Categorisation of Male and Female Domestic Cats: The Effects of Training

Submitted by

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I certify that all material in this dissertation which is not my own work has been identified and that no material has been previously submitted and approved for the award of a degree by this or any other University.

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Abstract

People are very good at determining the gender of human faces and can perform the task at near perfect levels quickly (Bruce, Ellis, Gibling & Young, 1987). It has been suggested that this exceptional performance is the result of perceptual learning. Quinn, Palmer and Slater (1999) investigated whether people are able to learn to differentiate between male and female domestic cats from their faces alone. They found that before training, performance was at chance level which rose to above chance after training. This study extends this earlier work and examines the features that people use to make this discrimination and also, the conditions under which the most successful categorisation takes place. Experiment 1 examined whether people could tell the two sexes apart without any form of training and found that people performed at an above chance level, but only for male cats. It was also found that colour was an important factor in people's decision making. Experiment 2 employed training techniques to enable participants to gain some experience of cat faces in an attempt to raise performance levels. It was found that those trained with male cats performed better than chance whilst those trained with female cats did no better than chance. Experiment 3 attempted to remove colour and other paraphernalia by training with line drawings of the cat faces. It was found that with no training, participants only performed at chance level. After training, this improved to above chance. A ceiling effect was also observed. The findings are discussed to relevant literature on face processing and perceptual learning.

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CD-Rom including:

- The main program used in all experiments
- The source code to the program
- Images of all cat faces used

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Alan Jordan
(1958 – 2003)

1. Introduction

1.1 Visual Expertise in Everyday Life

Visual expertise – it sounds like something that only a few people possess. We can all consider ourselves visual experts though, recognising thousands of objects without effort and in a variety of guises on a daily basis. For example, for the vast majority of us, we know what a tree looks like and can instantly recognise it as such upon presentation. That is despite the very large number of species, changes due to climate (e.g. seasonal changes in deciduous varieties) and condition (e.g. changes due to management and disease). These abilities of categorisation and discrimination of objects are probably two of the most important skills we posses. Without them, living would be an extremely difficult and dangerous task.

How do we put objects into categories when examples of the same object may differ substantially? The fuzzy concepts approach proposed by Rosch, Mervis, Gray, Jonhson and Boyes-Bream (1976) accepts that the boundaries between categories are not so clear cut. This theory claims that what is required for categorisation is the formation of a prototype for an object and then compare the presented object to that prototype. What this prototype consists of has been the subject of much debate. Rosch (1978) argues that the prototype is not a specific example but rather formed from features of the object that are consistent across exemplars. Other theories (e.g. Estes, 1994) suggest that the prototype is the best exemplar for that category. Both approaches agree, however, on 3 levels of categorisation; the super-ordinate, basic level and sub-ordinate (see figure 1-1). Prototypes will be formed at the basic level since this is the level at which abstraction is at its highest.

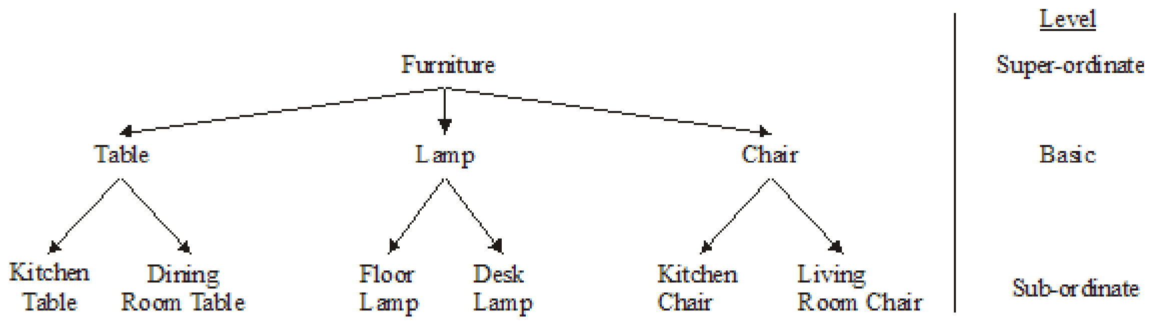


Figure 1-1: The organisation of the concept of "furniture". Taken from Rosch (1976), level descriptors added

Rosch *et al*. (1976) have also demonstrated that the basic level can be considered the entry point for categorisation. They presented participants verbally with a name for a type of object. This name was either at the super-ordinate level (e.g. tool), the basic level (e.g. hammer) or sub-ordinate level (e.g. claw hammer). Half a second later, they presented a picture of an object and asked to participant to respond if the picture was the object that they had heard. They found that those participants who were presented with the basic level descriptor responded faster than those who were presented with a word representing the other two levels of abstraction. This result was taken as support for the theory that naming objects at either the super-ordinate or sub-ordinate levels requires additional processing and that the initial level of categorisation is the basic level. This, however, is not always true for all people and all objects as experts show a different behaviour.

1.2 Expertise and Categorisation

Experts in their field are able to make judgments in their field of expertise that novices cannot. For example, bird watchers are able to discriminate between a wide variety of species whereas a novice is limited to a select few. Tanaka and Taylor (1991) have shown the effects of expertise on categorisation performance. They found that bird and dog experts responded as fast at the sub-ordinate level as they did at the basic level on verification tasks and were more likely to use sub-ordinate names (e.g. beagle) than those from the basic level (e.g. dog), suggesting that the entry point for experts is at a level lower than the basic level. Using this example of a dog, it can be suggested that the reason for this lower entry point is because experts are able to determine features that distinguish a beagle from a labrador just as fast and efficiently as they would be able to distinguish a dog from a cat.

1.3 Perceptual Learning

How we learn to discriminate one object from another has been the focus of much research. One possible theory is that people are able to learn via experience due to repeated exposure to a stimulus – termed perceptual learning (Gibson, 1969). Perceptual learning and its effects have been demonstrated in a number of laboratory studies. A well reported study by Biederman and Shiffrar (1987) revealed that after a short period of training, novice students could successfully sex day-old chicks to a level comparable with professionals – despite the fact that the photographs of the genital regions of the chicks were notoriously difficulty to classify (Gibson, 1969). Another study has revealed differences between levels of visual expertise in radiologists (Myles Worsley, Johnston & Simons, 1988). Myles-Worsley, Johnston and Simons (1988) report a study examining the successes rate of identifying abnormal[1] and normal x-rays amongst radiologists with varying levels of experience and comparing their performance with their ability to process human faces – a skill at which most people are experts at. They found that for abnormal x-rays, a linear trend emerged with novices performing worst, below their ability to recognise faces and senior radiologists performing best and at a level that was comparable to their face recognition skills. This was taken as support for the theory that through experience, radiologists become more adept at detecting features that may indicate disease. Indeed,

[1] X-rays containing an abnormality that indicates disease that was not present in any of the other images

they cite further evidence to suggest that experienced radiologists identify abnormal X-rays faster than novice (Christensen et al., 1981 as cited in Myles Worsley et al., 1988). Experience has also been shown to enable people to categorise totally novel objects (greebles, see figure 1-2 for an example) into family, races and genders (Gauthier, Williams, Tarr & Tanaka, 1998).

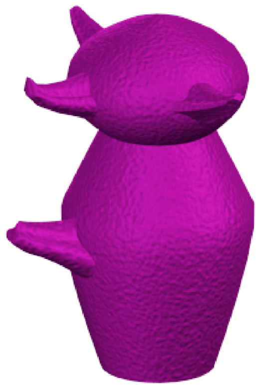


Figure 1-2: Example of a greeble (Gauthier *et al*., 1998)

The big question relates to what is actually happening during the learning process. Gibson and Gibson (1955) highlight two opposing views – differentiation and enrichment. Enrichment suggests that the learning process involves certain features of a stimulus becoming more salient over repeated exposure. In this view, the stimulus is perceived as initially impoverished which becomes more detailed over time. Differentiation on the other hand proposes that all stimuli are as rich and detailed as they can be and that the learning process involves being able to pick out the differences (i.e., the distinctive features) between them through experience.

1.4 Expertise with Faces

The studies considered so far have involved experts in a particular domain (e.g. birds, dogs). Virtually all of us are experts with faces though. Without this face expertise, social functioning would become extremely difficult, as exemplified by those suffering from prosopagnosia; a condition in which face identification is impaired (see Young, 1998 p. 81 for a brief overview). This level of expertise has been demonstrated through laboratory studies. Like the experts reported by Tanaka and Taylor (1991), Tanaka (2001) has shown that people will use basic level names to describe objects (e.g. "dog" as opposed to "beagle") but reliably use sub-ordinate names (e.g. "Bill Clinton" as opposed to "human") to refer to famous faces. At the same time, Bornstein (1963, as cited in Young, 1998p. 7) described a prosopagnosic patient who lost her previously high level of expertise in birds when she became prosopagnosic which suggests that faces may indeed be processed in a similar fashion to other objects of visual expertise.

How do we become experts in faces? An interesting effect that may give a clue to the process involved is known as the other race effect. The phenomenon observed in this effect is that people are able to discriminate between faces of their own race but find it difficult to do so for faces of other races, leading to responses such as "they all look alike!" O'Toole, Abdi, Deffenbacher and Valentin (1995) proposed that perceptual learning was responsible for the effect. They argue that repeated exposure to faces of one particular race leads to the ability to discriminate finely between them whilst the relative lack of experience with other races leads to difficulties in recognition. O'Toole, Peterson and Deffenbacher (1996) extended this work to examine participants' ability to categorise individuals of their own and other races by sex. They again found a distinct advantage for faces of the observers' own race. Dehon and Brédart (2001) report another important finding. In their study on age estimation of other races employing Caucasian and African Belgians, they found that Caucasians made more errors in the age estimation of Africans than for their own race. The reverse, however, was not found; i.e. Africans performed at a similar level for both races. Since all the Africans employed in the study had been resident in Belgium for at least 5 years, Dehon and Brédart conclude that this experience of living in a predominantly Caucasian environment had enabled to Africans to process both African and Caucasian faces equally well.

Experience has also been shown to play a role in the face processing mechanisms of infants. Quinn, Yahr, Kuhn, Slater and Pascalis (2002) demonstrated that infants prefer to look at a female face rather than a male face. Since most infants' primary caregiver is female, Quinn *et al*. also examined whether infants raised by males showed a preference for male faces. This result was indeed found and is taken to be supportive of the theory that experience plays a role in face processing.

It has been argued that face processing and visual expertise are closely linked. Diamond and Carey (1986) report that dog experts' recognition of dogs is impaired by inversion of the image of the dog; an effect they argue is analogous with the finding that face recognition in adults is impaired when the face is inverted (Yin, 1969).

1.5 Animal Faces

It would appear then that our experience of faces tunes the mechanisms for recognising faces to faces of our own race and, for infants, to the gender of their primary caregiver. Hence, one would not expect human performance on animal faces to be anywhere near the performance for human faces. Indeed, Pascalis, de Haan and Nelson (2002) have demonstrated that adults and even 9-month-old infants are able to discriminate between human faces but not between monkey faces. Six-month-old infants however, showed no preference for human faces and were able to discriminate equally between the two species.

Pascalis *et al*. argue that this effect is caused by a decreasing ability to discriminate between faces of other species because the face recognition systems become more tuned to the human face through experience.

1.5.1 Learning of Domestic-Cat Faces and Vocalisations

Despite the difficulties in discriminating between other species' faces, recent research has suggested that humans are able to discriminate between different types of cat vocalisations to an above chance level (Nicastro & Owren, 2003). In this study, Nicastro and Owren found that those with experience of the specific cats used in the study performed better than those who had not, suggesting the learning of cat sounds from experience. Regarding cat faces, previous research has shown learning of gender in cat faces (Quinn et al., 1999). In their study, Quinn *et al*. presented participants with pictures of male and female cats. Before any form of training, performance was only at chance level. After training was given with the most successfully identified cats, however, performance rose to above chance level. The effect of training would appear to be the result of the participants gaining experience in cat faces allowing them to begin processing them at a sub-ordinate level in a similar way to the experts reported by Tanaka and Taylor (1991).

The main issue with Quinn *et al*.'s study related to the stimuli that were used. No record of neutering was taken and it has been suggested that neutering affects the way male cats develop (Fogle, 1991). Fogle proposed that neutering a male cat before he reaches sexual maturity can result in the jowls and neck not developing as fully as a cat who has not been neutered (see figure 1-3). The result will be a male that looks more like a female and hence, the participants would have had a difficult task in discriminating gender from the faces alone!

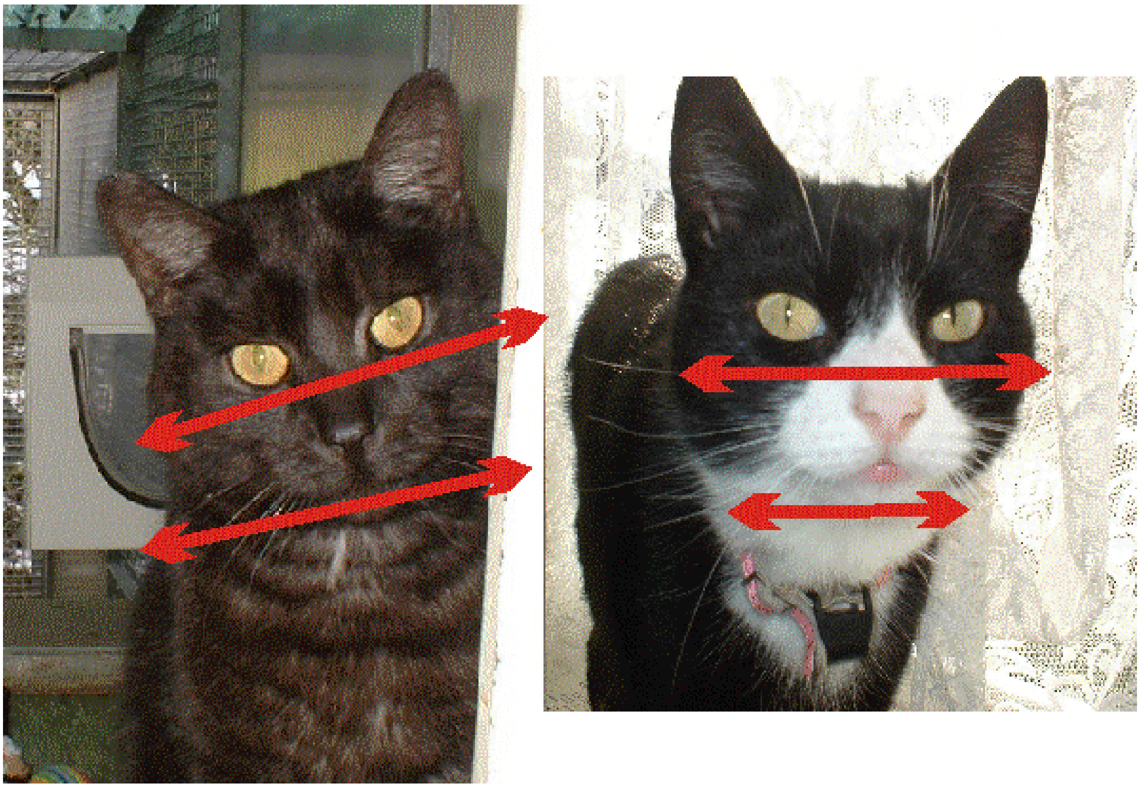


Figure 1-3: The difference in jowl and neck widths in un-neutered (left) and neutered (right) cats

A second issue is that the original study used cat faces of both genders during training. In their study, Quinn *et al*. found that some cats are more readily identifiable than others (within sex groups). If cat faces do contain gender specific features then training with one sex alone might aid discrimination since cats that were identified at a below chance level may contain some features that are being extracted by participants but applied incorrectly. Training with the most, and, the least successfully identified cats may aid learning as participants would be able to reassign certain features to the correct sex. Such training could be successful because of the binary nature of the task; if a cat does not contain the features of a male then it must be female.

A further issue relates to the colour of the cats. Price and Humphreys (1989) report that when objects are structurally similar, classification is influenced by colour and texture.

Hence, it can be hypothesised that people will use colour as a cue to aid classification as male or female[2]. Removing colour as a cue could draw attention to other features present in the face which are a more reliable source of information for gender. Therefore, experience with line drawings of cat faces may lead to an enhancement of the identification rate.

The aim of this study is to examine whether people can learn to discriminate between male and female cats from looking at their faces alone. In order to address the issues raised in the study by Quinn *et al.*, only un-neutered or late neutered[3] males will be used. Over the course of 3 experiments it will examine:

- Peoples' performance at and techniques for gender categorisation without any form of training,
- the effects of colour on categorisation,
- performance after training with male cats,
- performance after training with female cats,
- the effects of using line drawings.

It is predicted that, due to the lack of any experience of gender processing of cat faces, participants will only perform at chance level before they receive any training. During this phase, it is expected that participants will use colour as a cue for classification. After training however, it is anticipated that successful identifications will increase to an above chance level. It is also expected that this increase will be different for participants trained

[2] Since all the cat faces used in the study were covered with fur, texture is unlikely to have any effect.

[3] Males that were neutered after reaching sexual maturity (approximately 12 months of age).

with male cats and those trained with females. This is because the distinctive features discussed thus far refer to males. There are no reported features that are unique to female cats, therefore it is predicted that those trained with male cats will score higher than those trained with females as the latter group are not being exposed to distinctive features. It is also expected that experience with line drawings of cat faces which contain no information regarding colour or surroundings, will aid successful categorisation due to more emphasis being placed upon the features present in the face.

2. Experiment 1

Gender Identification Without Training

Experiment 1 examined if people are able to identify the gender of cats with no training. In the previous study by Quinn *et al*. (1999), there was no significant difference in the successful number of identifications by participants when they could view the head only, the body only or the full cat. Hence it was decided to use pictures of cat faces only.

2.1 Method

2.1.1 Design

There was one group of participants. Quantitative data representing the scores of participants (the dependent variable), response bias, their experiences of cats and qualitative data consisting of statements about their categorisation technique were collected.

2.1.2 Participants

40 participants (15 males and 25 females) aged between 18 and 56 took part (*M* = 26.52, SD = 7.08). To encourage participation, a bottle of champagne was offered as a prize for the top score and bottles of wine to those finishing in 2nd and 3rd place.

