Active versus passive expectancy for words
by Leo Henry Nickol

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in Psychology
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Abstract:
The Posner-Snyder (1975) cost-benefit theory predicts that the more an event is actively expected, the greater the inhibition to respond to other nonassociated events will be. This prediction was investigated by varying the relative proportion of two different types of events, words and nonwords, presented to subjects in three conditions—75% words, 50% words, and 25% words. Reicher's (1969) forced-choice design was used to present the stimuli, and both response choice and reaction time were recorded. Significantly greater differences between word and nonword reaction times were observed when the relative proportion of words to nonwords was increased. These results support the theory. No trend toward word-nonword differences was found for the response choice results. This might be due to the resource-limited nature of the task, instructions which emphasized accuracy or both.

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ii

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This thesis has been read by each member of the thesis committee
and has been found to be satisfactory regarding content, English usage,
format, citations, bibliographic style, and consistency, and is ready
for submission to the College of Graduate Studies.

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v

ACKNOWLEDGMENT

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ix

ABSTRACT

        The Posner-Snyder (1975) cost-benefit theory predicts that the more an event is actively expected, the greater the inhibition to respond to other nonassociated events will be. This prediction was investigated by varying the relative proportion of two different types of events, words and nonwords, presented to subjects in three conditions--75% words, 50% words, and 25% words. Reicher's (1969) forced-choice design was used to present the stimuli, and both response choice and reaction time were recorded. Significantly greater differences between word and nonword reaction times were observed when the relative proportion of words to nonwords was increased. These results support the theory. No trend toward word-nonword differences was found for the response choice results. This might be due to the resource-limited nature of the task, instructions which emphasized accuracy or both.

INTRODUCTION

The role that a subject's expectancies play in determining how rapidly and accurately he or she can process a visual stimulus has been investigated in a number of ways (e.g., Auerbach & Leventhal, 1973; Haber, 1966; Neely, 1977; Posner, 1979). It is now clear that expectancy is a highly complex phenomenon. Kahneman and Tversky (1982) point out that "in contrast to formal theories of judgment and decision, which employ a single notion of probability, psychological analyses of responses to uncertainty reveal a wide variety of processes and experiences, which may follow different rules" (p. 143).

Empirical data strongly suggest that differing types of expectancy may produce dissimilar results. Two general types of expectancy which have been experimentally distinguished are passive and active. Posner and Snyder (1975) utilized a matching task in which subjects were presented with a priming item prior to the appearance of a stimulus requiring a response. The stimulus consisted of a pair of letters (e.g., A A), and a subject was required to press either a <u>yes</u> key if the letter pair matched or a <u>no</u> key if it did not. The priming item was either a neutral warning signal (e.g., +) or a signal of the same type as the to-be-presented stimulus pair (e.g., A). The priming item appeared 500 ms before and remained directly over the stimulus pair (e.g., $\begin{smallmatrix} A \\ A \ A \end{smallmatrix}$). The principle dependent variable analyzed was the subject's reaction time. <u>Yes</u> responses when the letter pair matched

and <u>no</u> responses when the letter pair did not match were analyzed

separately. The major findings reported concerned the <u>yes</u> responses to

matching stimulus letter pairs. Facilitation was measured by

subtracting the mean reaction time when the prime and stimulus pair

matched from the mean reaction time when the stimulus pair was

preceded by the neutral warning signal. Inhibition was measured by

subtracting the mean reaction time when the prime and stimulus pair

did not match (e.g., $\begin{smallmatrix} & B \\ A & A \end{smallmatrix}$) from the mean reaction time when the

stimulus pair was preceded by the neutral warning signal. It was

reported that when the prime matched the stimulus pair on 80% of the

trials, facilitation was high but inhibition was also high. On the

other hand, when the prime matched the stimulus on only 20% of the

trials, facilitation was still high but there was no inhibition effect.

Posner (1979) interpreted these findings as support for distinction

between automatically activated mental pathways and those pathways that

require a subject's conscious attention for activation. He describes

these processes as follows:

> Put simply, the idea is that automatic activation facilitates
> the passage of messages that share the same pathway; but
> since pathways can be active in parallel, such activation has
> no inhibitory consequences. This one-sided bias is quite
> different from the effects that occur after subjects begin to
> attend to the input pathway. Since attentional mechanisms
> are of limited capacity, facilitation of the attended pathway
> is accompanied by a widespread inhibition in the ability of
> information from any other activated pathway to reach the
> mechanisms that subserve attention. (p. 99)

Posner and Snyder's (1975) study is problematic because of

serious methodological difficulties. In the matching task that they

employed, it was not necessary for subjects to use the priming item at

all; they could make the required matches whether or not a warning

signal had been presented. This is an important point to consider if

conclusions are dependent upon the occurrence of a valid prime which,

subsequently, affects a subject's strategies. They reported that

something perhaps even more ambiguous was happening. It appeared

from their results that their subjects, instead of using the prime as

a warning signal, were using the prime to make the matches. They

recounted the following:

> First, the most serious problem with the experiments reported
> in this paper is that attention to the prime often appears to
> be used to match the prime item against the array. This
> serves to facilitate the "yes" responses to matching pairs
> when the prime also matches the array and "no" responses to
> mismatching prime-array pairs. This strategy alone can
> account for many of our results without invoking any effect
> of attentional capacity per se. (p. 680)

Although the authors felt that their findings were strong enough to

overshadow these difficulties, they suggested that more tests of the

hypothesis using nonmatching designs need to be made.

