

## Proactive interference and gender change in short-term memory\*

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An examination was made of the salience of word gender as an encoding dimension. Ss received three Brown-Peterson tests with Spanish nouns, all of the same gender. On Test 4, there was a change in word gender for experimental Ss, and no change for control Ss. A small, but significant, release from PI occurred with gender change. Results were interpreted in terms of Wickens's (1972) classification of stimulus dimensions.

One of the indicants that has been used to identify the stimulus characteristics to which Ss are responsive is the amount of release from proactive interference (PI) associated with a change in those stimulus characteristics. The logic behind this approach is based on the findings from two experiments using the Brown-Peterson paradigm. In that paradigm, Ss are briefly presented a set of stimuli and recall is tested after a retention interval during which rehearsal is minimized.

Keppel and Underwood (1962) showed that recall in this situation is subject to test order effects. Recall was high on the first test but dropped with succeeding tests. On this basis, they concluded that performance on a particular test was partially determined by the amount of PI that had built up over the previous tests. That item similarity was a factor in determining the amount of PI was demonstrated by Wickens, Born, and Allen (1963). Their Ss were given three Brown-Peterson tests with either letter or number stimuli; the drop in recall over tests indicated that interference was increasing. On the fourth test, experimental Ss received a change in type of stimuli, e.g., from numbers to letters, while control Ss received no change. The sharp increase in recall of experimental Ss, relative to the performance of control Ss, was ascribed to a release from PI produced by a change in the encoding characteristics of the stimuli.

There have been numerous studies patterned after Wickens, Born, and Allen (1963), the express intention of which has been to identify the stimulus attributes that are encoded by the S. The argument is that a change in a stimulus attribute will produce an increase in recall only if the S has encoded that attribute. In addition, the amount of release accompanying a stimulus change has been related to the salience of a particular encoding dimension. It is on these bases that Wickens (1972) has noted certain regularities in the relationship between encoding dimensions and amount of PI release. In general, changes in semantic characteristics, such as taxonomic category, produce the greatest release from PI. Intermediate amounts of release are found with shifts in physical characteristics, e.g., number of phonemes, and in other unclassifiable characteristics, such as word

frequency. The least amount of release has been found with changes in marking-syntactic dimensions. In this last category are included shifts in the items' part of speech, tense, and number. With the single exception of shifts in semantic markers, changes in marking-syntactic characteristics have produced negligible amounts of PI release. The present study extends the investigation of marking-syntactic dimensions to word gender.

### METHOD

#### Design and Procedure

There was one experimental group (E) and one control group (C). Three words were presented on each of four Brown-Peterson tests. All Ss were treated identically on the first three tests and received Spanish nouns, all of which were of the same gender. On Test 4, there was a change in gender for experimental Ss and no change for control Ss. Two practice trials with alphanumeric stimuli preceded actual testing. An identical procedure was used on each test. First, an asterisk was shown for 2 sec as a ready signal. Three words then appeared for 1.5 sec, and the S was instructed to read them aloud. Next, a three-digit number was presented; Ss counted backwards by threes from this number for 15 sec. Finally, a question mark appeared for 8 sec, during which time the S tried to recall the three words, in order if possible. If another test was to follow, it began immediately. At the conclusion of the four tests, Ss were asked for written free recall of all the test stimuli.

The words for each test were printed diagonally on a 2 x 2 in. slide from top to bottom. The slides were shown by a Kodak Carousel projector regulated by a Gerbrands tape timer.

#### Materials

Spanish nouns are tagged for gender, feminine nouns being preceded by the definite article, *la*, and masculine nouns by *el*. In addition, most feminine nouns end in *-a*; most masculine nouns end in *-o*. Two sets of 12 Spanish nouns, one feminine and one masculine, were used as stimuli. In neither case, however, did the articles appear, nor were the items ones that had the conventional endings to indicate gender. Thus, there were no physical characteristics of the words that could have been used as unambiguous cues to gender. Examples of feminine nouns are *luz*, *pared*, and *canción* (translated as light, wall, song); examples of masculine nouns are *reloj*, *arroz*, and *mueble* (translated as clock, rice, furniture). The items chosen as stimuli were frequently occurring, physically dissimilar, and semantically unrelated words. Each set of 12 nouns was arbitrarily divided into four groups of three words each. The order of words within triads remained unchanged throughout the experiment, but each triad appeared equally often in the four test positions across Ss.