2.1.3 Stimuli

The stimuli consisted of 40 (20 male and 20 female) images, each of a single cat face. All were in colour and it was attempted to take the pictures of the cats at a distance of approximately 50cms. Many of the male cats were strays (due to difficulties in finding un-neutered cats) and were nervous about people approaching them. Hence, some of the pictures of male cats were taken at a longer range (~150cms). The original photographs were taken on a digital camera at a resolution of 640 x 480 pixels at a colour depth of 24 bits and were resized to 400 x 300 pixels for display via the presentation program.

2.1.4 Procedure

Participants completed the experiment electronically without the experimenter present (see appendix E for instruction sheet). The procedure was split into three parts:

2.1.4.1 Initial Questionnaire

First, participants provided information regarding whether they owned, or had considerable personal experience of any cats. If they did, they were asked to say what sex the cats were and also to write down a few of the personality traits of the cat. This was submitted as an email to a member of the research team.

2.1.4.2 Testing Phase

Upon completion of the questionnaire, participants began the gender identification task on a computer. An example of the program's main interface is shown below in figure 2-1.

Figure 2-1: Screenshot of the computer program used to present the faces to participants and record their responses

Participants were required to use the two buttons below the cat's image to make a response. The images were placed into a random order by the program and presentation by sex was also random for each participant. Participants were instructed that there would be 20 males and 20 female but the program did not limit their choices in making their decisions. Before the presentation of each image, there was a 2 second countdown. After the trial had finished the participant was presented with their score.

2.1.4.3 Final Questionnaire

The participants then provided information as to how they identified the faces as either male or female. As in the first stage, this was submitted by email to the researcher.

2.2 Results and Discussion

2.2.1 Participants' performance

The average score obtained was 53.94%[4] (M = 21.575, SD = 2.969). These data are

[4] As there are only two possible responses, chance level is 50%

represented in figure 2-2. Using a one-sample t-test, the scores obtained were found to be significantly different from the score of 50%, $t_{39} = 3.355$, $p < 0.05$ indicating that participants were performing at an above chance level. This difference from chance was only statistically significant for the score obtained for male cats ($t_{39} = 3.269$, $p < 0.025$). Scores for female cats were only at chance level ($t_{39} = 1.868$, $p > 0.05$).

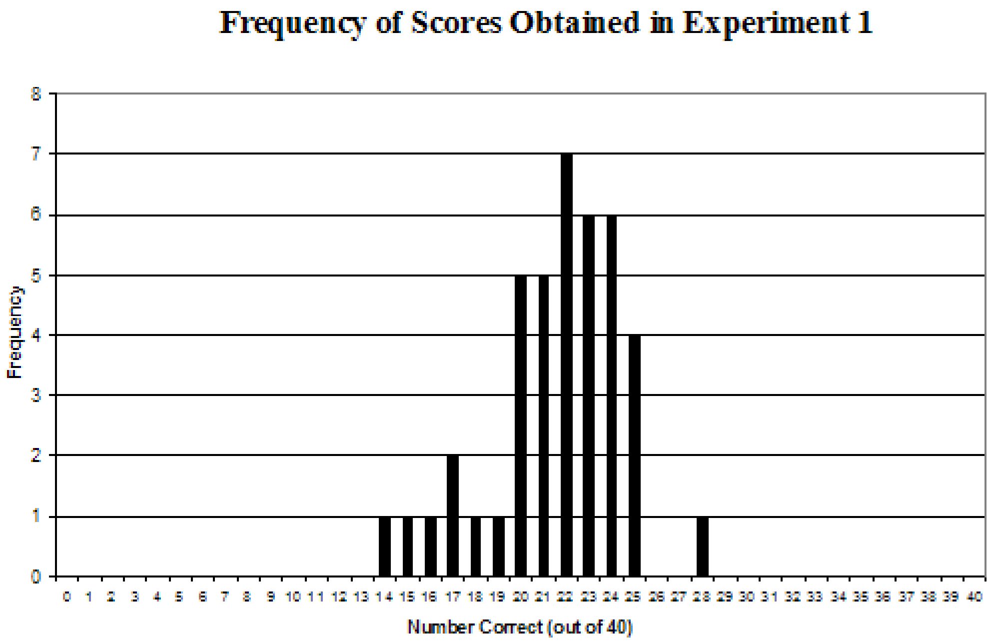


Figure 2-2: Frequency data obtained during experiment 1

Male cats were correctly identified 55% of the time ($M = 22$, SD = 7.581). For female cats, this score was slightly lower; 52.88% ($M = 21.15$, SD = 4.614). The difference between the variances of the two groups was found to be significant; $F_{1,38} = 7.686$, $p < 0.01$. The average number of times that the top 5 and bottom 5 cats were identified is shown in table 2-1.

Table 2-1: Mean number of times the top 5 and bottom 5 male and female cats were identified

		Mean number of times identified (out of 40)	Mean percentage	SD
Male cats	Top 5	32.2	80.5	2.280
	Bottom 5	13.2	33	1.483
Female cats	Top 5	27.4	68.5	1.817
	Bottom 5	15.6	39	0.894

From these results, it appears that males are either identified well or poorly. Females are much more consistently identified. The results presented thus far suggest that participants were able to use features present in male cat faces with some features being correctly attributed to maleness and others, incorrectly, to femaleness. Table 2-2 shows in rank order, the number of times each cat face was successfully identified.

Table 2-2: Rank order of cat faces based upon the number of times they were correctly identified (out of 40)

	Males			Females		
Rank	**Face Nº***	**Nº correct**	**%**	**Face Nº***	**Nº correct**	**%**
1	12	35	87.5	2	29	72.5
2	4	34	85	8	29	72.5
3	17	32	80	14	28	70
4	18	30	75	19	26	65
5	20	30	75	9	25	62.5
6	10	28	70	20	24	60
7	19	27	67.5	5	23	57.5
8	1	24	60	16	23	57.5
9	5	23	57.5	11	21	52.5
10	8	21	52.5	12	21	52.5
11	6	19	47.5	1	20	50
12	7	19	47.5	4	20	50
13	13	19	47.5	17	20	50
14	9	17	42.5	3	18	45
15	11	16	40	10	18	45
16	3	15	37.5	7	17	42.5
17	2	14	35	13	16	40
18	14	13	32.5	6	15	37.5
19	15	13	32.5	15	15	37.5
20	16	11	27.5	18	15	37.5

* See appendix A for photographs

The 5 most successfully and 5 least most successfully males and females are presented in figures 2-3, 2-4, 2-5 and 2-6.

Figure 2-3: The five most successfully identified males

Figure 2-4: The five least successfully identified males

Figure 2-5: The five most successfully identified females

Figure 2-6: The five least successfully identified females

2.2.2 Colour and sex of cats

It was examined whether the colour of the cat affected classification. Each cat was coded as being light, medium or dark by two reviewers with a high level of agreement ($r = 0.837$, $p < 0.01$). There were 8 male and 8 female cats classified as dark. This compares to 6 males and 3 females that were classified as light and 6 males and 9 females that were classified as medium. The average number of times males and females were correctly identified for the three colours are shown in figure 2-7.

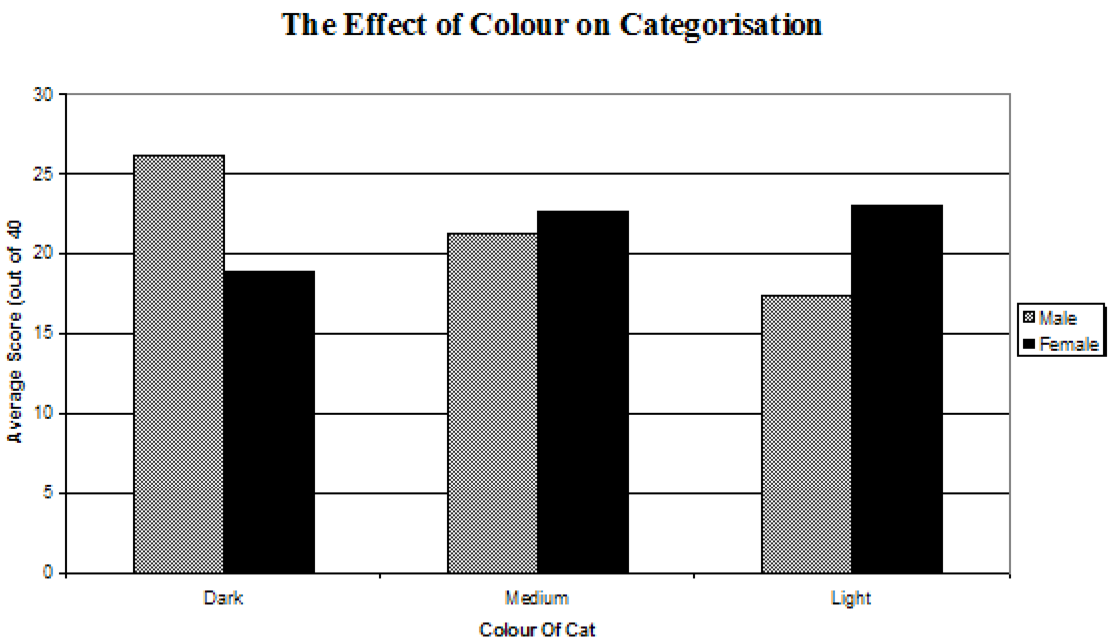


Figure 2-7: The effects of colour – dark males and light females stand the best chance of correct identification

A two-way ANOVA revealed no main effect of gender, $F_{1,34} = 0.001$, $p > 0.05$, and no main effect of colour, $F_{2,34} = 0.430$, $p > 0.05$, indicating that males were not identified reliably more than females and dark cats were not reliably identified more than light cats. There was a reliable interaction of gender and colour, however, $F_{2,34} = 3.892$, $p < 0.05$. This result suggests that the colour of the cat influences how the cat is identified as male or female such that dark cats are more likely to be labelled as male and light ones as female.

2.2.3 Effects of cat ownership

Table 2-3 below shows the number of participants who had experience of cats together with the average score for each group. An independent samples t-test revealed no statistical differences between the two groups (t_{38} = -0.815, $p > 0.05$) indicating that having experience of cats does not help categorisation of gender (see section 5.1.2, page 46 for further discussion).

Table 2-3: Mean scores of participants with and without experience of cats

	N	Mean score
Experience of cats	22	53.086
No experience of cats	18	55.000

2.2.4 Bias in responses

The computer software did not constrain participants' responses to ensure that they gave an equal number of responses for male and female. Analysis of the responses given reveals no significant bias towards one sex; mean number of male responses = 20.425, mean number of female responses = 19.575, t_{39} = 1.075, $p > 0.05$. These results indicate that the higher score obtained for male cats was not the result of participants responding with more male responses.

2.2.5 Categorisation techniques

Participants claimed to use a variety of techniques to identify the cats which are summarised in table 2-4[5]. In the study by Quinn *et al*. (1999), a very large number of techniques were reported, a pattern that was repeated here. The response of interest is the number (25%) of respondents who reported colour as an important factor in making their decisions, higher than the 9.375% found by Quinn *et al*. There was also a considerable number of responses that referred to behavioural characteristics (e.g. aggressive)

[5] When cat colour is given as a response to one sex with other, more specific factors (e.g. Males = colour, Females = round eyes, surroundings) colour is scored as a general technique as it requires a comparison between males and females and is not specific to one particular sex (e.g. if males are dark then females will be considered to be not dark, i.e. light).

characteristics. The responses given are discussed in more detail in section 5.1.1, page 45.

Table 2-4: Techniques used to classify the cats in experiment 1

	Participants Scoring >= 60% (*N* = 11)	Participants Scoring 55% and 57.5% (*N* = 12)	Participants Scoring 47.5%, 50% or 52.50% (*N* = 11)	Participants Scoring <= 45% (*N* = 6)
General	Width of face Comparisons with own cat Colour (3) Moustache Size* Expression* Guesswork* Face* Length of nose*	Size Colour (3) Head shape (2) Ear size Face shape	Tattered ears or eyes Meanness Colour (2) Face width Build size	Colour (2)**
Males	Moody Mischievous (2) Messy Wide jowls Active Adventurous Big head Pointed face*	Aggressive behaviour Cheeky Chewed ears Mangled eyes Wide face Large face Interesting Square eyes Wide jowls and nose Flat forehead	Aggressive Attractive Round face Curious Harsh, rough looking Skinnier Square head Scruffier Fight marks Narrower, pointed faces	More fluffy** Cuter** Large face** Stocky build** Thinner** Wide face** Fat face
Females	Small head Vacant Slim face Fat Lazy Sweet face Rounder face*	Surroundings Slim figures Snobby Small head Wider eyes Open Round eyes Delicate features	Not aggressive Unattractive Slim face (2) Shy Rounder in face More “full” Sweeter look Less aggressive stance Softer	Skinny** Thin face** Not cute** Smaller face and body frame** Eyes** Surroundings** Lighter** Fluffier** Fiercer looking** Narrow face** Skinny face

* = Descriptors used by participants scoring the 5 highest scores
** = Descriptors used by participants scoring the 5 lowest scores

3. Experiment 2

Gender Identification of Domestic Cat Faces with Training

The results obtained in experiment 1 suggest that people are not particularly good at determining the sex of a cat from the face. It appears that largely irrelevant factors such as colour[6] and perceived behavioural characteristics are taken as the primary indicator of gender. In an attempt to improve correct identification, experiment 2 trained participants with exemplars of either male or female cats. It is predicted that scores obtained after training will be higher than those before training. Experiment 1 also revealed that the 5 most and 5 least successful identified cats were male. This greater variation in features might be beneficial to the learning process as it suggests that participants are detecting gender-specific features and that some are being correctly attributed to maleness whilst others are incorrectly assigned to femaleness. Therefore it is predicted that participants trained with male cats will score higher on subsequent tasks than those trained with female cats.

3.1 Method

3.1.1 Design

Two groups of participants were used. One group received training with male cats and the other with female cats. The experiment contained three phases – two training phases and one test phase. Quantitative data in the form of (1) overall score, (2) an individual score

[6] Colour is specific in very few cases and popular beliefs about the relationship between sex and colour are often incorrect. For example, despite the popular phrase of a "ginger tom" this colour is not exclusively for male cats as there are many female ginger cats.

for male and female cats and (3) response bias were collected.

3.1.2 Participants

50 participants (23 males and 27 females) aged between 18 and 56 took part in the study. (M = 26.52 years, SD = 7.08).

3.1.3 Stimuli

The images used in experiment 1 were printed onto photographic paper measuring 6 x 4 inches with an inkjet printer. These photographs were used in conjunction with the computer images.

3.1.4 Procedure

3.1.4.1 Training phase 1 – training with a single sex

From the set of printed photographs, the 5 most and 5 least successfully identified cats (from both male and female groups) were used as training material (ranks 1 – 5 and 16 – 20 in table 2-2). Participants were placed in alternating order into one of two groups:

- group 1 received training with photographs of the 10 male cats and
- group 2, the 10 female cats.

The photographs were placed in front of the participant and they were asked to put them into two piles – one containing the most identified faces and the other, the least identified. After they attempted this they were told how many cats they had correct in each pile and they were given another chance to sort the pictures again, and, if necessary, a third. If they had not successfully sorted the faces after three attempts, they were told which group each cat belonged to.

3.1.4.2 Training phase 2 – training with both sexes

After the first training period, participants completed the computerised test of 10 cats (the 5 males and 5 female at ranks 6, 7, 13, 14 & 15 in table 2-2, page 26) using the software described in section 2.1.4.2. Once the participant gave an answer, the program gave them immediate feedback as to whether they were right or wrong. At the end of the task, they received feedback on their performance in terms of a percentage score.

3.1.4.3 Testing phase

Once all the training phases had been completed, participants undertook the main categorisation task. This took the same form as the second training session (see section 3.1.4.2) except this time, no immediate feedback was given. The cats used for testing were the males and females at ranks 8, 9, 10, 11 and 12 in table 2-2 (see page 26). These cats were chosen as:

- they fell at the mid point of the ranking list,
- the mean number of correct identifications for each sex was comparable; males = 21 (52.5%) and females = 21.2 (53%), so that neither sex was more likely to be identified than the other, on the basis of experiment 1.

At the end of the task, they received feedback on their performance in terms of a percentage score.

3.2 Results and Discussion

3.2.1 Participants' performance on test trials

3.2.1.1 Overall performance

The average score obtained across both groups was 52% (average 5.2 correct, SD = 1.616). This result did not differ significantly from chance[7]; $t_{49} = 0.875$, $p > 0.05$ indicating that overall, training did not improve scores over experiment 1. The data obtained from both training conditions are presented in figure 3-1.

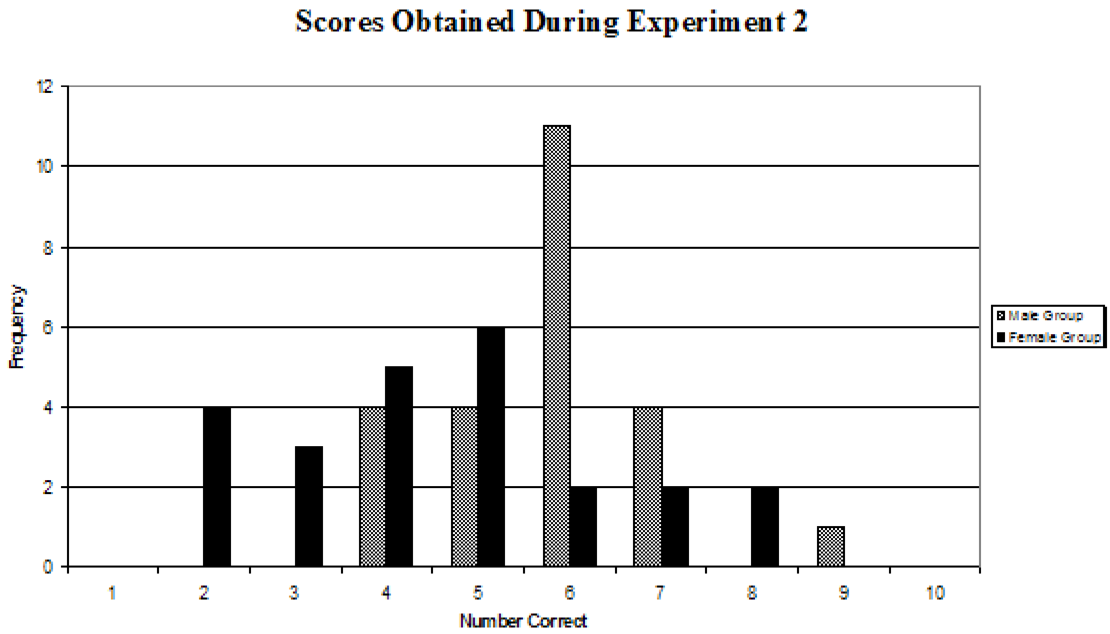


Figure 3-1: Scores obtained in experiment 2 for each of the two training groups

Overall, both male and female cats were identified 52% of the time but the two genders had different standard deviations (males = 4.183, females = 8.337). This difference is significant; $F_{1,8} = 10.800$, $p < 0.025$. This result is in contrast to experiment 1 where there was a far greater variation in the number of times male cats were identified. The number of times the gender of each cat was correctly identified is shown in table 3-1.

