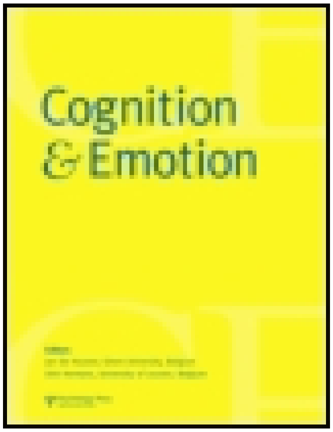

Cognition and Emotion
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/pcem20

From bad to worse: Symbolic equivalence and opposition in fear generalisation

Marc Bennett[a], Dirk Hermans[a], Simon Dymond[b], Ellen Vervoort[a] & Frank Baeyens[a]

[a] Faculty of Psychology and Educational Sciences, Centre for Learning and Experimental Psychopathology, University of Leuven, Leuven, Belgium

[b] Department of Psychology, Swansea University, Swansea, UK

Published online: 27 Oct 2014.

COGNITION AND EMOTION, 2014
http://dx.doi.org/10.1080/02699931.2014.973833

Routledge
Taylor & Francis Group

BRIEF REPORT

From bad to worse: Symbolic equivalence and opposition in fear generalisation

Marc Bennett[1], Dirk Hermans[1], Simon Dymond[2], Ellen Vervoort[1], and Frank Baeyens[1]

[1]Faculty of Psychology and Educational Sciences, Centre for Learning and Experimental Psychopathology, University of Leuven, Leuven, Belgium
[2]Department of Psychology, Swansea University, Swansea, UK

The present study compared the impact of symbolic equivalence and opposition relations on fear generalisation. In a procedure using nonsense words, some stimuli became symbolically equivalent to an aversively conditioned stimulus while others were symbolically opposite. The generalisation of fear to symbolically related stimuli was then measured using behavioural avoidance, retrospective unconditioned stimulus expectancy and stimulus valence ratings. Equivalence relations facilitated fear generalisation while opposition relations constrained generalisation. The potential clinical implications of symbolic generalisation are discussed.

Keywords: Symbolic generalisation; Fear; Avoidance.

Individuals with anxiety often fear events absent from a traumatic episode and that lack any perceptual similarity to events present at the time of conditioning (Augustson & Dougher, 1997; Hermans, Baeyens, & Vervliet, 2013). In such instances, *conceptual* or *symbolic generalisation*, whereby learned fear spreads to neutral events based on pre-existing conceptual relationships, is likely to be involved. For example, Dunsmoor, Martin, and LaBar (2012) paired certain members of category (e.g., types of animals) with an unpleasant shock and later observed different members to evoke heightened fear in the absence of shocks. While symbolic generalisation is

Correspondence should be addressed to: Marc Bennett, Faculty of Psychology and Educational Sciences, Centre for Learning and Experimental Psychopathology, University of Leuven, Tiensestraat 102 - Bus 3712, 3000 Leuven, Belgium. E-mail: Marcpatrick.bennett@ppw.kuleuven.be

Thanks to Bram Vervliet for helpful comments and feedback.
This work was supported by the Flemish Research Council [grant number G.0518.11].

interesting in the context of anxiety disorders, it is relatively understudied and deserving of further scrutiny.

Symbolic generalisation relies on the ability to spontaneously respond to an event in terms of its arbitrary relationship to other events (Hayes, Barnes-Holmes, & Roche, 2001). One approach to study this involves training relations between perceptually dissimilar (arbitrary) stimuli and then testing for untrained *derived stimulus relations*. For instance, using nonsense words, Dymond, Roche, Forsyth, Whelan, and Rhoden (2008) trained two stimuli as the "same" as a central stimulus (trained *equivalence relations*). Two other stimuli were trained as the "opposite" of this central stimulus (trained *opposite relations*). This established an equivalence pair and an opposite pair of stimuli. Participants then spontaneously (i.e., in the absence of feedback) combined these trained relations to derive equivalence relations *within* both pairs and derive opposition relations *between* both pairs. In a subsequent fear-conditioning paradigm, a stimulus from the equivalent pair was aversively conditioned to control avoidance; pressing a space bar prevented an unconditioned stimulus (US). A stimulus from the opposite pair was non-aversively conditioned and prompted a withheld space bar press. The remaining stimulus of the equivalence pair then produced a higher rate of generalised avoidance than the remaining stimulus of the opposite pair. Derived equivalence with an aversively conditioned stimulus (CS) seemed to facilitate generalised avoidance while derived opposition did not. In this way, the control exerted by stimuli over emotion may be said to change in accordance with their derived stimulus relations.

