 The main effect of the Thatcher Illusion.



3.2 The effect of the Thatcher Illusion in relation to facial expression:

3.2. A mixed design ANOVA was conducted with repeated measures on face type (2 levels) and orientation (2 levels) for each expression condition. The results showed that there were no significant differences between the age groups in their looking duration between upright expressions of happy, sad, angry or neutral facial configurations (see bar graph in figure 4a).

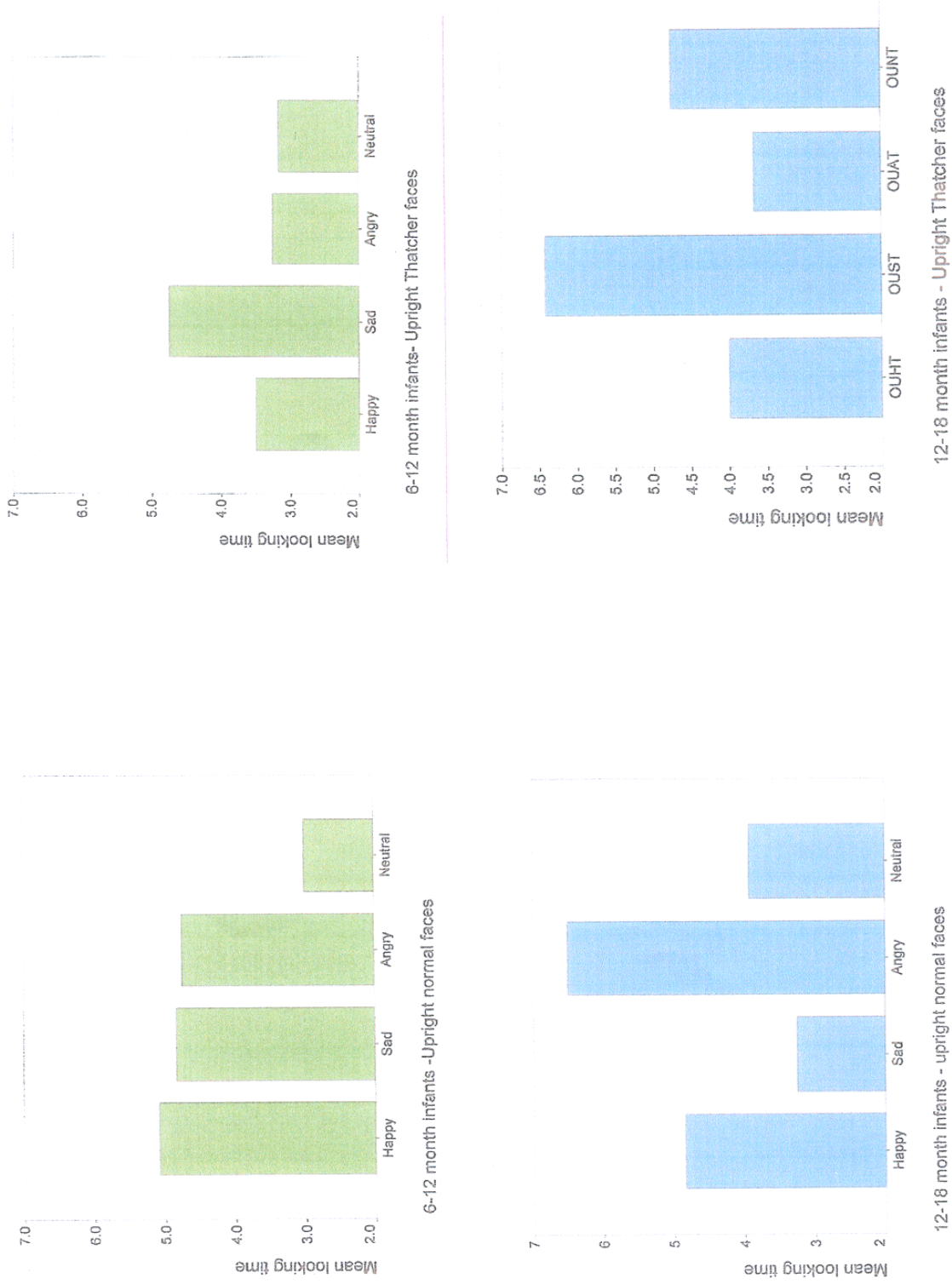
However, three significant results were found between the normal and Thatchered face types within the sad and angry expression conditions when the faces were presented in the inverted orientation (see figure 4b labelled as A, B, and C respectively).

A) Infants aged 6-12 months looked significantly longer at the Thatchered inverted sad face than the normal inverted sad face ($F(3,60); 5.132, p=0.035; t(22); 2.607, p=0.011$).

B) Infants aged 12-18 months looked also significantly longer at Thatchered inverted sad faces than normal inverted sad faces ($F(3,60); 3.691, p=0.018; t(43); 2.94, p=0.005$).

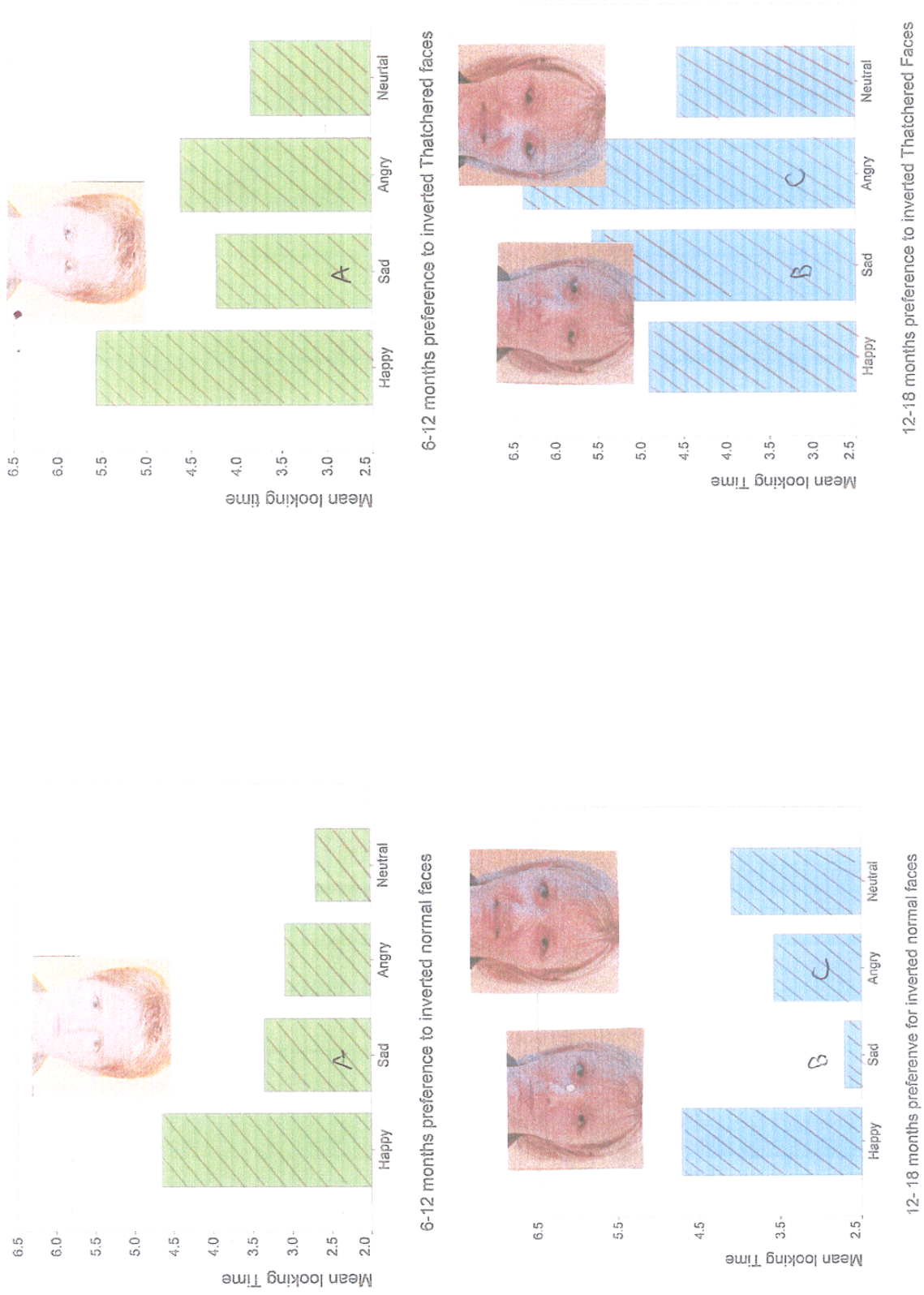
C) Infants aged 12-18 months looked significantly longer at Thatchered inverted angry faces than the normal inverted angry faces ($F(1,20); 14.688; p=0.001; t(34); 2.345, p=0.025$).

Figure 4a. The effect of the Thatcher Illusion with four different expressions in the upright orientation.



The infants showed no significant preferences in this upright orientation between expressions.

Figure 4. The effect of the Thatcher illusion with four different expressions in the inverted orientation.



3.3 The effect of the Thatcher Illusion within different expressions conditions.

To explore what effect the Thatcher illusion had if the faces displayed different expressions further mixed-design ANOVA's were conducted on each expression condition separately. A side preference was explored in this analysis. The results of these analyses are reported below under separate expression sub-headings and are discussed in section 4.