[7] Since there were 10 cats used for testing, chance was 5 out of 10 correct

Table 3-1: Rank ordering of the number of times each cat was identified during experiment 2

	Males			**Females**		
Rank	**Face Nº**	**Nº correct****	**%**	**Face Nº**	**Nº correct****	**%**
1	4 (8)*	30	60	3 (12)*	33	66
2	5 (1)*	29	58	4 (16)*	33	66
3	1 (7)*	28	56	2 (11)*	30	60
4	3 (5)*	22	44	1 (4)*	18	36
5	2 (6)*	21	42	5 (1)*	16	32

* The numbers in brackets refer to the face number from experiment 1 for ease of identification in appendix A.

** Out of 50, thus 25 is 50%

3.2.1.2 Group 1 – Training with male cats

The average score obtained by participants trained with male cat pictures was 58% (M = 5.8, SD = 1.155). This score was found to be better than chance; $t_{24} = 3.464$, $p < 0.005$, $\delta = 0.93$. The mean scores and bias for male and female cats are shown in table 3-2.

Table 3-2: Mean scores and bias for the male training group

		Gender of cat	
		Male	*Female*
Score (out of 5)	Mean (SD)	2.96 (0.676)	2.84 (0.746)
Bias (out of 10)	Mean (SD)	5.12 (0.833)	4.88 (0.833)

Both sexes of cat were identified better than chance – males; $t_{24} = 3.404$, $p < 0.005$, females; $t_{24} = 2.279$, $p < 0.05$ and there was no evidence of bias; $t_{24} = 0.721$, $p > 0.05$.

3.2.1.3 Group 2 – Training with female cats

The average score obtained by participants trained with female cat pictures was 46%

(average = 4.6, SD = 1.803). This score was not different from chance; $t_{24} = -1.109$, $p > 0.05$. The mean scores and bias for male and female cats are shown in table 3-3.

Table 3-3: Mean scores and bias for the female training group

		Gender of cat	
		Male	*Female*
Score (out of 5)	Mean (SD)	2.24 (1.165)	2.36 (0.907)
Bias (out of 10)	Mean (SD)	4.88 (1.055)	5.12 (1.055)

Neither males nor females were identified better than chance – males; $t_{24} = -1.116$, $p > 0.05$, females; $t_{24} = -0.771$, $p > 0.05$. Nor was any effect of bias[8] observed; $t_{24} = -0.569$, $p > 0.05$.

3.2.2 Comparison of Group 1 and 2

A comparison between the scores obtained by participants in groups 1 and 2 indicates that the scores obtained by those in the male training condition ($M = 5.8$) are significantly higher than those trained in the female group ($M = 4.6$); $t_{48} = 2.803$, $p < 0.01$.

These results indicate that training with male cats does improve peoples ability to discriminate between male and female cats and that this improvement exists for both male and female cats. Hence, when training with the cats that were considered the most and least like their sex, only males provide the required information to aid discrimination. Females, on the basis of this sample, do not possess these features.

[8] i.e. a tendency to select on gender more than the other

4. Experiment 3

Gender Identification of Line Drawings of Domestic Cat Faces

Price and Humphreys (1989) report that when objects share a similar structure, people will often resort to colour and texture in order to categorise them. In experiment 1, such an effect of colour was observed. Other effects of paraphernalia (e.g. beards, glasses) on face recognition in humans have also been reported (Freire & Lee, 2003). In an effort to remove all effects of colour and texture, experiment 3 investigates people's ability to determine the gender of cat faces from line drawings of their faces. It is predicted that those trained with line drawings will perform better than those who receive no training.

4.1 Method

4.1.1 Design

This study employed the same design as Experiment 2 of Quinn, *et al*. (1999) (described in full in Palmer, 1998). There were two groups, one received training and the other not. Quantitative data were collected in the form of the scores obtained by each participant (overall score, male cats and female cats) and response bias during the test phase.

4.1.2 Participants

50 participants (28 males and 22 females) aged between 22 – 59 took part in the study (M = 31.6, SD = 11.26).

4.1.3 Stimuli

The cat faces images used in experiment 1 and 2 were manipulated using Adobe Photoshop®. First they were converted to grayscale format and then the filter "Photocopy" was applied. These images were printed and then the outline of the face, eyes, nose and mouth were traced using tracing paper. Examples are shown in figure 4-1. Each image was mounted on a piece of card approximately 15cm x 15cm.

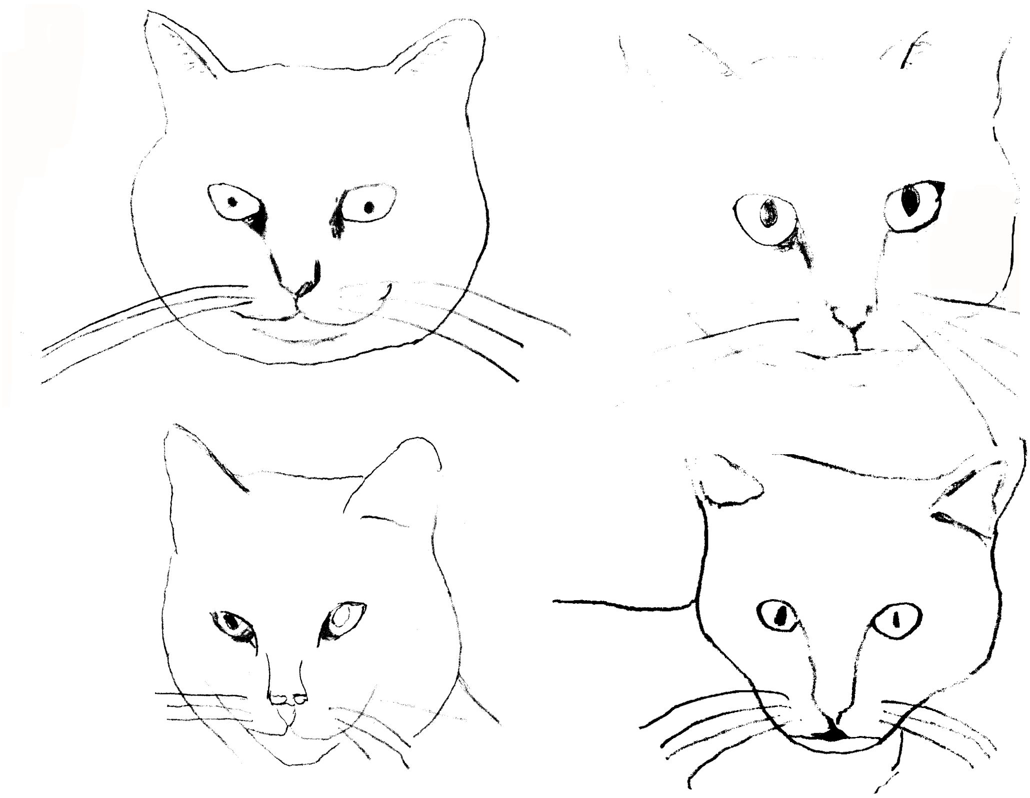


Figure 4-1: Examples of the line drawings using in experiment 3. The top two cats are female, the bottom two, male

4.1.4 Procedure

Participants were allocated randomly to one of two groups. Group 1 received training and then completed the test phase. Group 2 only completed the test phase.

4.1.4.1 Training phase – group 1 only

From the set of 40 drawings, 30 were selected as training material. These were the males and females at ranks 1 – 7 and 13 – 20 in table 2-2 (see page 26). All 30 drawings were placed in front of the participant who was seated at a desk. The drawings were presorted into two piles – one containing the 15 males and the other the 15 females. They were asked to study the drawings for a total of 10 minutes and attempt to determine the features that indicate the gender of the cats. At the end of the 10 minutes, the drawings were removed from view.

4.1.4.2 Testing phase – both groups

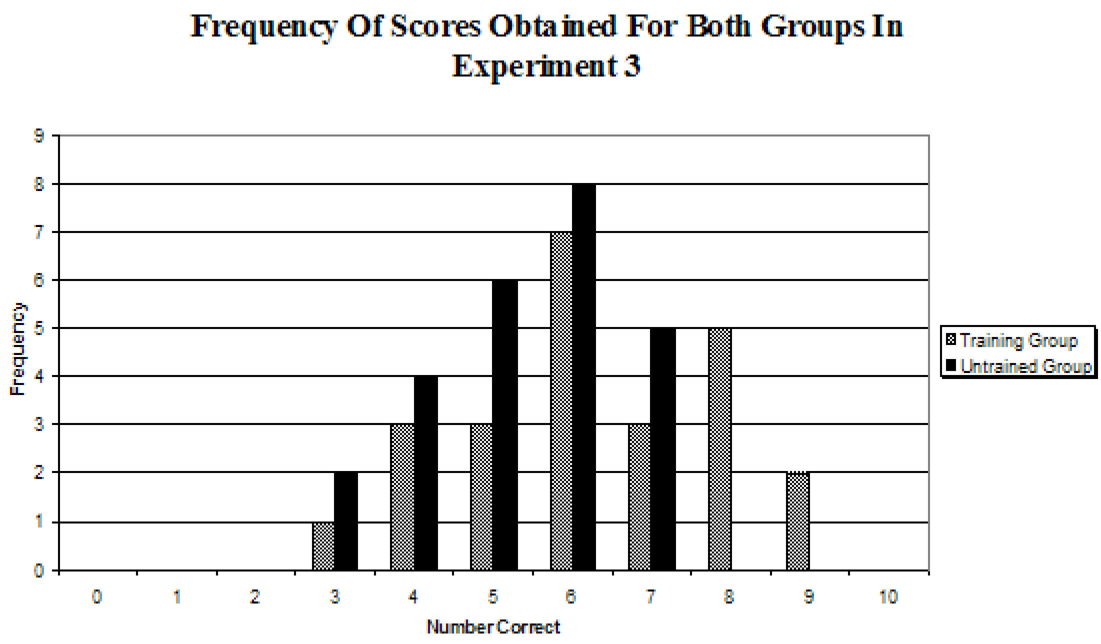
10 drawings (the 5 male and 5 females at ranks 8 – 12 in table 2-2, page 26) were used as test stimuli. These drawings were shuffled into a random order before the first participant and were kept in the same order for subsequent participants. They were presented one at a time and participants were asked to indicate on an answer sheet whether they thought the cat was male or female. They were instructed that there would be 5 males and 5 females but they were not to deliberately balance their answers.

4.2 Results and Discussion

4.2.1 Participants' performance

4.2.1.1 Overall performance

Overall, participants obtained an average score of 58% ($M = 5.8$, SD = 1.512). These data are presented in figure 4-2.



4.2.1.2 Performance with training (group 1)

The average score obtained by participants who were trained with line drawings was 62% (M = 6.2, SD = 1.683). This result was found to be significantly higher than chance; $t_{24(1\text{-tailed})} = 3.565$, $p < 0.001$, $\delta = 0.94$. The mean scores and bias obtained for male and female cats is shown in table 4-1.

Table 4-1: Mean scores and bias for group 1

		Gender of cat	
		Male	*Female*
Score (out of 5)	Mean (SD)	3.08 (0.909)	3.12 (1.053)
Bias (out of 10)	Mean (SD)	4.96 (1.020)	5.04 (1.020)

Both sexes of cat were identified at above chance level (males; $t_{24(1\text{-tailed})} = 3.190$, $p < 0.0025$, females; $t_{24(1\text{-tailed})} = 2.942$, $p < 0.005$) and there was no evidence of a bias in responses; $t_{24} = -0.196$, $p > 0.05$.

4.2.1.3 Performance without training (group 2)

The average score obtained by participants who did not receive training was 54% ($M = 5.4$, SD = 1.225). This score was not significantly different from chance; $t_{24} = 1.633, p > 0.05$. The mean score and bias for male and female cats is shown in table 4-2.

Table 4-2: Mean scores and bias for group 2

		Gender of cat	
		Male	*Female*
Score (out of 5)	Mean (SD)	2.88 (0.6)	2.52 (0.823)
Bias (out of 10)	Mean (SD)	5.36 (0.757)	4.64 (0.757)

Male cats were identified at above chance level; $t_{24} = 3.167, p < 0.005$ whilst females were identified no better than chance; $t_{24} = 0.122, p > 0.05$. The difference in bias was found to be significant; $t_{24} = 2.377, p < 0.05$. This result suggests that the reason for male cats being identified at a level above chance is due to participants providing significantly more "male" responses, artificially boosting the score for male cats.

4.2.1.4 Comparison of groups 1 and 2

A comparison between groups 1 and 2 reveals that participants who received training scored significantly higher than those who did not; $t_{48(\text{1-tailed})} = 1.922, p < 0.05$, supporting the hypothesis that experience of line drawings of cat faces will improve gender categorisation.

4.2.2 Individual cat identification

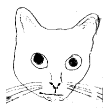
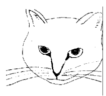
Tables 4-3 and 4-4 below show the male and female cats respectively, together with the number of times they were identified.

Table 4-3: Male cats in order of successful identification after training

Rank	Cat face Nº*	After Training Nº of times correct	%	Before Training Nº of times correct	%	Picture
1=	1	21	84	12	48	
1=	7	21	84	21	84	
3	6	13	52	14	56	
4	8	12	48	16	64	
5	5	10	40	9	36	
Average		15.4	61.6	14.4	57.6	

* See appendix B

Table 4-4: Female cats in order of successful identification after training

Rank	Cat face Nº*	After Training Nº of times correct	%	Before Training Nº of times correct	%	Picture
1	16	21	84	10	40	
2	4	19	76	16	64	
3	12	15	60	16	64	
4	11	14	56	12	48	
5	1	9	36	9	36	
Average		15.6	62.4	12.6	50.4	

* See appendix B

4.2.2.1 Comparison between groups 1 and 2

4.2.2.1.1 Male cats

After training, the successful identification rate increased from 57.6% to 61.6%. Only cat number 1showed a significant rise; $\chi^2 = 7.219$, $p < 0.01$.

4.2.2.1.2 Female cats

Training resulted in successful female identifications increasing from 50.4% to 62.4%. This difference was significant; $t_{48(\text{1-tailed})} = 2.244$, $p < 0.025$. Only one female cat's identification stayed the same after training – cat number 1. However, cat number 16 was the only one to show a significant increase; $\chi^2 = 10.272$, $p < 0.005$.

These two results suggest that the increase observed after training was largely due to the effects on two cats; one male and one female (see section 5.2.2 for further discussion).

5. General Discussion and Conclusion

5.1 Categorisation of cat faces in experiment 1

The results from experiment 1 reveal that without training, people's ability to categorise domestic-cat faces as male or female depends upon the sex of the cat. The scores obtained by participants for male cats are reliably better than chance, yet female cats are only identified at chance level. This was not due to participants giving more "male" responses than "female" ones as no significant bias was observed. One possible explanation for the results comes from the observations made on cat colour. Male cats were more successfully identified if they were dark and females if they were light. If colour was the primary indicator of gender, then it is possible that the results reflect that people are able to identify more males correctly simply because there were more dark males than light females in the test set. There were 6 males classified as light and 5 of these fell into the bottom 9 successfully identified males. These males were all identified less than 50% of the time. For female cats, the large dominance of medium coloured cats may have led to participants relying much more on guesswork, however 7 of the 9 medium females fell into the top 10 successfully identified females whereas this group only contained 2 of the 8 dark females. Overall, colour appears to have had a large effect on people's categorisation when no training is given. This result supports the findings of Price and Humphreys (1989) and Freire and Lee (2003).

5.1.1 Categorisation techniques

Categorisation techniques other than colour were quite varied. One participant commented that they made use of the surroundings to guide categorisation. This is interesting because this individual had moved away from thinking purely about the cat to the cat's carer too! These results are useful because abstract terms such as "mean-looking" or "perky" have been found to be beneficial for recognising faces (e.g. Bower & Karlin, 1974 as cited in O'Toole et al., 1995). Whether the use of such terms for this stimulus is useful is open to question, especially due to inconsistent assignment of terms – some people considered males cats to be cute, others attributed this term to females.

These results also suggest that those with the higher scores tend to use general categorisation techniques rather than attributing one unique feature to a particular sex. In total, participants scoring 60% or more referred to 8 (35%) general techniques and 15 (65%) sex specific techniques. This compares to those scoring 45% or lower who list 1 (5%) general and 18 (95%) sex specific techniques. There was also a difference in the types of descriptors used. Twelve references (26%) were made to physical characteristics of the face by those scoring 55% or more. This compares to those scoring 52.5% or below list 7 (16%) such features. It would appear then that those who do better at categorisation are doing so through the use of physical facial cues.

5.1.2 Effects of prior experience with cats

In both experiment 1 and the study by Quinn *et al*. (1999), prior experience did not help people in the categorisation task. This is not unexpected since vets used by Quinn *et al*. would be expected to use the genitals to sex a cat (more reliable than the face). It is suggested here that the reason that those participants in experiment 1 who had experience of cats performed no better than those who did not is because they have no prototype of male or female cat faces. Instead, they only need to recognise a few cats; their own! Hence, it is likely that these cats will be stored as specific exemplars rather than examples of their sex.

5.2 Categorisation of cat faces by gender after training

5.2.1 Use of photographs (experiment 2)

The results from experiment 2 indicate that training can improve people's ability to discriminate between male and female cats, but only if male cats are used in training. An explanation for this is as follows: it appears that male cats have features that are distinguishable (see Fogle, 1991) but females do not. Results from experiment 1 indicate that males contain features that are detectable but some are incorrectly applied to femaleness. The experience with male cats received by group 1 in experiment 2 demonstrated this effect and, as a result, they were able to reassign the features that they may have attributed to males to females. Those who received experience of female cats did not receive the information required to make this correction and, hence, performed at a level close to chance.

