

*Evaluative Conditioning*

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*Evaluative Conditioning*

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### *Evaluative Conditioning*

did not occur without subjects being able to verbalise the affective valency of the facial expression following each CS, only two out of the forty-five subjects appeared to be able to correctly verbalise whether either disgust, angry or happy expressions followed the relevant CS. Since EC occurred only to foodstuff CSs followed by the disgust UCS, this suggests that the selective conditioning observed in the present study occurred without many subjects being able to verbalise whether the negatively valenced expression paired with the CS was either an angry or a disgust expression. However, the degree to which specific knowledge of the UCS might have been processed is unclear from the nature of the contingency awareness questions that were asked. Subjects were simply asked whether the CS was followed by faces expressing disgust, anger or happiness; since they were shown four different faces expressing the UCS

### *Evaluative Conditioning*

Second, if the present findings represent an example of evaluative conditioning (EC), then they do not support the view that EC occurs without contingency awareness (e.g. Baeyens et al., 1988, 1990). In the present study, evaluative conditioning with disgust expressions as the UCS did not occur unless subjects were at least aware of the affective value of the UCS that followed each individual CS. In this respect, these findings are more consistent with some other EC studies which have also reported a failure to find EC in unaware subjects (Allen & Janiszewski, 1989; Fulcher & Cocks, 1997).

There may be a number of reasons why the present results deviate from theoretical positions which claim that EC can occur without the subject's awareness of or ability to verbalise the contingencies. First, EC in unaware subjects has been claimed primarily in an EC paradigm which uses liked/disliked faces as the UCSs and neutral faces as the CSs (e.g. Baeyens et al., 1988, 1989, 1990; Baeyens & de Houwer, 1995). Davey (1994b) has argued that there are both methodological and statistical problems with both the paradigm that is used and the studies that have to date been conducted using this paradigm, and these problems make the conclusion that EC occurs without awareness of contingencies a premature one. Secondly, Field & Davey (1997) have used a concept-conditioning paradigm which mimics the EC faces paradigm to show that conditioning without awareness could be an artefact of the stimulus selection procedures inherent in the design of this paradigm. For instance, they found apparent EC effects even in control conditions where the CS had never been explicitly paired with the UCS. In such circumstances, predicted changes in the evaluation of the CS had occurred even though subjects had never experienced the contingencies - so it not surprising that subjects could not articulate the contingencies. Field & Davey (1997) have argued that because the EC faces paradigm requires subjects effectively to choose their own CSs, there is a selection bias towards choosing stimuli whose evaluations shift during the procedure in the affective direction predicted by EC - *even though they need never be paired with the relevant CS*. In the present study, CSs were assigned to subjects in a balanced and

### *Evaluative Conditioning*

meaningful way, whereas the disgust emotion tends to be selective in the stimuli that will elicit it, cf. Barker & Davey, 1995). This may explain the failure to find any differential conditioning effects with angry and happy UCSs. This does not mean that conditioning cannot be achieved with these stimuli - but that they are likely to require significantly more trials than for semiotically-related stimuli such as foodstuffs and disgust facial expressions.

The relative speed with which differential conditioning can be achieved between foodstuffs and disgust expressions has obvious adaptive advantages. Because many substances that can be orally incorporated may be poisonous or illness-inducing, the need to learn rapidly about the properties of such substances is essential, and the selective association effect found with foodstuffs and facial expressions of disgust is an ideal method of rapidly transmitting information about foods between individuals.

Thus, if the disgust emotion does have an evolved communicative function designed to endow a stimulus with negative affect, this function is still very much geared towards selectively transmitting negative affect about foodstuffs.

### **Implications for Evaluative Conditioning**

Differential conditioning effects between foodstuffs and facial expressions of disgust were found (1) only with measures of like/dislike, and not with measures of positive/negative or revulsion, and (2) only in subjects who were consciously aware of the contingencies.

First, it is interesting that when conditioning occurs it is found only with the most general of the affective dependent variable measures (i.e. liked/disliked), and not, for example, on dimensions which were more specific to the UCS (i.e. revulsion). The reason for this may be that the pairing of foodstuffs with disgust expressions merely transmits the need to *avoid* such foodstuffs because they might be potentially harmful, and does not transfer more specific responses typical of the disgust emotion (such as nausea) to the CS. Although no measure was taken of subjects' preferences for each foodstuff prior to conditioning, their existing preferences for individual foodstuffs may make transfer of very specific disgust properties (such as revulsion, nausea) to the UCS more difficult, although the most general of the disgust responses (avoidance) can be conditioned more easily. Mere transfer of avoidance through pairing of foodstuffs with the disgust facial expression would fulfil the necessary adaptive function of such pairings.