Happy Faces: Infants presentation side-preferences for happy face configurations:

A main effect of presentation-side ($F(1, 9); 26.369, p=0.001$) and an interaction of presentation side dependent on face type was found from the mixed design ANOVA ($F(1, 9); 5.616, p=0.049$). Pair-wise t tests identified this to be within the older infant age group as, the happy normal face presented in the inverted orientation. This configuration was looked at more when presented on these infants right-side ($t(8); -2.296, p=0.051$) (see figure 5.3).

Sad Faces: Infants presentation-side preferences for the Sad face configurations:

A significant interaction was found from the mixed-design ANOVA, this was a side x orientation interaction ($F(1, 9); 7.435, p=0.023$). Infants aged 6 to 12 months looked significantly longer at normal sad faces on their left-side when presented in the upright than inverted orientation (pair-wise t -test; $t(1,9); 0.43, p=0.011$). This profile was similar in the older age group, but did not attain significance in the post hoc tests (see figure 6.1).

Angry Faces: Infants presentation-side preferences for the angry face configuration:

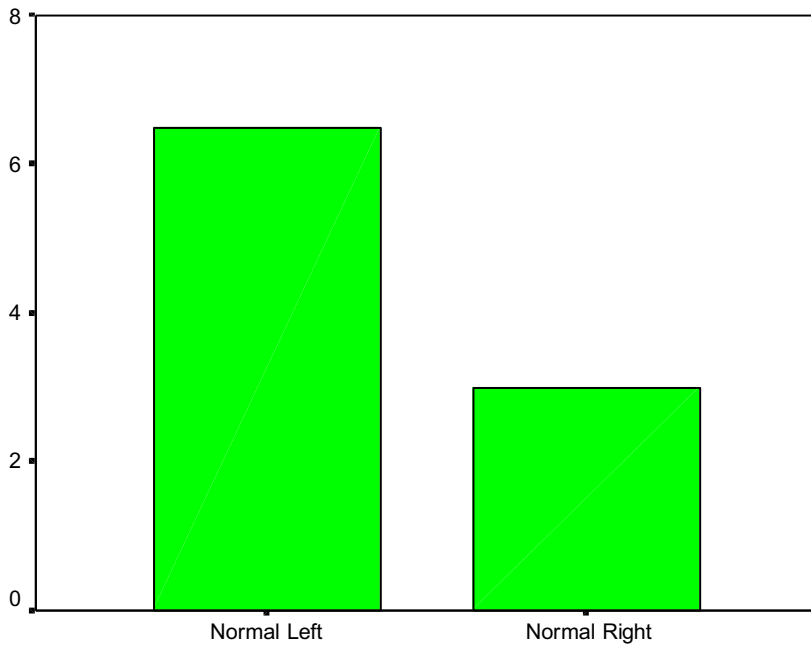
A significant interaction was found from the mixed design ANOVA between face types and an orientation ($F(1, 6); 17.934, p=0.005$). This is between the normal face types which are presented in the inverted orientation; and the Thatchered face type that were presented in the upright orientation. The infants aged 6-12 months looked longer at the normal angry face when presented in the inverted orientation, and Thatchered faces, when they were presented in the upright orientation, if they were presented on their left side (see figures 7.3 and 7.4 labelled A). The infants aged 12-18 months also looked longer at the normal angry face on their right side if it was inverted in orientation (Pair wise t test: $t(69); 0.0654, p=0.014$) (see figure 7.3 labelled B).

Neutral Faces: Infants presentation-side preferences for neutral face configurations:

A significant side difference ($F(1, 9); 26.369, p = 0.001$) and an interaction between side X face type was found ($F(1, 9); 5.163, p = 0.049$). Infants aged 6 to 12 months showed a difference on their right-side for looking at neutral faces in the upright orientation demonstrating a preference for Thatchered neutral faces (Pair-wise t test; $t(9); 0.897, p = 0.015$) in preference to normal neutral upright faces (see figures 8.2 and 8.3 labelled A). Also, these infants aged 6-12 months prefer to look at Thatchered neutral inverted faces on their right side (Pair-wise t test: $t(9); -2.842, p = 0.019$), (See figure 8.4 labelled B).

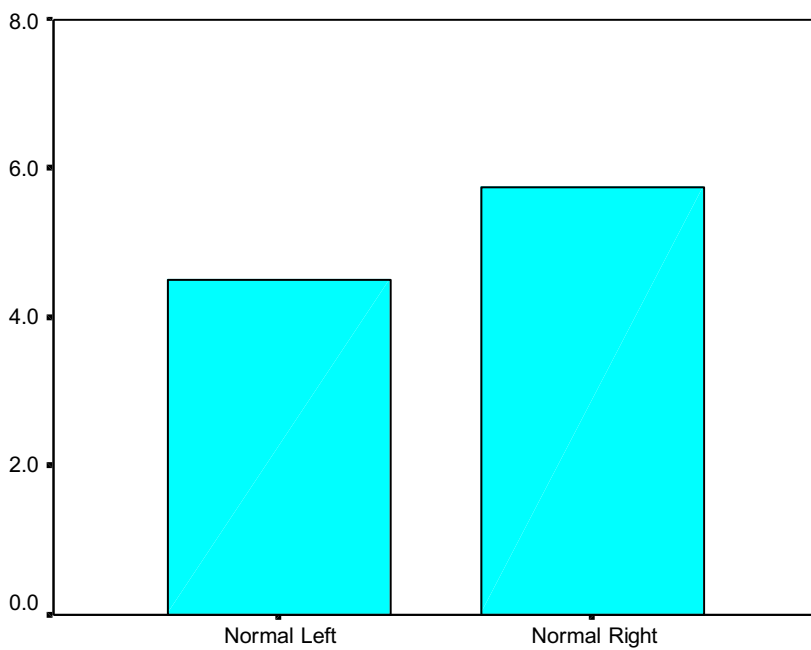
Figure 5.1 Upright Normal Happy Faces x Presentation side preferences.

Infants 6-12 months



Happy Faces x presentation side

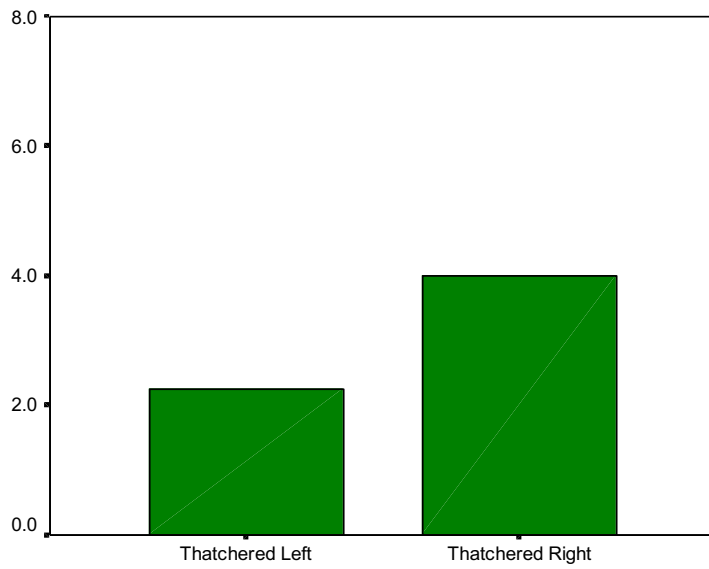
Infants 12-18 months



Happy faces x presentation side

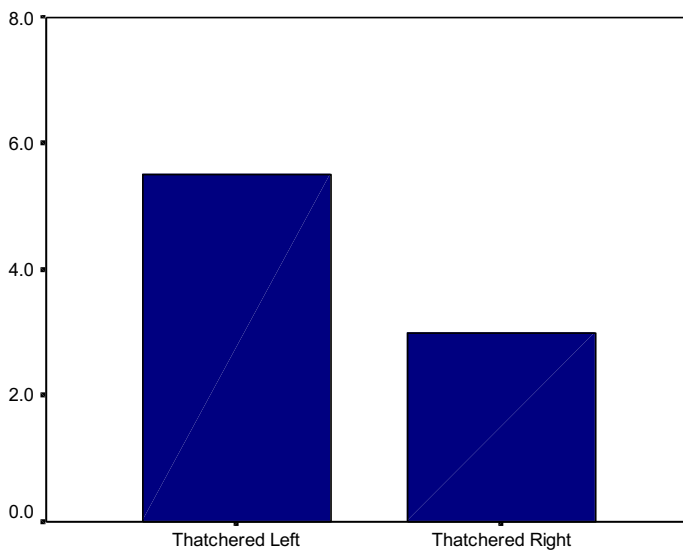
Figure 5.2 Upright Thatchered Happy Faces x Presentation side preferences.