5.2.2 Line Drawings (experiment 3)

Line drawings remove all paraphernalia and other extraneous cues and, if there are non-paraphernalia, gender specific features present in cat faces which can be used to sex the cat then this type of stimulus is more suited to picking them up than photographs are. The highest average score in this study was achieved with line drawings – 62%. After training the mean number of identifications for male and female cats was comparable (males = 61.6%, females = 62.4%) despite the fact that before the gap was much wider (males = 57.6%, females = 50.4%). This result suggests that a score in the region of 62% is something of a ceiling, a similar conclusion to that drawn by Quinn *et al*. (1999).

What is happening during training is very difficult to interpret. One possible explanation regards the formation of a prototype for male and female cats. Through training, a prototype of male and female cats begins to build. Due to the short length of time given though, the prototype only contains a couple of features that indicate the sex of the cat. For example, after training, the top three males have wide noses whilst the top three females have narrow noses. For the bottom two in each group, the reverse is true. However, nose width is not the only feature present – shape of head also seems to have had an effect. Despite having a wide nose, the male cat ranked third (number 6) also has a very round head; the same characteristics possessed by female number 11. The male cat was identified *less*[9] after training indicating that his face was more salient than his nose, a hypothesis supported by the fact that the aforementioned female improved after training.

Overall, it appears people can learn something about cat faces but the prototype formed after only 10 minutes of training is in its early infancy and therefore, not very reliable as it was based on only a few features. How these features interact is also prone to error.

5.3 Learning of Cat Faces

Why is it so hard to learn gender from cat faces? One possibility is that, as reported by Pascalis *et al*. (2002), the ability to discriminate between faces that are not human decreases through infancy, until by adulthood, such a skill is almost non-existent. Under this hypothesis, we would not expect people to perform above chance. Before training, this was indeed found. Through the experience of training however, people performed at a level that was above chance suggesting that people can determine the gender discriminating features of other species. This is analogous to the finding on the other race effect reported

[9] Not statistically significantly however

by Dehon and Brédart (2001). Due to their experience of Caucasian faces, African Belgians were now able to make age estimations for Caucasians and Africans equally well. In this study, the short experience of cat faces enables people to make sex judgements on the faces.

An interesting issue that arises out of this study is that of how a cat face is processed; i.e. as an object or as a face? It can be argued that drawing a distinction between face processing and visual expertise for other objects is not required. As de Haan, Humphreys and Johnson (2002) point out:

> *"Currently, there is little empirical evidence to distinguish developmental learning of face recognition and learning of visual expertise for other object categories as adults."*
>
> *(de Haan et al., 2002)*

It must be remembered however, that studies on experts do not present the stimulus in such a way as it would be processed as a face. For example, the dogs shown to the dog experts by Diamond and Carey (1986) were presented in a side-on shot (i.e. a profile of the whole animal). This form of presentation implies object recognition. This study and the study by Quinn *et al*. (1999) both presented cat faces in a way that participants are likely to want to try to process the faces like a human face and comparisons with human facial stereotypes were common (see table 2-4, page 31). Experiment 1 also revealed that those participants who score higher than 60% on this task primarily listed physical features of the face as their technique for categorising the face. As such, the studies on cat faces are a little different from other studies that have compared human face perception to expertise for objects (e.g. Diamond & Carey, 1986; Tanaka & Taylor, 1991; Rossion, Gauthier, Goffaux, Tarr & Crommelinck, 2002). If the cat faces are indeed being processed as faces then processing may be interfered with due to differences between the human and cat face. Hence, as people try to learn the features that determine male and female cats, the mechanisms in place for this task are likely to be those appropriate for human features, making the task very difficult.

Finally, there is one more possibility that must be considered. It is not known whether cats use facial features to discriminate between the two sexes or if other identification techniques (such as smell) are used. It may be that whilst there is some gender typical features in the faces, it might not be the only feature and hence, relying solely on the face is in itself a flawed tactic. Such a hypothesis would explain why some cat faces become more distinct after training whereas other do not.

5.4 Future work

There are three major issues with this study that future work could address. The first, and probably most important issue relates to the length of training time given to participants. In their study, training greeble experts, Gauthier, Williams, Tarr and Tanaka (1998) trained participants for a total of 9 hours in 1 hour sessions spread over 10 weeks whilst the African Belgians reported by Dehon and Brédart (2001) had a minimum of 5 years of experience with Caucasian faces. In comparison, this study gave very little training! Considering that cat faces do not contain the discrete features of the greebles and are more like a human face, it is clear that more training would be required in order to reach the levels observed with human faces.

The length of training time given in experiment 2 was determined by the participant, whereas during experiment 3 there was a set period of exposure to the drawings. This makes comparison of the results of these two experiments very difficult, both in terms of training and stimuli. To correct this, another condition is required in each experiment. In this condition, participants would receive the other type of stimulus (i.e. line drawings would be added to experiment 2 and photographs added to experiment 3).

The second issue relates to the cats themselves. A number of participants commented that they thought that female cats would look at the camera whilst the males would not. This was due to choosing the best photographs available. Un-neutered or late neutered male cats were very hard to find and as a result, all were included in the study, regardless of the quality of the photographs. Since it did not matter if females were neutered or not, there was an abundance of females that could be used. As a result the photographs of the females tended to be of better quality than those of the males and this difference might have been picked up on.

Finally, using photographs or line drawings as the means of providing experience has restrictions. 3D models can provide far more information than static 2D images and might be beneficial to the learning process (see Eysenck & Keane, 1995 p. 66-67) which could lead to and improvement in successful identification.

In conclusion, people are able to discriminate between male and female cats but this skill is not as robust as the discrimination between human male and female faces. In everyday life, we make judgements as to whether a human is male or female but not so with cats. Thus, the experience that people have with making judgements about human faces far outweighs that which they have with cat faces. Maybe, as people become greater cat face experts, performance levels such as those seen with human faces will be possible.

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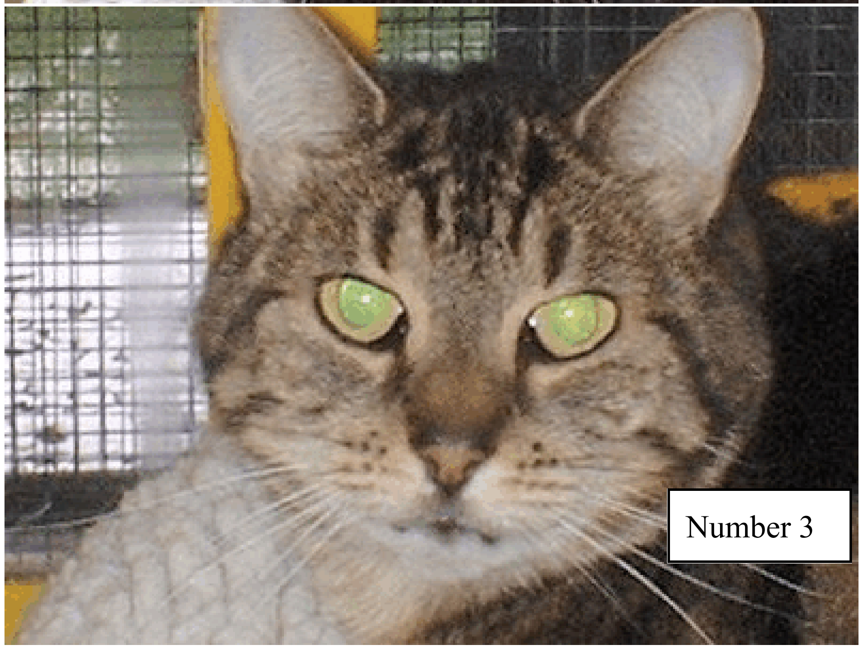
7. Appendix A – Photographs Used

Females


Number 20


Number 2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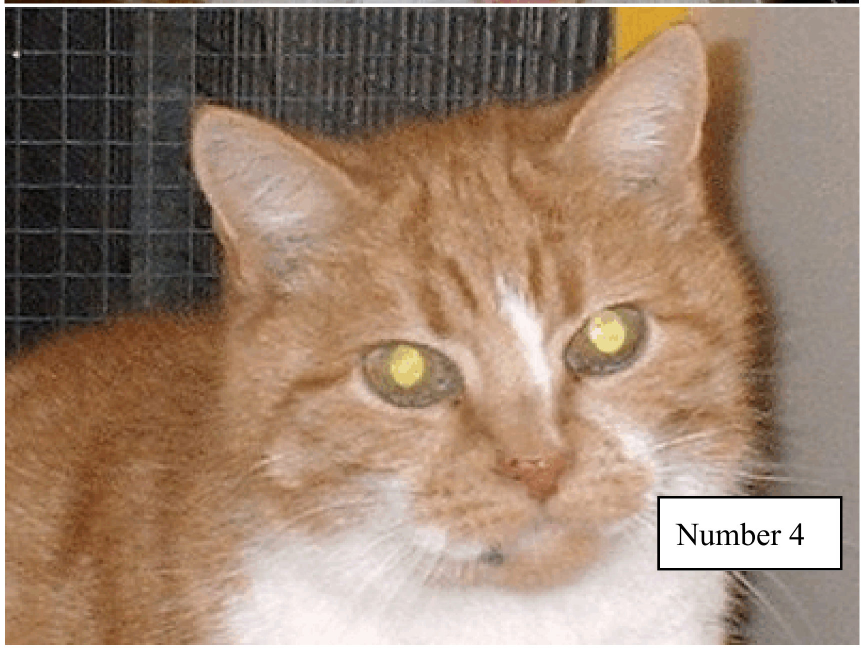
Number 4

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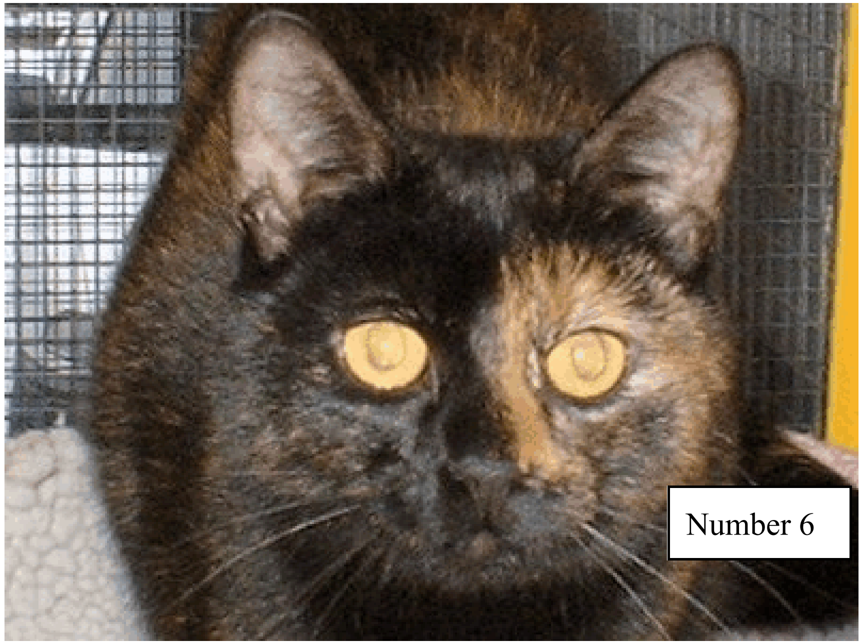
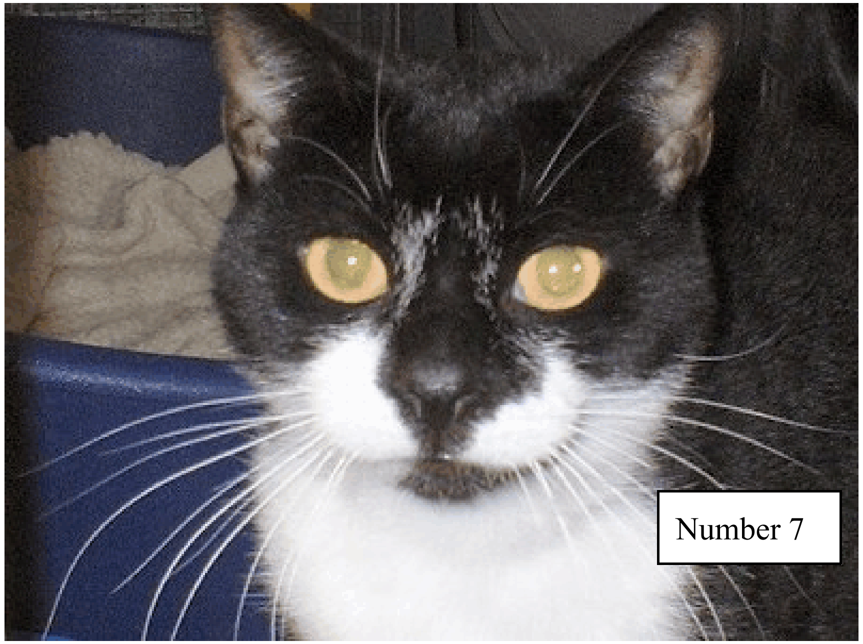


Number 6

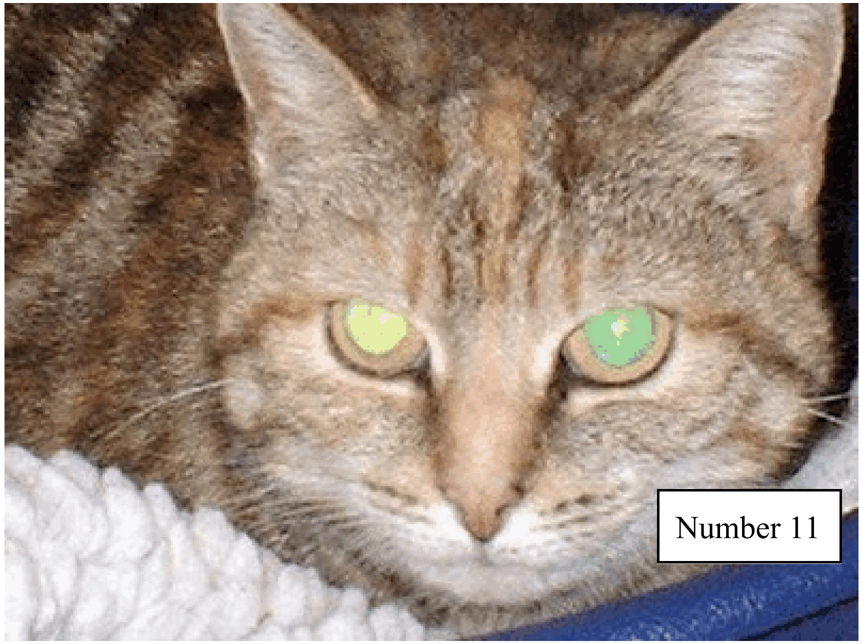


Number 7

Number 8

Number 9

Number 10



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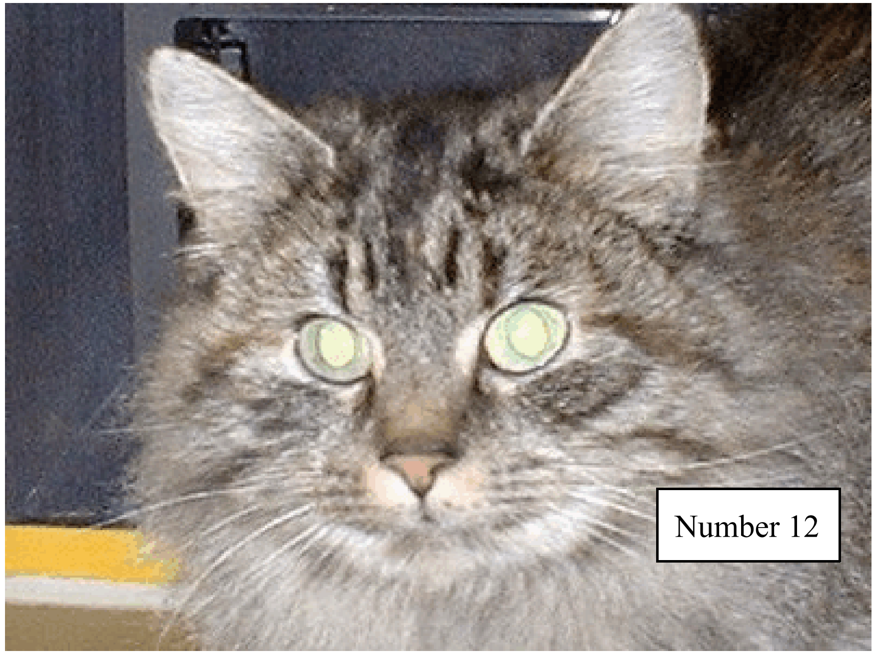