#### Subjects

The Ss were 192 students at the University of Texas at El Paso

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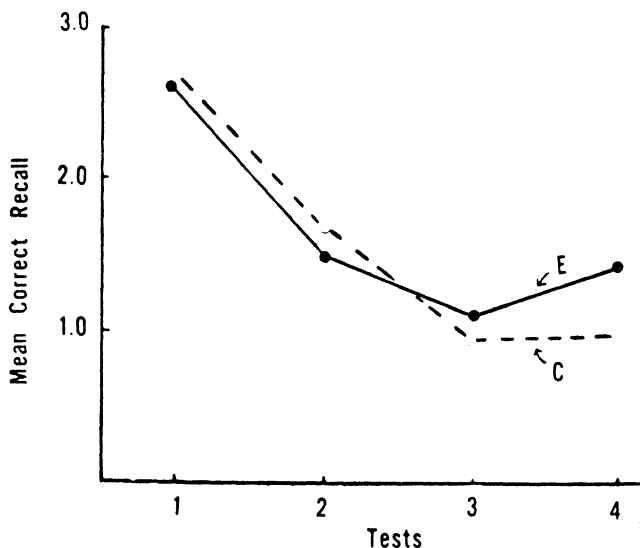


Fig. 1. Mean correct recall as a function of test and condition.

who volunteered for participation in the experiment. There were 96 Ss in each condition, and they were assigned to conditions by a block randomization procedure. Prior to serving in the experiment, Ss were asked to rate themselves on a scale of bilingualism. The scale ranged from 1 to 9, with 1 representing knowledge of only English, 9 representing knowledge of only Spanish, and 5 representing equal fluency in English and Spanish. Ss were not accepted if their self-ratings were 1. The mean rating in Condition E was 4.56 (SD = 1.16) and in Condition C was 4.64 (SD = 1.22). Thus, Ss were fairly fluent in Spanish. Data for 47 Ss were discarded because of failure to follow instructions, apparatus failure, unfamiliarity with one or more of the words, or E error.

## RESULTS

An item was considered correct if it was given, whether or not it was in the correct serial position. Mean correct recall is presented in Fig. 1.

Recall was first analyzed across Tests 1-3. Performance was high on the initial test and dropped on the second and third tests. This pattern of results is typical for the Brown-Peterson paradigm (cf. Wickens, 1972). The decrease in recall over Tests 1-3 was significant,  $F(2,380) = 236.91$ ,  $p < .001$ . There was no reliable effect of condition nor did condition interact with tests. Thus, there was buildup of PI over tests, but this buildup was not differential with respect to condition.

Performance on the critical Test 4 can be seen in the figure. Control Ss who received no change in gender showed no change in recall between Tests 3 and 4,  $t(95) = .18$ . Experimental Ss, however, whose Test-4 stimuli were of a different gender than those appearing on Tests 1-3, demonstrated an increase in recall,  $t(95) = 2.38$ ,  $p < .05$ . The amount of PI release can be gauged by dividing the difference between E and C performance on Test 4 by the drop in recall from Test 1 to Test 4 for the C group. By this measure, there was 23% release

from PI. On Test 4, the level of recall was significantly higher for experimental Ss than it was for control Ss,  $t(190) = 3.25$ ,  $p < .01$ .

The generalizability of this PI release over items was examined by dividing the Ss into eight groups on the basis of the particular triad presented on Test 4. Within each of these groups, the difference between the experimental and control Ss on Test 4 was calculated. Superior performance by the experimental Ss was found in seven out of the eight comparisons. By a Wilcoxon rank-sum test, this difference was significant,  $p < .05$ . Thus, even though only a subset of items from this class of Spanish nouns was used in the experiment, the E-C difference would probably occur with other items from the same class.

The occurrence of errors from prior lists as intrusions on Test 4 has frequently been used as a measure of release from PI. Usually, interlist errors are reduced when there has been a shift in the encoding category. In the present case, there were 23 interlist errors when gender changed; when there was no change in gender, 24 interlist errors occurred on Test 4. These values in terms of opportunities to make an error are 12% and 15% for C and E groups, respectively.

