Classical Conditioning of Preferences for Stimuli*

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Several authors have recently discussed the implications of classical conditioning for consumer behavior (e.g., McSweeney and Bierley 1984; Nord and Peter 1980). However, little empirical evidence actually shows that classical conditioning can alter behaviors that are of interest to consumer research. The present experiment provides some initial evidence that it can. In this experiment, preference ratings for stimuli that predicted pleasant music were significantly greater than preference ratings for stimuli that predicted the absence of music. These preferences also generalized to other stimuli that resembled the ones actually used.

Nord and Peter (1980) argued that classical conditioning might alter consumer preferences in television advertising. Classical conditioning occurs when an arbitrary stimulus (the conditioned stimulus, or CS) predicts some other stimulus (the unconditioned stimulus, or US). After several trials, a response (the conditioned response, or CR) to the CS develops. Nord and Peter reasoned that advertisers could use the product as the CS and a pleasant stimulus as the US. If classical conditioning occurred, then an increase in consumer preference for the product (the CR) should be observed after the product is paired with the pleasant stimulus.

Nord and Peter's argument is plausible; classical conditioning does occur when people serve as subjects (e.g., Hilgard 1931). However, responses of interest to consumer research have rarely been studied. Gorn (1982) provides a rare exception to this rule. He showed students slides of either beige or blue pens (the CSs) while they listened to either liked or disliked music (the USs). Subjects were then asked to take a pen. More students chose the color of pen which had been associated with the liked music rather than with the disliked music, potentially demonstrating that classical conditioning can change preferences.

If Gorn did actually demonstrate classical conditioning, however, his procedure is atypical. First, Gorn paired the CS (the color pen) with the US (the music) only once for one minute. While classical conditioning may occur after only one trial (e.g., Shurtleff and Ayres 1981), it usually requires a very strong US, such as an intense shock or a nauseating drug. Second, Gorn apparently presented the pens and music at the same time. This procedure usually does not produce strong classical conditioning in the laboratory (e.g., Beecroft 1966; Smith, Coleman, and Gormezano 1969). Instead, effective conditioning procedures usually present the CS before the US (the pen before the music).

Third, Gorn did not include the proper control procedure to establish that classical conditioning occurred. Rescorla (1967) argued that the following procedure demonstrates classical conditioning. First, a CS-predictive group of subjects is exposed to the CS followed by the US (the pen followed by music). Second, a random-control group is exposed to the same number of CSs and the same number of USs, but these CSs and USs are presented randomly with respect to each other. That is, the subjects see the pen and hear the music, but the two stimuli are presented randomly in time instead of sequentially. Classical conditioning is said to occur only if preferences increase for the CS-predictive group and do not increase for the random-control group.

These groups are used to demonstrate classical conditioning because they separate behaviors that result from the relation between the CS and the US from behaviors that result from the presence of the CS, the presence of the US, or some interaction between them (pseudoconditioned responses). Mere exposure to the

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CS may change preferences for that stimulus (e.g., Zajonc 1968). Alternatively, the presence of a US may sensitize the subject to react differently to a CS even when the CS does not predict the US. Rescorla's procedure effectively separates true classically conditioned responses from these other pseudoconditioned responses. Behaviors that occur when a CS predicts a US will occur in the CS-predictive group. Pseudoconditioned behaviors that occur when either the CS or US—or both—are present, but that do not depend on a predictive relation between the CS and US, will occur in both the CS-predictive and the random-control groups. Because Gorn did not use this procedure, he did not adequately demonstrate that the preference changes were true conditioned responses and not pseudoconditioned responses.

It should be noted that we are not arguing that Gorn's findings are not classical conditioning. We are arguing that Gorn's results occurred under conditions that are not optimal for conditioning. We are also arguing that pseudoconditioning cannot be ruled out as an explanation for his findings. Pseudoconditioning is a subtle phenomenon: the value of the random-control procedure is its ability to rule out pseudoconditioning without having to identify whether it occurred or what produced it.

The present experiment tries to show that preferences for arbitrary stimuli can be classically conditioned. Colored geometric figures served as the CSs and the theme music from the movie *Star Wars* served as the US. Colors and music were chosen for study because they were the stimuli used by Gorn.