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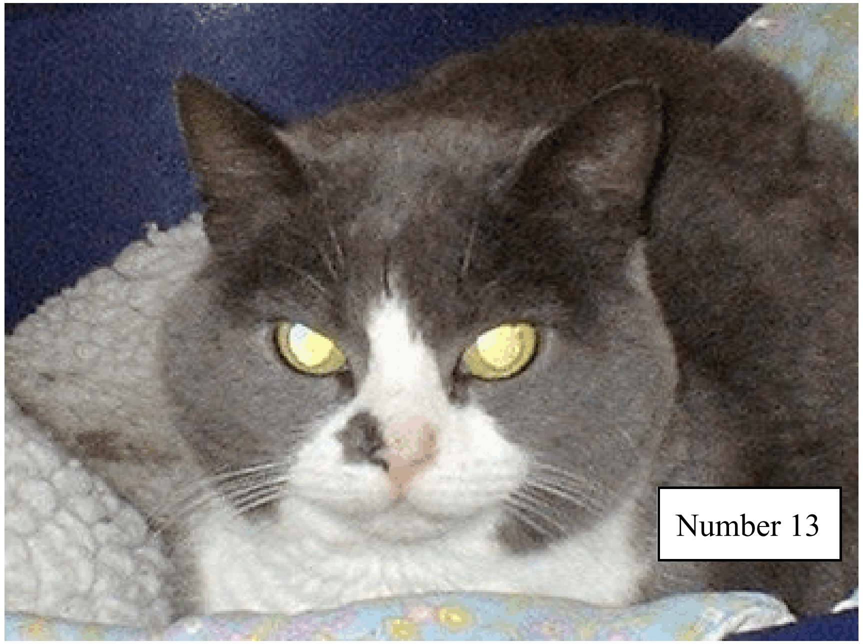
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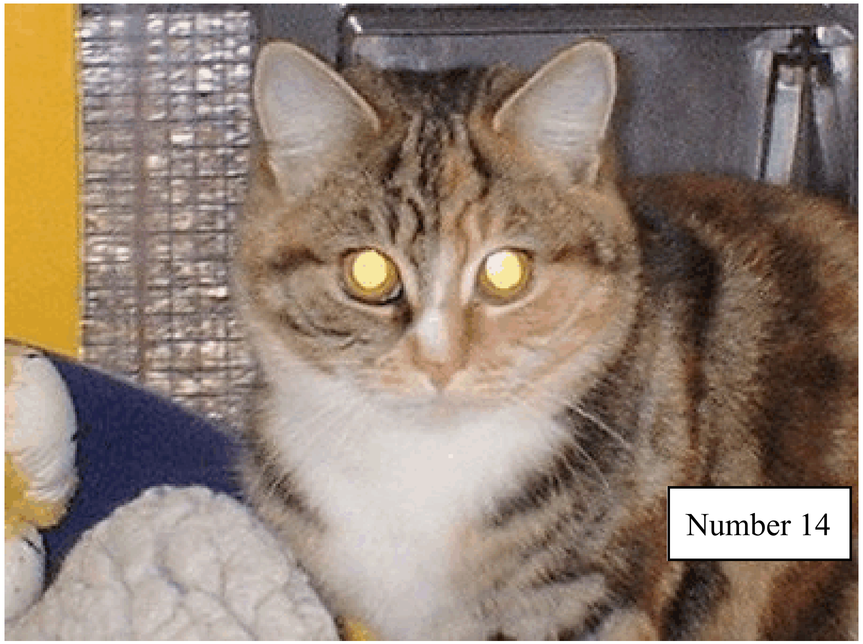
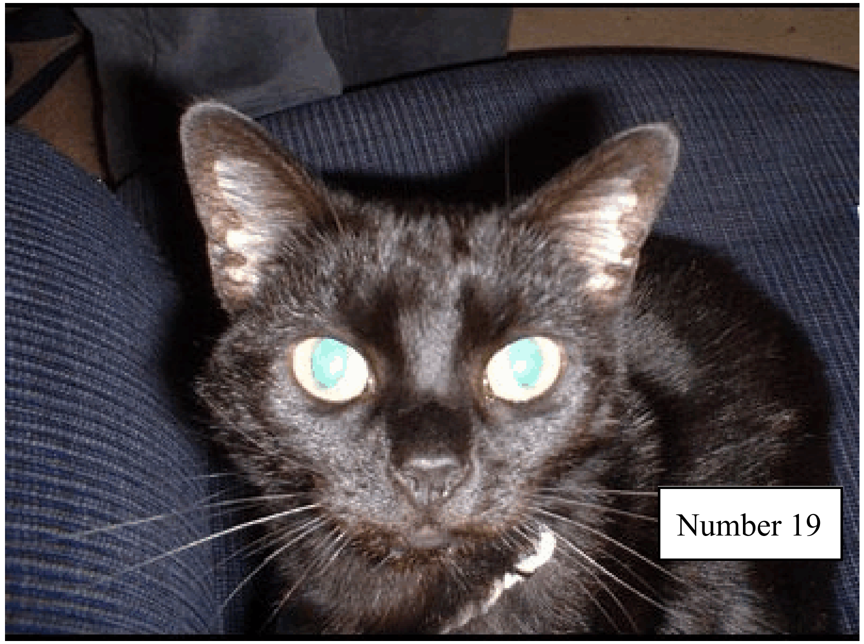
Number 15


Number 14


Number 16


Number 17


Number 19


Number 18


Number 1

Males


Number 20


Number 2


Number 3


Number 4


Number 5

Number 6

Number 7

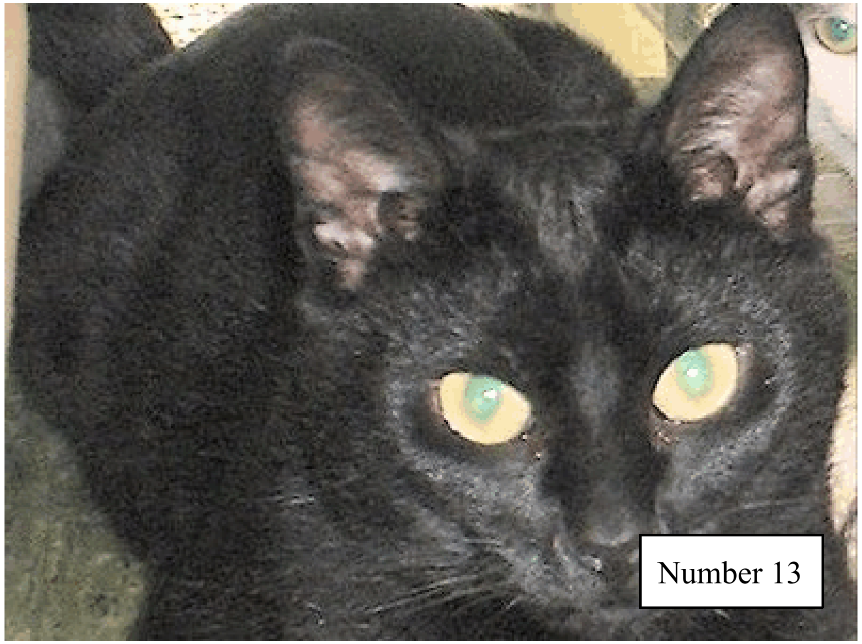
Number 8


Number 9


Number 10


Number 11


Number 12



Number 13

Number 14

Number 15

Number 16

Number 17

Number 18

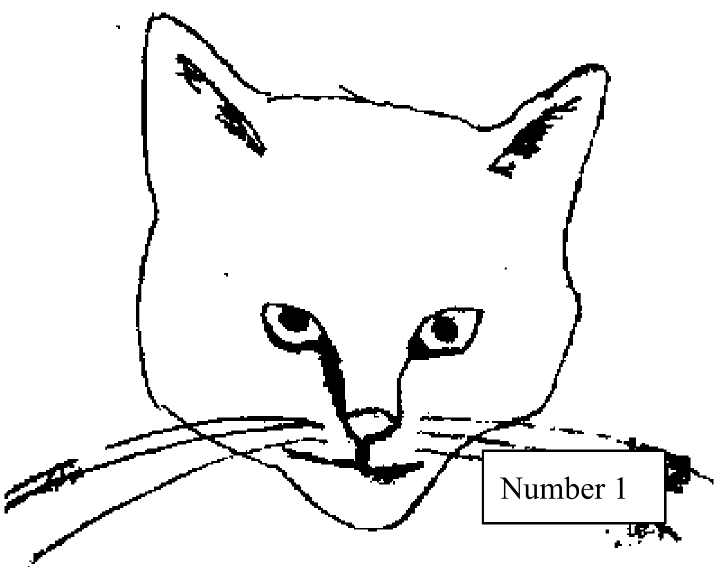
Number 19

Number 1

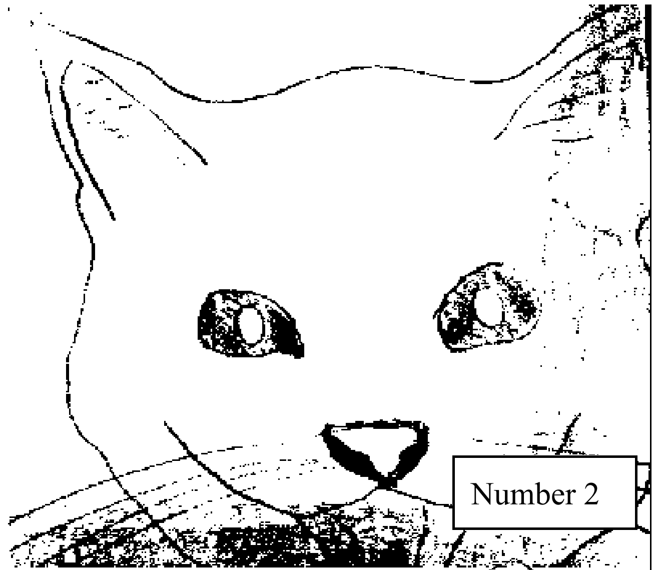
8. Appendix B – Line Drawings Used In Experiment 3

Note: Due to difficulties of scanning tracings, the images presented in this appendix are not of the quality of original drawings.

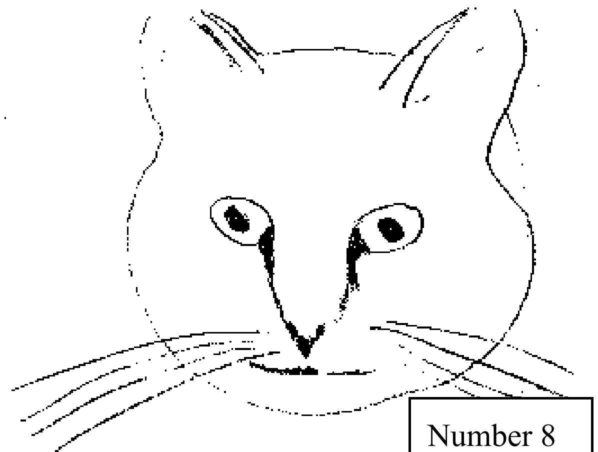
Females



Number 1



Number 2



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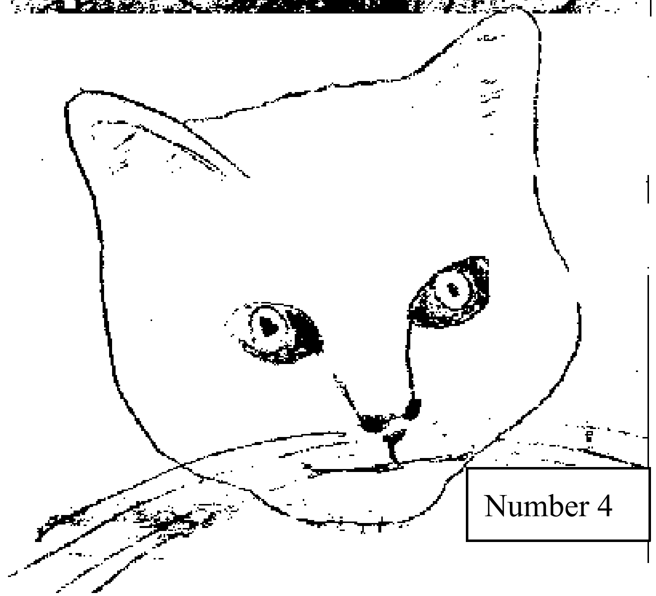

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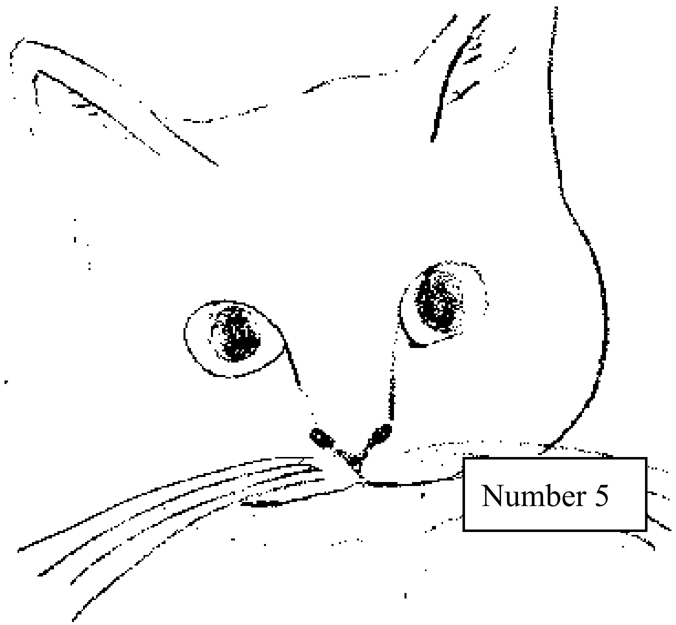

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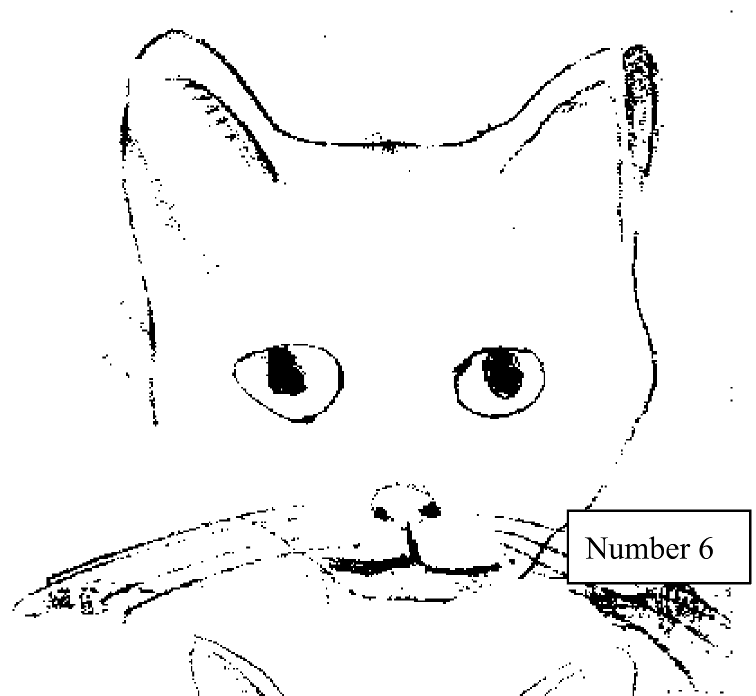

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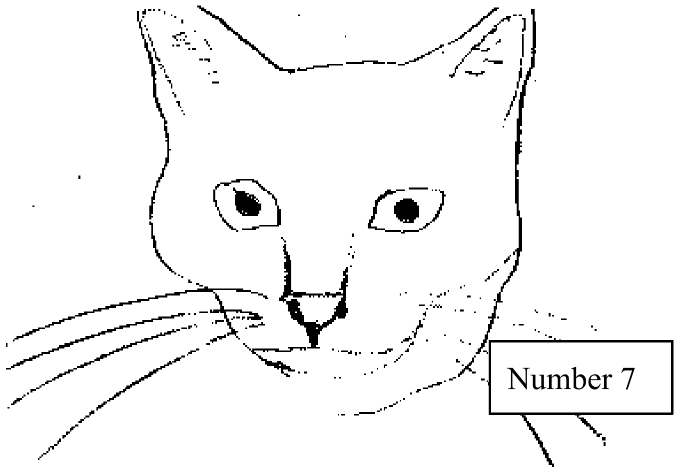

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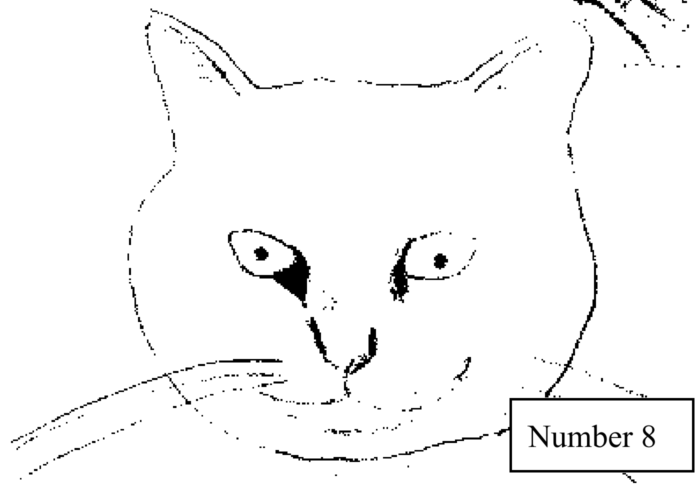

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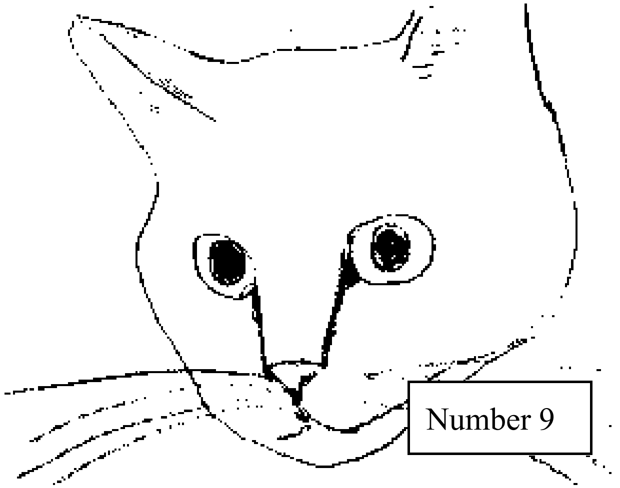

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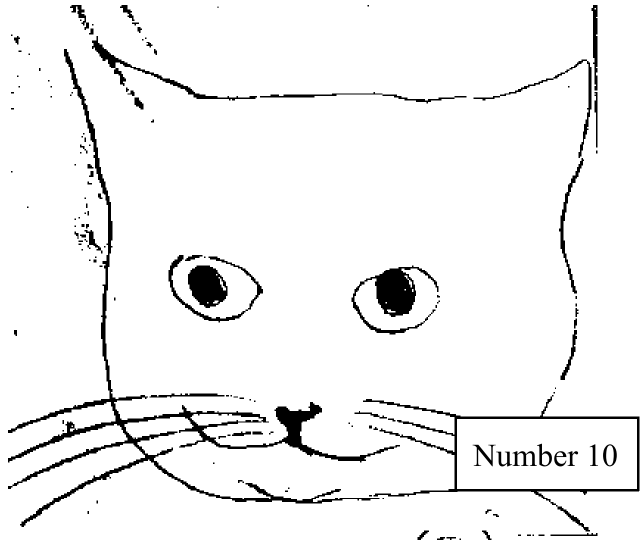