Infants 6-12 months



Happy faces x presentation side

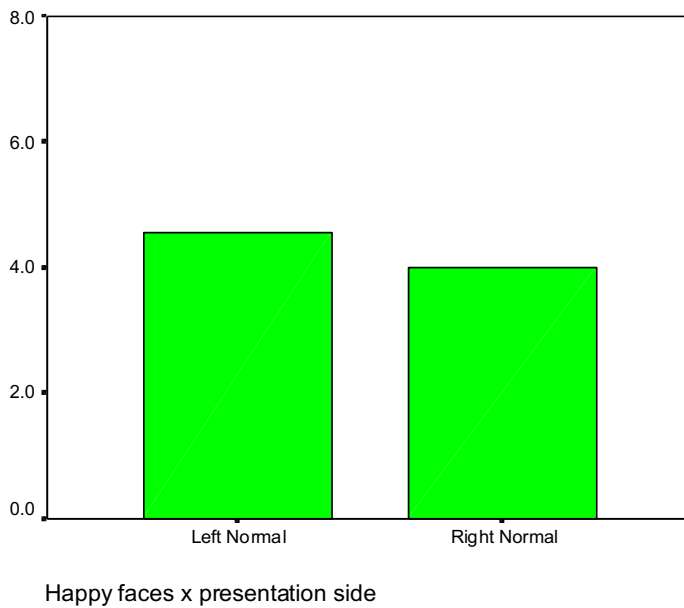
Infants 12-18 months



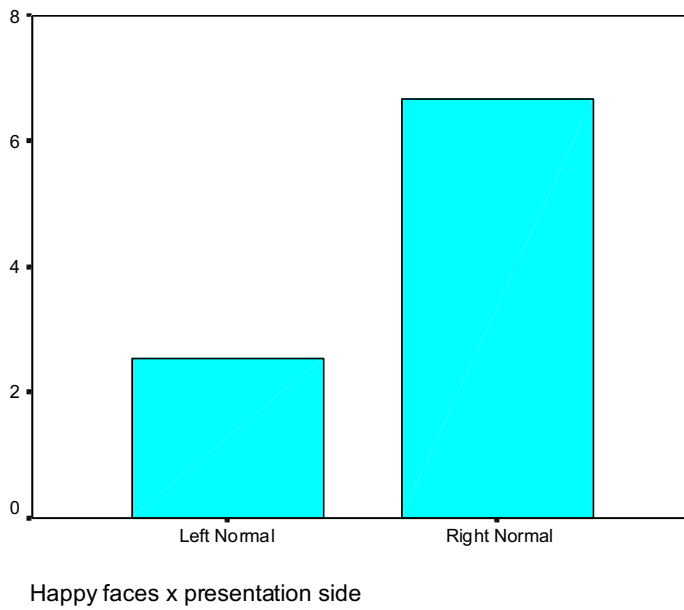
Hpaay Faces x presentation side

Figure 5.3 Inverted Normal Happy Faces x Presentation side preferences.

Infants 6-12 months



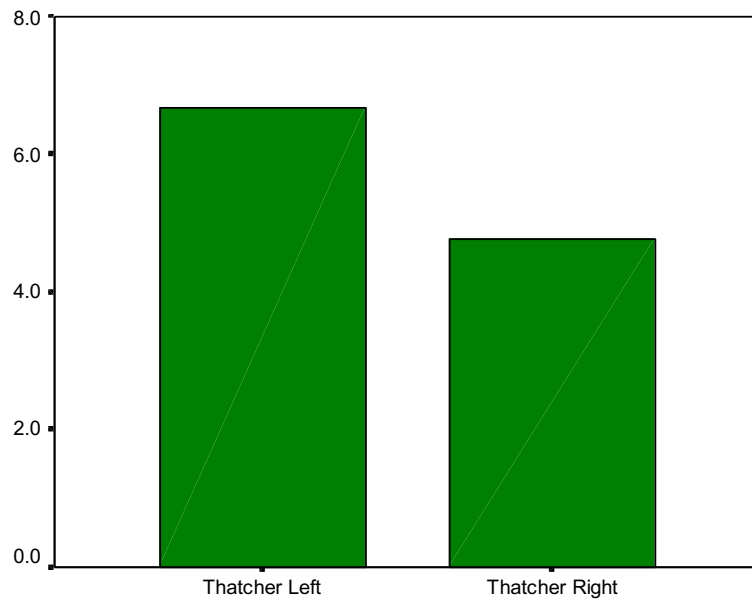
Infants 12-18 months



These graphs demonstrate that infants aged 12-18 months look longer at the happy normal face on the right of their central gaze if the face is presented in the inverted orientation.

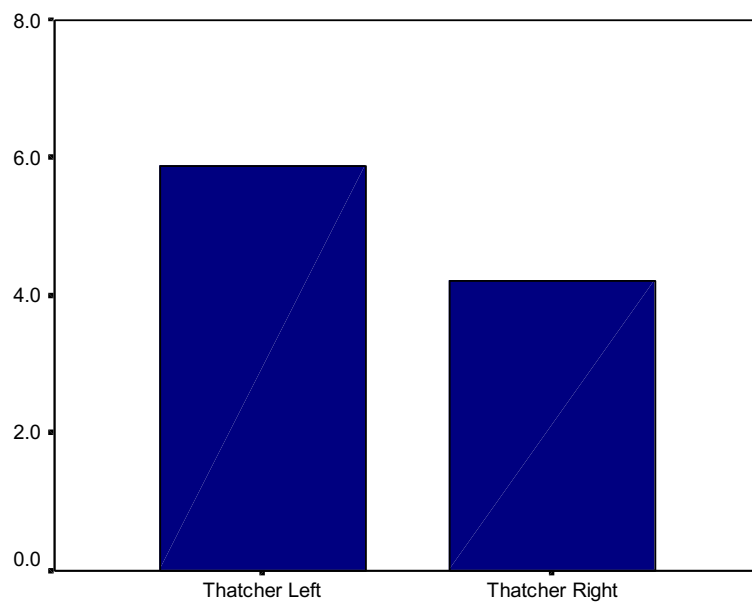
Figure 5.4 inverted Thatchered Happy Faces x Presentation side preferences.

Infants 6-12 months



Happy faces x presentation side

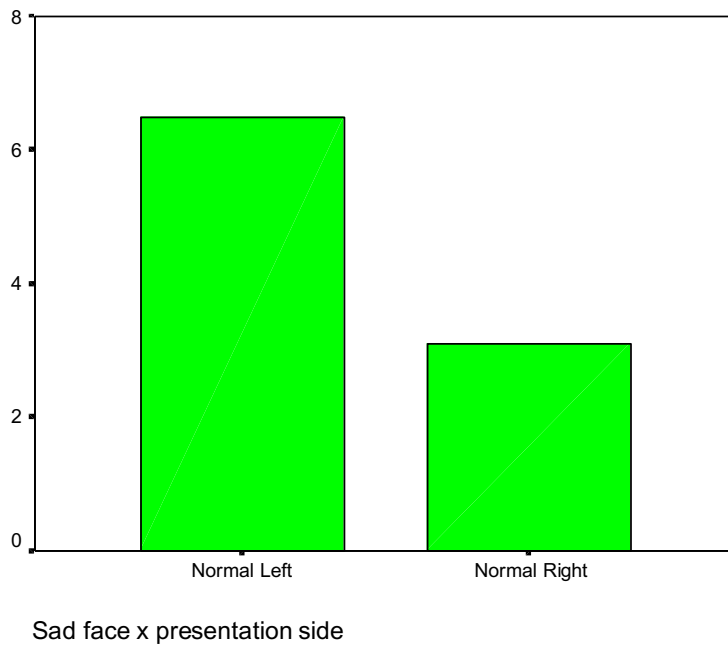
Infants 12-18 months



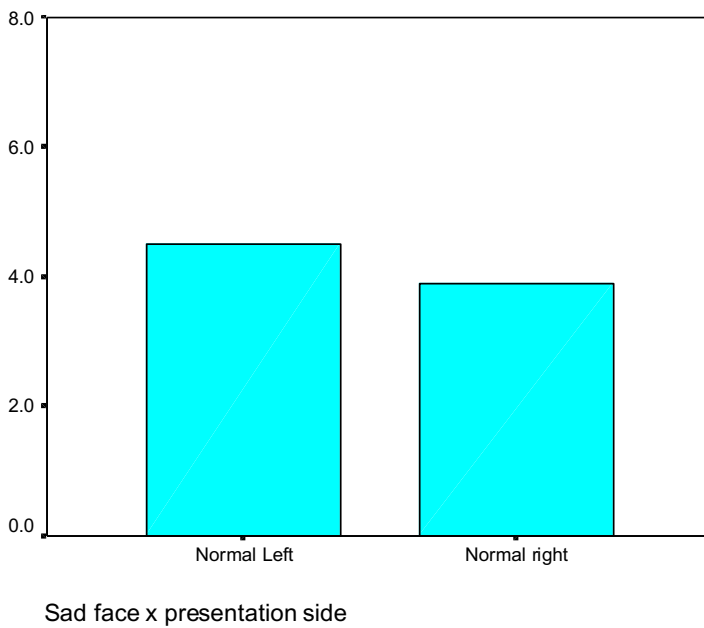
Happy face x presentation side

Figure 6.1 Upright Normal Sad Face x Presentation side preferences.

Infants 6-12 months



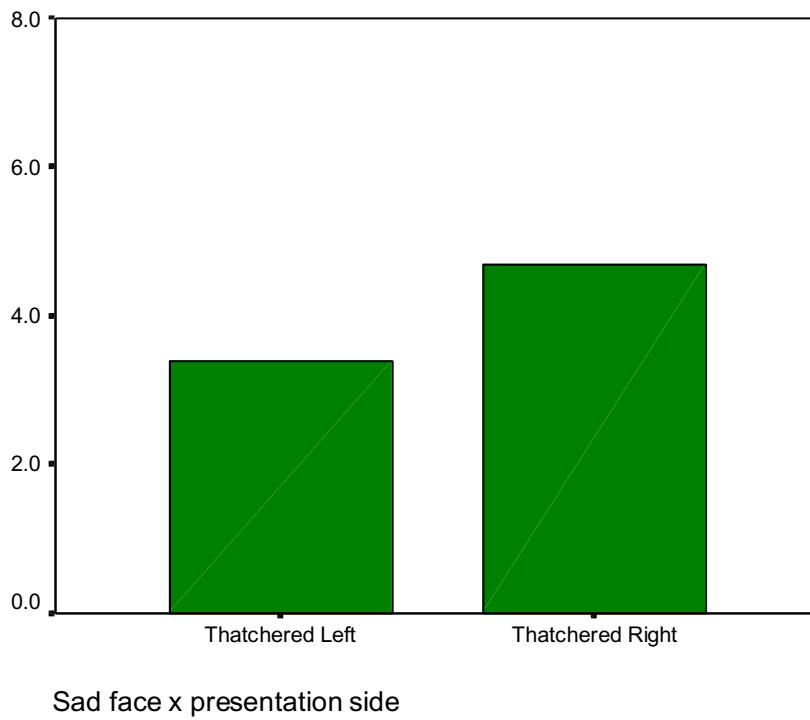
Infants 12-18 months



The top graph demonstrates that infants aged 6-12 months look longer at sad normal faces on the left of their central gaze when they are presented in the upright orientation.