For the first group of subjects—red-predictive—red stimuli were consistently followed by music, blue stimuli were followed by music on half of their presentations, and yellow stimuli were never followed by music. For a second group—yellow-predictive—yellow stimuli were consistently followed by music, blue stimuli were followed by music on half of their presentations, and red stimuli were never followed by music. For a random-control group, we presented the same number of red, blue, and yellow stimuli as were presented for groups 1 and 2, and music was presented, but the stimuli and the music were presented randomly with respect to each other. A CS-only control group also saw the colored stimuli, but music was never presented.

The CS-only control group was used to assess subjects' color preferences independent of the classical conditioning procedure. The red-predictive and yellow-predictive groups were included to ensure that any changes in preference occurred regardless of the predictive color. The random-control group was included to determine whether any preference changes were really classically conditioned responses.

The psychophysical technique of magnitude estimation was used to assess subjects' preferences for the stimuli (Stevens 1972). This technique was chosen because it has been used to quantify a variety of social opinions in the past, and it has been shown to produce ratio level scaling (e.g., Stevens 1972). Magnitude estimation is a direct scaling method in which subjects are asked to assign numbers to stimuli so that the numbers indicate their perception of the magnitude of an attribute of the stimulus. For example, subjects might be asked to scale the brightness of a light. After showing them a standard light and assigning it a value of 10, the subjects would be asked to assign the number 5 to lights that are half as bright, the number 30 to lights that are three times as bright, and so on. To check the validity of this technique, a paired-comparison test was also used. Because the preference ratings were the same for both the magnitude-estimation and paired-comparisons measures, data will be presented only for magnitude estimation.

Preferences for new stimuli that resembled the ones used in the experiment were also assessed. Generalization of the conditioned response to other similar stimuli is typically found in classical conditioning experiments (e.g., Pavlov 1927). Therefore, it should also be found in the present experiment if classical conditioning does occur. Finally, the results were analyzed separately for subjects who were rated as aware or unaware of the purpose of the experiment. Several authors have argued that cognitive factors explain classical conditioning when human subjects are used (e.g., Brewer 1974). Other authors have argued that conditioning can occur in humans without awareness (e.g., Kennedy 1970, 1971), or that a cognitive theory does not provide a better explanation of the data than behavioral theories (e.g., Dulany 1974). The present experiment will assess the degree to which awareness of the CS-US contingency played a role in this conditioning.

METHOD

Subjects

One hundred introductory psychology students from Washington State University served a subjects. For their participation they received credit towards fulfillment of a class requirement. Sign-up sheets for the experiment were posted in an area of the Psychology Department where introductory students freely selected the experiment of their choice. The sheets for this experiment specified that subjects must not be color blind and must like the music from *Star Wars*.

Subjects were randomly assigned to one of two experimental groups or one of two control groups, with the restriction that 30 subjects served in each experimental group and 20 in each control group. Random assignment was used to eliminate systematic differences in color preferences among the groups.

Apparatus and Procedure

Conventional relay circuitry was used to control a Kodak Carousel slide projector (Model E-2) that projected the image of the conditioned stimulus on a screen located three meters directly in front of the subjects.

The 12 CSs were slides of red, blue, or yellow circles, squares, triangles, or rectangles. The apparent size of the projected image varied from 20 to 40 centimeters for the widest dimension.

Each session consisted of 84 trials, the maximum number that could be presented without making the session excessively long. Each trial began with a five-second presentation of the CS. If a US was scheduled, the CS was followed by a ten-second presentation of the music from *Star Wars*. The music was presented through headphones at an intensity of 60 db. It interrupted a 50 db white noise, which was presented at all other times. An intertrial interval that averaged 45 seconds with a minimum intertrial interval of 10 seconds (see Catania and Reynolds 1968) followed the CS or US. This intertrial interval was selected to maximize the number of CS-US presentations while providing a fairly long intertrial interval. Classical conditioning is usually stronger for longer intertrial intervals than for shorter ones (e.g., Terrace et al. 1975). The CSs were arranged in seven different blocks, with each block consisting of a different random order of the 12 CSs. To control for stimulus order effects, approximately one-half of the subjects in each group were exposed to one random order. The other subjects received a different random order.