*Evaluative Conditioning*

## **Discussion**



### *Evaluative Conditioning*

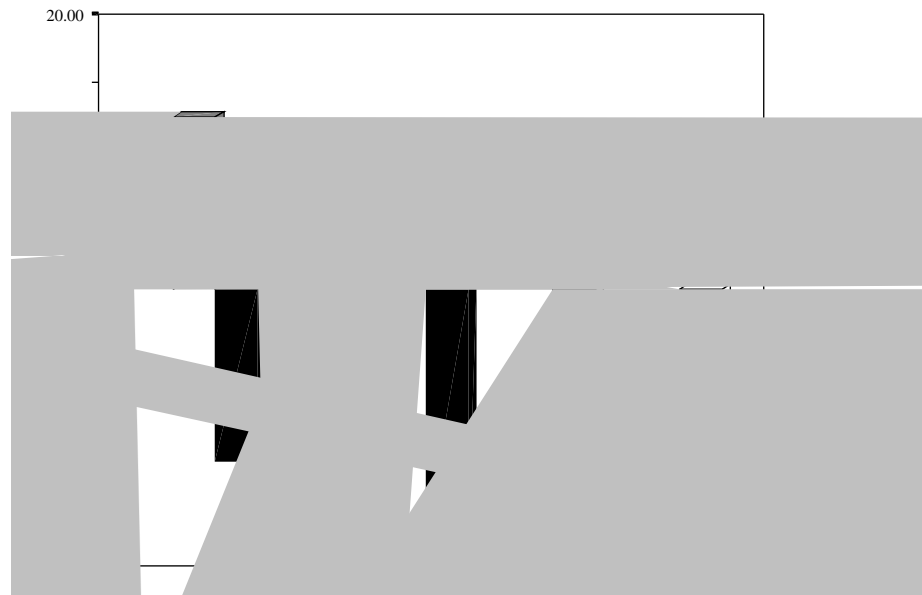
subjects were aware or unaware of the CS-UCS contingencies. Disgust-relevant CSs paired with a disgust UCS show a larger post-conditioning shift to the disliked end of the scale in aware subjects. Subjects who were unaware of the contingencies either showed little change in their liking of the stimuli (meat CS condition) or showed a negative shift that was much less pronounced (vegetable CS condition). Shifts in evaluation to disgust-irrelevant CSs (cars) were small in both aware and unaware subjects, but with aware subjects rating the car CSs as more likeable after pairing with a disgust UCS. In order to test whether these differences between aware and unaware subjects were meaningful, a series of Wilcoxon tests<sup>1</sup>

### *Evaluative Conditioning*

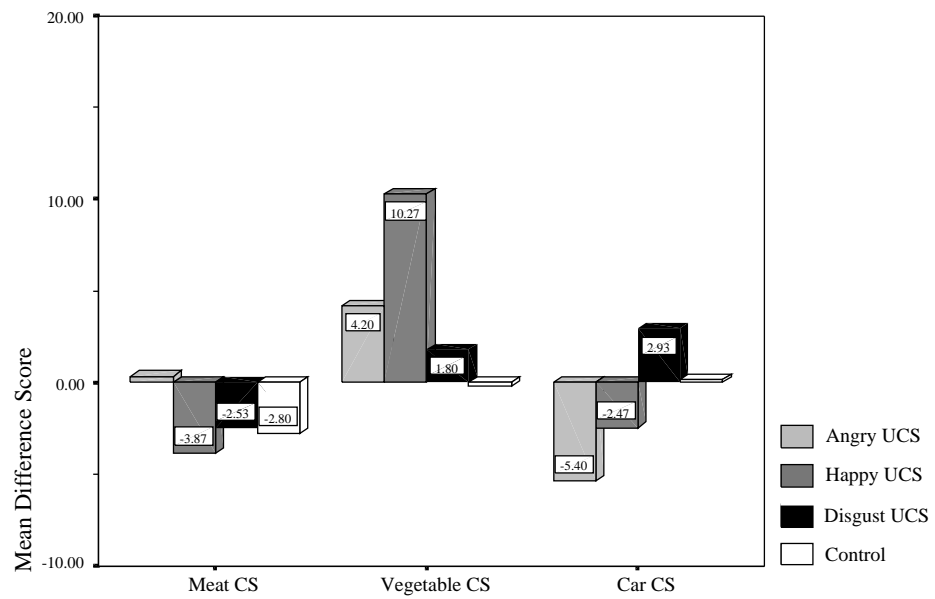
and the vegetable CS group and the car CS group [mean difference of transformed data = -3.21, SE = 1.413,  $p < 0.05$ ] - but only for CSs paired with the disgust UCS. This indicates that while disgust UCSs only had a significant effect on disgust relevant CSs, the other forms of UCS generated statistically similar data across all types of CS.

