An Appropriate Control Condition for Evaluative Conditioning

by

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Abstract
Research into the effects of pairing affectively non-valenced stimuli (CS) with affectively valenced stimuli (UCS) in a Pavlovian conditioning paradigm, has provided *prima facie* evidence of a new and distinct form of human conditioning. However, most of this research into what has been called 'Evaluative Conditioning (EC)', has been conducted without the use of appropriate control conditions to rule out non-associative accounts of the results. Traditional control methods used in the autonomic conditioning literature are argued to be inappropriate measures for EC due to differences between the paradigms. This begs the question: what is an appropriate control condition for EC? The problems surrounding the controls currently employed in EC research are discussed and a new type of control condition is proposed which is specifically designed to overcome these problems.

Introduction
Evaluative conditioning (EC) research has shown that pairing a subjectively neutral conditioned stimulus (CS) with a previously rated 'liked' or 'disliked' unconditioned stimulus (UCS) results in the transfer of affective value from the UCS to the CS. Hence, an affectively neutral CS acquires the 'liked' or 'disliked'

valence of a UCS (Levey & Martin, 1975; Baeyens, Eelen, Crombez, & Van den Bergh, 1992). Unlike associative learning, research indicates that in EC the conditioned response (the valence shift) is strongly resistant to extinction (Baeyens, Crombez, Van den Bergh & Eelen, 1988) and can occur without subjects having conscious awareness of the contingencies involved (Baeyens, Eelen, & Van den Bergh, 1990). These anomalies have lead researchers to conclude that EC is a qualitatively distinct form of conditioning (Baeyens, 1993). Davey (1994), however, has argued that some of this evidence is equivocal due to methodological weaknesses in the crucial studies. Most notably, there are no non-paired random control conditions, which are traditionally used in conditioning research to demonstrate that any effects are due to associative links between a specific CS and UCS and not the result of repeated exposure to the stimuli. In essence, Davey has argued that without these non-paired controls, EC cannot be shown to be associative in nature and therefore should not be expected to show the same effects as Pavlovian conditioning (namely extinction of the UCR and awareness of contingencies).

Traditional Controls in EC Research

In the basic EC experiment there are three stages. In the first stage subjects are asked to rate a number of stimuli along a 21 point scale ranging from -100 (dislike) through zero (neutral) to +100 (like). The stimuli are typically pictures of human faces (Baeyens *et al*, 1988, 1990, 1992) or artists' paintings (Levey and Martin, 1975). At the end of this stage the experimenter selects the three most liked stimuli, the three most disliked stimuli and 12 neutral stimuli (stimuli with a rating between -10 and +10). The liked, disliked and three of the neutral pictures are selected for use as UCSs. The CSs are all neutral pictures and are chosen to be paired with a UCS on the basis of perceptual similarity between the pictures. This results in nine CS-UCS pairings: 3 × Neutral-Like (N-L); 3 × Neutral-Dislike (N-D); and 3 × Neutral-Neutral (N-N). These CS-UCS pairs are presented a number of times in semi randomised order according to a set of timing parameters. Typically these parameters might be that the CS appears for 1 second; followed by a 4 second gap; followed by the UCS which is also presented for 1 second; followed by an 8 second gap before the onset of the next CS, and so on. The semi randomised presentation schedule ensures that a CS-UCS pair is never presented more than twice consecutively. During the final stage subjects are asked to re-rate all of the CSs and UCSs from the conditioning stage using the same like-dislike scale from the first stage.

There are two within-subject controls in this paradigm which EC researchers use to draw inferences about the presence of associative learning: (1) the N-N pairings; and (2) discriminative effects. The N-N pairs where a neutral CS is paired with a neutral UCS should result in no change to the CS since the UCS has no affective value which can transfer to the CS. If these N-N pairings result in no valence shift in the CSs, whilst CSs from N-L and N-D pairings do shift, then conditioning can be inferred. The second feature is the discriminative nature of the conditioning trials such that some CSs are paired with liked UCSs and others with disliked UCSs. This should result in differential valence transfer to the CS depending on which type of UCS it was paired with. Learning is seen as the result of an associative connection if CSs paired with liked UCSs shift in a different direction to those paired with disliked UCSs. However, it is questionable whether or not this is actually enough to infer *association* based learning.