The subjects served in four groups. For the red-predictive group, the red geometric figures were always followed by music, blue figures were followed by music on a random 50 percent of their presentations, and yellow figures were never followed by music. For the yellow-predictive group, yellow geometric figures were always followed by music, blue figures were followed by music on a random 50 percent of their presentations, and red figures were never followed by music. For the random-control group, the figures and music were presented at the same average rate as for the predictive groups, but they were presented randomly with respect to each other. For the CS-only group, the figures were presented but the music was not.

The subjects were tested in groups of four and were comfortably seated between partitions that prevented them from seeing and talking to each other. Pre-recorded instructions given through the headphones told them that they would view a slide presentation while attempting to predict music. Subjects were asked to predict the music to give them something to do.

If there were no questions about the instructions, the room was darkened and the session started with all events automatically controlled by relay circuitry. Sessions lasted 77 minutes for the predictive and random-control groups (84 trials with a 45-second intertrial interval, a 5-second CS, and a 10-second US on half of the trials). The average session lasted 70 minutes for the CS-only group because music was not presented. Although it is undesirable, this difference in session length could not be eliminated without violating Rescorla's (1967) design for the demonstration of classical conditioning. Also, differences in session length did not distort the results. The random-control and CS-only groups responded similarly in spite of this slight difference in session length, and both responded differently from the predictive groups.

Immediately following the session, the subjects participated in an eight-minute practice task of magnitude estimation of line lengths. This was done to make sure they understood how to assign numbers to represent an attribute of a stimulus (e.g., length or preference) as required by the magnitude estimation task. Pre-recorded instructions for this task and for the task assessing their preferences were presented over the headphones. When subjects understood the line length task, magnitude estimation was used to assign their preferences for the CSs. Each CS was presented and rated twice. Two different random orders of stimulus presentation were used, with each order presented to approximately half of the subjects in each group. During the ratings, each CS appeared next to a standard stimulus—a blue circle—that was assigned the value of ten. The subjects were allowed 20 seconds to rate their preference for each CS by assigning it a number that represented how well they liked the CS relative to the blue-circle standard. The preference test required approximately eight minutes.

To test for generalization, the subjects were also asked to rate 12 other stimuli (red, yellow, and blue diamonds, rubics, trapezoids, and hexagons). Again, each stimulus was presented twice in two different random orders. The blue diamond was used as the standard stimulus for these ratings. At the end of the experiment, each subject was asked, "How did you predict the music?" and "What do you think the purpose of the experiment was?" A written explanation of the purpose of the experiment was then distributed and questions were answered.