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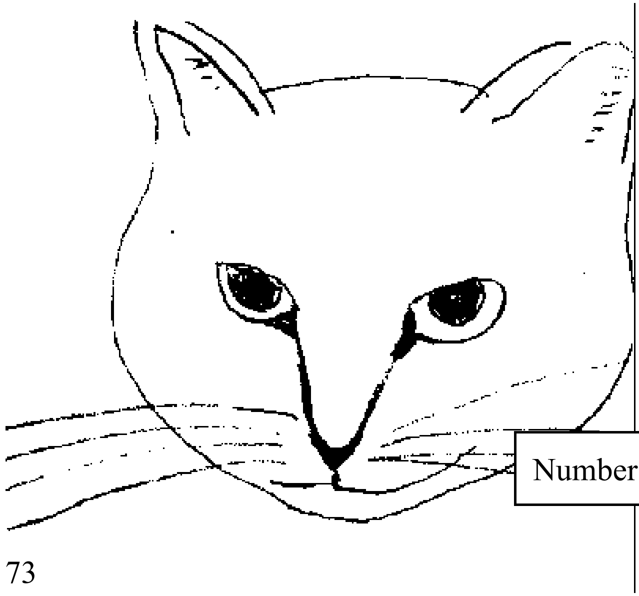

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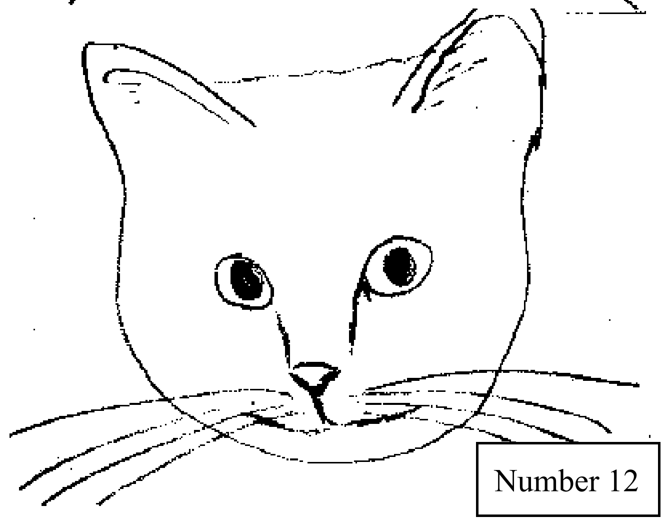

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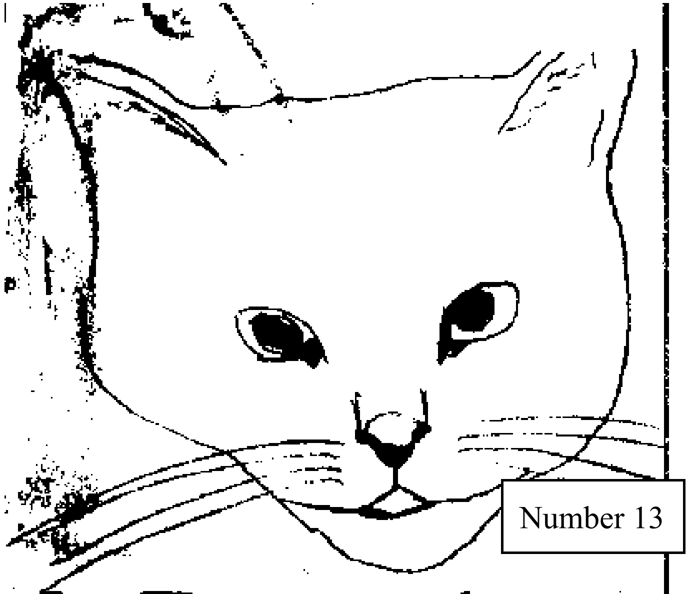

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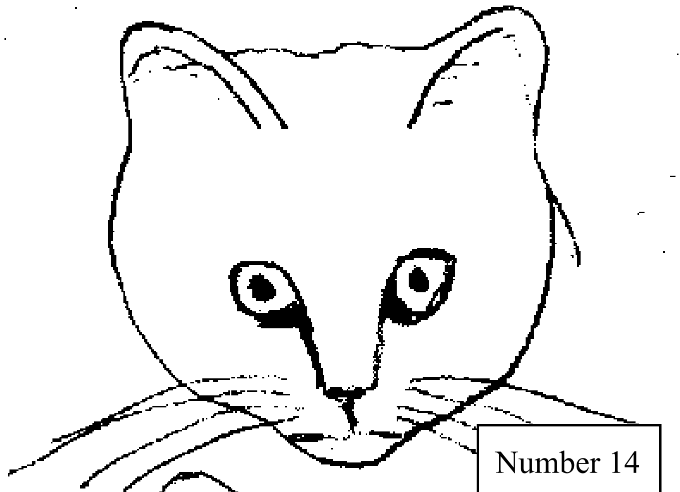

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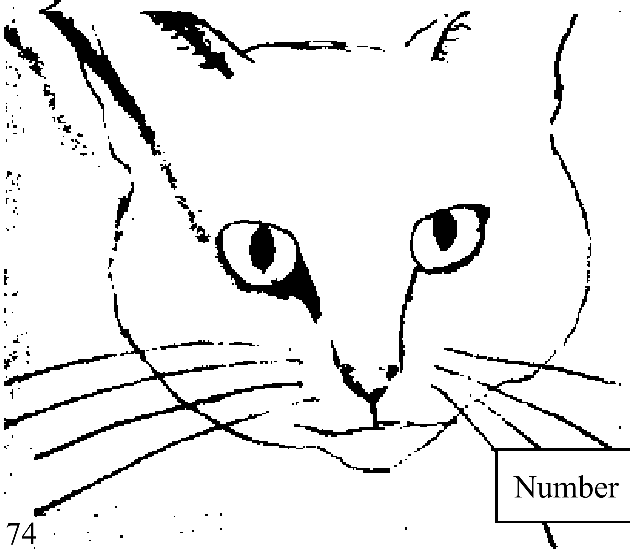

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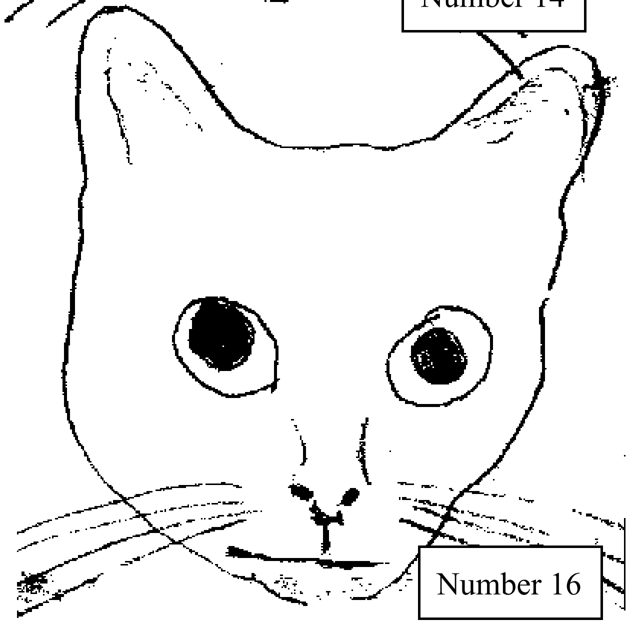

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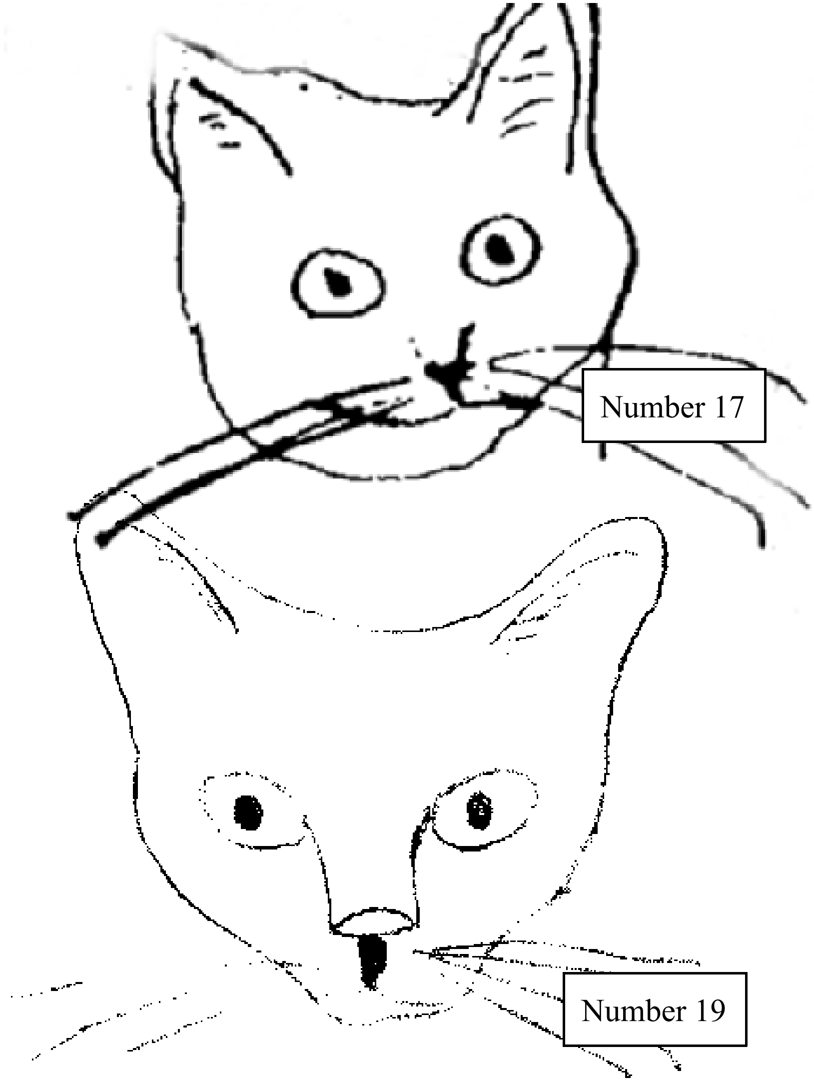
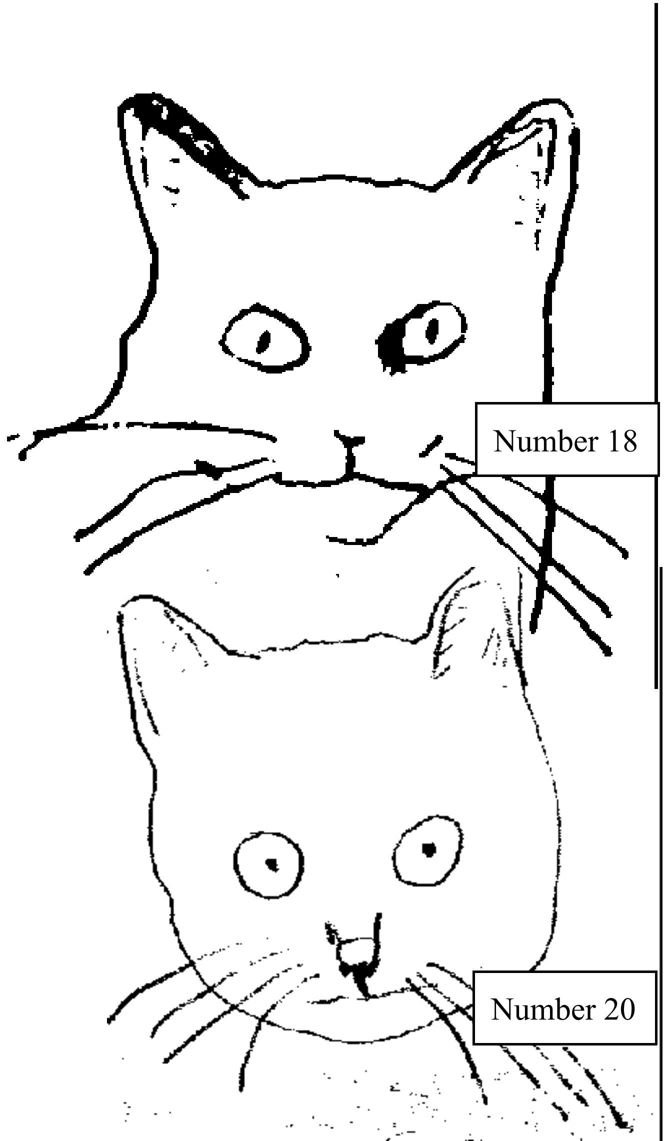
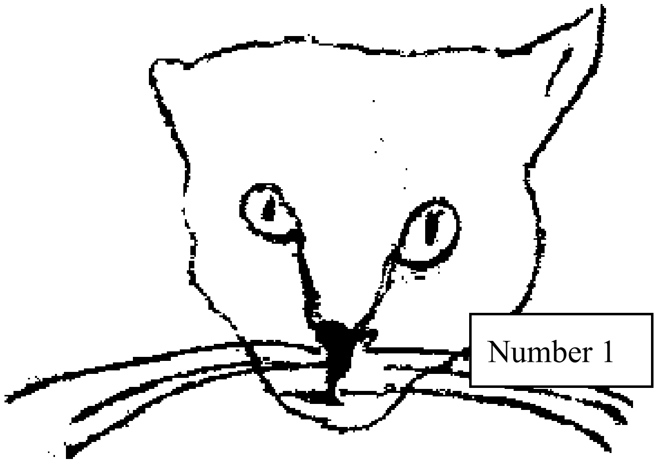
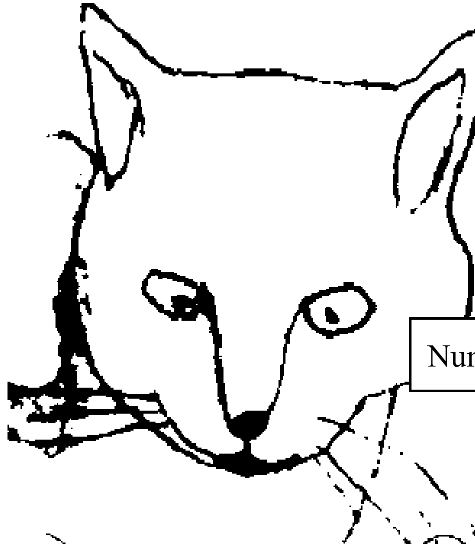

Number 17
Number 19


Number 18
Number 20

Males



Number 1



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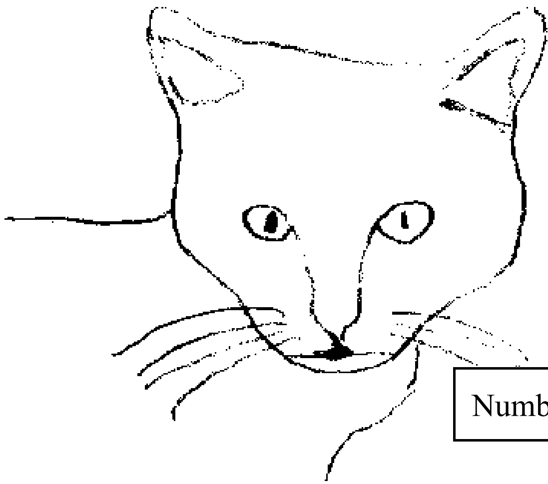

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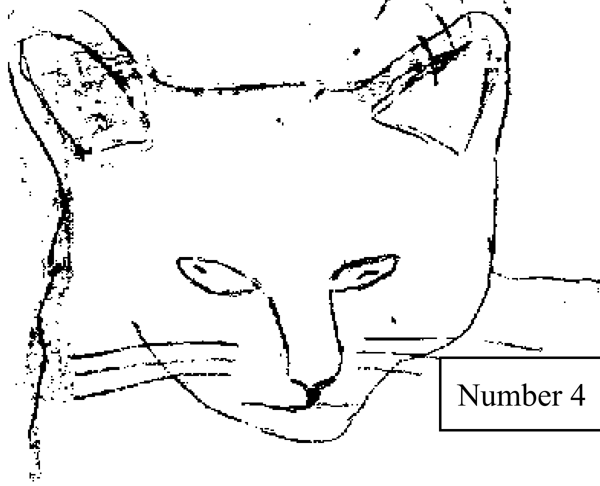

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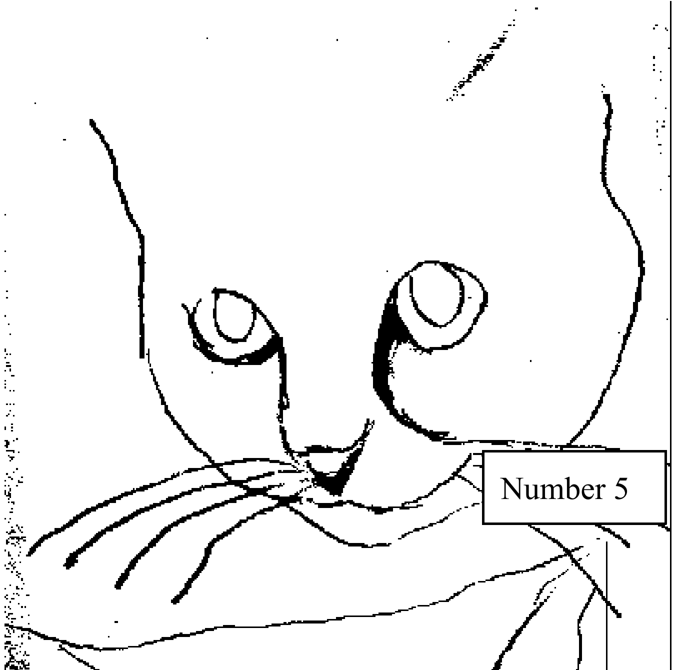