The EC paradigm described above is analogous to a traditional discriminative conditioning paradigm, where a CS+ is always paired with a UCS whilst a CS- is explicitly unpaired with that UCS. This results in one stimulus pairing where there is a definite association (CS+) and one where there is not (CS-). Therefore, if an effect is observed for the CS+ but not the CS- it must be the result of an association. Rescorla (1967) has criticised this kind of control procedure on the grounds that the CS- could become a predictive signal for the *absence* of the UCS. This being so, the CS+/CS- paradigm cannot provide evidence about the associations between stimuli because both CSs predict an event. In the EC paradigm, the CS+ is a CS paired with a valenced UCS (a liked or disliked one), while the CS- is a CS paired with a non-valenced UCS (a neutral one). Therefore, the zero shift in ratings seen in the N-N pairs may simply be the result of these CSs predicting the *absence* of valence. If this is the case then these pairings also tell us nothing of the associative nature of the N-D or N-L pairings. The same argument applies to the discriminative nature of the N-L and N-D pairs because CSs from both pairs enter into associations with UCSs. In addition to this, either of the valenced pairings (N-D or N-L) can be seen as predicting the absence of the other implying that discriminative responding may not be the result of subjects associating a specific neutral stimulus with a specific liked/disliked stimulus but simply because they are associating one pair type with the presence of a valence (be it 'liked' or 'disliked') and one pair type with the absence of it. Whether this kind of process is occurring or not, there are still no comparison pairs within the design where a CS-UCS association is not occurring and so these controls cannot demonstrate the presence of associative learning.

Shanks and Dickinson (1990) have argued that a well balanced within-subject control should equate "exposure to all classes of stimuli, thus controlling for non-associative effects, while varying the associations that the CSs enter into. However, such a design assumes that the pairing of a particular CS with a particular UCS is counterbalanced across Ss, so that any difference in the postconditioning measure can be attributed to the association a CS enters into rather than to the properties of that particular CS" (p 21). According to this definition, EC paradigms fail to fit the criteria that CS-UCS pairings are counterbalanced across subjects, since pairings are dependent on the subjects' original evaluations and the experimenter matching CSs and UCSs on the basis of perceptual similarity. Without this counterbalancing it is possible that apparently opposite shifts in ratings between CSs paired with liked UCSs and those paired with disliked UCSs, are the result of differential effects of repeated exposure on stimuli selected to be paired with liked, disliked or neutral UCSs. In other words it is the specific features of the CSs which cause the observed shifts rather than the pairing process.

In order to demonstrate that EC effects are what they are purported to be, two key issues have to be addressed: (1) do the controls used demonstrate that effects are the result of CS-UCS associations rather than mere exposure?; and (2) do the controls used rule out the possibility that the results are due to the specific properties of the CSs?. Clearly the two within subject controls currently employed do not adequately address these issues and so it is necessary to look at ways in which between-group methods can be employed as a solution.

Is a random control group appropriate for EC?

The traditional method for demonstrating that learning effects are the result of associations between stimuli is called the truly random control condition (Rescorla, 1967). In this procedure one group of subjects receives the normal CS-UCS pairings whilst a second group sees the same CSs and UCSs but with no *contingency* between them. This is done through presenting the CS as in the experimental condition but with randomly distributed UCSs. In addition the interval between stimuli is increased to eliminate any chance of the CS predicting nonoccurrence of the UCS - the crucial factor being the interval between presentations. Although Davey (1994) has advocated this procedure in EC paradigms, Baeyens and De Houwer (1995) have argued that this is not an appropriate control for EC because EC does not rely on *contingency* alone. Truly random control operates through eliminating any contingency between the CS and UCS such that CSs no longer reliably predict UCSs. EC, however, is dependent on temporal contiguity, and since stimuli in the truly random control condition can still appear in the same 'time window' (i.e. temporally proximal), valence shifts could still occur. In support of this, Baeyens, Hermans and Eelen (1993) have demonstrated that it *is* CS-UCS *contiguity* rather than CS-UCS contingency which is crucial for EC to occur. In fact, Baeyens and De Houwer suggest that a more appropriate control would be the random presentation of all CSs and UCSs. However, the random presentation of all CSs and UCSs would allow single CS-UCS pairings to occur in the same time window and so the same arguments hold.

