SALIENT TASK-IRRELEVANT STIMULI DISRUPT ORTHOGONAL INFORMATION BUT ENHANCE CORRELATED INFORMATION

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Abstract

Garner's speeded classification paradigm is the tool of choice for gauging the effect of irrelevant information on the perception of task information. The paradigm consists of three tasks. In Baseline, task-irrelevant stimulus dimensions are held constant and the participant classifies values on the task-relevant dimension. In Filtering, the participant again classifies values on the relevant dimension but values on the task-irrelevant dimension also vary from trial to trial in a random fashion. Finally, in Correlation the task-irrelevant values vary again but now in correspondence with values of the task-relevant dimension. In a series of experiments with the same stimuli, we manipulated the perceptual salience of the task-irrelevant dimension. The results showed that making the irrelevant stimuli salient impaired task performance in Filtering. However, the same manipulation improved task performance in Correlation. We conclude that attention-grabbing irrelevant information is not always detrimental to performance. Whether or not such information disrupts performance depends on its relationship with the task-information.

Garner's speeded classification paradigm is a popular tool in the investigation of selective attention. In this paradigm, the participants are asked to make judgments about values from one dimension of the stimulus while ignoring irrelevant variation on a second dimension of the stimulus. For example, the participant is required to determine whether the shape is a square or a circle while ignoring the shape's color (whether it is red or green).

The full paradigm includes three different types of blocks defined by what happens to the *task-irrelevant* dimension. In the *baseline* condition (B), the task-irrelevant dimension is held at a constant value throughout the blocks of trials. The to-be-judged attribute (say, color) changes from trial-to-trial in a random fashion but the distractor attribute (shape) is always the same (all shapes are circle). In the *filtering* condition (F), both the target attribute and the task-irrelevant attribute change from trial to trial in a random fashion. In the *correlation* condition (C), the task-irrelevant attribute again varies, but does so in a corresponding fashion.

The ability to attend selectively is measured by contrasting performance in the filtering and the baseline conditions. If the speed and accuracy of performance in filtering equals that at baseline, selective attention is good. The parity shows that the participant focused on the target dimension (color) without suffering distraction from irrelevant variation on the other dimension (shape). Conversely, if filtering performance is worse than that at baseline, then selective attention to color has failed. This difference in performance is called *Garner interference* (GI).

Pairs of dimensions that lead to substantial Garner interference are called *integral dimensions* (e.g., the horizontal and vertical position of a dot). With integral dimensions, one cannot attend to one dimension without also noticing the other dimension. Therefore, selectivity fails for such dimensions. Pairs of dimensions associated with negligible Garner interference are called *separable dimensions* (e.g., the size of a circle and the angle of the diameter crossing it, Garner & Felfoldy, 1970). With separable dimensions, selective attention to each dimension is good. People can analyze stimuli constructed of separable dimensions with ease and concentrate on either one.

The correlation condition provides for an additional measure of selectivity. If the responses to the target attribute are faster under correlation than at baseline, then selective attention to the target has again failed. Obviously, the participant noticed the corresponding variation of the irrelevant attribute to maximize her or his performance with respect to the target attribute. This failure of selective attention is called facilitation or *Garner facilitation*.

A major variable known to affect the Garner measures is relative dimensional discriminability or salience (Melara & Mounts, 1993; Melara & Algom, 2003). A salient dimension intrudes on a less salient dimension more than vice versa. Such asymmetries are expressed in asymmetrical Garner effects. Consider a Garner paradigm with word as one dimension and ink color as the second dimension. Suppose that the words are more salient than the print colors. Then, performance with color in the filtering condition will be worse than performance with color in the baseline condition (GI). In contrast, one does not expect to find Garner interference for words because irrelevant variation in the less salient dimension of color does not take a toll on performance.

Note that the Garner effect is typically derived within a dimension [i.e., GI=RT(F)-RT(B) is calculated separately for word and color]. The pertinent GI effects are then compared across the two dimensions. An implicit yet important comparison is missing from the literature (although it is implied): The difference in performance in the filtering conditions across highly salient and less highly salient values of the irrelevant dimension. This comparison was performed in the current experiment.

If the comparison between two filtering conditions was implied (though not tested) in former research, the correlation condition with differing levels of salience has been completely ignored. In the correlation condition of the Garnerian paradigm, a value of the task-irrelevant dimension (e.g., a word) appears always (mostly) in tandem with a value of the target dimension (an ink color). For example, the word TABLE always (mostly) appears printed in red, the word WATCH in green, and the word BOOK in blue. This arrangement differs, of course, from that in filtering in which the words and colors are conjoined in a random fashion.

Consider now the role of relative dimensional salience. As I just recounted, a salient irrelevant dimension disrupts performance in the filtering task. However, the same salient irrelevant dimension enhances performance in the correlation task. Because the nominally irrelevant word is actually predictive of the target color, a more salient word would enhance color performance more than a less salient word.

In the current experiment, we used color as the relevant dimension and word as the irrelevant dimension. To create two levels of discriminability we manipulated salience throughout words legibility. We asked: How does salience of the irrelevant dimension affects attention in filtering and in correlation?