Figure 6.2 Upright Thatchered Sad Face x Presentation side preferences.

Infants 6-12 months



Infants 12-18 months

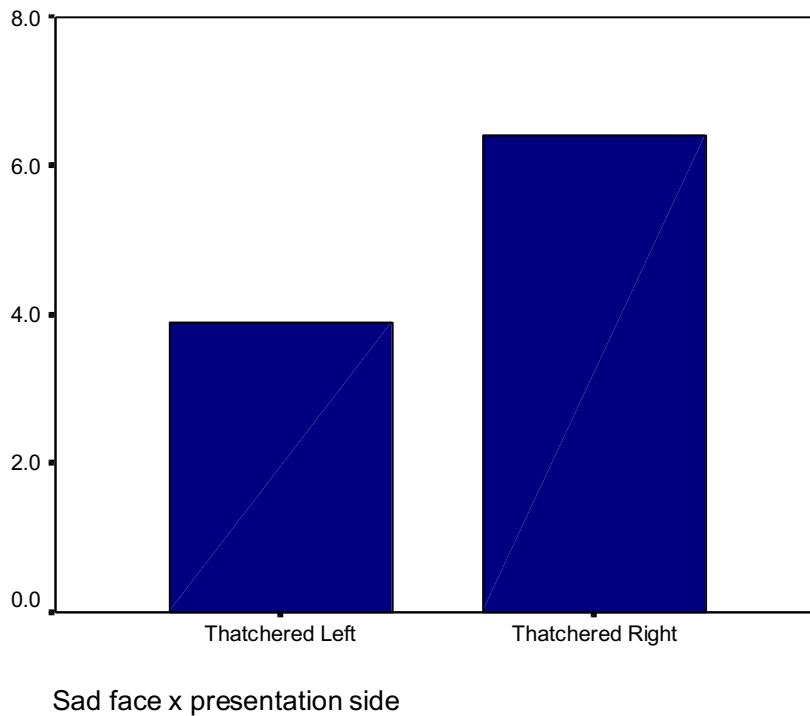
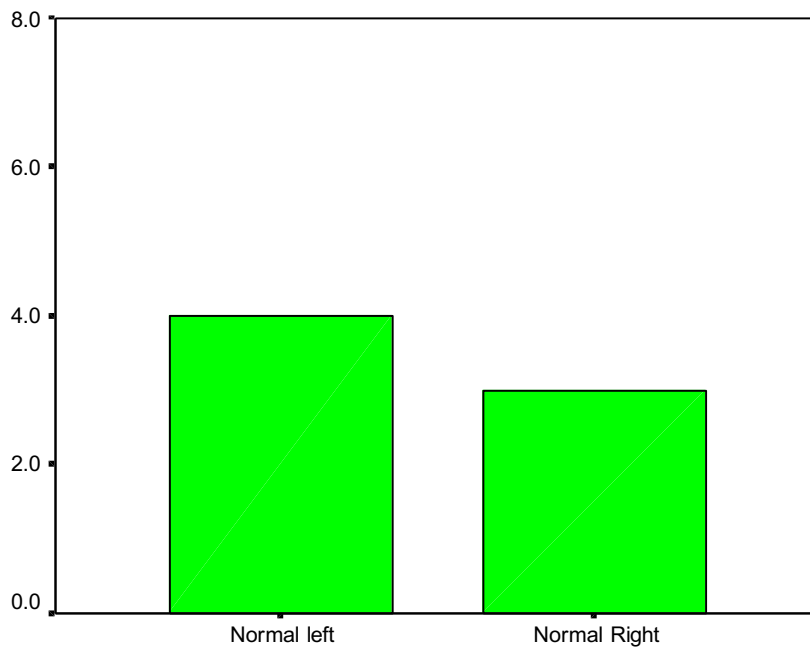


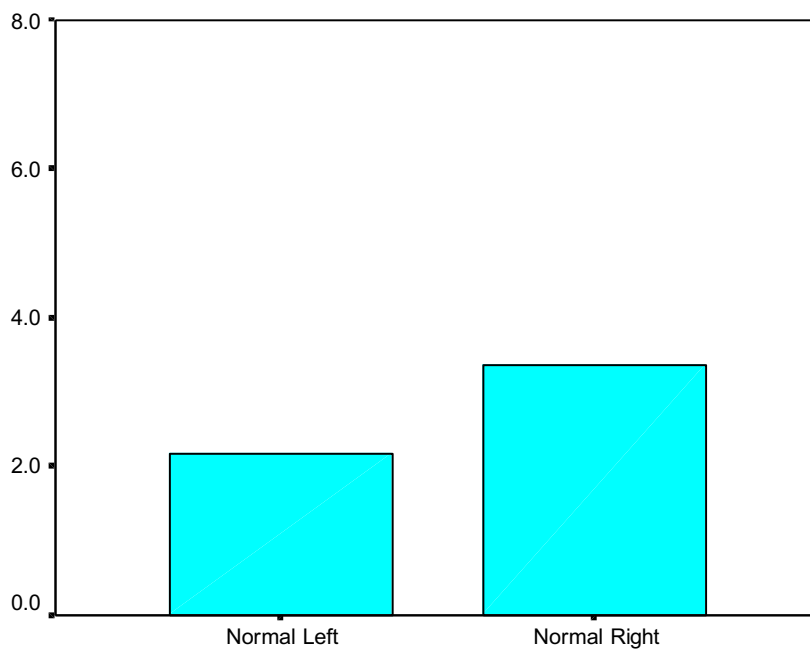
Figure 6.3 Inverted Normal Sad Face x Presentation side preferences.

Infants aged 6-12 months



Sad faces x presentation side

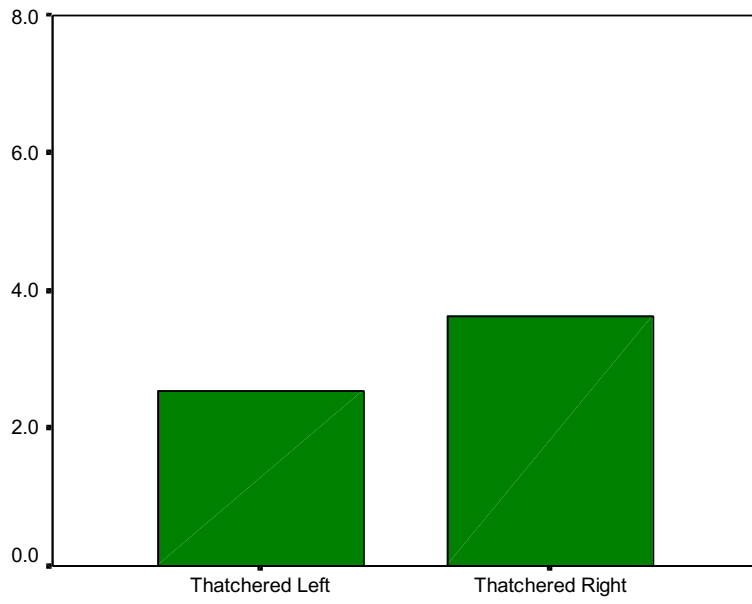
Infants aged 12-18 months



Sad faces x presentation side

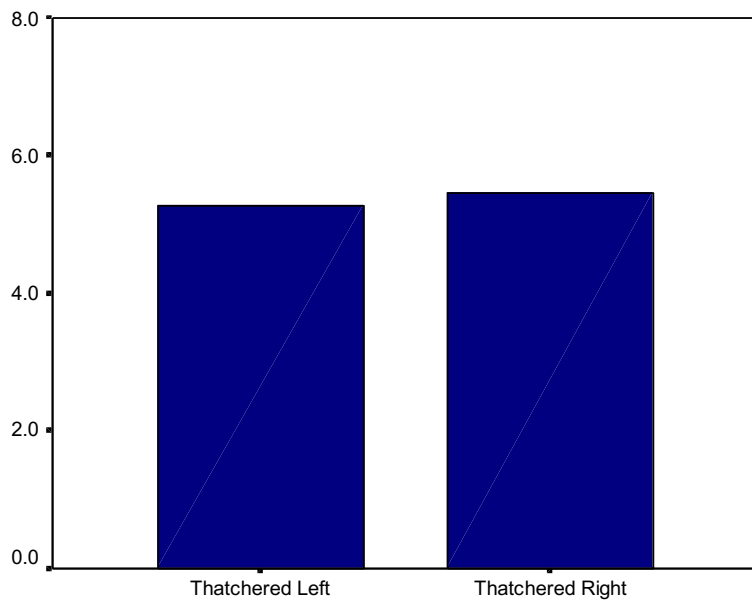
Figure 6.4 Inverted Thatchered Sad Face x Presentation side preferences.