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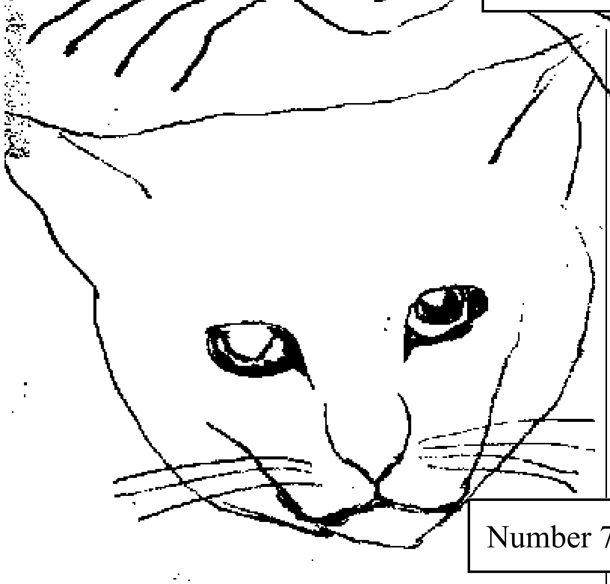

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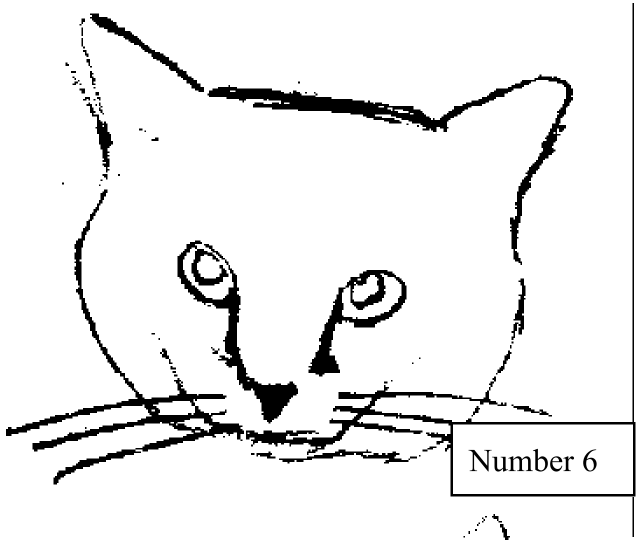

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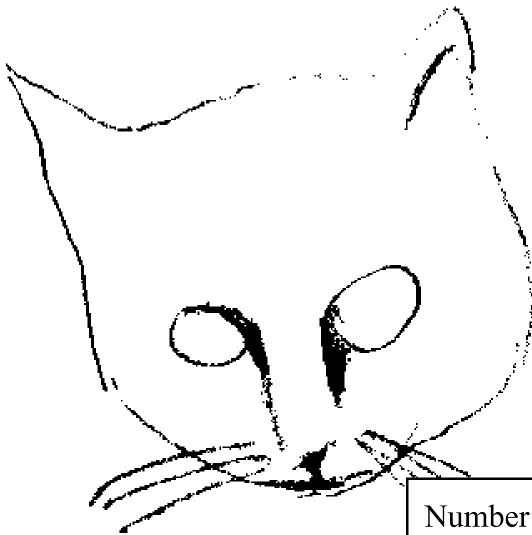

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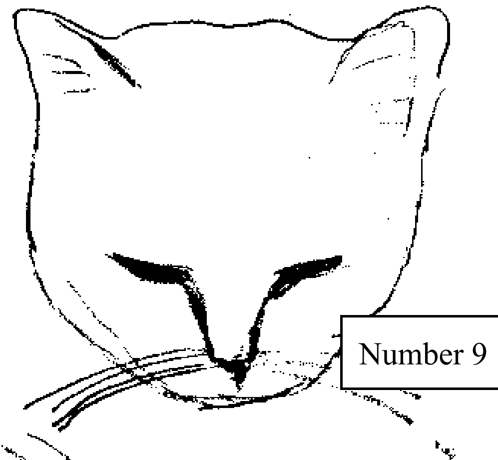

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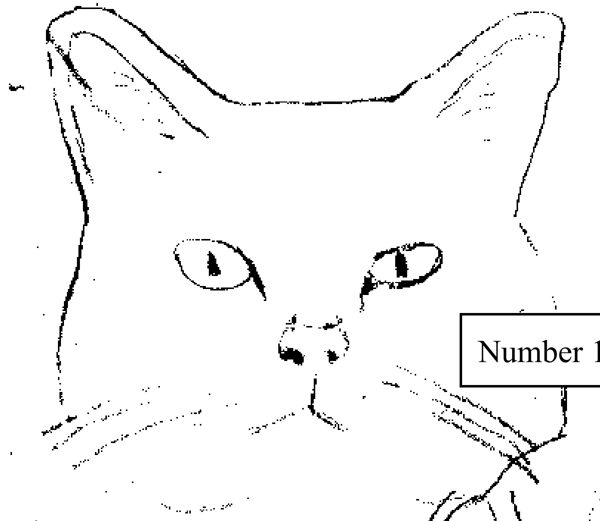

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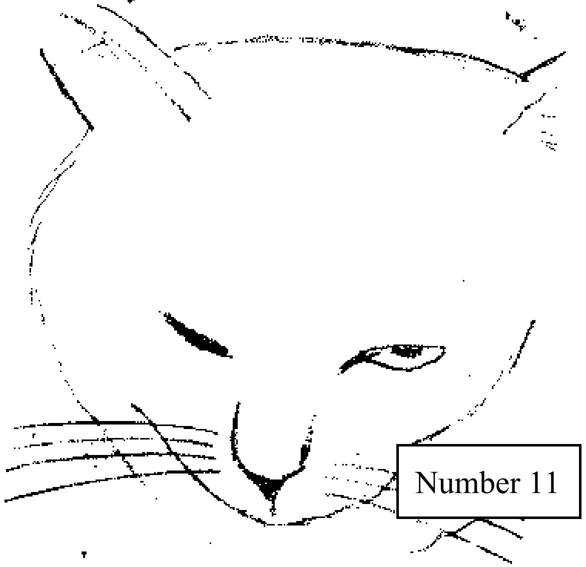

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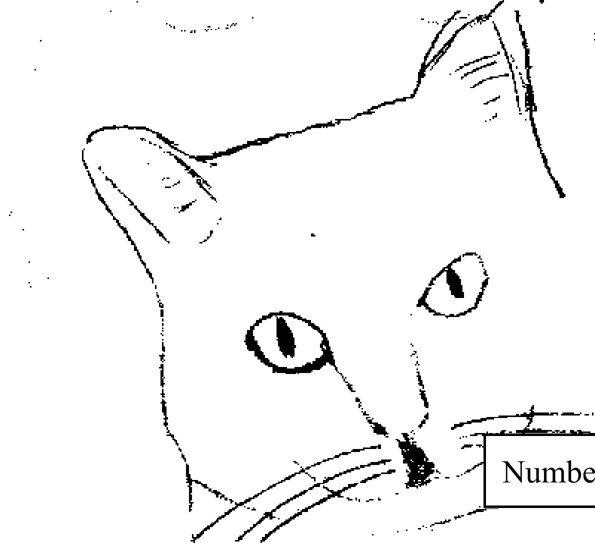

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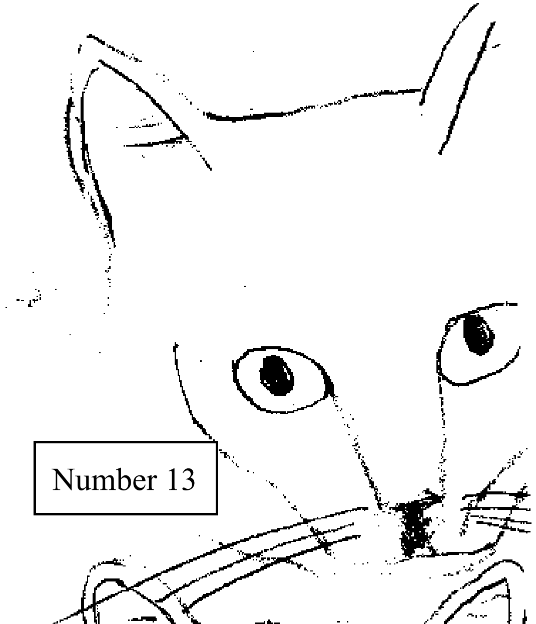

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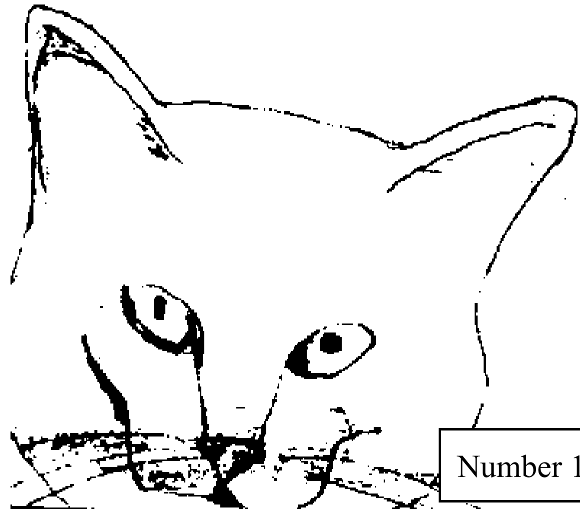

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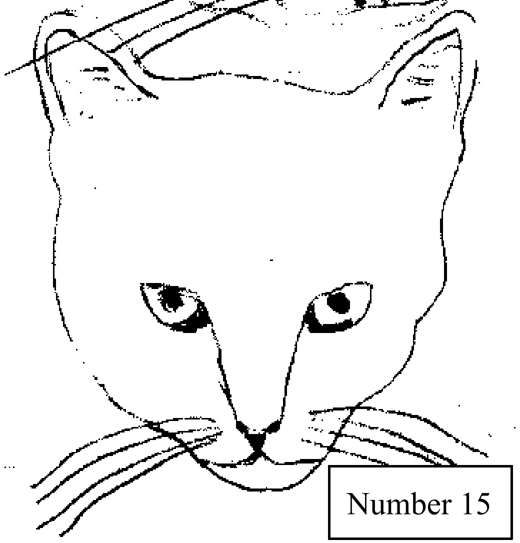

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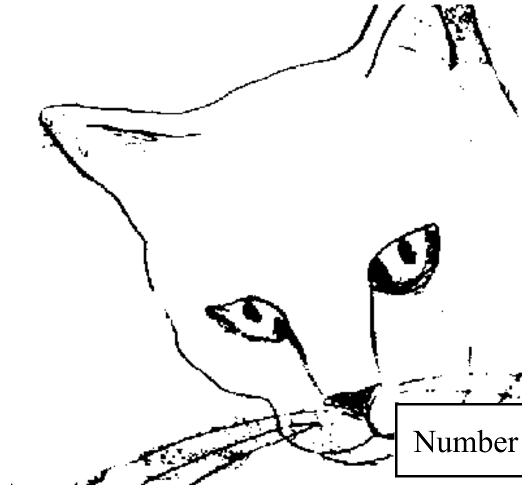

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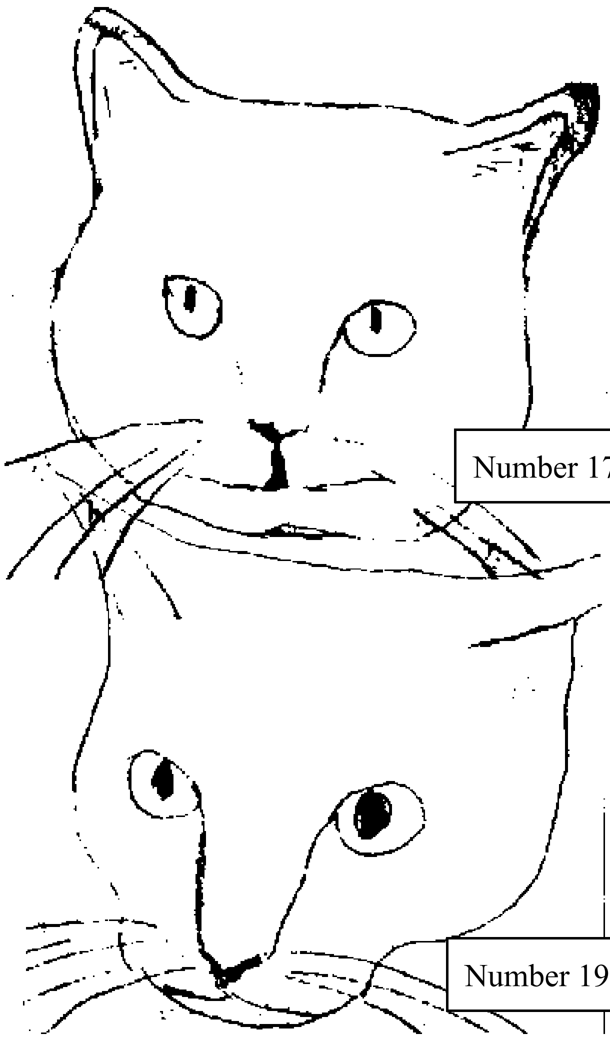
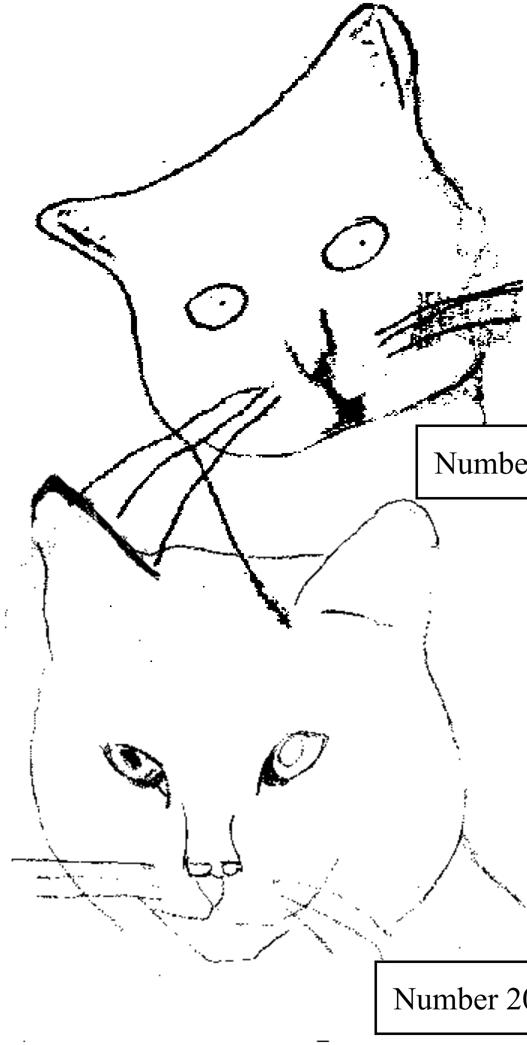


Number 17

Number 19



Number 18

Number 20

9. Appendix C - Raw Data for Experiment 1

Participants' Scores

	Males				Females					
Participant	Correct	%	Bias	%	Correct	%	Bias	%	Total Right	%
1	7	35.00%	20	35.00%	7	35.00%	20	35.00%	14	35.00%
2	8	40.00%	21	38.10%	7	35.00%	19	36.84%	15	37.50%
3	8	40.00%	20	40.00%	8	40.00%	20	40.00%	16	40.00%
4	9	45.00%	21	42.86%	8	40.00%	19	42.11%	17	42.50%
5	9	45.00%	21	42.86%	8	40.00%	19	42.11%	17	42.50%
6	9	45.00%	20	45.00%	9	45.00%	20	45.00%	18	45.00%
7	9	45.00%	19	47.37%	10	50.00%	21	47.62%	19	47.50%
8	12	60.00%	24	50.00%	8	40.00%	16	50.00%	20	50.00%
9	11	55.00%	22	50.00%	9	45.00%	18	50.00%	20	50.00%
10	12	60.00%	24	50.00%	8	40.00%	16	50.00%	20	50.00%
11	12	60.00%	24	50.00%	8	40.00%	16	50.00%	20	50.00%
12	9	45.00%	18	50.00%	11	55.00%	22	50.00%	20	50.00%
13	10	50.00%	19	52.63%	11	55.00%	21	52.38%	21	52.50%
14	10	50.00%	19	52.63%	11	55.00%	21	52.38%	21	52.50%
15	11	55.00%	21	52.38%	10	50.00%	19	52.63%	21	52.50%
16	9	45.00%	17	52.94%	12	60.00%	23	52.17%	21	52.50%
17	10	50.00%	19	52.63%	11	55.00%	21	52.38%	21	52.50%
18	12	60.00%	22	54.55%	10	50.00%	18	55.56%	22	55.00%
19	11	55.00%	20	55.00%	11	55.00%	20	55.00%	22	55.00%
20	11	55.00%	20	55.00%	11	55.00%	20	55.00%	22	55.00%
21	10	50.00%	18	55.56%	12	60.00%	22	54.55%	22	55.00%
22	9	45.00%	16	56.25%	13	65.00%	24	54.17%	22	55.00%
23	9	45.00%	16	56.25%	13	65.00%	24	54.17%	22	55.00%
24	11	55.00%	19	57.89%	12	60.00%	21	57.14%	23	57.50%
25	11	55.00%	19	57.89%	12	60.00%	21	57.14%	23	57.50%
26	12	60.00%	21	57.14%	11	55.00%	19	57.89%	23	57.50%
27	13	65.00%	23	56.52%	10	50.00%	17	58.82%	23	57.50%
28	13	65.00%	23	56.52%	10	50.00%	17	58.82%	23	57.50%
29	11	55.00%	19	57.89%	12	60.00%	21	57.14%	23	57.50%
30	12	60.00%	20	60.00%	12	60.00%	20	60.00%	24	60.00%
31	11	55.00%	18	61.11%	13	65.00%	22	59.09%	24	60.00%
32	14	70.00%	24	58.33%	10	50.00%	16	62.50%	24	60.00%
33	12	60.00%	20	60.00%	12	60.00%	20	60.00%	24	60.00%
34	12	60.00%	20	60.00%	12	60.00%	20	60.00%	24	60.00%
35	13	65.00%	22	59.09%	11	55.00%	18	61.11%	24	60.00%
36	12	60.00%	19	63.16%	13	65.00%	21	61.90%	25	62.50%
37	13	65.00%	21	61.90%	12	60.00%	19	63.16%	25	62.50%
38	16	80.00%	27	59.26%	9	45.00%	13	69.23%	25	62.50%
39	15	75.00%	25	60.00%	10	50.00%	15	66.67%	25	62.50%
40	12	60.00%	16	75.00%	16	80.00%	24	66.67%	28	70.00%