Dymond et al. (2008) found that if one stimulus was directly paired with a threatening outcome, then equivalently related stimuli functioned *as if* they too predicted threat while opposite stimuli did not. However, a potential shortcoming of the procedures employed was that the stimuli belonging to the opposite pair were also equivalent and one of these was non-aversively conditioned. It is possible that opposite stimuli prompted little generalised avoidance because of derived equivalence with a non-aversive CS rather than opposition to an aversive CS. Therefore, it cannot be conclusively stated that derived opposition restricted generalisation and that symbolic relations had a different impact on generalised avoidance.

The present study further compared the impact of symbolic equivalence and opposition relations on fear generalisation. We sought to exclude equivalence with a non-aversive CS as an alternative explanation for poorly generalised avoidance to an opposite stimulus. To accomplish this, related stimuli were never non-aversively conditioned. This allowed for an unambiguous comparison of different symbolic relations in fear generalisation. We employed avoidance behaviour, US expectancy reports and stimulus valence ratings as proxies of fear. This offers a more exhaustive analysis of the construct of fear than previous studies that solely examined behavioural avoidance. It was hypothesised that stimuli in derived equivalence relations with a CS would produce more generalised fear than stimuli in derived opposite relations with a CS.

An important question yet to be addressed is whether stimuli in derived opposition with a CS are in some way "safe" or "pleasant" or simply "non-threatening"? Symbolic generalisation predicts that stimuli in derived opposition relations with an aversive CS should be negatively associated with threat and generate positive valence. That is, conceptual opposition with threat may drive individuals to believe there is no danger. As a secondary aim, we hypothesised that stimuli in derived opposition with a CS would prompt (1) lower US expectancies and (2) more positive valence ratings than a neutral stimulus.

METHOD

Participants

Seventy-two undergraduate students (58 female) participated in exchange for course credits (*M* = 18.40 years old, *SD* = 1.10 years). The sample size was based on prior research from our lab that employed a similar paradigm. Approval was granted by the ethical committee of the Faculty of Psychology and Educational Science (S55215) and participants provided informed consent. Exclusion criteria are detailed in the next section, and all manipulations and measures are reported.

Apparatus

Experiments were conducted in a sound attenuated cubicle on a Dell desktop PC with a 17″ monitor, and programmed using the Relational Completion Procedure (Dymond & Whelan, 2010) and Affect4 (Spruyt, Clarysse, Vansteenwegen, Baeyens, & Hermans, 2010). Two wingdings characters (♓ and Ω) were selected as cues for equivalence and opposite relations. Relations were established between 8 three-letter nonsense word stimuli that are alphanumerically represented (A, S1,S2,O1,O2,N1,N2,N3).[1] Here, "S" indicates stimuli trained in equivalence relations; "O" indicates stimuli trained in opposite relations; and "N" indicates stimuli with no specified relations. These words appeared in capitals letters, size 32 black Arial, against a blue background. Stimuli were counterbalanced across participants.

In line with Dymond et al. (2008), multiple unpleasant USs were used comprising of co-occurring images and sound. One of 12 body mutilation images[2] from the *International Affective Picture System* was shown for 3 s, 1024 × 768 pixels (Lang, Bradley, & Cuthbert, 2001). Normative data indicate that these 12 images are unpleasant (*M* valence = 1.49, *SD* = 0.53; Libkuman, Otani, Kern, Viger, & Novak, 2007). An aversive sound of a female scream was modified using Audacity 1.2.6, and played via headphones for 2 s at 90 dB. Previous data indicated that this sound is unpleasant (*M* = 1.21, *SD* = 0.51; Van Diest, Bradley, Guerra, Van den Bergh, & Lang, 2009).