Infants 6-12 months



Sad faces x presentation side

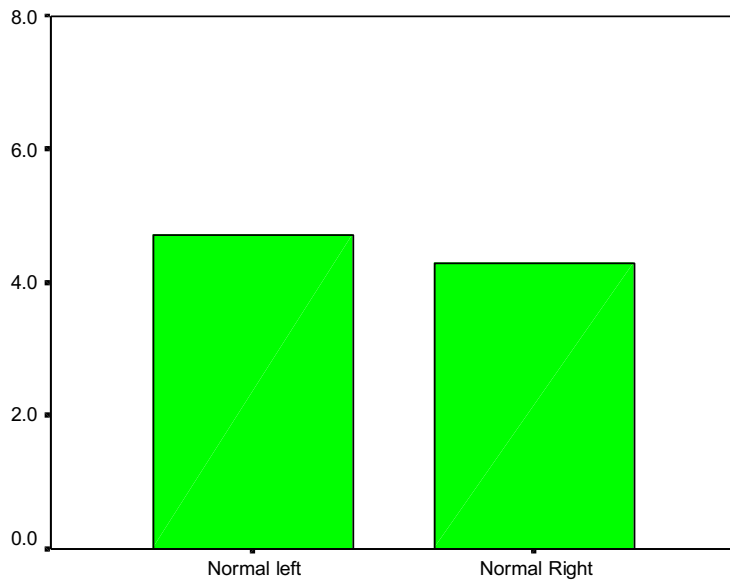
Infants 12-18 months



Sad faces x presentation side

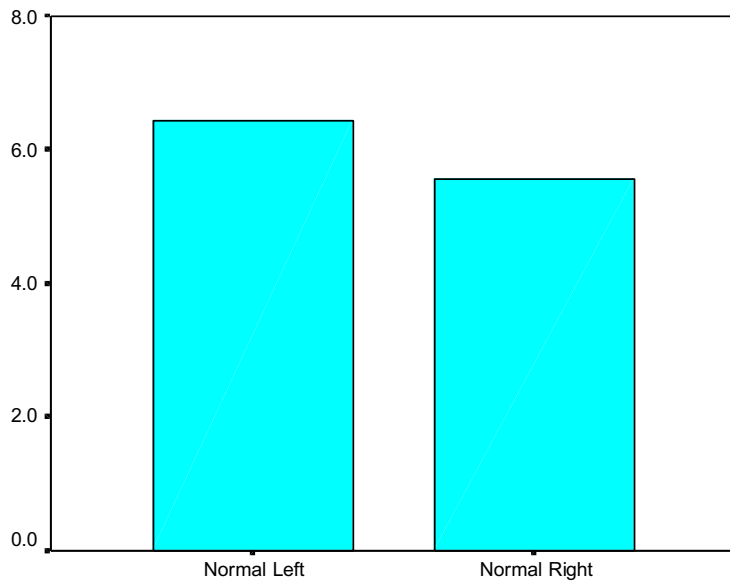
Figure 7.1 Upright Normal Angry Faces x Presentation side preferences.

Infants 6-12 months



Angry Faces x presentation side

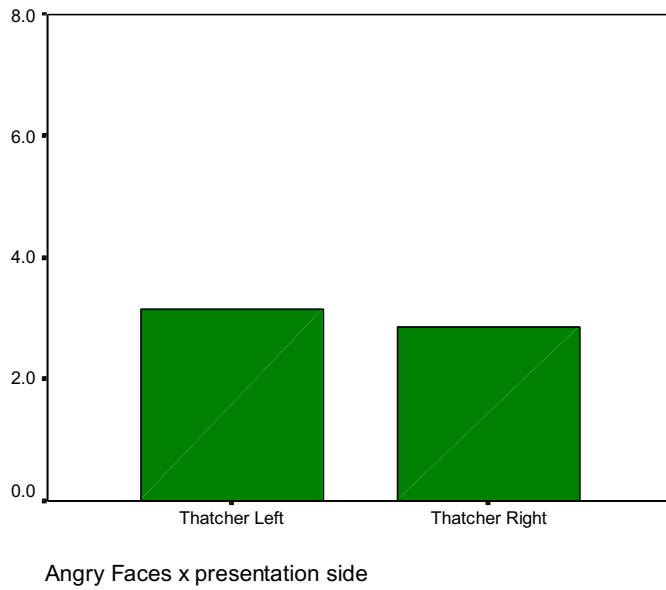
Infants 12-18 months



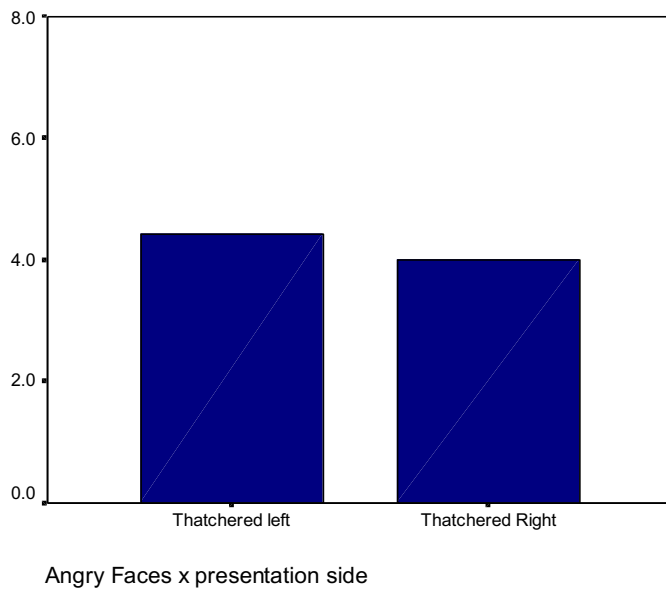
Angry faces x presentation side

Figure 7.2 Upright Thatchered Angry Faces x Presentation side preferences.

Infants 6-12 months



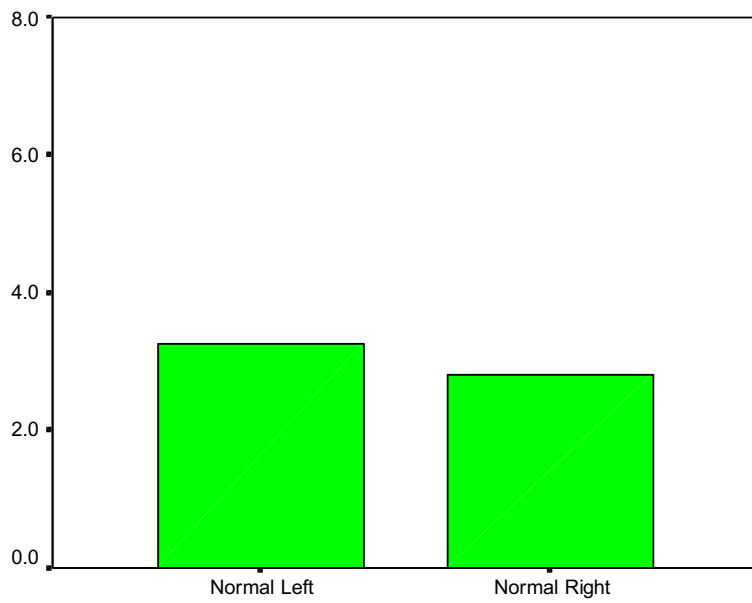
Infants 12-18 months



This graph shows that these younger infants look longer to the left of their central gaze at Thatchered faces when the faces were presented in the upright orientation,

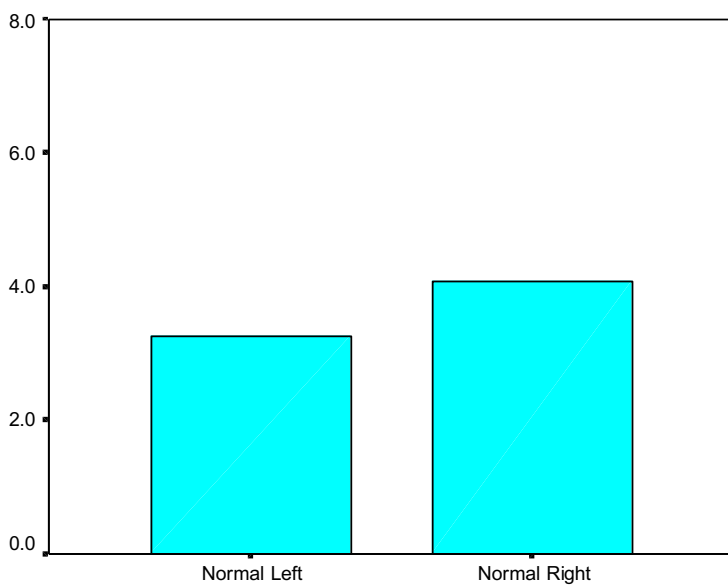
Figure 7.3 Inverted Normal Angry Faces x Presentation side preferences.

Infants 6-12 months



Angry faces x presentation side

Infants 12-18 months

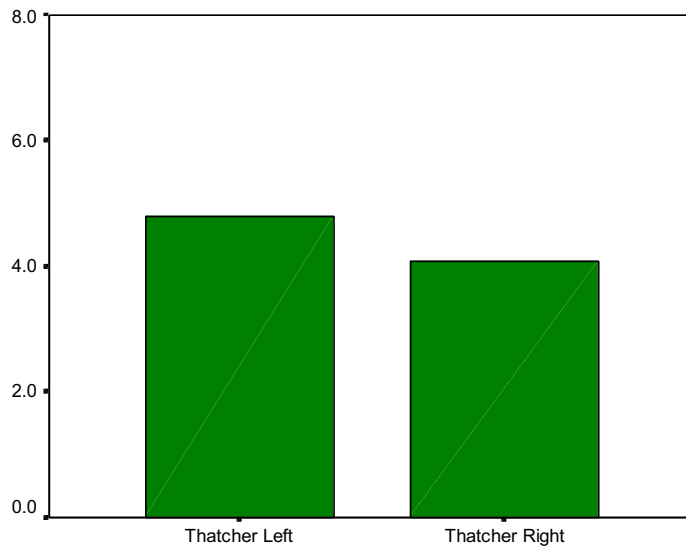


Angry Faces x presentation side

This graph demonstrates that the infants aged 12-18 months look longer at the normal angry face on their right side if it was inverted in orientation.