In addition, autonomic conditioning paradigms utilise delay conditioning where the CS and UCS overlap or follow on immediately making it possible to introduce an inter-stimulus interval into the truly random control which eliminates immediate temporal contiguity. In EC however, an inter-stimulus interval of up to 4 seconds already exists (e.g. Baeyens *et al*, 1988, 1990) which means that if conditioning is occurring, it is in the absence of immediate temporal contiguity. Since EC is not reliant on immediate temporal contiguity between the CS and UCS, the removal of this contiguity in the truly random control will have no effect. The arguments against the use of a truly random control are convincing especially given that acquired valence shifts have been established with single CS-UCS exposures (Stuart *et al*, 1987); however, their own suggestion of using a random presentation schedule is equally flawed. The implication is that any control condition must avoid single contiguous pairings of a CS and UCS.

Hence, the truly random control procedure can neither verify that experimental effects are due to associations nor eliminate the possibility that effects are due to repeated exposure (because if the experimental stimuli are associated, this association occurs across a temporal interval and one trial learning can occur in the control condition). This being the case there is obviously a need for some procedure which does eliminate these factors.

The Block/Sub-Block control

One attempt has been made to provide an adequate control for exposure and association in the EC literature. This involved a control condition using 'block presentations' of the CSs and UCSs such that CSs and UCSs were paired with themselves (Shanks and Dickinson, 1990). In this procedure, the first CS was presented in a pair with itself five times[1]. Then after an inter-trial interval (comparable to that used in the paired condition) the first UCS was presented, in a pair with itself, five times. Then the second CS was presented in the same way and so on. This seems, *prima facie*, to provide an adequate control for exposure as all CSs and UCSs are presented the same number of times as in the paired condition, but unlike a truly random presentation schedule, the CSs are paired with themselves and so cannot enter into an association with a UCS by chance. Closer inspection of this procedure reveals that subjects still effectively receive CS-UCS pairings, only in blocks - so the CS-UCS contiguity still exists (Figure 1). At the very least they see a single CS-UCS pairing when the last CS of one block is presented and the first UCS of the next block (cf. Davey, 1994) (see Figure 1).

[1] Therefore the subject received 10 presentations of CS1 which is comparable to the number of times that that CS was presented to subjects in the paired condition.

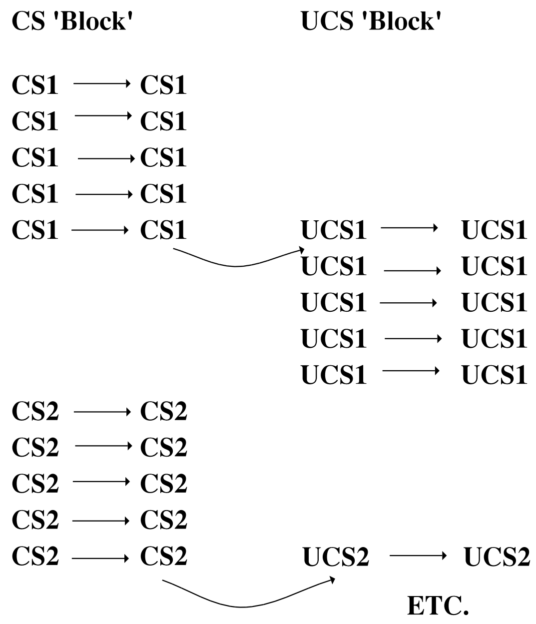

Figure 1: Diagram showing how the control condition employed by Shanks and Dickinson (1990) resulted in single CS-UCS pairings.

