Transfer of Function Visual Stimuli through Equivalence Relations with Verbal Stimuli

Article *in* European Journal of Behavior Analysis · June 2006

DOI: 10.1080/15021149.2006.11434260

2 authors:

Rafael Ferro García
Centro de Psicologia C.E.D.I., Granada. Spain
65 PUBLICATIONS **518** CITATIONS
SEE PROFILE

Luis Valero
University of Malaga
107 PUBLICATIONS **601** CITATIONS
SEE PROFILE

Transfer of Function of Visual Stimuli through Equivalence Relations with Verbal Stimuli

Rafael Ferro
Centro de Psicología Clínica CEDI, Granada, Spain

Luis Valero
School of Psychology, University of Málaga, Málaga, Spain

Transfer of function through equivalence relations may explain verbal processes that occur in psychological disorders and during therapy. However, methodological problems have affected the results and analyses of experimental studies. We established equivalence relations between visual stimuli (paintings) and descriptive words or phrases with a positive or negative function with one stimulus to test whether this function transferred to other paintings in the same class. The study was replicated with 10 adult participants with pretest and posttest evaluations, and the experimental procedure was automated with a PC and specially designed software. Although all participants established the equivalence relations, between-stimuli and between-subject variability was considerable. Transfer of function appeared in four participants. The variability is consistent with earlier results, and the findings point strongly to the relevance of other variables such as previous history and language.

Key words: equivalence relations, transfer of function, language, matching-to-sample, alternating treatment design

---

The phenomenon of transfer of function through equivalence relations has been widely studied, owing to its potential to explain phenomena such as emotional disorders and certain therapeutic processes (Dougher, Augustson, Markham, Greenway, & Wulfert, 1994). Two related terms need to be distinguished. Dymond and Rehfeldt (2000) used the term "transfer" to describe response patterns indicative of a transfer of function through symmetrical equivalence relations. Thus, it is assumed that if the vehicle through which new functions emerge is an equivalence relation, the phenomenon is termed transfer of function, whereas if the relations between stimuli are of a different nature, the phenomenon is then termed transformation of function (Dymond & Rehfeldt, 2000; Luciano & Gómez, 2001). Specifically, transfer of function refers to the acquisition by the stimulus of a new function after a variable is applied to a different member of that equivalence class. Thus in a test of functional equivalence we would expect to see a new reinforcing or punishing function for a given stimulus after that function is applied to a unique and different stimulus in the same functional class (Dougher, 1998; Dougher & Markham, 1996; Dymond & Rehfeldt, 2000; Pérez-González, 1994).

Numerous experimental studies have investigated a variety of types of transfer of function. To date, findings have been published for transfer of discriminative functions (Barnes, Browne, Smeets & Roche, 1995; Barnes & Keenan, 1993; Catania, Horne & Lowe, 1989; De Rose, McIlvane, Dube, Galpin, & Stoddard, 1988; Roche, Barnes-Holmes, Smeets, Barnes-Holmes, & McGeady,

Rafael Ferro, Centro de Psicología Clínica, CEDI, Avda. de la Constitución 25, 7-Izqda., 18014 Granada, Spain.
Luis Valero, School of Psychology, University of Málaga, 29071 Málaga, Spain.
We thank to K. Shashok for translating the original manuscript into English.
Correspondence concerning this article should be addressed to Rafael Ferro at Centro de Psicología Clínica, CEDI, Avda. de la Constitución 25, 7-Izqda., 18014 Granada, Spain; Tel. +34 958 286650; E-mail: rferro@correo.cop.es.

2000), transfer of ordinal functions (Green, Sigurdardottir, & Saunders, 1991; Lazar, 1977; Lazar & Kotlarchyk, 1986; Markham, Dougher, & Augustson, 2002; Sigurdardottir, Green, & Saunders, 1990; Wulfert & Hayes, 1988), transfer of contextual control (Dougher, Perkins, Greenway, Koons, & Chiasson, 2002; Gatch & Osborne, 1989; Kohlenberg, Hayes, & Hayes, 1991; Lynch & Green, 1991; Meehan & Fields, 1995), conditioned punishment and reinforcement functions (Barnes-Holmes, Keane, Barnes-Holmes, & Smeets, 2000; Greenway, Dougher, & Wulfert, 1996; Hayes, Devany, Kohlenberg, Brownstein, & Shelby, 1987; Hayes, Kohlenberg, & Hayes, 1991), respondent functions (Augustson & Dougher, 1997; Augustson, Dougher, & Markham, 2000; Dougher, Augustson, et al., 1994; Markham, Dougher, & Augustson, 2002), conditioned sexual arousal (Roche & Barnes, 1996, 1997; Roche, Barnes-Holmes, et al, 2000) and self-discrimination response functions (Dymond & Barnes, 1994; 1995; 1996).