Method

Participants

Sixteen young men and women from the Department of Psychology, Tel Aviv University, volunteered to perform in the experiment in partial fulfillment of course requirement. All participants were native Hebrew speakers and had normal or corrected-to-normal visual acuity.

Apparatus and materials

We used only neutral words in the experiment. The words were presented singly in various ink colors. Stimulus presentation and measurement were governed by a DirectRT Precision Timing Software (Version 2008.1.0.11). The stimuli were displayed on a 17 in. color monitor set to a resolution of 1,024 x 768 pixels. Using the standard color palettes, we created the prototypical colors of red, blue, green, brown, and orange. A Logitec external headset with a microphone, fitted to each participant, collected the vocal responses.

Design

The neutral words in color were manipulated in two ways. First, they were presented under high or low legibility. Second, the word and colors were conjoined in a random fashion in one condition (filtering) or in a consistent fashion (correlation) in the other condition. The two manipulations created the four conditions summarized in Table 1. Word legibility was manipulated by controlling the space between the letters. The high readability words were presented without spaces between the letters (e.g., "CHAIR"), and the low readability words were presented with 3 spaces between each letter ("C   H   A   I   R").

In two blocks, the arrangement was that of filtering: Each of the 5 words was presented in each of the 5 ink colors twice, making 50 trials per block in all. In two other blocks, the arrangement was that of correlation: Each word was presented 10 times in the <u>same</u> ink color, making 50 trials per block in all. The order of the blocks was counterbalanced across participants.

Table 1: Four blocks of trials created by the factorial combination of salience and word-color arrangement. Each participant performed in all blocks.

		Word Salience (legibility)	
		High	Low
Color-Word Association	Random (Filtering)	*Block 1*	*Block 2*
	Constant (Correlation)	*Block 3*	*Block 4*

The participants were sitting approximately 60 cm from the screen, so that the words subtended a maximum of 5.4 degrees of visual angle in width and 1.52 degrees in height. The words were presented in Arial 22 font over a white background. The word appeared at the center of the screen and remained visible until the participant's vocal response. The next stimulus appeared 1s after the response. In order to avoid adaptation or strategic responding (e.g., fixating on a small portion of the print to avoid reading), we introduced a trial-to-trial spatial uncertainty of 50 pixels around the center location. In order to avoid habituation, a new set of neutral words was used in the second Garner condition (filtering or correlation).

Procedure

The participants were tested individually. Each participant was randomly assigned to one of the orders. The participants performed the task of speeded color naming in a sequence of four blocks separated from each other by breaks of approximately 1 min. The entire experiment lasted about 15 min.

Results and Discussion

The four columns of Figure 1 give the respective means for RT for correct identification of the ink colors. The results at the left-hand half of Figure 1 represent the filtering condition with high and low word legibility. It took participants to name the color of high legibility words 740 ms on average, but it took them to name the color of the same words under low legibility 716 ms on average. The 24 ms difference was significant [$t(15)=1.99$, $p<.05$]. This pattern of RT reversed in the constant-color condition as can be seen in the right-hand half of Figure 1. In this condition, the participants responded to the color of highly legible words faster than to that of poorly legible words [mean of 680 and 709 ms, respectively; $t(15)=-1.82$, $p<.05$]. The interaction of word legibility (high, low) and color assignment (random, constant) documented the reversal of the pattern of results [$F(1,15)= 10.01$, $p<.01$].

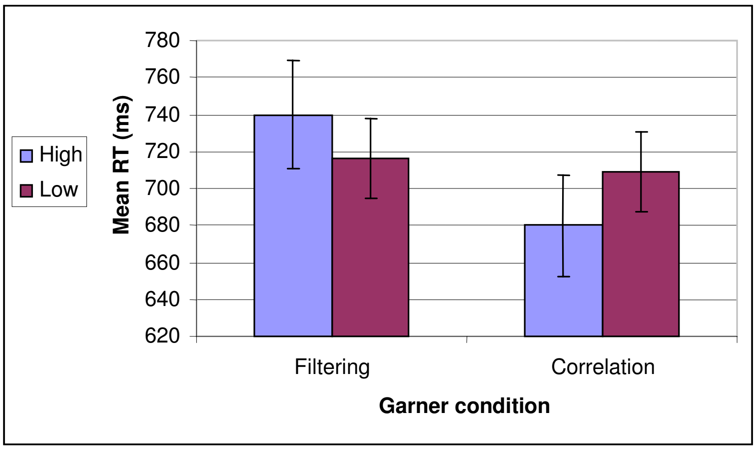

Figure 1: Mean RTs for the high and low legibility items in the filtering and the correlation conditions. The bars represent one standard error around the mean.

Clearly, the variable of salience affected performance differently in the filtering and correlation conditions. In filtering, the highly discriminable words induced greater interference in the color-naming task. The participants responded slower to the color when the carrier word was more salient. In the correlation condition, by contrast, the participants responded faster when the carrier word was more salient. We concluded that the effect of salient irrelevant information is not uniformly negative. It is when the information is random. However, it is useful and supports task performance when the information is correlated with the task information.

References

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