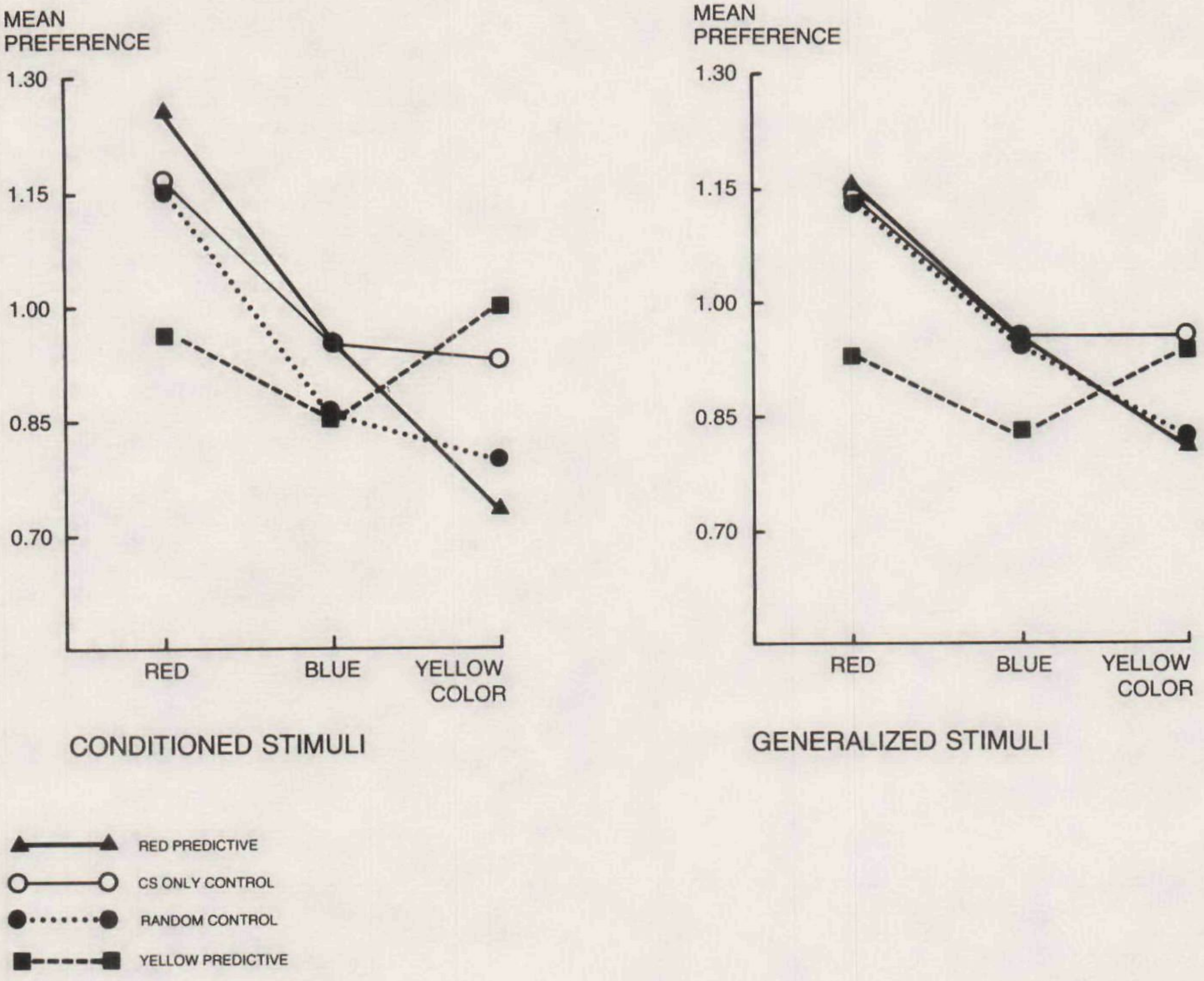
RESULTS

Each subject generated eight magnitude-estimation values for each of the colors. The geometric mean of the eight values was calculated to obtain a preference score for each color for each subject that was not influenced by the extreme scores that typically occur for magnitude estimation. Because these scores were not normally distributed across subjects, all statistics were applied to the $\log_{10}$ transformations of the scores. Figure A contains the mean of the subjects' preferences for the red, blue, and yellow stimuli. The axes on the left contain the results for the stimuli that the subjects actually saw. The axes on the right contain the results for the generalized stimuli.

A mixed model analysis of variance was applied to these results and appears in the Table. It assessed the effect of group (red-predictive, yellow-predictive, random, and CS-only), color (red, blue, yellow) and their interaction on the subjects' preferences for the stimuli that they actually saw and for the generalized stimuli. Omega-squared statistics were calculated to assess the

FIGURE A

MEAN PREFERENCE RATINGS FOR ALL FOUR GROUPS



magnitude of the group-by-color interaction (Keppel 1973, p. 553). The Table also contains the results of similar analyses applied to the two experimental groups alone, to the two control groups alone, and to unaware subjects in the predictive groups. The last analysis will be explained later.

The Table shows that the effect of group on ratings was not significant. Therefore, the groups used approximately the same numbers to assign preferences to stimuli. The Table also indicates that the effect of color was highly significant. This effect cannot be attributed to the classical conditioning procedure because it appeared for the CS-only and random-control groups. Newman-Keuls pair-wise comparisons showed that there were no significant differences in preferences for the colors when the random-control group was compared to the CS-only control group ($p > 0.05$). For both of these groups, red was significantly preferred to blue and to yellow ($p < 0.05$), but blue was not significantly preferred to yellow ($p > 0.05$). Therefore, the subjects entered the experiment with a preference for red over blue and yellow.