US expectancy was recorded with a 21-point Likert scale where −10 = definitely unlikely, 0 = uncertain and 10 = definitely likely. Stimulus valence was recorded with a 21-point Likert scale where −10 = highly unpleasant, 0 = neutral and 10 = highly pleasant. Scales appeared horizontally at the bottom of the screen and responses were made via mouse clicks.

PROCEDURE

Establishing derived stimulus relations

On each trial, a *sample* stimulus first appeared in the upper-left screen (e.g., [A]). A *relational cue* appeared 1 s later in the upper-middle screen (e.g., [same]). Finally, an empty square appeared 1 s later in the upper-right screen (e.g., [?]). These items collectively represented an incomplete relational 'sentence' (i.e., [*L*]/same/[?]). Five *optional* stimuli then appeared in the lower screen (e.g., [S1,O1,N1,N2,N3]). Participants were instructed to use the mouse and place 1 optional stimulus into the empty box. Four parts ran without any pauses or additional instructions.

Part A

Two wingdings characters were trained as the "same" and "opposite" relational cues. Sample and optional stimuli were familiar objects that differed along a physical dimension. There were six sets of objects; five boxes (small to large), five lines (short to long), five discs (crescent to full circle), five faces (sad to happy), five sets of dots (few to many) and five trees (short to tall). An *equivalence* trial (e.g., [small box]/same/[?]) required the selection of the optional stimulus perceptually identical to the sample (i.e., [small box]/same/[small box]). An *opposite* trial (e.g., [small box]/opposite/[?]) required the selection of the optional stimulus perceptually furthest from the sample (i.e., [small box]/OPPOSITE/[largest box]). Corrective feedback ("Correct" or "Wrong") followed each trial for 3 s and then a 3 s intertrial interval (ITI). Trials appeared randomly until 12 consecutively correct responses were made. At this point, Part B began.

[1] Nonsense word stimuli: BEH, FIH, CUG, VEP, MAU, SUG, GAJ, ZID, RUV, LER.

[2] IAPS identifiers: #3000, #3010, #3030, #3051, #3062, #3063, #3064, #3080, #3100, #3102, #3130, #3150.

Part B

Trials were identical to Part A except six different object sets were used: five buildings (small to large), five wavelengths (low to high frequency), five columns (narrow to wide), five shades (black to white), five trees (straight to bent) and five stars (few to many points). Four equivalence trials and four opposite trials were randomly presented without corrective feedback. Trials were separated by a 3 s ITI. This ensured that relational cues were successfully trained. If eight correct responses were made, then Part C began. If not, then Part A restarted.

Part C

Sample and optional stimuli were now nonsense words. Four trials were randomly presented: [A]/same/[*S1*,O1,N1,N2,N3], [A]/same/[*S2*,O2,N1,N2,N3], [A]/opposite/[S1,*O1*,N1,N2,N3] and [A]/opposite/[S2,*O2*,N1,N2, N3] (see Figure 1). Optional stimuli for each trial are indicated in the second set of brackets with the correct choice in italics. Corrective feedback ("Correct" or "Wrong") displayed on screen for 3 s after each selection, followed by a 3 s ITI. Part D began after 32 consecutively correct responses were made.

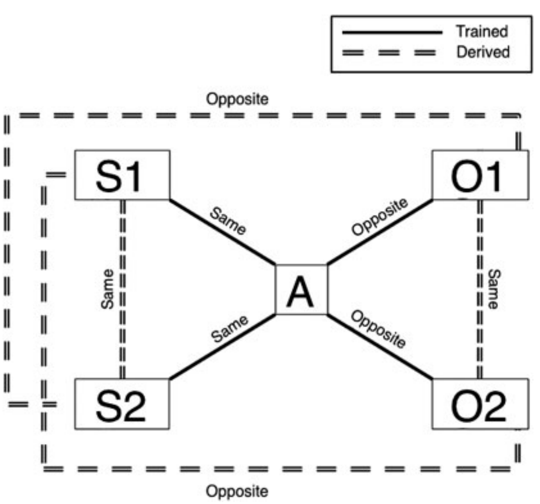

Figure 1. *Schematic representation of the trained and symbolically derived stimulus relations. Solid lines indicate stimulus relations trained and dashed lines indicate symbolically derived stimulus relations.*