Cat Identification

	Males		Females	
Face Number	Times Correct	%	Times Correct	%
1	24	60.00%	20	50.00%
2	14	35.00%	29	72.50%
3	15	37.50%	18	45.00%
4	34	85.00%	20	50.00%
5	23	57.50%	23	57.50%
6	19	47.50%	15	37.50%
7	19	47.50%	17	42.50%
8	21	52.50%	29	72.50%
9	17	42.50%	25	62.50%
10	28	70.00%	18	45.00%
11	16	40.00%	21	52.50%
12	35	87.50%	21	52.50%
13	19	47.50%	16	40.00%
14	13	32.50%	28	70.00%
15	13	32.50%	15	37.50%
16	11	27.50%	23	57.50%
17	32	80.00%	20	50.00%
18	30	75.00%	15	37.50%
19	27	67.50%	26	65.00%
20	30	75.00%	24	60.00%

10. Appendix D – Raw Data Obtained In Experiment 2

Participant's Performance

	Males				Females						Training
No.	Correct	%	Bias	%	Correct	%	Bias	%	Total	%	Condition
1	3	60.00%	5	60.00%	3	60.00%	5	60.00%	6	60.00%	Male
2	4	80.00%	7	57.14%	2	40.00%	3	66.67%	6	60.00%	Male
3	4	80.00%	6	66.67%	3	60.00%	4	75.00%	7	70.00%	Male
4	2	40.00%	4	50.00%	3	60.00%	6	50.00%	5	50.00%	Male
5	4	80.00%	7	57.14%	2	40.00%	3	66.67%	6	60.00%	Male
6	2	40.00%	5	40.00%	2	40.00%	5	40.00%	4	40.00%	Male
7	2	40.00%	4	50.00%	3	60.00%	6	50.00%	5	50.00%	Male
8	3	60.00%	4	75.00%	4	80.00%	6	66.67%	7	70.00%	Male
9	3	60.00%	5	60.00%	3	60.00%	5	60.00%	6	60.00%	Male
10	3	60.00%	6	50.00%	2	40.00%	4	50.00%	5	50.00%	Male
11	3	60.00%	4	75.00%	4	80.00%	6	66.67%	7	70.00%	Male
12	3	60.00%	5	60.00%	3	60.00%	5	60.00%	6	60.00%	Male
13	3	60.00%	6	50.00%	2	40.00%	4	50.00%	5	50.00%	Male
14	2	40.00%	5	40.00%	2	40.00%	5	40.00%	4	40.00%	Male
15	3	60.00%	5	60.00%	3	60.00%	5	60.00%	6	60.00%	Male
16	2	40.00%	5	40.00%	2	40.00%	5	40.00%	4	40.00%	Male
17	3	60.00%	5	60.00%	3	60.00%	5	60.00%	6	60.00%	Male
18	3	60.00%	5	60.00%	3	60.00%	5	60.00%	6	60.00%	Male
19	4	80.00%	4	100.00%	5	100.00%	6	83.33%	9	90.00%	Male
20	3	60.00%	5	60.00%	3	60.00%	5	60.00%	6	60.00%	Male
21	3	60.00%	5	60.00%	3	60.00%	5	60.00%	6	60.00%	Male
22	3	60.00%	5	60.00%	3	60.00%	5	60.00%	6	60.00%	Male
23	2	40.00%	5	40.00%	2	40.00%	5	40.00%	4	40.00%	Male
24	4	80.00%	6	66.67%	3	60.00%	4	75.00%	7	70.00%	Male
25	3	60.00%	5	60.00%	3	60.00%	5	60.00%	6	60.00%	Male
26	4	80.00%	7	57.14%	2	40.00%	3	66.67%	6	60.00%	Female
27	3	60.00%	6	50.00%	2	40.00%	4	50.00%	5	50.00%	Female
28	3	60.00%	5	60.00%	3	60.00%	5	60.00%	6	60.00%	Female
29	0	0.00%	3	0.00%	2	40.00%	7	28.57%	2	20.00%	Female
30	1	20.00%	5	20.00%	1	20.00%	5	20.00%	2	20.00%	Female
31	3	60.00%	4	75.00%	4	80.00%	6	66.67%	7	70.00%	Female
32	1	20.00%	4	25.00%	2	40.00%	6	33.33%	3	30.00%	Female
33	5	100.00%	7	71.43%	3	60.00%	3	100.00%	8	80.00%	Female
34	2	40.00%	4	50.00%	3	60.00%	6	50.00%	5	50.00%	Female
35	0	0.00%	3	0.00%	2	40.00%	7	28.57%	2	20.00%	Female
36	2	40.00%	4	50.00%	3	60.00%	6	50.00%	5	50.00%	Female
37	2	40.00%	6	33.33%	1	20.00%	4	25.00%	3	30.00%	Female
38	3	60.00%	6	50.00%	2	40.00%	4	50.00%	5	50.00%	Female
39	1	20.00%	5	20.00%	1	20.00%	5	20.00%	2	20.00%	Female
40	3	60.00%	4	75.00%	4	80.00%	6	66.67%	7	70.00%	Female
41	2	40.00%	5	40.00%	2	40.00%	5	40.00%	4	40.00%	Female
42	2	40.00%	5	40.00%	2	40.00%	5	40.00%	4	40.00%	Female
43	2	40.00%	6	33.33%	1	20.00%	4	25.00%	3	30.00%	Female
44	3	60.00%	5	60.00%	3	60.00%	5	60.00%	6	60.00%	Female
45	2	40.00%	4	50.00%	3	60.00%	6	50.00%	5	50.00%	Female
46	2	40.00%	5	40.00%	2	40.00%	5	40.00%	4	40.00%	Female
47	4	80.00%	5	80.00%	4	80.00%	5	80.00%	8	80.00%	Female
48	2	40.00%	5	40.00%	2	40.00%	5	40.00%	4	40.00%	Female
49	2	40.00%	4	50.00%	3	60.00%	6	50.00%	5	50.00%	Female
50	2	40.00%	5	40.00%	2	40.00%	5	40.00%	4	40.00%	Female

Cat Identification

	Males		Females	
Face Number	Times Correct	%	Times Correct	%
1	28	56.00%	18	36.00%
2	21	42.00%	30	60.00%
3	22	44.00%	33	66.00%
4	30	60.00%	33	66.00%
5	29	58.00%	16	32.00%

11. Appendix E - Raw Data Obtained In Experiment 3

Participant	Age	Sex	Answer 1	Answer 2	Answer 3	Answer 4	Answer 5	Answer 6	Answer 7	Answer 8	Answer 9	Answer 10	Number Correct	Male Bias	Female Bias	Male Score	Female Score	Condition
1	38	M	F	M	M	F	M	F	F	M	F	M	4	5	5	2	2	Training
2	22	M	M	M	F	M	F	M	F	M	M	M	4	7	3	3	1	Training
3	23	M	M	F	M	F	F	M	F	M	M	F	8	5	5	4	4	Training
4	23	F	M	F	F	F	F	M	F	F	M	F	6	3	7	2	4	Training
5	24	F	F	F	M	M	M	M	F	M	F	M	5	6	4	3	2	Training
6	24	F	M	F	F	F	F	F	M	M	M	F	7	4	6	3	4	Training
7	23	M	M	F	M	M	F	M	M	F	F	F	8	5	5	4	4	Training
8	25	M	M	F	F	M	F	F	M	F	M	F	5	4	6	2	3	Training
9	26	M	M	F	F	F	F	M	F	M	M	F	7	4	6	3	4	Training
10	22	F	M	F	F	F	F	M	M	M	F	M	8	5	5	4	4	Training
11	28	F	M	F	M	M	F	F	F	M	M	F	6	5	5	3	3	Training
12	35	M	F	M	F	F	F	M	F	M	M	M	4	5	5	2	2	Training
13	35	F	M	F	F	F	F	M	M	M	F	F	9	4	6	4	5	Training
14	33	F	M	F	M	M	F	F	M	M	M	M	6	7	3	4	2	Training
15	37	M	M	F	M	F	M	F	F	M	F	M	6	5	5	3	3	Training
16	24	M	M	F	F	M	F	M	M	M	F	F	8	5	5	4	4	Training
17	26	M	F	M	M	M	F	F	F	M	F	M	4	5	5	2	2	Training
18	27	M	M	F	M	F	F	M	M	M	F	M	9	6	4	5	4	Training
19	56	M	M	F	M	M	M	F	F	F	M	M	3	6	4	2	1	Training
20	23	M	M	F	M	F	F	F	M	M	F	M	8	5	5	4	4	Training
21	29	F	M	F	F	M	F	M	F	M	F	M	6	5	5	3	3	Training
22	31	F	M	F	F	F	F	F	F	M	F	M	6	3	7	2	4	Training
23	24	F	M	M	F	F	F	F	M	M	F	M	6	5	5	3	3	Training
24	50	F	M	F	M	M	F	M	F	M	F	M	7	6	4	4	3	Training
25	30	F	M	M	F	F	F	F	F	M	F	M	5	4	6	2	3	Training
26	23	F	M	F	M	M	F	M	M	F	F	M	7	6	4	4	3	No Training
27	23	F	M	F	F	F	M	M	F	M	F	F	7	4	6	3	4	No Training
28	57	F	M	M	M	M	F	F	M	F	F	F	6	5	5	3	3	No Training
29	24	F	M	M	F	F	F	F	M	M	F	M	6	5	5	3	3	No Training

Participant	Age	Sex	Answer 1	Answer 2	Answer 3	Answer 4	Answer 5	Answer 6	Answer 7	Answer 8	Answer 9	Answer 10	Number correct	Male Bias	Female Bias	Male Score	Female Score	Condition
30	30	M	F	M	F	M	F	M	M	M	F	F	6	5	5	3	3	No Training
31	56	F	F	M	M	F	M	M	F	M	F	F	6	5	5	3	3	No Training
32	32	M	F	M	M	F	F	M	M	M	M	F	7	6	4	4	3	No Training
33	59	F	F	F	M	M	M	M	F	M	F	M	5	6	4	3	2	No Training
34	30	F	F	M	M	M	F	M	F	M	M	F	5	6	4	3	2	No Training
35	33	F	M	F	F	F	F	M	F	M	F	M	7	4	6	3	4	No Training
36	29	M	M	F	F	M	M	M	F	M	F	F	6	5	5	3	3	No Training
37	59	M	M	F	M	M	F	F	F	M	F	M	6	5	5	3	3	No Training
38	35	M	F	M	M	F	M	F	F	M	F	M	4	5	5	2	2	No Training
39	22	M	M	F	M	M	M	M	F	F	M	M	4	7	3	3	1	No Training
40	23	M	F	M	M	F	M	F	F	M	M	M	3	6	4	2	1	No Training
41	23	M	F	F	M	F	M	F	M	M	M	M	5	6	4	3	2	No Training
42	45	M	M	F	F	M	F	M	F	M	F	M	6	5	5	3	3	No Training
43	28	M	F	F	M	M	M	F	M	M	M	F	5	6	4	3	2	No Training
44	27	F	M	F	M	F	F	M	F	M	M	M	7	6	4	4	3	No Training
45	57	M	F	F	M	M	M	F	F	M	M	M	3	6	4	2	1	No Training
46	23	F	F	M	M	F	M	F	F	M	F	M	4	5	5	2	2	No Training
47	29	M	M	F	F	M	M	F	F	M	F	M	4	5	5	2	2	No Training
48	23	M	M	F	M	M	M	F	M	F	M	F	5	6	4	3	2	No Training
49	30	M	F	F	F	F	M	M	F	M	F	M	5	4	6	2	3	No Training
50	22	M	F	F	F	F	M	M	M	M	F	M	6	5	5	3	3	No Training

<u>Answer Sequence</u>

Sex	M	F	M	F	F	M	M	M	F	F
Face Number	1	4	8	11	16	6	5	7	12	1

Cat Identification

Presentation Order	1	2	3	4	5	6	7	8	9	10
Cat Sex	M	F	M	F	F	M	M	M	F	F
Face Number	1	4	8	11	16	6	5	7	12	1
Correct After Training	21	19	12	14	21	13	10	21	15	9
%	84	76	48	56	84	52	40	84	60	36
Correct Before Training	12	16	16	12	10	14	9	21	16	9
%	48	64	64	48	40	56	36	84	64	36
Overall	33	35	28	26	31	27	19	42	31	18
%	66	70	56	52	62	54	38	84	62	36

12. Appendix E – Instruction Sheet For Experiment 1

Take part in a 5 minute experiment and win a bottle of Champagne!
Bottles of wine (red or white - your choice) are on offer too for 2nd and 3rd places!

THE STUDY

We are interested in your judgement of whether a domestic cat is male or female, simply by looking at their face. We are also interested in how you came to make such decisions.

You can click on the underlined to text to send an email!

At this point it should be made clear that this experiment is not carried out anonymously. We request that you provide us with your email address. This information is to be used to;

- Collate all the information that you provide together,
- contact you to see if you are interested in taking part in further experiments on this subject and
- award prizes!

If you only wish to take part in this first experiment then please feel free to do so – there is no obligation on your part to carry on with future work. Your data will only be included in the final study if all components are completed. Therefore, if you do not wish your data to be included after completing the categorisation task, simply do not complete the final part. You may also email either myself (****@exeter.ac.uk) or AM (******@exeter.ac.uk) stating you do not wish data submitted by yourself to be included in the final analysis. The three components are; sending two short emails and completing the identification task in which you will see the faces of 40 cats. In total, this experiment will take between 5 and 10 mins.**

Procedure

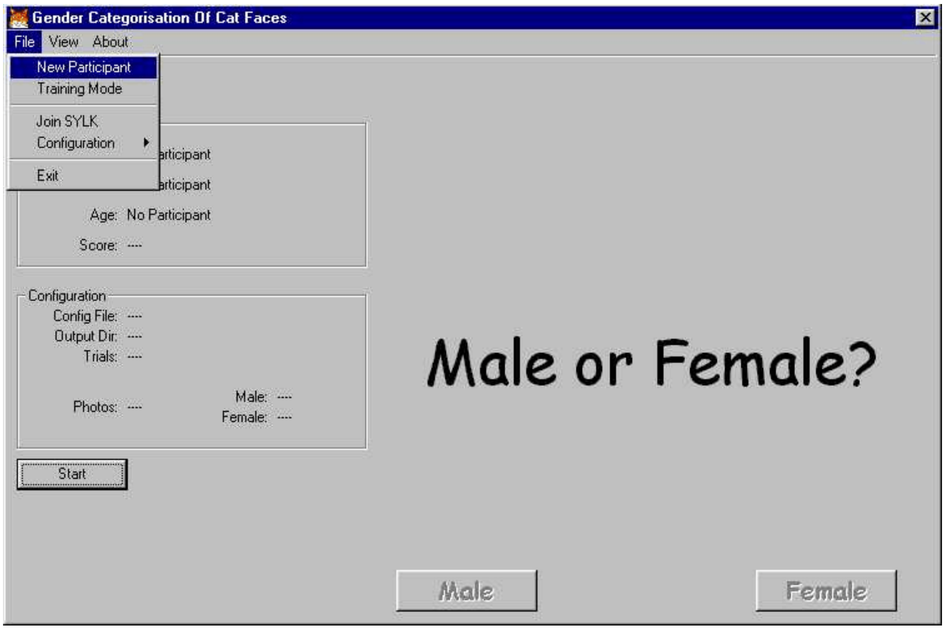
1) Send an email to Dr AM (******@ex.ac.uk) with the subject line "Gender Identification of Cat Faces". In this email, please tell us if you have any cats at home, or whether you have spent a significant amount of time around the furry felines (maybe at home with your parents). We would like a brief description of the cat, such as size, sex, age and personality and, if more than one cat is reported on, a name would be useful (you can make this one up if you wish!). Include anything you wish to say about them! If you do not have any cats or feel you do not have sufficient experience of them, simply state "NO CATS" in the body of your email.

2) Complete the identification task. A specialised program has been written for this task. You will find it on the P drive:

P:\Apps\cat faces\Cat Faces.exe

Running the program brings up the main screen. The only thing you will have to set up yourself is the participant information. Select:

File ➜ New Participant



to bring up the new participant window. Three pieces of information are required - your age, sex and ID. Your ID should be your email address.

Click on OK to return to the main screen - you are now ready to being the experiment. The task is straightforward. You will be presented with 40 pictures of cat faces, 20 of which are male, 20 of which are female. Below the picture of the cat are two buttons - "Male" and "Female". Simply click the appropriate button to indicate your decision. After clicking, the next face will be presented and so on. There is no time limit involved but please do not take too much time - it is your first judgement we are after. In line with this is that you cannot go back to change a previous answer. Therefore think before you click! After all 40 pictures have been presented you will received a message to say the experiment has finished. Clicking OK to this message will reveal your score which will be located underneath your age in the "Current Participant" box. Close the program (either with the close button or select File ➜Exit). This is important to protect your results from accidental erasure!

3) Send an email to me at ******@ex.ac.uk with the subject line "Gender Identification of Cat Faces". In this email, please tell me what it was about the cats that made you decide which sex they were.

That's it - all done! The prizes for the competition will be awarded after 100 responses have been received. Winners will be notified via email. In the event of a tie, there will be a "face off" with one more run through the cat faces to decide the winner.

If in any doubt before you get started, or if there is some problem with the software, please email myself (******@ex.ac.uk) or AM (*****@ex.ac.uk) and we'll do our best to help you.

THANK YOU!

MSc Psychological Research Methods

13. Appendix F – Instruction and Answer Sheet for Experiment 3

<u>Experiment 3</u>

Thank you for agreeing to take part in this experiment. The purpose of this study is to examine if the gender of domestic cats can be determined from line drawings of their faces.

To begin with, please indicate whether you are male or female: ❑ Male ❑ Female

Also, please tell us your age: ______

<u>Instructions</u>

If you have any questions at any time during the experiment, please ask the experimenter

Phase 1:
In front of you will see two piles of drawings of domestic cat faces. One pile contains male cats and the other contains females. Examine these drawings and see if you can decide what features determine the gender of the cat. You can look through the drawings one by one or spread them out so that all are visible – it is up to you. You have ten minutes for this task.

Phase 2:
After the 10 minutes have expired you will be shown 10 drawings of cat faces one by one – 5 will be male and 5 will be female but they will be presented in a random order. Please indicate whether you think the presented cat is male or female by writing “M” or “F” in the table below:

Cat Face Number	Sex M/F
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

That’s it!! Thank you again for taking part.