Two conditions are necessary and sufficient to show that transfer has occurred. First, equivalence relations must be documented with a procedure involving at least three comparison stimuli and at least two equivalence classes, with no additional training to reach criterion. Second, when the transfer test is performed with a stimulus unrelated with the function of interest, the function should appear with no further explicit training. These are the criteria we used in our review of the literature to determine whether transfer occurred in the experiments reported below.

Of a total of 30 studies we reviewed, only 8 of them (26%) reported results that satisfied the above criteria. Many studies used procedures with only two choices of response, which meant that the level of correct responses attainable by chance was 50%. Indeed, relations did appear by chance in some participants for stimuli that "should not" have been related. In these cases other explanations for the results were possible in the light of the methods and experimental procedures used. In some participants, "transfer of function" appeared in 100% of the trials, whereas in others transfer was variable. The line of research that has yielded the highest percentages of transfer in the largest proportions of participants to date is transfer of respondent functions. In these studies transfer was seen in more than 60% of the trials and 100% in some subjects (Augustson & Dougher, 1997; Dougher et al., 1994). Transfer of consequential functions appears more difficult to achieve, having been reported in one of four studies at a rate of 58% (Greenway, Dougher, & Wulfert, 1996). Transfer of sexual arousal was reported to take place in two out of three studies (Roche & Barnes, 1997; Roche et al., 2000). In the series of experiments that studied transfer of self-discrimination responses, transfer was seen in two studies (Dymond & Barnes, 1994, 1996), but the results were variable.

Once studies with serious methodological problems were excluded, transfer was found in 20% to 80% of the participants from all the studies. This variability suggests that the variables of relevance to the phenomenon have not yet been identified, as others have already noted (Augustson, Dougher, & Markham, 2000; Dougher et al., 1994; Dougher & Markham, 1994), and that the findings probably reflect other factors which might include the manner in which the trials were evaluated and the verbal instructions given for the experimental tasks.

The experiment reported here aimed to test empirically whether transfer of function could be documented with a methodologically enhanced testing procedure designed to allow more robust conclusions to be drawn. Our aim was to test transfer of function by including in the equivalence relations verbal statements that denoted a favorable or unfavorable judgment, i.e., that had a positive or negative enjoyment rating function. We first attempted to create stimulus relations among works of art (paintings), establishing arbitrary relations with different subjective judgments. In the next step, only some of the paintings were paired with adjectives denoting a favorable (positive) or unfavorable (negative) opinion of the painting's artistic quality, to observe whether the enjoyment rating function was transferred to the other pictorial stimuli. To determine whether there was a change in the enjoyment rating function, participants were asked to rate pictures on a scale of verbal categories (ranging from 1 to 4). After training in conditional relationships and the association with adjectives denoting favorable or

unfavorable judgments, we noted whether the nature of these subjective judgments expressing pleasure or displeasure changed as a result of stimulus equivalence depending on which word (judgment) had been associated.

Method

Design

A pretest-posttest design to investigate stimulus relations was used together with a single-case alternating treatment design for training (Barlow & Hersen, 1988; Kazdin, 1982). Alternating treatments consisted of training in four stimulus classes (A1 with B1; A2 with B2, etc.), where each specific stimulus relation gives rise to specific discriminative contingencies. This type of design, termed the transfer baseline method, was first proposed by Dymond and Rehfeldt (2000). Pretest and posttest evaluations were obtained for the subjective judgments each participant gave to each pictorial stimulus. In addition, we evaluated the novel equivalence relations that should have appeared in order to carry out within-subject comparisons of the appearance of new stimulus relations in subsequent tests.

The same design was replicated in 10 participants. Both the order and the number of trials were identical for all participants, and the order of training was also identical. The only difference between participants was in the number of trials needed to reach training criteria (90% correct responses). A minimum criterion of 80% correct responses was required in equivalence tests to consider that a given stimulus relation had been unequivocally established.

Participants were not given explicit instructions for matching the stimuli, but were told only how to use the PC mouse to select their choice on the screen, and that they were to match the stimuli in the center of the screen with those in the corners. They were told that the purpose of the experiment was to study how well they could distinguish between different styles of painting.