Therefore, this approach contains the same flaw as the truly random control schedule - it does not eliminate single contiguous pairings of a CS and UCS. Indeed, Shanks and Dickinson's results showed very similar response profiles in their control and experimental groups which could have been the result of one trial learning or conditioning surviving the 'block' presentation.

The control method proposed here is a modification of the Shanks and Dickinson paradigm. There are two kinds of blocks in this procedure: sub-blocks, and blocks (see figure 2).

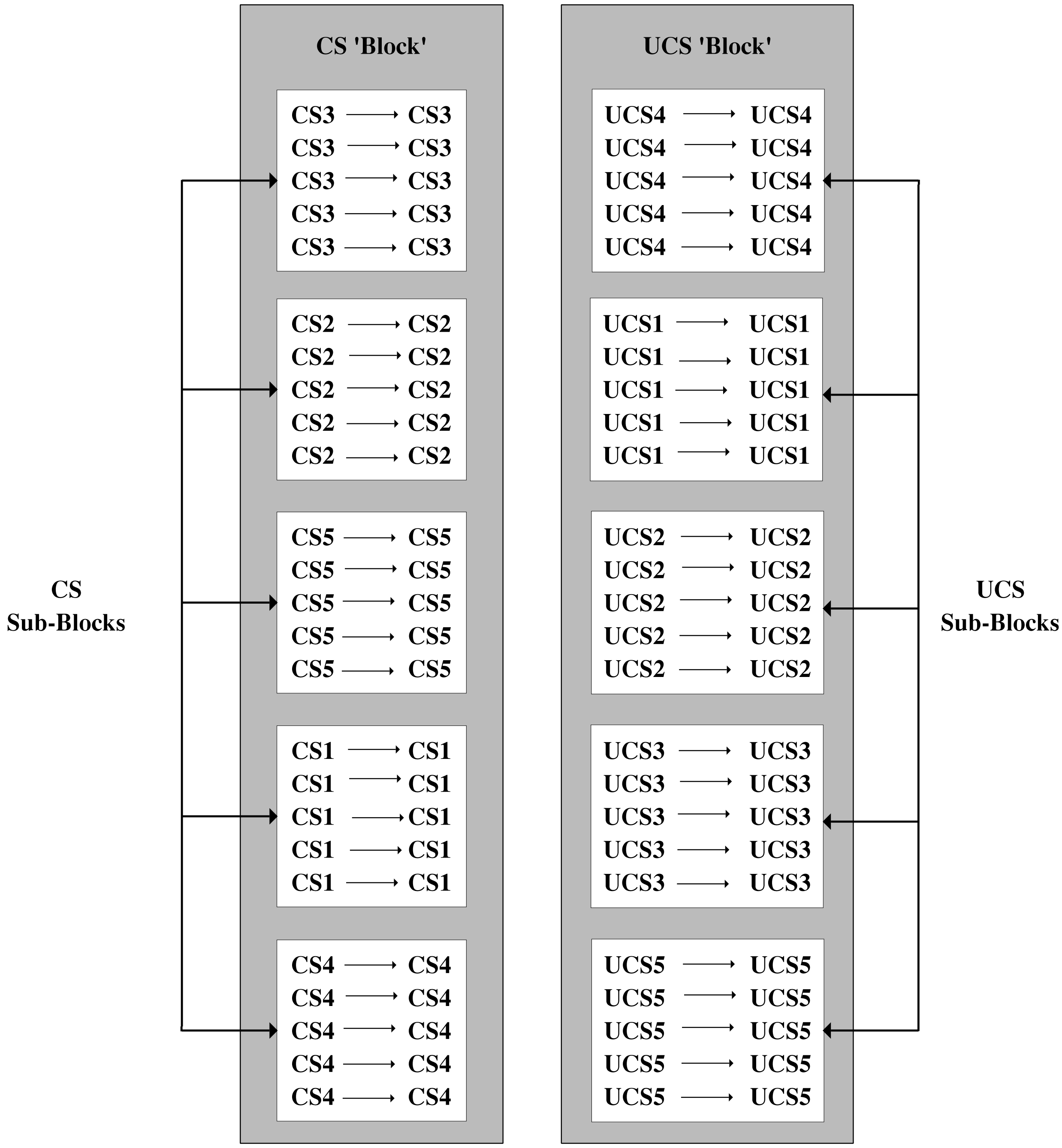

Figure 2: Diagram showing the 'block/sub-block' control paradigm. Both the main CS Block and main UCS block contain five sub-blocks which can be randomly ordered/ counterbalanced within the main block. The two main blocks themselves can also be counterbalanced.

Sub-Blocks - These are block pairings of a single stimulus with itself using the same timing parameters as in the experimental condition. For example, it might consist of a presentation of a CS (or UCS) for 1 second, followed by an interval of 4 seconds, followed by the *same* CS (or UCS) being presented again for 1 second. There would then follow an 8 second interval before the pair is presented again. The number of times that the pair is presented is dependent on how many times that stimulus appeared in the paired condition. If a given stimulus was presented 10 times in the experimental condition, then there should be 5 self-pairings in the control block (so the stimulus appears 10 times in all). This set of self-paired presentations is a sub-block.

Blocks - A 'block' is a collection of sub-blocks. The 'CS block' consists of all of the CS sub-blocks in random or counterbalanced order whilst the UCS block contains all of the UCS sub-blocks again in random or counterbalanced order. The number of sub-blocks contained within a block will of course be dependent on the number of CSs and UCSs used in the paired condition. In the example used earlier on there were 9 different CS-UCS pairings, which would result in 9 CS sub-blocks and 9 UCS sub-blocks.