Part D

Eight trial types were presented twice in a random order and without feedback: [S1]/same/[*S2*,O2, N1,N2,N3], [S2]/same/[*S1*,O1,N1,N2,N3], [S1]/opposite/[*O2*,S2,N1,N2,N3], [O2]/opposite /[*S1*, O1,N1,N2,N3], [O1]/same/[*O2*,S2,N1,N2,N3], [O2]/same/[*O1*,S1,N1,N2,N3], [O1]/opposite/[*S2*,O2,N1,N2,N3] and [S2]/opposite /[*O1*,S1, N1,N2,N3] (the correct choice is indicated in italics; see Figure 1). Trials were separated by a 3 s ITI. Fourteen out of 16 correct responses were needed to continue. A lower score restarted Part A and four attempts at Part D were allowed.

Fear conditioning

Here, instructions stated that nonsense words would appear in the centre of the screen and could be followed by unpleasant images and sounds. S1 was aversively conditioned (S1+) and appeared four times for 5 s followed by a 3 s US. S1+ also appeared once for 5 s and was followed by 3 s blank screen where no US was presented. A previously unseen nonsense word was used as a non-aversive CS– and appeared five times for 5 s followed by 3 s blank screen without the US. Trials were presented quasi-randomly, with no more than two consecutive trials with the same stimulus, and separated by a 10–14 s ITI.

An operant avoidance task then commenced. Instructions stated that unpleasant images and sounds could be avoided by pressing the spacebar. To facilitate discriminative avoidance, participants were instructed to avoid if they expected the US. S1+ or CS– appeared on screen for 5 s. A space bar press in their presence removed the stimulus and initiated a 3 s blank screen without a US. If the space bar was not pressed during a S1+ presentation, then a 3 s US followed. If the space bar was not pressed during a CS– presentation, then a 3 s black screen without a US followed. Trials were separated by a 10–14 s ITI and continued until eight consecutive avoidance responses to S1+ were made. If CS– was avoided or S1+ was not avoided, then the number of correct responses was reset. Participants were not informed of this performance criterion.

Generalised avoidance

Instructions stated that nonsense words would appear, which could be followed by an unpleasant image and sound. Participants were informed that they could make whatever responses felt appropriate. S1+ (CS) was presented to ensure maintained avoidance and related stimuli were also presented: S2 (derived equivalence stimulus), O1 or O2 (derived opposition stimulus) and Nx (an unseen neutral nonsense word). As two stimuli were in derived opposition with S1+, we introduced a between-groups factor with two levels. Group 1 was shown S1+, S2, Nx and O1, quasi-randomly four times each. Group 2 was shown S1+, S2, Nx and O2, quasi-randomly four times each. On each trial, a stimulus appeared for 5 s followed by a 10–14 ITI. If the space bar was pressed whilst a stimulus was on screen, the stimulus was removed and a 10–14 s ITI began. If the space bar was not pressed the stimulus remained on screen for 5 s followed by a 10–14 s ITI. The US never followed any stimulus.

Self-report measures

In accordance with our between-group factor, Group 1 reported US expectancy for S1, S2, O1 and Nx. Group 2 reported US expectancy for S1, S2, O2 and Nx. After generalised avoidance testing, participants rated their expectancy when (1) the avoidance response was assumed to be present and (2) the avoidance response was assumed to be absent. Questions appeared in the centre screen in a random order reading "Imagine that (e.g., S1) appears and you (press/do not press) the space bar. How likely is it that images and sounds will follow?"

Stimulus valence was rated before fear conditioning and after the generalised avoidance testing. Due to a programming error, participants were not divided into two groups and they reported valence for both O1 and O2. Stimuli S1+, S2, O1, O2 and Nx appeared in centre screen in a random order and participants were asked to indicate how pleasant or unpleasant they found these words.

Data analysis

Symbolic generalisation of fear requires (1) symbolic relationships between stimuli and (2) a conditioned fear response. Participants were therefore required to derive stimulus relations within four attempts at Part D. Twenty-one participants did not meet this criterion. Participants were also required to demonstrate reliable avoidance of S1+ (eight consecutive avoidance responses). Five participants did not fulfil this criterion. These data are not reported. This produced a final sample of $N = 46$ (20 participants in Group 1 and 26 in Group 2).