Participants

A total of 10 participants (5 women, 5 men) took part in the study. All participants were adults (age range 20 to 42 years). All were university students or graduates, but none had specialized knowledge of equivalence relations or previous experience with discrimination procedures similar to those used here. Only Subject 1 had participated previously in an experiment on conditional discrimination. Nine of the subjects performed the experiment in a single session that lasted approximately 90 minutes; the other subject used two sessions (morning and afternoon).

Equipment and Setting

A Pentium PC was used to control stimulus presentations and record the responses. All stimuli were displayed on a 14-inch 800 × 600 pixel screen as a 24-bit color image measuring 6 × 5 cm. The specially-designed software (Igualación Lab Version 1.2, Valero, 2005; Ferro & Valero, 2005) displayed each picture and delivered the consequences automatically. The program was designed as a set of generic tasks for matching-to-sample discrimination trials, and allowed for multiple settings for stimulus display, visual and auditory consequences, parameters for correct responses, latency, and data file storage and export for analysis with the Statistical Package for Social Sciences (v. 11.0).

Stimuli

The visual stimuli used here were parts of actual nonfigurative paintings scanned from high-quality print reproductions from the Thyssen-Bornemisza Museum in Madrid. The verbal stimuli were adjectives or short sentences that denoted favorable or unfavorable judgments of the painting's artistic quality. A total of 20 different stimuli (paintings) (4 stimulus classes consisting of 5 members each) were used. Each group was identified with a capital letter, and each stimulus class was identified by number (Figure 1). The stimulus groups A, B and C were parts of paintings; stimuli in group D were descriptive words or phrases that indicated favorable or unfavorable judgments that were arbitrarily associated with different stimuli. Stimuli in group E were short statements that denoted subjective value judgments that the participants assigned to the pictures.

Procedure

In the matching-to-sample procedure a stimulus was displayed in the center of the screen, and when the participant clicked on it, the other four comparison stimuli appeared (one in each corner of the screen). When the participant clicked on one of these stimuli, reinforcing contingencies (sound and a score display) or punishing contingencies (time out) appeared depending on whether the participant's choice was correct or incorrect. All comparison stimuli were displayed at random in each trial. Reinforcing contingencies were held constant across training trials. The responses in the probes of equivalence relations never had explicit consequences; instead there was a 2-second pause until the start of the next trial (Ferro & Valero, 2005; Valero & Luciano, 1997).

To ensure that there were no differences in procedure between the training trials and the trials to evaluate equivalence relations, the same matching-to-sample technique was used for the subjective judgments of the paintings. The participants were not aware that they were performing a different task, i.e., judging paintings instead of matching them. In the subjective judgments of paintings there were no correct or incorrect responses; instead participants chose one of four possible responses from a Likert-like scale: I don't like it at all (1 point), I don't like it (2 points), I like it (3 points) or I like it a lot (4 points) (Figure 1). The general procedure consisted of 7 phases (Figure 2):

Phase 1. Pretest subjective judgments that participants gave to each stimulus. A total of 20 trials were used for each stimulus relation (EA, EB and EC, see Figure 1), i.e., 5 trials per painting.

Phase 2. Conditional discriminations AB and AC were trained. Groups of 10 trials were used, with a criterion of 90% correct responses needed to continue to the next phase.

Figure 1. Paintings and words or phrases used as stimuli. Pintura = Painting, Horrible = Horrible, Mediocre = Mediocre, Maestra = Masterpiece, Genial = Work of genius, No me gusta nada = I don't like it at all, No me gusta = I don't like it, Me gusta = I like it, Me gusta mucho = I like it a lot.