**Contingency awareness and shifts in evaluative conditioning:** Only 2 out of 45 subjects met the criteria for the *strong* measure of contingency awareness by correctly naming the type emotion expressed on the face that followed each of the three conditioning CSs. However, a total of 27 out of the 45 subjects met the criteria for the 'weak' measure of contingency awareness by bgr01-5 cuative evathe

*Evaluative Conditioning*



## Evaluative Conditioning



**Figure 1:** Graph to show the mean change in positiveness across conditioning for meat, vegetable and

## *Evaluative Conditioning*

*Stage 4: Assessment of contingency awareness.* After the end of Stage 3, all subjects were once more shown the five CS pictures they had seen during the post-conditioning assessment stage. In the case of each CS picture, they were asked to say (1) whether, in the conditioning stage, the CS had been followed by a ‘good’ face (e.g. happy) or a ‘bad’ face (e.g. angry or disgusted), and (2) more specifically, whether the CS had been followed by a happy face, an angry face, a disgusted face, or nothing. Both questions included a ‘don’t know’ option. The former is a *weak* criterion measure of awareness of contingencies, in which subjects can verbalise the affective value of the UCS paired with each CS, the latter is a *strong* criterion measure in which subjects can verbalise more precisely the characteristics of the individual UCS paired with each CS. These ‘weak’ and ‘strong’ criteria are similar to the criteria used to establish awareness of contingencies in most EC studies (e.g. Baeyens et al., 1988, 1989, 1990).

## **Results**

**Data reduction and data screening:** Evaluation difference scores for each subject were calculated by subtracting Stage 3 ratings from those in Stage 1 for each scale. Difference scores for ratings to the two control stimuli were combined into a single score. The data for all measures were prone to heterogeneity of variance and slightly skewed distributions on some variables. For this reason, all data were transformed using a square root transformation. Since the data contained negative scores (of which a square root cannot be taken), the transformation was carried out on the absolute data values; the direction of response (i.e. positive or negative) was then re-instated to the transformed data to provide an accurate transition of the initial scores.

**Positive and negative feelings:** The mean difference scores for this first measure are shown in Figure 1. All shifts in ratings were small. A CS Type (meat/vegetable/car) × UCS Type (disgust/anger/happy) mixed ANOVA was conducted (with CS Type as a repeated measure) on the difference scores. There was no significant main effect of UCS Type ( $F < 1$ ) or CS Type [ $F(2,41)=1.11, p = 0.34$ ] or of the two way interaction [ $F(6,123) = 1.06, p = 0.39$ ].

*Evaluative Conditioning*

stimulus presentations on each video remained the same for the 5 subjects that viewed that video.

Type of CS	Video	CS1	UCS1	CS2	UCS2	CS3	UCS3	Control 1	Control 2
Meat	1	Meat 1	Disgust Faces	Meat 2	Angry Faces	Meat 3	Happy Faces	Meat 4	Meat 5
	2	Meat 1	Happy Faces	Meat 2	Disgust Faces	Meat 3	Angry Faces	Meat 4	Meat 5
	3	Meat 1	Angry Faces	Meat 2	Happy faces	Meat 3	Disgust Faces	Meat 4	Meat 5
Vegetables	4	Veg 1	Disgust Faces	Veg 2	Angry Faces	Veg 3	Happy Faces	Veg 4	Veg 5
	5	Veg 1	Happy Faces	Veg 2	Disgust Faces	Veg 3	Angry Faces	Veg 4	Veg 5
	6	Veg 1	Angry Faces	Veg 2	Happy Faces	Veg 3	Disgust Faces	Veg 4	Veg 5
Cars	7	Car 1	Disgust Faces	Car 2	Angry Faces	Car 3	Happy Faces	Car 4	Car 5
	8	Car 1	Happy Faces	Car 2	Disgust Faces	Car 3	Angry Faces	Car 4	Car 5
	9	Car 1	Angry Faces	Car 2	Happy Faces	Car 3	Disgust Faces	Car 4	Car 5

**Table 1:** Table to show the arrangement of stimuli on each of the nine video tapes.

*Stage 3: Postconditioning assessment.* After viewing the conditioning video, subjects were then shown all five CS pictures in random order and asked once again to rate each stimulus on the three rating scales described in Stage 1.