Finally, the group-by-color interaction in the Table shows that the conditioning procedure altered the subjects' initial color preferences. The interaction was highly significant when the results for all subjects or for the two experimental groups were analyzed. It was not significant when the results for the control groups were analyzed. Therefore, the group-by-color interaction represents true classical conditioning. It occurred for the two predictive groups and not for the control groups.

The effect of the classical conditioning procedure was

TABLE

F-VALUES FROM A MIXED MODEL ANALYSIS OF VARIANCE APPLIED TO SUBJECTS' PREFERENCE RATINGS

Stimuli	Color	Group	Interaction	Omega-squared
		All groups		
Conditioned	23.10[d] (2, 192)	0.06 (3, 96)	4.91[d] (6, 192)	0.073
Generalized	19.03[d] (2, 192)	1.61 (3, 96)	2.47[a] (6, 192)	0.029
		Predictive groups		
Conditioned	11.49[d] (2, 116)	0.61 (1, 58)	14.80[d] (2, 116)	0.133
Generalized	9.77[c] (2, 116)	2.69 (1, 58)	7.51[c] (2, 116)	0.068
		Control groups		
Conditioned	11.48[d] (2, 76)	0.72 (1, 38)	0.18 (2, 76)	0.000
Generalized	8.81[c] (2, 76)	0.46 (1, 38)	0.37 (2, 76)	0.000
		Unaware subjects in predictive groups		
Conditioned	6.25[b] (2, 90)	0.57 (1, 45)	5.99[b] (2, 90)	0.066
Generalized	10.54[d] (2, 90)	0.94 (1, 45)	2.94 (2, 90)	0.027

[a] $p < 0.05$.
[b] $p < 0.01$.
[c] $p < 0.001$.
[d] $p < 0.0001$.
NOTE: Degrees of freedom appear in parentheses.

complicated, however. Comparing the red-predictive group to the random-control group indicates that conditioning produced a nonsignificant ($p > 0.05$) increase in preference for red and a nonsignificant decrease in preference for yellow ($p > 0.05$). Comparing the yellow-predictive group to the random-control group shows that conditioning produced a non-significant increase in preference for yellow ($p > 0.05$) and a significant decrease in preference for red ($p < 0.05$). Therefore, the significant effect of the conditioning procedure was a combination of a non-significant increase in preference for the predictive stimuli and a significant or non-significant decrease in preference for the stimuli that predicted the absence of music.

The proportion of the variance accounted for by the group-by-color interaction is a measure of the size of the effect of the classical conditioning procedure. The Table shows that the omega-squared statistic was 13.3 percent when the data from the predictive groups were considered. The size of this effect fell to 6.8 percent when the generalized stimuli were considered.

Examination of Figure A suggests that the preferences for the blue stimuli were not significantly different for any of the groups, even though the blue stimuli predicted music on half the trials for both of the experimental groups, but not for the control groups. Newman-Keuls pair-wise comparisons support this conclusion. None of these statistics was significant when preferences for the blue stimuli were compared for each possible pairing of two of the four groups ($p < 0.05$).

To clarify the effect of the conditioning procedure, preferences for stimuli were plotted as a function of the probability that music followed them, for the two experimental groups. These results appear in Figure B, which shows that when the color of the stimulus was held constant, the stimuli that were followed by music were more highly preferred than those that were not. Neuman-Kuels statistics were applied to the results in Figure B to assess the significance of the differences between the ratings of each color stimulus when it did and did not predict the music. All differences were significant ($p < 0.05$) except the difference for the yellow generalized stimuli.