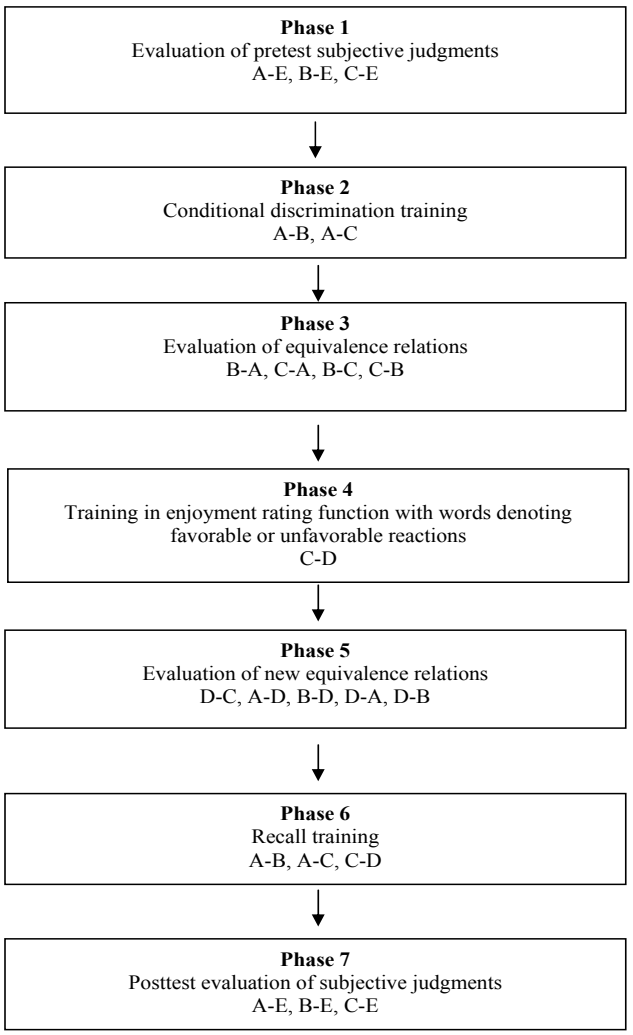

Figure 2. Scheme of the experimental procedure.

Phase 3. Emergent symmetric relations (BA and CA) and transitive relations (BC and CB) were evaluated. A total of 20 randomized trials per relation were used. If the criterion of 80% was not met for any given relation, the previous training phase was repeated until the required criterion was achieved, and the emergent relations were again evaluated.

Phase 4. The C-D relation was trained between one of the paintings (C1-C2-C3-C4) and the words or phrases with favorable or unfavorable judgmental value (horrible, mediocre, masterpiece, work of genius). A criterion of 90% correct responses within a block of trials was required. All participants performed at least 100 trials for this relation to ensure similarity in the training conditions across participants.

Phase 5. New equivalence relations were evaluated (D-C, A-D, B-D, D-A and D-B). A total of 20 trials were used for each new relation (5 trials per stimulus).

Phase 6. Training in recall of the trained relations (A-B, A-C and C-D), with a total of 150 trials (50 trials per relation), and a criterion of 90% correct responses per block of 50 trials.

Phase 7. The posttest subjective judgment given by each participant to each painting was again recorded.

Results

The data were analyzed individually as for a single-case design, but because of space limitations only the data and graphs for evaluation trials are shown. In general, all participants correctly established equivalence relations between stimuli, although 6 of the 10 participants needed extra training (Participant 2, 4, 5, 6, 7 and 8) to attain the discrimination criterion. For the emergent relations, 8 of the 10 participants reached the criterion for establishing new equivalence classes (A-B-C-D). The two other participants (Participant 7 and 8) did not attain the criterion for two of the emergent relations. We can therefore say that equivalence relations between paintings and verbal stimuli appeared in all participants. This is consistent with the results reported in many earlier studies of equivalence relations.

Transfer of stimulus functions as manifested by changes in the nature of the judgment (favorable to unfavorable or vice versa) was seen in only 4 of the 10 participants for most of the stimuli. Participant 9 showed changes in the type of judgment for 11 of the stimuli; Participant 5 showed changes for 10 stimuli; and Participants 6 and 8 showed changes for 8 of the 12 stimuli. The results for the remaining participants showed considerable variation. Participants 1 and 7 changed their subjective judgment for 4 stimuli, Participants

2 and 4 changed their judgment for 2 of the 12 stimuli, and Participant 3 showed changes for one of the stimuli. Participant 10 showed no changes in any of the judgments, and Participant 2 showed changes in the opposite direction to that predicted for 4 of the stimuli. Figure 3 illustrate the pretest and posttest data for the subjective judgments in all participants.