## *Evaluative Conditioning*

used pictures of cars.

**Design:** For each CS type there were 5 available images, 3 of these were selected to be experimental stimuli which would be paired with a UCS picture and the remaining 2 were used as unpaired control stimuli. The nine different conditioning videos were constructed so that each of the 3 experimental CSs were paired with different emotionally valenced UCS faces on different videos. This ensured that the CS-UCS presentations were fully counterbalanced across subjects. The two control stimuli were never paired with UCS faces, and were used to assess how ratings might change over successive ratings. Table 1 shows how stimulus presentations were arranged on each video. For example, on video number 1, the first experimental CS (meat picture 1) was presented four times, on each occasion being paired with one of the four different disgust facial expressions. Meat picture 2 was paired with the four angry expressions, and so on. The sequencing of pairings on each video was randomised. This design ensured that all classes of CS were paired with all classes of UCS.

**Procedure:** Subjects were randomly assigned to one of 3 different groups: (1) A meat CS group (who saw only meat products paired with facial expressions), (2) A vegetable CS group (who saw only vegetable products paired with facial expressions), and (3) A car CS group (who saw only cars paired with facial expressions). Once the subject was assigned to a group, they were then assigned to one of the three video conditions for that group. Thus, each of the nine videos was viewed by 5 subjects.

*Stage 1: Baseline Assessment.* Before viewing the conditioning video, subjects were asked to rate each of the 3 CS pictures and the 2 control pictures on three separate 200-point scales which measured (1) whether their feelings to the item in the picture were positive or negative, (2) the extent to which they felt revulsion to the item in the picture, and (3) how much they liked or disliked the item in the picture. All three measures utilised a visual-analogue scale ranging from -100 (very negative/extreme revulsion/dislike) through zero (neutral in all cases) to +100 (very positive/ no revulsion/like). These scales were based on the 200-point scales normally used in EC studies (e.g. Baeyens et al., 1988, 1990).

*Stage 2: Conditioning.* Each subject then watched the conditioning video. All nine videos followed an identical format. They contained three types of pairings, CS-angry UCS, CS-Disgust UCS, and CS-Happy UCS. Each CS was paired with the four different examples of the UCS to ensure that any effects were the result of the emotional information in the face rather than other specific attributes of the face. Each CS was shown for 2 sec followed by a 1 sec inter-stimulus interval, and then a UCS of the appropriate type for 2 sec. There was a standard 8-sec inter-trial interval before the next pairing. The presentations were made in a quasi-randomised order, but the order of

## *Evaluative Conditioning*

products) or disgust-irrelevant CSs (pictures of cars) was investigated. The effect of facial expressions of disgust on CS evaluations were also compared with the evaluative effects produced by pairing CSs with two other facial expressions, namely anger and happiness. The study also investigates whether the affective value of a facial expression such as disgust can be transferred to cueing stimuli with which it has been paired in a classical conditioning paradigm.

## **Method**

### **Subjects**

Forty five subjects took part in the experiment, 15 in each of the three experimental conditions (see Table 1). There were 27 females and 18 males who were all undergraduate students at the University of Sussex. Because of the nature of the CS material, no vegetarians were used in the study. Subjects were tested individually and were all volunteers who were not paid for their participation.

### **Procedure**

**Stimuli:** The UCSs used in the experiment were pictures of emotionally expressive faces. Three facial expressions were used: happy, angry and disgusted. Pictures of facial expressions were generated by asking 17 volunteers to pose in a video-recorded session making facial expressions that they considered to reflect happiness, anger or disgust. Video stills were taken of each expression and printed using a colour video printer. All expressions hfc...206(of)]TJ334.T\*[(printer6)ured St 17 expressions hfc4(b-







# Evaluative Conditioning Using Disgust Facial Expressions as Unconditioned Stimuli: Evidence for Selective Conditioning Effects

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