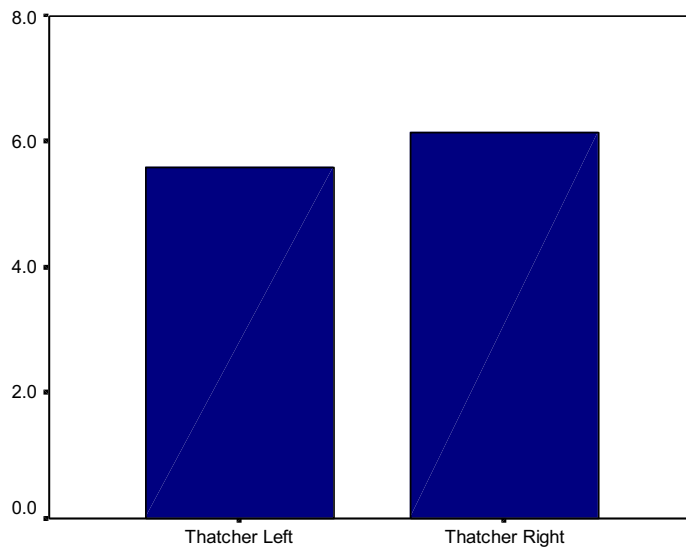
Figure 7.4 Inverted Thatchered Angry Faces x Presentation side preferences.

Infants 6-12 months



Angry faces x presentation side

Infants 12-18 months

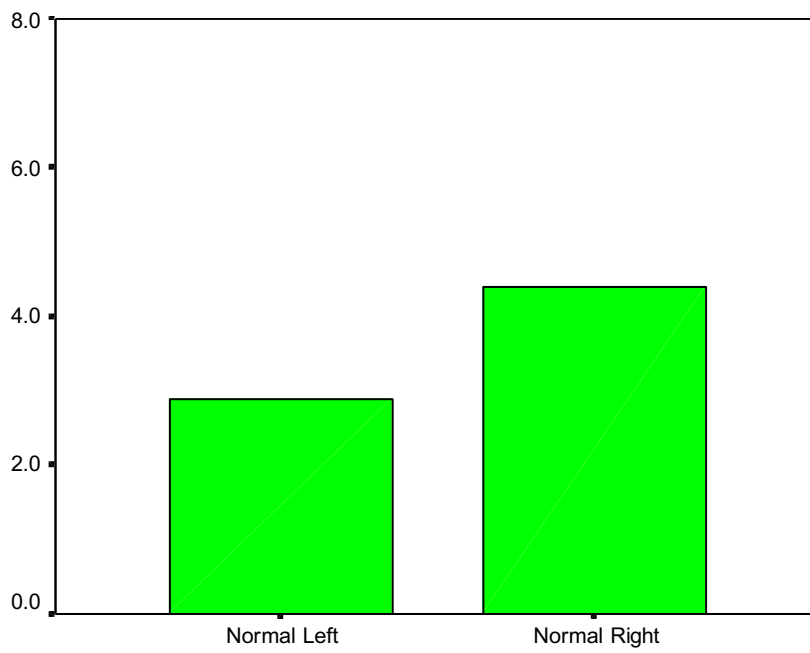


Angry Faces x presentation side

These graphs demonstrate that infants aged 6-12 months looked longer to the left of their central gaze at the normal angry face when the faces were presented in the inverted orientation.

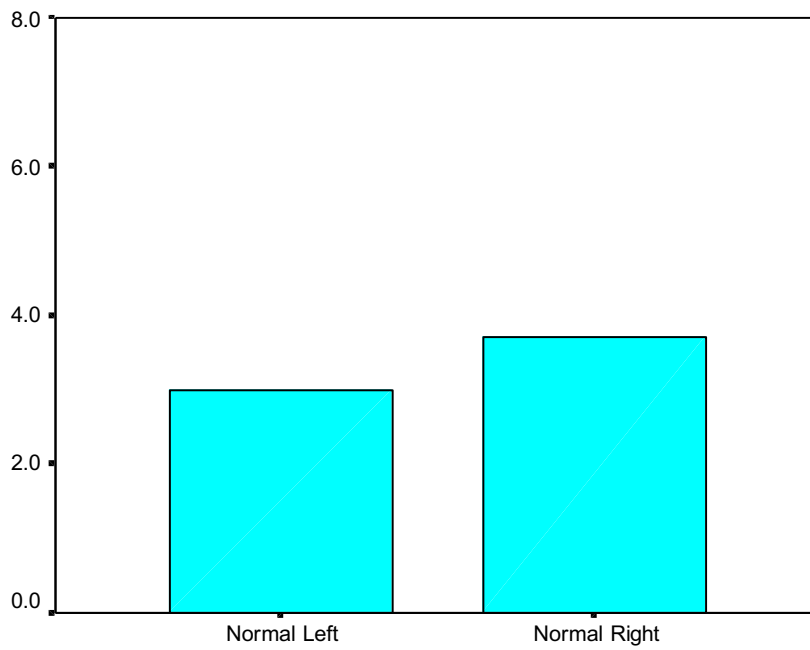
Figure 8.1 Upright Normal Neutral Faces x Presentation side preferences.

Infants 6-12 months



Neutral Faces x presentation side

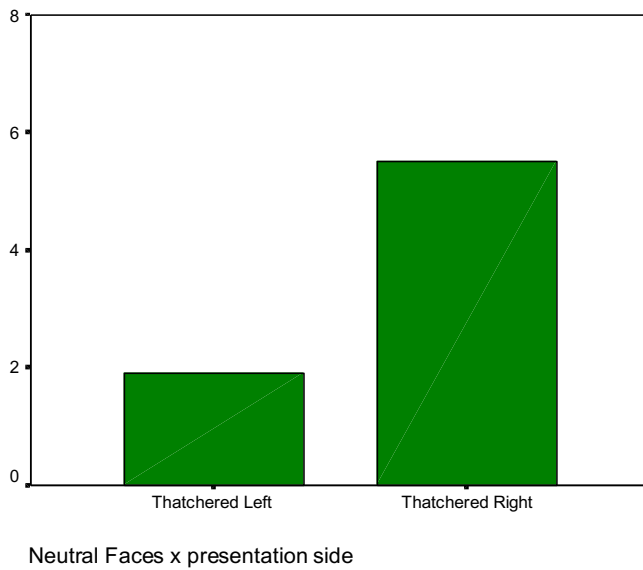
Infants 12-18 months



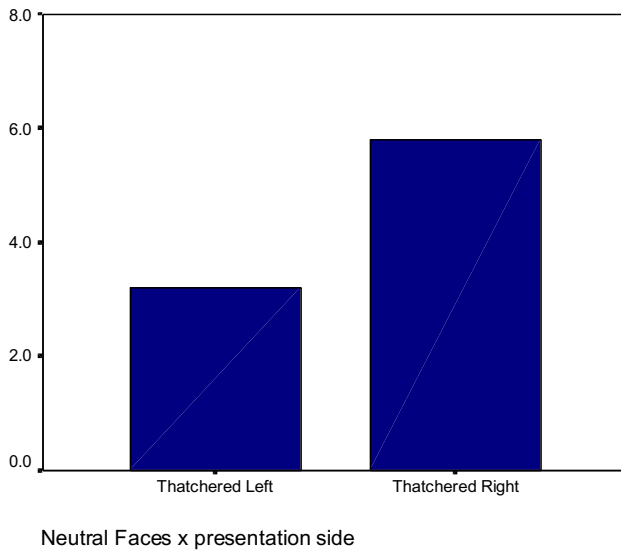
Neutral Faces x presentation side

Figure 8.2 Upright Thatchered Neutral Faces x Presentation side preferences.

Infants 6-12 months



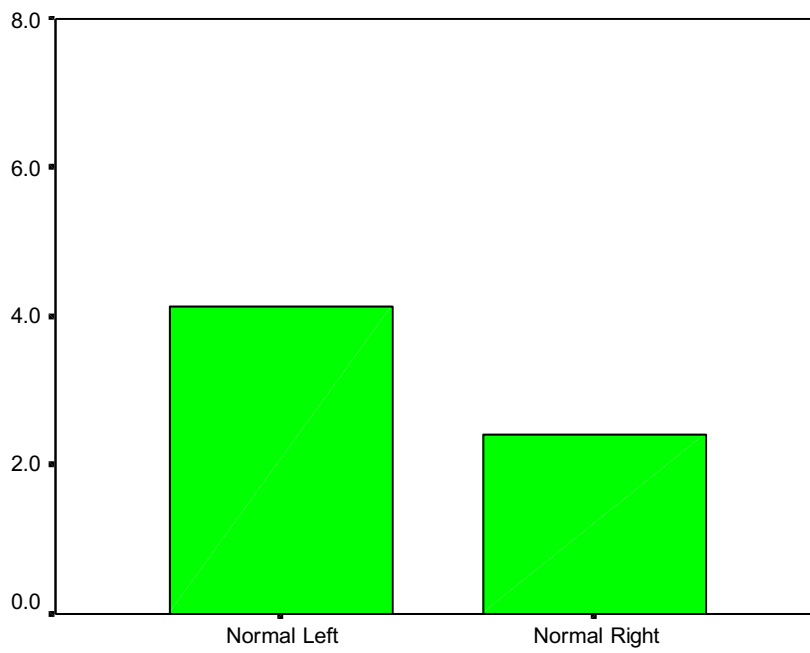
Infants 12-18 months



These graphs demonstrate that the infants aged 6 to 12 months prefer to look on their right side at Thatchered neutral faces when these faces are presented in the upright orientation.