Subjects' awareness of the purpose of the experiment was assessed by evaluating their responses to the question: "What was the purpose of the experiment?" Two judges independently classified the subjects as aware or unaware. Subjects were classified as aware if they had a global idea that a relation existed between the figures, the music, and preferences for the music. They did not need to show a detailed knowledge of which stimuli were more or less predictive or of how that should influence their preferences. The two judges initially agreed on the classification of 85 percent of the subjects and reached agreement on the other 15 percent.

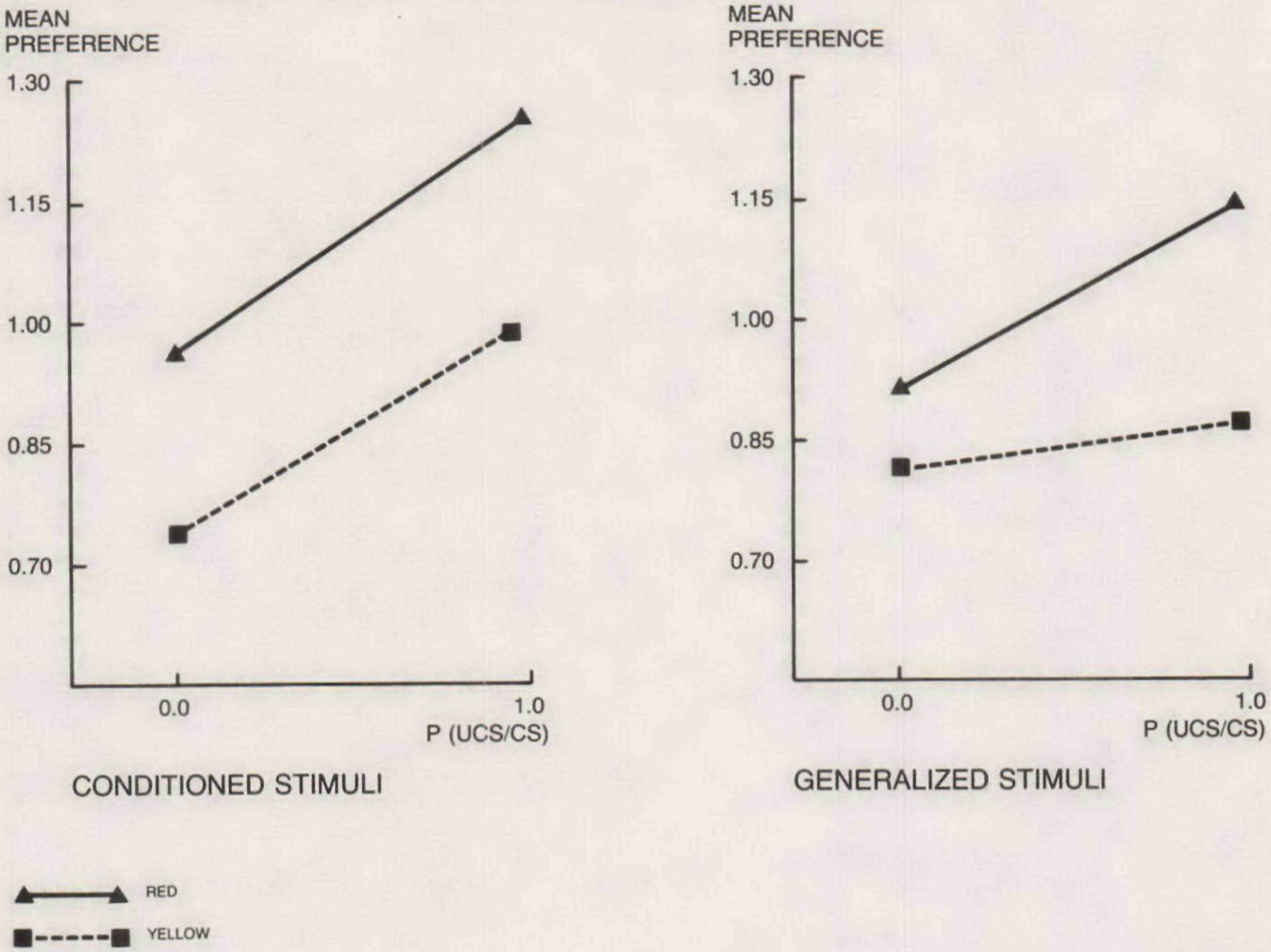
The relation of awareness to the group-by-color interaction was assessed by conducting an analysis of variance on the scores of the 78 percent of subjects in the predictive groups who were classified as unaware. If awareness is necessary for classical conditioning, then a significant group-by-color interaction should not appear for the unaware subjects. The Table shows that the group-by-color interaction was significant for the unaware subjects when the ratings for the conditioned stimuli were examined. Therefore, awareness, as measured here, was not necessary for the conditioning procedure to change preferences. But awareness may have contributed to the strength of conditioning. The group-by-color interaction was not significant for unaware subjects when the ratings for the generalized stimuli were examined. The size of the omega-squared statistics for both the conditioned and similar stimuli also dropped when the aware subjects were omitted from the analysis.