Figure 2 shows how the blocks and sub-blocks might be arranged for a study which used 5 CS-UCS pairings in the experimental condition. The CS block contains 5 sub-blocks each of which is a CS paired with itself as described above. The numeric labels of the CSs and UCSs allow experimental pairs to be identified. So, after stage one of the experiment CS1 was selected to be paired with UCS1 (based on their perceptual similarity) and if this were the experimental condition, these two stimuli would have been presented contingently. In this control condition though, the CS1 and UCS1 are paired with themselves to form sub-blocks and these sub-blocks are assigned a random position within the respective main blocks. The order of presentation of the CS block and the UCS block can be counterbalanced such that half of the subjects see all of the CSs first whilst the other half see the UCSs first. Indeed, the order of sub-blocks within each block can also be counterbalanced across subjects too in preference to random ordering.

This procedure is superior to that of Shanks and Dickinson in that it ensures that only *one* CS-UCS pairing is ever seen (the very last CS of the 'CS block' and the very first UCS of the 'UCS block' or vice versa) and this could be controlled for across conditions by counterbalancing the order of CS sub-blocks before the presentation of the UCS block and doing the same for the UCS sub-blocks. Any anomalies resulting from this single pairing would be dissociable from the other results and if necessary trials could be arranged so that the last CS block and first UCS block contained non-experimental stimuli which are subsequently ignored in the analysis. In addition, counterbalancing the order of the main blocks acts as a safeguard against block presentation order effects and any single-pairing effects (because when the UCS block is presented first, this single pairing will be backwardly presented and there is no evidence to suggest that EC can survive backwards presentations (cf. Hammerl and Grabitz, 1993)). Conditioning should not survive the block presentations because of the counterbalancing of sub-blocks which ensures that subjects can have no awareness of which CS was selected to be paired with which UCS. If conditioning does survive, then this should be apparent because the effects should be eliminated by the reversing the block order from CS-UCS to UCS-CS.