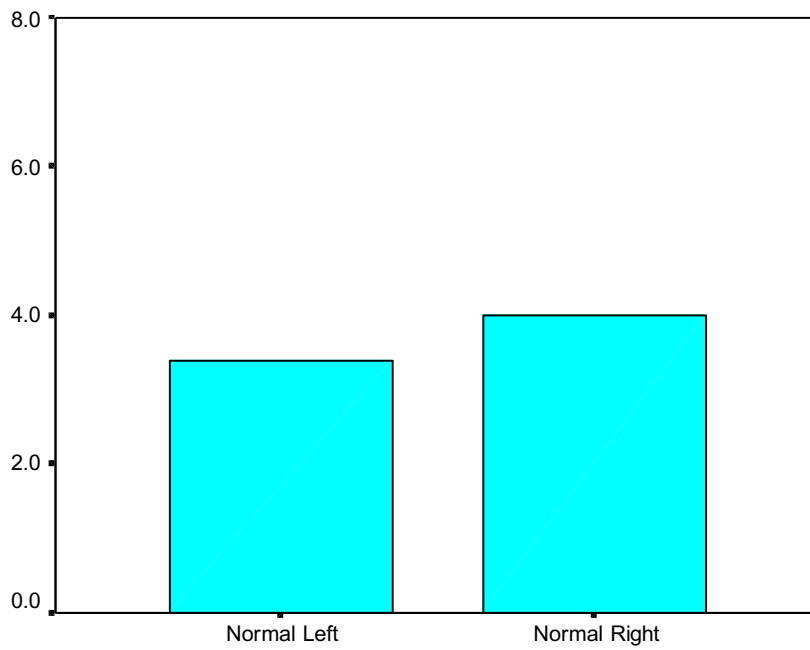
Figure 8.3 Inverted Normal Neutral Faces x Presentation side preferences.

Infants 6-12 months



Neutral Faces x presentation side

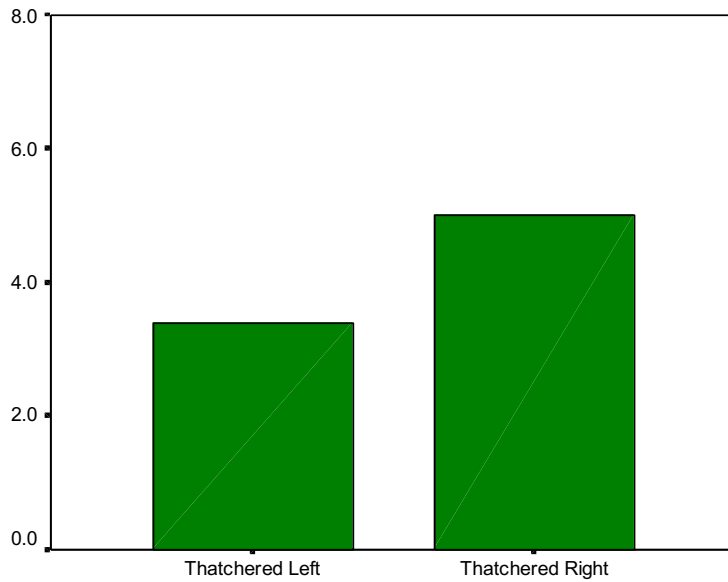
Infants 12-18 months



Neutral Faces x presentation side

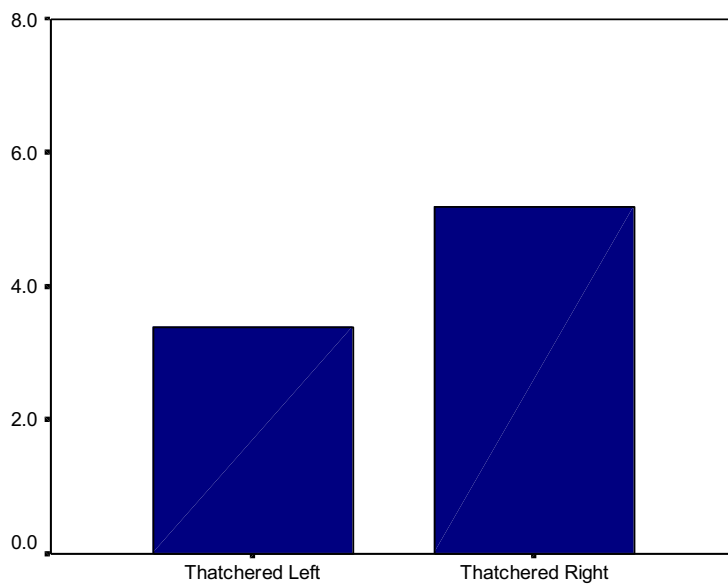
Figure 8.4 Inverted Thatchered Neutral Faces x Presentation side preferences.

Infants 6-12 months



Neutral faces x presentation side

Infants 12-18 months



Neutral Faces x presentation side

Summary of Results.

The results from these ANOVA's and pairwise t tests exploring developmental differences between two infants groups in their abilities to configurationally process faces of four different expressions found similarities and differences. The similarities were that both the younger and older infants looked at upright normal sad faces more when they were presented on their left side and angry normal faces on their right if these were presented upside down. The four evident differences between these groups were firstly that the younger infants looked at the neutral upright normal face more if presented on their right. However, in contrast these infants aged 6-12 months looked more at the normal angry face in the upright orientation when this configuration was on the left of their central gaze. The older infants looked more at the upright normal angry face more if it was presented on the right of their central gaze and finally, these infants aged 12-18 months looked more at the normal happy faces if they were inverted in orientation.

4. Discussion

This study asked a question about the infants' developing abilities for processing faces, specifically, what the distinctions infants' aged 6-12 and 12-18 months could make between different facial configurations. To do this, an investigation was done to see if infants of this age range would show a preference to *facial configurations* from *faces per se*. This was achieved by using the Thatcher Illusion (Thompson 1980) as a stimulus because it has been said that it could separate the configurational involvement in preferring to look at faces from the visual cues used to holistically distinguish between them (Parks Coss and Coss 1980; Rock 1988; Searcy and Bartlett 1993).

The experimental hypothesis predicted that these infants would look at facial configurations and mostly those that were *expressing happiness* or *looked as if they were* (i.e. upright normal happy face, inverted Thatchered happy face or inverted normal angry and sad face). The results revealed that not all of the faces that expressed happiness (or appeared to) were preferred by these infants (i.e. the upright normal happy face) although; the majority were preferentially

oriented towards (i.e. the inverted happy Thatchered face and the inverted normal angry and sad faces). However, these results did confirm confirmed that this infant age range, 6-18 months, *did prefer to look at facial configurations than faces per se* since, the infants looked longer at inverted Thatchered faces. Further, a developmental difference was found showing that the younger infants looked at these faces for a longer duration than the older infants.

These findings fall in line with previous research proposing that infants from five months are able to distinguish between faces (Oster and Ewy 1980: La Barbara et al 1976: Nelson and Dolgin 1985) and perhaps from seven to nine months are able to categorise different facial configurations (Johnson et al 1997: De Schonen 1993). Further it agrees with previous research which has found that younger infants look at stimulus for longer than older infants in preferential looking tasks (Slater 199).

Following this, a two part observation was done looking at what distinctions these infant groups made between different upright and inverted facial configurations. Firstly, the upright faces were analysed to see if the infants preferred to look at any one of the four different expressions (happy, sad, angry, and neutral) and to see if the infant groups differed in the duration of time they looked at these upright facial configurations. No significant results were found which was surprising, since previous research has reported preferences for happy faces from angry, or sad, in infants of four months (La Barbara et al 1976: Oster and Ewy 1980 respectively) and for fear, in infants of seven months (Nelson and Dolgin 1985). Neither an expression (Ley and Strauss 1986) nor a novelty preference (Johnson 1997) was elicited from the investigation as had been previously found in infant studies.

Next, the infants' preferences for different expressions in inverted faces were investigated. The results revealed a similarity and a difference. There was a similarity in that both of these infant groups looked longer at inverted Thatchered sad faces. However, in contrast, there was a difference, the older infant group (12-18 months) looked significantly longer at the Thatchered inverted angry face. In view that the hypothesis predicted, based on Kestenbaum and Nelson's (1990)

research, that the infants would look at facial configurations that *were happy or appeared happy* these findings were supportive to some extent. They allow an explanation to be proposed suggesting that these infants may be looking at facial configurations with a preference for *the appearance of happiness*. That is, if Thatchered sad faces can be inferred to be a smile. However, an explanation as to why the older, but not the younger, infants look longer at the Thatchered angry face (which maybe looks as if it were *happy* as well, when perceived upside down) remains without an explanation.

It was because of these rather confusing findings that further analysis of these infants' duration scores was made. This time each expression condition was investigated separately. The idea was to eliminate inferences between expression conditions and to see what differences these infant groups showed when looking at, happy normal and Thatchered faces or, angry normal and Thatcher faces or, sad normal and Thatchered faces or, neutral normal and Thatchered faces. The findings and interpretations of these are reported below following which suggestions for further studies are given.

The results revealed for happy faces that the infants aged 12-18 months looked at the Happy normal face for a longer duration of time when they were inverted in orientation and if it was presented on the right of their central gaze. These result falls in line with Kestenbaum and Nelson's (1990) research and suggest infants can distinguish between inverted faces with a preference for happy. This fits the hypothesis.