For avoidance and US expectancy, mixed repeated measures analysis of variance (ANOVA) with 1 within-subjects factor (stimulus) with four levels (S1+, S2, O1/O2 and Nx) and 1 between-subjects factor (group) with two levels [Group 1 (shown O1) and Group 2 (shown O2)] were conducted. Due to a programming error, participants were not divided into two groups while reporting stimulus valence. There was 1 within-subject factor (stimulus) with five levels (S1+, S2, O1, O2 and Nx). Stimulus valence ratings were reported pre-conditioning (X) and post-generalisation (Y). A mean difference score was then calculated ($d = Y - X$). A negative mean d-score indicates that valence ratings for a stimulus became negative while a positive mean d-score indicated that ratings became positive. A repeated measures ANOVA was calculated to examine the effect of stimulus on mean d-score. Where Mauchly's test revealed that sphericity could not be assumed the Greenhouse-Geisser correction is reported. Bonferroni corrections were used as the rejection criterion was adjusted when pairwise comparisons were calculated. Effect size was calculated using η_p^2. The alpha level was set at .05.

RESULTS

Establishing derived relations

A mean of 2.04 attempts at Part D (SE = 0.05) were needed to establish the derived stimulus relations. A mean of 39.02 Part A trials (SE = 2.06) were completed. A mean of 23.04 Part B trials (SE = 1.20) were completed. As such, relational cues reliably designated equivalence and opposition relations. A mean of 94.70 Part C trials (*SE* = 0.66) were completed. A mean of 28.63 Part D trials (*SE* = 0.05) were completed. As such, S1+ was in a derived equivalence with S2 and derived opposition with O1 and O2. Also, opposition stimuli were in derived equivalence with each other (see Figure 1).

Avoidance learning

A mean of 11.04 S1+ trials (*SE* = 0.71) and 8.67 CS– trials (*SE* = 0.60) were completed. There was significantly more avoidance in the presence of S1+ (*M* = 9.89, *SE* = 0.55) than CS– (*M* = 0.65, *SE* = 0.52), $t(42) = 20.80$, $p < .001$, $df = 42$, $d = 2.54$.

Generalised Avoidance

There was a main effect of stimulus on generalised avoidance, $F(2, 67) = 73.96$, $p < .001$, $\eta_p^2 = 0.64$ (see Figure 2A). Avoidance generalised to the equivalent stimulus; pairwise comparisons revealed it evoked more avoidance than both a neutral stimulus, $p < .001$, and opposite stimulus, $p < .001$. This suggests differential effects of equivalence and opposition relations on generalised avoidance. However, pairwise comparisons indicated that avoidance of the equivalent stimulus was lower than the CS, $p < .001$. Finally, there was no significant difference between neutral and equivalent stimuli, $p = .08$

There was no main effect of group, $F(1, 42) = 1.58$, $p = .22$, and no interaction between group and stimuli, $F(3, 39) < 1$, $p = .80$. Therefore, there were no differences in generalised avoidance of the two opposite stimuli, O1 (*M* = 0.79, *SE* = 1.47) and O2 (*M* = 0.67, *SE* = 1.43).

US expectancy ratings

Retrospective US expectancy was reported when the avoidance response was assumed to be present. There was no main effect of stimulus, $F(3, 109) = 1.77$,