DISCUSSION

The present study shows that classical conditioning can alter preferences for arbitrary stimuli. These results

FIGURE B

MEAN PREFERENCE RATINGS AS A FUNCTION OF THE CONDITIONAL PROBABILITY THAT A US FOLLOWED A CS



cannot be explained by the subjects' initial color preferences because the rating for a particular stimulus was higher when it predicted music than when it did not—even when color was held constant (Figure B). The results cannot be explained by familiarity with the CS or US or some interaction between them because results for the predictive groups differed from those for the random-control group. Finally, the fact that generalization occurred supports the idea that the changes in preferences were classically conditioned: generalization is a typical occurrence in classical conditioning experiments.

The effect of conditioning was complicated, however. Figure A shows that preferences for red stimuli increased relative to controls and preferences for yellow stimuli decreased when red stimuli predicted music. Preferences for yellow increased and preferences for red decreased when yellow stimuli predicted music. Although these effects were not all statistically significant, they did contribute to the significant overall effect of the procedure.

These results are not unexpected, however. They would have occurred if the present procedure produced both excitatory and inhibitory conditioning. Inhibitory conditioning is usually found in classical conditioning procedures such as the present one in which one CS (CS^+) predicts the US and another CS (CS^-) predicts its absence (e.g., Rescorla 1969). An inhibitory response becomes conditioned to the CS^- and takes a form opposite to that taken by the excitatory CR to the CS^+. In the present case, the excitatory response is an increase in preference and the inhibitory response is a decrease in preference. If both excitatory and inhibitory conditioning occurred, then preferences for the red stimuli (CS^+) should increase, and preferences for the yellow stimuli (CS^-) should decrease for the red-predictive group. Preferences for the yellow stimuli (CS^+) should increase, and preferences for the red stimuli (CS^-)

should decrease for the yellow-predictive group. This is what was found. The significant effect of the procedure resulted from the combination of these other significant and non-significant effects.

Although classical conditioning occurred in the present experiment, the effect may or may not be useful in practice. First, the effect was small. Omega-squared was only 13.3 percent for the predictive groups, and it decreased to 6.8 percent for the generalized stimuli. Second, the effect may have required many pairings of the CS and US. The predictive color was followed by music 28 times before preference changes were measured. Third, conditioning occurred only when the CS strongly predicted the US. Preferences for the blue stimuli did not differ across groups, even though the blue stimuli predicted music on half of the trials for both of the experimental groups but not for the control groups. Fourth, the reported changes in preference might not produce behavioral changes of interest to consumer research. It cannot be assumed that consumers who report a preference for a product will also buy that product. Nor can it be assumed that preference changes that occur for arbitrary stimuli will also occur for products. All of the factors weaken the implications of these results for consumer research.

However, the present results do suggest that classical conditioning may be worth investigating in future experiments, which should focus on several factors which may have contributed to the weakness of the present effect. First, they should measure preferences before 28 trials have been conducted. Conditioning may have occurred long before 28 pairings of the CS and US, even in the present experiment.

Second, future experiments should use a better screening procedure. The present procedure asked for subjects who liked the music from *Star Wars*. Because subjects' preferences for this music might vary widely, some subjects may have received a US which was only minimally effective. The present screening procedure also dictated the use of a familiar US. Familiar USs usually produce weaker conditioning than unfamiliar ones (McSweeney and Bierley 1984). Therefore, another screening procedure which allowed for the use of a novel US might produce stronger preference changes.