Each E stimulus (short sentences denoting different degrees of pleasure or displeasure expe-

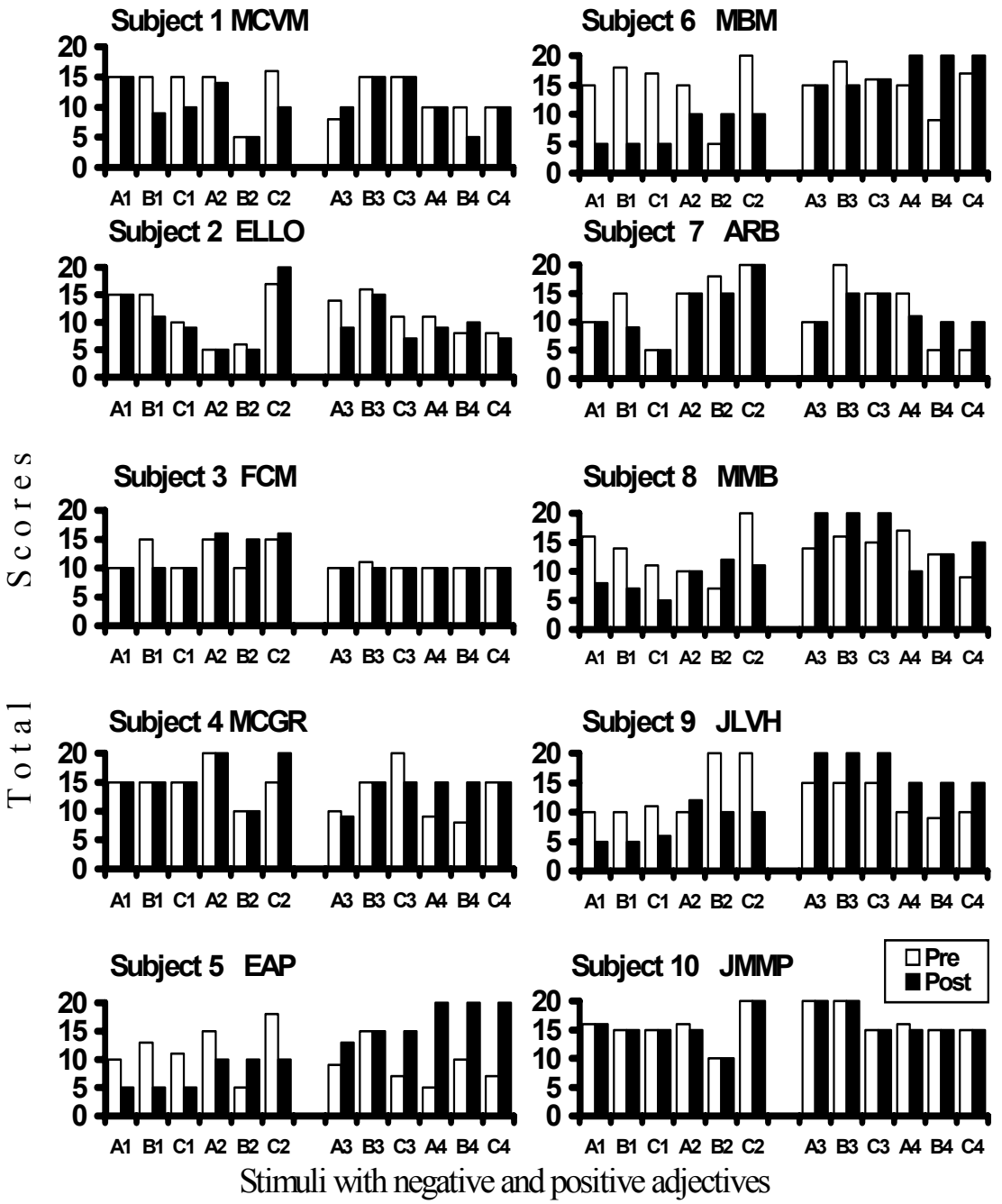

Figure 3. Stimuli with negative (unfavorable) and positive (favorable) descriptions.

rienced upon viewing the stimulus) was assigned a numerical value from 1 to 4 and treated as a nominal or categorical variable; the figures shown are the sums of all scores (the highest score was 20 and the lowest was 5). The results for stimuli 1 and 2 are shown separately from those for stimuli 3 and 4, as these pairs were expected to yield different results. Stimuli 1 and 2, associated with "unfavorable" judgments, were expected to yield lower scores, whereas stimuli 3 and 4, associated with "favorable" judgments, were expected to yield higher scores.

Nonparametric statistical analyses were done subject by subject with the Mann-Whitney U and Kolmogorov-Smirnov tests to detect possible within-subject differences between favorable and unfavorable stimuli (Table 1). Only Participants 5, 6, 8 and 9 showed statistically significant differences, a finding that confirmed the results described above. The data were also analyzed for all participants together as a single group, to look for possible significant differences between the pretest and posttest results. Student's *t* test for related samples detected no statistically significant differences (T = -1.839, df = 9, p = .09).