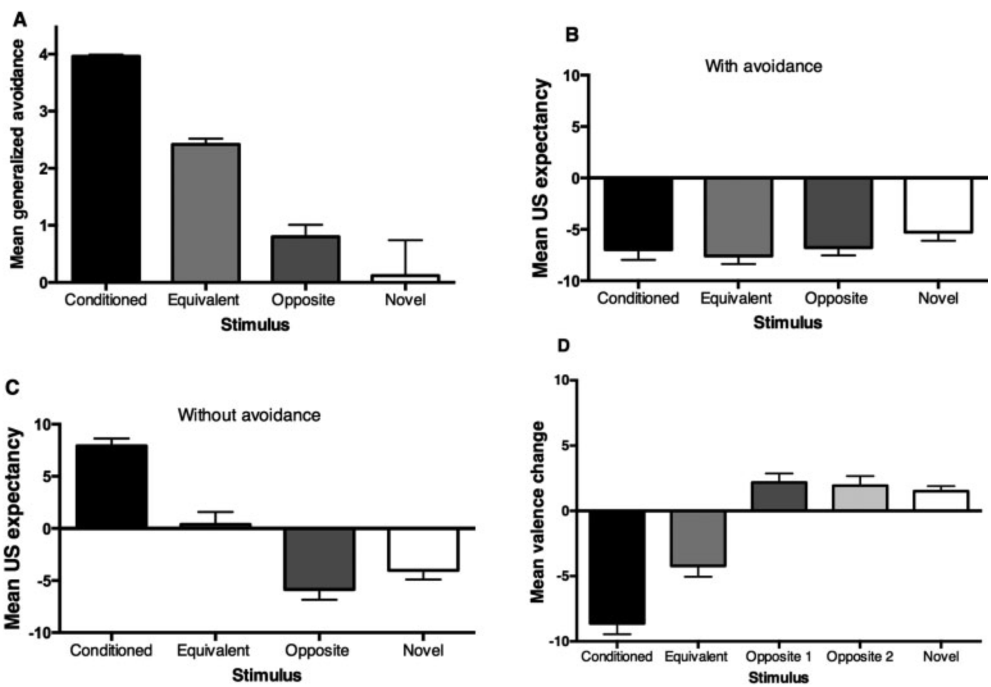

Figure 2. *(A) Mean number of avoidance responses. (B) Mean US expectancy ratings when the avoidance response was assumed to be present. (C) Mean US expectancy ratings when the avoidance response was assumed to be absent. (D) Mean valence change for stimuli. Error bars represent standard error.*

p = .17, no main effect of group, $F(1, 43) < 1$, p = .33, and no interaction between stimulus and group, $F(3, 109) < 1$, p = .90. Mean ratings of each stimulus were low (all *M's* ≤ −5.00) which suggests that participants learned avoidance reliably prevented the US (see Figure 2B).

US expectancy was also reported when the avoidance response was assumed to be absent. There was a main effect of stimulus on these ratings, $F(3, 87) = 35.85$, $p < .001$, $\eta_p^2 = 0.45$ (see Figure 2C). As predicted, pairwise comparisons revealed that the equivalent stimulus prompted higher ratings than the opposite stimulus, p = .01. As such, equivalent and opposition stimuli differed in terms of US expectancy. However, equivalent stimulus prompted lower US expectancy than the CS, $p < .01$. And, contrary to other predictions, ratings for the opposite stimulus were indistinguishable from novel stimulus, p = .77.

There was no main effect of group, $F(1, 41) < 1$, p = .40, and no interaction between group and stimulus, $F(2, 86) = 1.15$, p = .32. Therefore, the ratings prompted by the two opposite stimuli, O1 (M = −5.45, SE = 1.63) and O2 (M = −6.20, SE = 1.22), did not differ.

Valence ratings

There was a main effect of stimulus on valence change, $F(2, 87) = 40.01$, $p < .001$, $\eta_p^2 = 0.47$ (see Figure 2D). Pairwise comparisons showed that the equivalent stimulus differed significantly from the first opposite stimulus (O1), $p < .01$, and the second opposite stimulus (O2), $p < .01$. This suggests that equivalent and opposition relations differentially effected evaluative changes. The CS became significantly more unpleasant than the equivalent stimulus, $p < .01$. In contrast to other predictions, valence change did not differ between the novel stimulus and O1, p = .90, and O2, p = .90.

Generalised avoiders and non-avoiders

An unexpected, post-hoc, finding was bimodality in generalised avoidance to the equivalent stimulus. One group, *non-avoiders,* (N = 15, 32.60%) did not produce any generalised avoidance to the equivalent stimulus. The other group, *avoiders,* (N = 29, 67.40%) emitted generalised avoidance to the equivalent stimulus (M = 3.62, SE = 0.16). Here, generalised avoidance of the equivalent stimulus was indistinguishable from that of the CS, $t(28) = 1.88$, p = .07, d = 0.49.