At the conclusion of the four Brown-Peterson tests, Ss were asked for free recall of all the items. Mean correct recall was 5.24 and 5.50 for the E and C groups, respectively. This difference was not reliable,  $F(1,190) = 1.86$ ,  $p < .05$ .

## DISCUSSION

The results of this experiment demonstrate that a change in word gender produces release from interference. In comparison to changes in other stimulus features, however, the amount of release was rather small (cf. Wickens, 1972). The error data also reflected the relative ineffectiveness of gender change. Usually, interlist intrusions on the test following a shift are minimal or nonexistent. In the present case, a substantial number of such intrusions occurred; Group E was indistinguishable from Group C in this respect.

One possible explanation for the marginal effect of gender change could be the Ss' inability to identify the gender of the stimulus items. If an S was unable to classify the nouns as masculine or feminine, he could not differentially encode the items on this basis. There are several arguments against this explanation. Although the nouns were not tagged for gender with either the article or the conventional -o and -a endings, the items were common nouns and part of the vocabulary of the Ss. Since gender identification is an integral part of the ability to use nouns such as these in oral and written communication, knowledge of the nouns implies knowledge of their gender. Finally, if poor identification of gender was the reason for the relatively small amount of release, then there should have been a positive correlation between facility in Spanish and amount of release. To determine if this was the case, Ss in Condition E were divided into three categories on the basis of their self-ratings of fluency (i.e., ratings of 2-3, 4-5, and 6-9). Ss in the lowest category ( $N = 12$ ) showed no release from PI. There was release for the Ss in the medium and high fluency categories; however, these two categories of Ss did not differ from each other, with recall in both increasing by a mean of .29 items on the shift trial. Since the number of Ss in the lowest fluency category was small

and since amount of release did not increase with fluency, once a moderate amount of fluency was present, it is unreasonable to conclude that the minor amount of release found in this experiment is attributable to the Ss' inability to identify gender.

The present data are generally in accord with Wickens's (1972) classification of stimulus dimensions on the basis of the amount of release produced by a shift on those dimensions. The amount of PI release is somewhat greater for a change in gender than for changes in other marking-syntactic dimensions, but is small relative to the amount of release found for other kinds of shifts. It appears, therefore, that word gender is not a particularly salient encoding dimension.

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# Trace and delay differential classical eyelid conditioning in human adults\*

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Experiment I compared trace and delay differential classical eyelid conditioning in adult human Ss at three ISIs (800, 1,100, 1,400 msec). Pure-tone CSs were used, with the trace CS having a duration of 50 msec and the delay CS terminating with the UCS. There was no significant trace deficit at any ISI, which indicates that the recognition or identification response involved in the differential classical conditioning of adult humans is maintained during long trace-stimulus offset to UCS-onset intervals. Experiment II compared trace and delay differential conditioning at 300-, 500-, and 800-msec ISIs. Again there was no trace conditioning deficit. Differential conditioning was significantly poorer at a 500- than at an 800-msec ISI, and no differential conditioning was found with a 300-msec ISI. The level of conditioning of the 300-msec group was much below that of the other groups and that expected for single-cue conditioning at the same ISI.

It has been established that trace and delay classical conditioning procedures are equally effective for the single-cue classical eyelid conditioning of normal adults. A comparison of the data of several early trace and delay conditioning studies leads to this conclusion, and a more recent study (Ross & Ross, 1971) has clearly demonstrated equal trace and delay conditioning performance across a wide range of interstimulus intervals (ISIs).

In contrast to these trace-delay comparisons of single-cue conditioning, there does not appear to be any research which has systematically investigated the

relative effectiveness of trace and delay CSs in differential classical eyelid conditioning. Given the fact that additional stimulus recognition and response requirements are involved in differential conditioning (e.g., Ross & Nelson, 1973), it might be expected that trace-delay differences would be found in differential conditioning, especially with ISIs where a relatively long interval intervenes between the offset of the trace CS and the onset of the UCS. Accordingly, Experiment I compared trace and delay differential conditioning at ISIs of 800, 1,100, and 1,400 msec, the shortest of which was found by Hartman and Grant (1962) to be optimal for delay differential eyelid conditioning.

## EXPERIMENT I

### Method

**Subjects and Apparatus.** The Ss were 96 college students

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