Discussion

This experiment aimed to analyze the stimulus relations that can be expected to appear in some psychological problems in which persons react emotionally to words, or in which associations exist between certain words. In addition, we wanted to test whether this function could transfer between stimuli, and thus whether these empirical observations might account for some of the processes that take place in the course of language-based therapeutic techniques.

In 8 of the 10 participants, equivalence relations were manifested as correct response rates of 100%, whereas the other 2 participants made errors during training. In other words it was possible to establish an equivalence relation between pictures and verbal judgments. However, with regard to transfer of the pretest and posttest subjective judgments for different pictures, there was considerable between-subject variability. In 4 out of 10 participants the predicted changes in the nature of the judgments was seen, i.e., lower scores were given to stimuli associated with "unfavorable" judgments, and higher scores were given to those associated with "favorable" judgments. However, 3 participants needed additional training and evaluation; in the rest of the participants, within-stimulus variability was substantial. The statistical analysis confirmed these conclusions, identifying as significant the results for only 4 participants.

The variability in our results is consistent with the findings of earlier studies. Between-subject

*Table 1. Statistical significance of the differences between responses to favorable (positive) and unfavorable (negative) stimuli (*p ≤ .05; **p ≤ .01)*

Participants	Negative stimuli	Positive stimuli	Mann-Whitney U	Mann-Whitney Z	Alpha	Kolmogorov-Smirnov Z	Alpha
1	10.33	10.83	15.5	.419	.699	.289	1
2	10.83	9.50	16.5	.243	.818	.577	.893
3	12.83	10.00	9	-1.897	.180	.866	.441
4	15.83	14.00	12.5	-1.051	.394	.577	.893
5	7.15	17.17	0	2.95	** .002	1.732	** .005
6	7.50	17.65	0	2.95	** .002	1.732	** .005
7	12.83	11.83	17.5	.083	.937	.577	.893
8	8.50	14.67	5	-2.10	* .041	1.155	.139
9	8.00	17.50	0	-2.934	** .002	1.732	** .005
10	15.17	16.67	15	-.540	.699	.289	1

differences are common: transfer of stimulus function was found in some studies but not in others. As noted by Markham, Dougher, and Augustson (2002), variable results are common in studies of transfer, and mean that caution is needed in drawing conclusions about transfer phenomena. None of the studies we reviewed provided a level of analysis as detailed as the results presented here for individual stimuli, or required a minimum criterion of 90% correct responses for stimulus discrimination. Within-stimulus differences were also found: some stimuli suggested equivalence and transfer of the enjoyment rating function, while others failed to produce clear results.

The variability in our findings was probably influenced by the fact that our experiments were done with adult participants who had an extensive history of language use and exposure to complex visual stimuli similar to the paintings we used. Although the relations were completely arbitrary, the equivalence relations established by our experimental protocol were probably insufficient to change previously established subjective judgments. In other words, the participant's pre-experimental history influenced the outcome of training.

Transfer of function may also depend on other variables such as the participant's experimental history. Errors during training were reflected as errors made during the equivalence tests, such that the greater the number of errors, the less likely it was that the judgments would become equivalence relations. In participants who showed transfer of function, the percentage of correct responses was high both during training and during equivalence tests. Because of conditional probability, it seemed that certain relations were more likely than others, such that small errors during previous trials made it less likely that the participant would attain a high rate of correct responses in subsequent trials.

In this study we attempted to draw a parallel between verbal associations during clinical interactions and descriptions of a psychological problem, and therefore used every-day words likely to be used in spontaneous, colloquial speech assuming that they denoted favorable or unfavorable content. Words such as "horrible" or "mediocre" probably have negative connotations, whereas words such as "masterpiece" or "work of genius" probably have positive connotations. But this is not necessarily the case, and depending on the individual's cultural and verbal context the value of these words might differ slightly between participants. Perhaps the fact that we created an expressly reinforcing or punishing history with the verbal judgments gave rise to a previous verbal repertoire that might have influenced instructional history (Nuzzolo-Gomez & Greer, 2004).

Perhaps changes occurred only in those participants for whom stimuli initially had a more neutral function. In these cases, however, the experimental matching-to-sample procedure forced participants to make a choice. No intermediate score halfway between the two extreme scores (indicating indifference) was available, so if the function was not clearly punishing or reinforcing, we would not expect to see any change in the participant's reaction to the stimulus.