DISCUSSION

The present study found that equivalent stimuli spontaneously evoked avoidance and negative stimulus valence ratings, although they prompted neutral US expectancy. Also, opposite stimuli produced little avoidance and positive valence ratings, as well as low US expectancy. This demonstrates that equivalence relations facilitate fear and avoidance generalisation while derived opposition relations may actually hamper generalisation. These findings are especially interesting given that both equivalent and opposite stimuli were perceptually dissimilar from the CS and are unlikely to have involved perceptual generalisation (e.g., Vervoort, Vervliet, Bennett, & Baeyens, 2014).

Our findings replicate and extend those of Dymond et al. (2008) who compared different symbolic relations in the context of avoidance. In that study, low avoidance of opposite stimuli may have resulted from equivalence with a non-aversive CS, rather than opposition with an aversive CS. In our procedure, the opposite stimulus was never in derived equivalence with non-aversive stimuli. Poor avoidance to opposite stimuli could only be accounted by symbolic opposition with an aversive CS. The present findings therefore offer an unambiguous interpretation of the role of symbolic equivalence and opposition relations in fear and avoidance generalisation.

A secondary objective was to examine the effect of symbolic opposition with a CS. We predicted that opposite stimuli would elicit low US expectancy and become positively valenced. That is, participants might conceive of opposite stimuli as the opposite of threat. The current study found no significant differences in the mean stimulus valence or US expectancy ratings between opposite and novel stimuli. A limitation, however, was that the novel stimulus was presented without the US (during generalised avoidance testing) before stimulus valence and US expectancy were self-reported. Repeated presentations of this stimulus without the US may have established it as a conditioned inhibitor that signalled the absence of a US. Future research will require novel stimuli that are not inhibitory (Rescorla & LoLordo, 1965). The consequences of symbolic opposition with a CS remain open to investigation. This is important given that opposition relations may motivate a search for safety, which is characteristic of certain anxiety disorders. For instance, should individuals with panic disorder experience distress in an open public space, they could derive conceptually opposite places (i.e., indoor private spaces) to be more safe and subsequently limit themselves to these areas (Rachman, 1984).

An interesting but unpredicted finding was that one-third of the participants (*non-avoiders*) did not produce generalised avoidance to equivalent stimuli while the remaining participants (*avoiders*) did. An explanation for this dichotomy is unclear. Both groups related stimuli with the CS but one did not show fear generalisation. Perhaps non-avoiders possessed some individual difference that reduced their propensity to symbolically generalise fear? For instance, the hesitation of some participants to generalise learned fear may be due to differences in emotional regulation (e.g., Lommen, Engelhard, & van den Hout, 2010). Further research will be required to replicate and gain experimental control over this effect so to determine the critical variables. Measures of individual differences in negative affect and avoidance behaviour may be useful in this regard.

A limitation of this study was the use of retrospective US expectancy ratings, which may have been influenced by the presentation of stimuli in extinction during the generalised avoidance test (Lovibond & Shanks, 2002). This may also explain the neutral US expectancy prompted by the equivalent stimulus. It is possible that upon the first presentation of the equivalent stimulus the avoiders and non-avoiders both expected an aversive outcome. By not avoiding the equivalent stimulus participants learned there was no US and had the opportunity to correct this flawed threat expectancy. Therefore, *non-avoiders* retrospectively reported that the equivalent stimulus was unlikely to be followed by the US. On the other hand, avoiding the equivalent stimulus blocked any opportunity to correct this flawed expectancy and, therefore, *avoiders* reported that the US was likely. As such, these two extremes of high and low expectancy may have generated an overall, neutral mean US expectancy. Future research will therefore greatly benefit from the use of trial-by-trial US expectancy ratings (e.g., Lovibond, 2006).

In conclusion, neutral events can be treated like threat signals and evoke fear if they are related to an aversive CS. This generalisation may be helpful as one can quickly respond to actual threat cues without prior learning. There is, however, the possibility that fear can spread to events that do not signal threat. In such cases individuals needlessly experience fear and engage in debilitating avoidance behaviours. Symbolic generalisation is particularly problematic given the extension of fear can go beyond the limits of perceptual similarity and be based on a rather arbitrary concepts of equivalence. But interestingly symbolic relations appear to have the capacity to limit this extension of fear on the basis of arbitrary concepts of opposition. Further research is needed on the facilitative or constraining effects of symbolic relations in the aetiology and maintenance anxiety disorders (Hermans et al., 2013).