The results for the sad face condition revealed that the younger infants, 6-12 months, looked significantly longer at the normal sad face if it was presented in the inverted orientation and if the face was presented on the left of their central gaze. The older infant group showed the same trend but their result did not reach significance. An interpretation of these results, although speculative, could be that, the normal sad face presented in the inverted orientation, was looked at for a longer duration if it were on the infants left because, the configuration was more 'strange' than the face on the infants right (that being the Thatchered sad face). The Thatchered sad face, may have shown some expression that could have been associated with a smile, therefore, a finding in line with Kestenbaum

and Nelson (1990) research may exist. The fact that the infants looked to their left may have been due to strangeness and if this were the case, a finding associated with De Schonen (1993) may exist since it was found that infants in their study looked more at faces on their left side when distinguishing between familiar and strange faces. If this interpretation is correct evidence of a change in face processing behaviour, from distinguishing between faces, to configurational processing, may have been found and thus used as support for De Schonen's (1993) findings.

For angry faces, the results showed that infants aged 6-12 months and the 12-18 month infants looked longer at the normal angry face when presented in the inverted orientation. However, if the faces were Thatchered and presented upright in orientation, only the infants aged 6-12 months looked longer at them and this was only if they were presented on the left of these infants central gaze. Overall, these results suggest that all of the infants show a preference for a facial configuration with an expression that *looks happy*. That is, if the normal angry face is actually perceived as such by the infants, when this face stimulus is presented upside down. If so, this result also falls in line with Kestenbaum and Nelson's (1990) research (detailed above). The difference between these groups could be interpreted to show that the younger infant group are looking at facial configurations that look novel. This being the case, Johnson et al's (1997) claim that infants of 5-7 months look at novel faces in preference to pleasant one is supported by this current result. Further, it may be showing something of a developmental shift between these groups as De Schonen et al (1993) proposes from their research, and this result may therefore be associated with progressive development, cortical growth and experiential learning; especially, if these results remain supported by proposals that infants look more at facial configurations in stimulus presented on the right of their central gaze (Ley and Strauss 1986) which, these older infants show a trend for doing, with this angry facial configuration and others in this study.

Finally, the results for neutral faces showed a difference between these infant groups in the duration of time these infants looked at neutral facial configurations.

The younger infants aged 6-12 months looked longer at the Thatchered neutral face if it was presented on the right of their central gaze and upright in orientation than the older infants aged 12-18 months. These results are still suggestive that infants are looking at facial configurations in an attempt to interpret the information being expressed from it. It could be inferred that this configuration looks like a subtle smile and maybe, infants do perceive with a preference facial configurations with an appearance of happiness as the outset hypothesis predicted. Accordingly, these results could be interpreted in line with Ley and Strauss (1986) who claim that the right side of the central gaze is looked at more for configurational information and facial expressions which remain a consistent trend in this study with specific facial configurations.

These final analyses were worth doing because it provided results that made some sense in relation to previous research in this field of study. Had the analysis been stopped after the two-part investigation, of infants' behaviour to upright and inverted faces, containing four different expressions, this study would have been at odds with many robust infant studies. Particularly with findings such as those reporting preferences for specific expressions in upright faces e.g. infants' preferences for a happy face until approximately 7 months when a preference for novelty kicks in (Johnson et al 1997).

This later set of statistical tests results has resulted in, it appears, productive as well as interesting findings. However, this study would benefit by three design changes. Firstly, an additional way of presenting the stimulus slides could be incorporated. That is, to present the slides to the infants horizontally, as in this study, but also to present them vertically, either side of the infants' central gaze. This would qualify the trend found in this investigation revealing a right or left sided bias in processing specific facial configurations. However, as a consequence of doing this, the study would increase the infants' overall duration of looking time at the face stimuli hence, a between-subjects design is proposed instead of the repeated-measures design used in this investigation because it is felt the infants would get tired of looking at twice the amount of stimuli slides. These alterations would confirm whether the presentation-side biases are truly associated with particular facial configurations. The theory is that if the infants looked longer at specific facial configurations on their right or left when presented

horizontally, than when they are presented vertically, the side bias found in this study, and in other studies, would be verified.

Secondly, to confirm the speculated happy face bias in this experiment, a further study looking at the infants' preferences between positive and negative facial configurations would be beneficial. It is suggested that a further preferential looking task is done with pairs of faces containing a positive (happy or smiling) with a negative (angry or sad) Thatchered or normal facial expressions. The hypothesis would be that infants would preferentially orient to positive facial expressions from 8 months. Before this, a novelty bias may be evident.

A further modification could be done, that is to equal out the amount of slide pairs in each expression condition. In this study, the infants were shown an unequal amount of slides within each expression condition however; this was not a problem because the repeated measures design accounted for these between condition differences. Notwithstanding this, it would be more stringent to tighten up this factor to insure future reliability of the results.

In addition, and because of these proposed alterations, the amount of infant participants would ideally be increased in any future investigations so that the developmental progression of configurational face processing could be investigated more precisely. It is proposed that the group divisions could be increased from 2 groups of infants aged 6-12 and 12-18 months to 4 groups of infants of 5-7 months, 8-11 months, 12-14 months and 15-18 months.

Taken together, the consequence of these alterations could be great as it could determine whether future studies using the Thatcher Illusion are able to observe the developmental progression of the infants' abilities for processing different facial expressions thus, future experiments could add to the existing knowledge of social and emotional development in mid-infancy.

In conclusion, the Thatcher Illusion appears to be a useful tool to investigate the infants' preferences for different facial expressions. It has elicited that there are developmental differences between infants of 6-12 and 12-18 months in their abilities to distinguish between happy, sad, angry and neutral facial

configurations. It has also highlighted some similarities between them. This investigation gained results that are consistent with previous face processing research and has, by incorporating the Thatcher Illusion with in a preferential looking task., added knowledge to this field of study with its ability to look at the infants' development of configurational face processing strategies in isolation from the strategies infants employ for face processing per se from 6-18 months Finally, it would seem that there remains potential to expand on the current findings thus allowing further explorations in infants' preferences and distinctions between various facial configurations.

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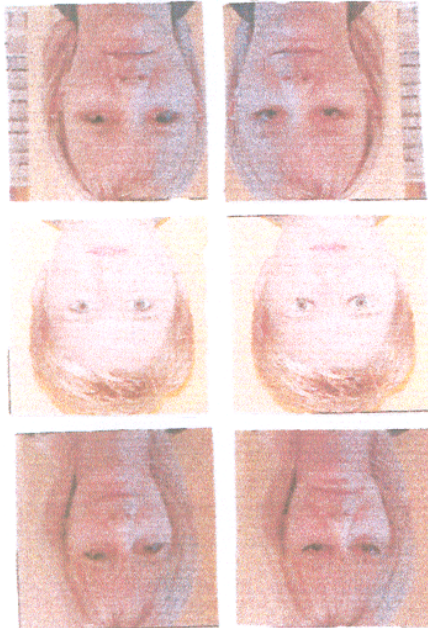
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Appendix

1. Face Stimuli – Neutral and Sad conditions
2. Face Stimuli – Happy and Angry conditions

Neutral condition stimulus.

Inverted Neutral face pairs.

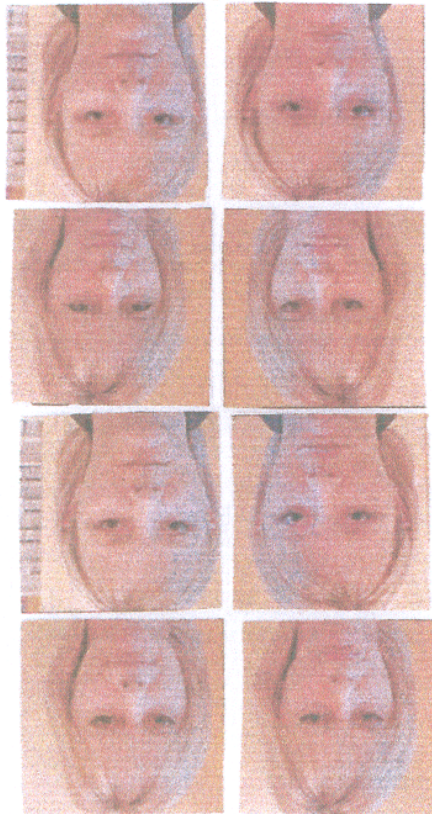


Upright Neutral Face pairs.



Sad Condition Stimulus.

Inverted Sad Face pairs.



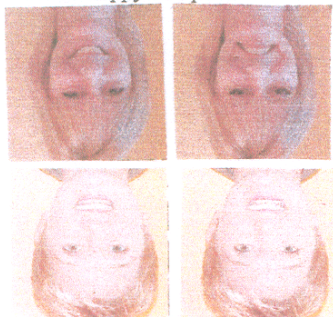
Upright Sad face Pairs.



Appendix 2. Stimuli face sets.

Happy Face condition stimulus.

Inverted Happy face pairs.

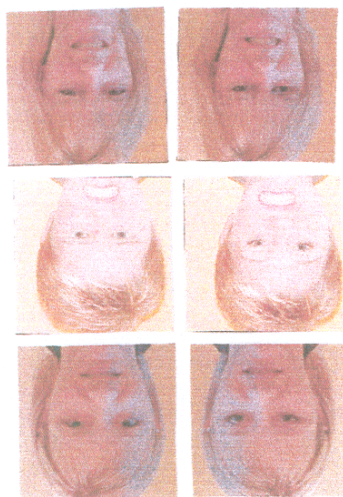


Upright Happy face pairs.



Angry condition stimulus.

Inverted Angry face pairs.



Upright Angry Face pairs.