Another possible explanation for the uncertain findings with regard to transfer of function is that new equivalence relation might have formed that added additional stimuli to previously formed relations, but which did not fulfill any particular function within the equivalence relation. This effect was seen in some participants who showed changes in the nature of their judgments and thus manifested evidence of transfer of function. They gave a score of 5 to "favorable" paintings and a score of 1 to "unfavorable" paintings, showing evidence of an equivalence relation practically identical to the one that was trained.

A procedure other than matching-to-sample, in which the stimuli (pictures, in this case) were associated directly with more strongly punishing or reinforcing stimuli (for example, associated pairs or classical conditioning) would create a stronger relation between novel stimuli, making participants more likely to change their judgments. This, however, would not be considered transfer of function through equivalence relations, strictly speaking. Moreover, as noted in the Introduction, earlier experiments that documented the transfer of function effect most clearly were those that used classical conditioning, e.g., associating unconditioned stimuli assumed to have a strong emotional impact with the judgmental sentences or pictures. Future research on the transfer of

stimulus function should attempt to document more conclusively the transfer of punishing or reinforcing functions with stimuli that have a clear, intense function, and should avoid conceptualizing transfer of function in terms of classical conditioning.

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.

Augustson, E.M., Dougher, M.J., & Markham, M.R. (2000). Emergence of conditional stimulus relations and transfer of respondent eliciting functions among compound stimuli. *The Psychological Record, 50*, 745-770.

Barlow, D.H., & Hersen, M. (1988). *Diseños Experimentales de caso único*. Barcelona: Martínez Roca.

Barnes-Holmes, D., Keane, J., Barnes-Holmes, Y., & Smeets, P.M. (2000). A derived transfer of emotive functions as a means of establishing differential preferences for soft drinks. *The Psychological Record, 50*, 493-511.

Barnes, D., Browne, M., Smeets, P.M., & Roche, B. (1995). A transfer of functions and a conditional transfer of functions through equivalence relations in three to six year old children. *The Psychological Record, 45*, 405-430.

Barnes, D., & Keenan, M. (1993). A transfer of functions through derived arbitrary and nonarbitrary stimulus relations. *Journal of the Experimental Analysis of Behavior, 59*, 61-81.

Catania, A.C., Horne, P., & Lowe, F. (1989). Transfer of function across members of an equivalence class. *The Analysis of Verbal Behavior, 7*, 99-110.

De Rose, J.C., McIlvane, W.J., Dube, W.V., Galpin, V.C., & Stoddard, L.T. (1988). Emergent simple discriminations established by indirect relations to differential consequences. *Journal of the Experimental Analysis of Behavior, 50*, 1-20.

Dougher, M.J. (1998). Stimulus equivalence and the untrained acquisition of stimulus functions. *Behavior Therapy, 29*, 577-591.

Dougher, M. J., Augustson, E.M., Markham, M.R., Greenway, D.E., & Wulfert, E. (1994). The transfer of respondent eliciting and extinction functions through stimulus equivalence classes. *Journal of the Experimental Analysis of Behavior, 62*, 331-351.

Dougher, M.J., & Markham, M.R. (1994). Stimulus equivalence, functional equivalence and the transfer of function. In S.C. Hayes, L.J. Hayes, M. Sato, & K. Ono (Eds.). *Behavior Analysis of Language and Cognition*. (pp. 137-152). Reno: Context Press.

Dougher, M.J., & Markham, M.R. (1996). Stimulus classes and the untrained acquisition of stimulus functions. In T.R. Zentall & P.M. Smeets (Eds.). *Stimulus Class Formation in humans and animals*. (pp. 115-138). Amsterdam: Elsevier.

Dougher, M.J., Perkins, D.R., Greenway, D., Koons, A., & Chiasson, C. (2002). Contextual control of equivalence-based transformation of functions. *Journal of the Experimental Analysis of Behavior, 78*, 63-93.

Dymond, S., & Barnes, D. (1994). A transfer of self-discrimination response functions through equivalence relations. *Journal of the Experimental Analysis of Behavior, 62*, 251-267.

Dymond, S., & Barnes, D. (1995). A transformation of self-discrimination response functions in accordance with the arbitrary applicable relations of sameness, more than, and less than. *Journal of the Experimental Analysis of Behavior, 64*, 163-184.

Dymond, S., & Barnes, D. (1996). A transformation of self-discrimination response functions in accordance with the arbitrarily applicable relations of sameness and opposition. *The Psychological Record, 46*, 271-300.