Manuscript received 24 April 2014
Revised manuscript received 15 September 2014
Manuscript accepted 3 October 2014
First published online 27 October 2014

REFERENCES

Augustson, E. M., & Dougher, M. J. (1997). The transfer of avoidance evoking functions through stimulus equivalence classes. *Journal of Behavior Therapy and Experimental Psychiatry*, *28*, 181–191. doi:10.1016/S0005-7916(97)00008-6

Dunsmoor, J. E., Martin, A., & LaBar, K. S. (2012). Role of conceptual knowledge in learning and retention of conditioned fear. *Biological Psychology*, *89*, 300–305. doi:10.1016/j.biopsycho.2011.11.002

Dymond, S., Roche, B., Forsyth, J. P., Whelan, R., & Rhoden, J. (2008). Derived avoidance learning: Transformation of avoidance response functions in accordance with the relational frames of same and opposite. *The Psychological Record*, *58*, 271–288.

Dymond, S., & Whelan, R. (2010). Derived relational responding: A comparison of matching to sample and the relational completion procedure. *Journal of the Experimental Analysis of Behavior*, *94*(1), 37–55. doi:10.1901/jeab.2010.94-37

Hayes, S., Barnes-Holmes, D., & Roche, T. (2001). *Relational frame theory: A post-Skinnerian account of human language and cognition*. New York, NY: Plenum Press.

Hermans, D., Baeyens, F., & Vervliet, B. (2013). Generalization of acquired emotional responses. In M. D. Robinson, E. R. Watkins, & E. Harmon-Jones (Eds.), *Handbook of cognition and emotion* (pp. 117–134). New York, NY: Guilford Press.

Lang, P., Bradley, M., & Cuthbert, B. (2001). *International affective picture system (IAPS). Instruction manual and affective rating* (Technical Report No. A-5). Gainesville, FL: Centre for Research in Psychophysiology, University of Florida.

Libkuman, T. M., Otani, H., Kern, R., Viger, S. G., & Novak, N. (2007). Multidimensional normative ratings for the international affective picture system. *Behavior Research Methods*, *39*, 326–334. doi:10.3758/BF03193164

Lommen, M. J. J., Engelhard, I. M., & van den Hout, M. A. (2010). Neuroticism and avoidance of ambiguous stimuli: Better safe than sorry? *Personality and Individual Differences*, *49*, 1001–1006.

Lovibond, P. (2006). Fear and avoidance: An integrated expectancy model. In M. G. Craske, D. Hermans, & D. Vansteenwegen (Eds.), *Fear and learning: Basic science to clinical application* (pp. 117–132). Washington, DC: American Psychiatric Association.

Lovibond, P. F., & Shanks, D. R. (2002). The role of awareness in Pavlovian conditioning: Empirical evidence and theoretical implications. *Journal of Experimental Psychology: Animal Behavior Processes*, *28*(1), 3–26. doi:10.1037/0097-7403.28.13

Rachman, S. (1984). Agoraphobia: A safety-signal perspective. *Behaviour Research and Therapy*, *22*(1), 59–70. doi:10.1016/0005-7967(84)90033-0

Rescorla, R. A., & LoLordo, V. M. (1965). Inhibition of avoidance behavior. *Journal of Comparative and Physiological Psychology*, *59*, 406–412. doi:10.1037/h0022060

Spruyt, A., Clarysse, J., Vansteenwegen, D., Baeyens, F., & Hermans, D. (2010). Affect 4.0: A free software package for implementing psychological and psychophysiological experiments. *Experimental Psychology*, *57*(1), 36–45. doi:10.1027/1618-3169/a000005

Van Diest, I., Bradley, M. M., Guerra, P., Van den Bergh, O., & Lang, P. J. (2009). Fear-conditioned respiration and its association to cardiac reactivity. *Biological Psychology*, *80*, 212–217. doi:10.1016/j.biopsycho.2008.09.006

Vervoort, E., Vervliet, B., Bennett, M., & Baeyens, F. (2014). Generalization of human fear acquisition and extinction within a novel arbitrary stimulus category. *PLoS ONE*, *9*(5), e96569. doi:10.1371/journal.pone.0096569.g006