Using a more powerful US might also produce conditioning for the blue stimuli. Classical conditioning has been demonstrated in animal experiments even when only one in ten CSs is followed by a US (e.g., Rescorla 1968). However, those experiments used a strong US. Increasing the strength of the US might also produce conditioning to the partially predictive (blue) stimuli in studies like the present one.

Third, future studies should avoid the use of a blue standard to measure preferences. The choice of a blue standard for the magnitude estimation task may have limited the variability of the preference scores for blue. This may also help to explain why preferences for the blue stimuli were not altered by the classical conditioning procedure. However, this choice probably did not importantly influence present results. As mentioned in the introduction, a paired-comparisons procedure was also used to assess subjects' preferences for the stimuli. This procedure did not use a blue standard but produced virtually identical results to the magnitude-estimation measure. The similarity of the measures is supported by their intercorrelations (R's > 0.52, $p < 0.0001$).

Fourth, future studies should use CSs and measure changes in behavior which are more directly relevant to consumer research. For example, Hearst and Jenkins (1974) argued that animals will approach the CS in a classical conditioning procedure. Future experiments might determine whether people exposed to a classical conditioning procedure that pairs a product with a pleasant stimulus will approach the product, potentially increasing the probability that they will buy it.

Although the present experiment demonstrated that classical conditioning can alter preferences, it did not establish how that procedure produced its effect. As argued earlier, studies using humans are always subject to interpretation in terms of demand characteristics (e.g., Sawyer 1975) or cognitive mediation (e.g., Brewer 1974). The present results can contribute to but not settle these disputes. Demand characteristics frequently do play a role when human subjects are used. The present instructions may have even inadvertently encouraged them by asking the subjects to try to predict the music. However, arguing that demand characteristics explain the present results does require making assumptions about how the subjects behaved that are not supported by any independent evidence in the present data. Also, if demand characteristics did play a role in this experiment, then they occurred only for the two predictive groups, not for the control groups. Apparently, asking the CS-only and random-control groups to predict the music did not encourage them to change their preference ratings for the stimuli that they saw. Therefore, although demand characteristics provide a possible explanation of how the present classical conditioning procedure produced its effects, they do not question that the procedure itself, and not the mere presence of the CS and US, produced the effect.

The present results can also contribute to, but not settle, the dispute over the role of awareness in conditioning. They indicate that awareness, as it was measured here, produced stronger classical conditioning, but was not necessary for conditioning to occur. Strong conclusions cannot be drawn from these results, however. First, Brewer (1974) argued that the improper assessment of awareness can lead to results that show conditioning without awareness. Some subjects may have been misclassified in the present study because no attempt was made to explore what they knew in detail. Second, even if all subjects were classified correctly, the present results only demonstrate a correlation between awareness and the strength of conditioning. They do not establish whether awareness produced stronger conditioning, whether stronger conditioning led to greater awareness, or whether both awareness and stronger conditioning resulted from some third variable.

Although the effect of awareness on conditioning cannot be conclusively assessed by the present results, these results are not alone in that respect. The role of awareness in conditioning cannot be conclusively assessed until a measure of awareness is developed that can unambiguously classify subjects as aware or unaware, and that is independent of their performance on the conditioning task.

If future studies show that classical conditioning does have practical significance, then those experiments together with the present one may have several implications for altering consumer behavior. First, they would show that classical conditioning can alter preferences. Second, they would suggest that advertisers who use classical conditioning should present the pleasant stimulus almost every time their product is seen. Conditioning did not occur in the present experiment when the CS was followed by the US on only half of its appearances. Third, future studies would suggest that products should be made as distinctive as possible to avoid providing free advertising for rivals. Generalization implies that conditioned increases in preference for one product will also occur for other products that resemble that product. Finally, the studies would suggest that classical conditioning can be used to decrease preferences for rival products by having rival products predict the absence of the pleasant US, as well as to increase preferences for products by having products predict the presence of the US.

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