Dymond, S., & Rehfeldt, R.A. (2000). Understanding complex behavior: The transformation of stimulus functions. *The Behavior Analyst, 23*, 239-254.

Ferro, R., & Valero, L. (2005). Formación de categorías pictóricas a través de relaciones de equivalencia. *Psicothema, 17*, 1, 83-89.

Gatch, M.B., & Osborne, J.G. (1989). Transfer of contextual stimulus function via equivalence class development. *Journal of the Experimental Analysis of Behavior, 51*, 369-378.

Green, G., Sigurdardottir, Z.G., & Saunders, R.R. (1991). The role of instructions in the tranfer of ordinal functions through simple and conditional equivalence classes. *Journal of the Experimental Analysis of Behavior, 55*, 287-304.

Greenway, D.E., Dougher, M.J., & Wulfert, E. (1996). The transfer of conditioned reinforcement and punishment via stimulus equivalence classes. *The Psychological Record, 46*, 131-143.

Hayes, S.C., Devany, J.M., Kohlenberg, B.S., Brownstein, A.J., & Shelby, J. (1987). Stimulus equivalence and symbolic control of behavior. *Revista Mexicana de Análisis de la Conducta, 13*, 361-374.

Hayes, S.C., Kohlenberg, B.S., & Hayes, L.J. (1991). The transfer of general and specific consequential functions through simple and conditional equivalence relations. *Journal of the Experimental Analysis of Behavior, 56*, 119-137.

Kazdin, A.E. (1982). *Single-case research designs*. New York: Oxford University Press

Kohlenberg, B.S., Hayes, S.C., & Hayes, L.J. (1991). The transfer of contextual control over equivalence classes through equivalence classes: a possible model of social stereotyping. *Journal of the Experimental Analysis of Behavior, 56*, 505-518.

Lazar, R. M. (1977). Extending sequence-class membership with maching-to-sample. *Journal of the Experimental Analysis of Behavior, 27*, 381-392.

Lazar, R.M., & Kotlarchyk, B.J. (1986). Second-order control of sequence-class equivalence in children. *Behavioural Processes, 13*, 205-215.

Lynch, D.C., & Green, G. (1991). Developmental and crossmodal transfer of contextual control of emergent stimulus relations. *Journal of the Experimental Analysis of Behavior,56*, 139-154.

Markham, M.R., Dougher, M.J., & Augustson, E.M. (2002). Transfer of operant discrimination and respondent elicitation via emergent relations of compound stimuli. *The Psychological Record, 52*, 325-350.

Meehan, F., & Fields, L. (1995). Contextual control of new equivalence classes. *The Psychological Record, 45*, 165-182.

Nuzzolo-Gomez, R., & Greer, R.D. (2004). Emergence of untaught mands or tacts with novel adjective-object pairs as a function of instructional history. *The Analysis of Verbal Behavior, 24*, 30-47.

Pérez-González, L.A. (1994). Las clases funcionales de estímulos y el control contextual en discriminaciones condicionales. *Psicothema, 6*, 71-80.

Roche, B., & Barnes, D. (1996). Arbitrary applicable relational responding and sexual categorization: A critical test of the derived different relation. *The Psychological Record, 46*, 451-475.

Roche, B., & Barnes, D. (1997). A transformation of respondently conditioned stimulus function in accordance with arbitrarily applicable relations. *Journal of the Experimental Analysis of Behavior, 67*, 275-301.

Roche, B., Barnes-Homes, D., Smeets, P.M., Barnes-Holmes, Y., & McGeady, S. (2000). Contextual control over the derived transformation of discriminative and sexual arousal functions. *The Psychological Record, 50*, 267-291.

Sigurdardottir, Z.G., Green, G., & Saunders, R.R. (1990). Equivalence classes generated by sequence training. *Journal of the Experimental Analysis of Behavior, 53*, 47-63.

Valero, L. (2005). Igualación-Lab: un programa informático para la experimentación en relaciones de equivalencia. *In press*.

Valero, L., & Luciano, M.C. (1997). Discriminación condicional en niños: los efectos de contingencias diferenciales de reforzamiento/tiempo fuera. *Psicothema, 9*(3), 599-608.

Wulfert, E., & Hayes, S.C. (1988). Transfer of a conditional ordering response through conditional equivalence classes. *Journal of the Experimental Analysis of Behavior, 50*, 125-144.