In addition, the Shanks and Dickinson procedure allowed block pairings of CSs with UCSs whilst this condition does not. In fact the CSs are block presented with other neutrally valenced CSs so even if conditioning can survive this form of presentation each CS will only ever be presented with a stimuli which has no affective value[2]

This 'random CS/UCS block/sub-block' paradigm can fulfil all of the criteria for a control condition appropriate for EC: (i) all CSs and UCSs are presented the same number of times as in the paired condition (thus controlling for exposure effects); (ii) no CS enters into any association with its chosen UCS (or any other UCS) - allowing conclusions to be drawn about the associative nature of any effects from the paired condition; (iii) there are no CS-UCS contingencies, and more importantly no *contiguous* relations between any CS and UCS because the CS and UCS never appear in the same time frame. In addition, using this control procedure eliminates artefactual accounts of any experimental effects because responses in this condition indicate the effects of re-presenting the CSs whilst

[2] Of course the last CS block can appear before a UCS block but this can be controlled for using the same techniques described for the single CS-UCS pairing above.

controlling for associations between CSs and UCSs. Hence, significant differences between this control group and a paired condition can be taken as indicative of association-based learning. Non-significant differences can be seen as support for an artefactual account, as subjects in the control condition receive presentations where no possible connection between a CS and its UCS is made.

To summarise, evaluative conditioning research has been dogged by methodological problems arising from the inadequacy of existing control procedures. More traditional control procedures have failed to meet the necessary requirements for an appropriate and adequate control for associations and exposure. However, the block/sub-block paradigm does meet the relevant criteria and its use in future work will allow more informed conclusions to be drawn about the nature of EC.

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References

Baeyens, F. (1993) - Human evaluative conditioning: A Pavlovian experimental analysis of the acquisition and representation of stimulus valence. *Doctoral Dissertation,* University of Leuven.

Baeyens, F. & De Houwer, J. (1995). Evaluative conditioning is a qualitatively distinct form of classical conditioning: a reply to Davey (1994). *Behaviour Research and Therapy, 33*, 825-831.

Baeyens, F., Eelen, P., & Van den Bergh, O. (1990) - Contingency awareness in evaluative conditioning: A case for unaware affective-evaluative learning. *Cognition and Emotion,* **4**, 3-18.

Baeyens, F., Hermans, D. & Eelen, P. (1993). The role of CS-US contingency in human evaluative conditioning. *Behaviour Research and Therapy, 31*, 731-737.

Baeyens, F., Crombez, G., Van den Bergh, O. & Eelen, P. (1988) - Once in contact always in contact: Evaluative conditioning is resistant to extinction. *Advances in Behaviour Research and Therapy*, **10**, 179-199.

Baeyens, F., Eelen, P., Crombez, G. & Van den Bergh, O. (1992) - Human evaluative conditioning; acquisition trials, presentation schedule, evaluative style and contingency awareness. *Behaviour Research and Therapy,* **30**, 133-142.

Davey, G.C.L. (1994) - Is evaluative conditioning a qualitatively distinct from of classical conditioning? *Behaviour Research and Therapy,* **32**, 291-299.

Hammerl, M., & Grabitz, H-J. (1993) - Human evaluative conditioning: Order of stimulus presentation. *Integrative Physiological and Behavioural Science*, **28**, 191-194.

Levey, A.B. & Martin, I. (1975) - Classical conditioning of human 'evaluative' responses. *Behaviour Research and Therapy,* **13**, 221-226.

Rescorla, R.A. (1967) - Pavlovian conditioning and its proper control procedures. *Psychological review,* **74**, 71-80.

Shanks, D.R. & Dickinson, A. (1990) - Contingency awareness in evaluative conditioning: A comment on Baeyens, Eelen and van den Bergh. *Cognition and Emotion*, **4**, 19-30.

Stuart, E.W., Shimp, T.A. & Engle, R.W. (1987) - Classical conditioning of consumer attitudes: Four experiments in an advertising context. *Journal of Consumer Research,* **14**, 334-349.