The present research is an attempt to address directly some

of the problems. It is proposed that the more an event is actively,

consciously expected, the greater will be the time required to respond

to an unexpected event. The relative proportion of two qualitatively

different types of stimuli, words and nonwords, was varied over

separate, blocked conditions. Subjects, in a particular condition,

were required to respond sequentially and individually to all of the

events, words and nonwords, in that condition. Expectancies are

assumed to develop solely by the interaction of the subjects with the

series of stimuli. They were not told, in any case, about the

probability of occurrence of either of the stimulus types.

This study utilized Reicher's (1969) forced-choice design for stimulus presentation. In this procedure, subjects are presented with a brief letter stimulus (e.g., WORD), which is immediately replaced by a visual noise mask to prevent further processing of the stimulus. Above the mask, there appears a horizontally oriented series of dashes; each dash corresponds to a letter position in the previously presented stimulus. Above and below one of the dashes appears a letter. The alternative choices and the masking field would appear as indicated below:

$$- - - \frac{D}{K}$$
$$\blacksquare\blacksquare\blacksquare\blacksquare\blacksquare\blacksquare\blacksquare$$

The participant responds by pressing a key to indicate whether the appropriate letter from the now-masked stimulus is in the top or bottom position of the two presented alternatives. One of the alternatives is always correct. In this case, the correct alternative response is top because the fourth position of the stimulus, WORD, is D and D is in the top position of the presented alternatives. The alternatives were presented above and below any one of the possible positions in the stimulus, and in the case of words, such as illustrated, either of the alternatives would make a word.

The purpose of the present experiment is to examine the effects that an increasing expectancy for one type of event (words) will have on an individual's ability to respond to another event (nonwords). The specific hypothesis is that as the proportion of words presented to a subject increases, his or her active, conscious expectancy to see words

will increase, and this increasing active expectancy for words will
inhibit responding to nonwords. Because this is a between-subjects
design, this change should be exhibited by an increased difference
between the times taken to respond to words and the times taken to
respond to nonwords in the condition where most words were presented
compared to those time differences in the condition where the least
words were presented. It is not anticipated that any strong trends
will be apparent for the nonwords. Aderman and Smith (1971), using
five-letter stimuli and a forced-choice design, were unable to get
their subjects to perform much above chance for correct recognition
on nonwords even after explicit directions concerning what they would
receive and following fifteen expectancy-confirming trials.

METHOD

Subjects

The subjects were 100 right-handed male and female college students enrolled in an introductory psychology course. They received some course credit for participating in the experiment. All subjects had 20/20 or corrected to 20/20 vision.

Apparatus

A Hewlett-Packard 9845B computer was used to record subjects' response choices and reaction times. The stimuli were presented on the computer monitor. The computer keys were covered with a piece of plyboard. In the upper right-hand corner of the plyboard, holes were drilled and buttons installed to provide access to three essential operation keys. These keys consisted of T for choice of a top alternative, B for choice of a bottom alternative, and C to continue with the next stimulus in the series. The T key and the B key were oriented horizontally 4 cm apart. The C key was 2 cm below and centered between the T and B choice keys

Stimulus Presentation

The subject was seated in front of the computer monitor, and then received instructions by the computer program concerning his or her task. Each was given nine practice trials to ensure that he or she had the necessary operational knowledge to perform the task. The practice trials consisted of number stimuli only. The subject was

instructed to use only the index finger of the right hand for all responses. During this period, communication with the experimenter was encouraged, and it was explained that other than the actual trials consisting of letters rather than numbers, the operations required of a subject would be identical. When the subject confirmed that he or she knew exactly what was required, the experimenter left the room and the experimental trials were initiated.

The method of stimulus presentation generally followed that of Reicher (1969). First, a small fixation cross appeared in the center of the screen. The subject focused on the cross. When he or she was ready to receive a stimulus, the subject pressed the C key. The fixation cross was then replaced by a four-letter stimulus, either a word or a nonword, presented on the monitor for 100 ms. The stimulus covered approximately 0.5° visual angle vertically and 1.5° visual angle horizontally at an average viewing distance of 40 cm. After 100 ms the stimulus was masked by four light-on-dark rectangles. Each rectangle corresponded to and covered one of the letter positions in the stimulus. Directly above this mask was a dashed line, with each one of the dashes corresponding to a letter position in the stimulus. On top of and below one of the dashes was a letter. The subject was asked to press quickly the T key if he or she felt that the top alternative letter had been correct in that position in the stimulus or to press quickly the B key if he or she felt that it was the correct response. One of the alternatives was always correct for the requested position. Both alternative choice--correct or incorrect--and reaction time was recorded for each response. Subjects were not informed

whether or not their choices had been correct until the completion of the trials.

Both the selection of 100 ms for the stimulus presentation time and the choice of the visual noise mask resulted from pretrial pilot studies. It was determined at that time that this time-and-mask combination yielded a consistent middle range performance for percentage correct of between 70% to 90% correct for both words and for nonwords. The visual noise mask used was made up by repeating a computer character. The Hewlett-Packard 9845B character (ASCII-#255) consisted of a vertically oriented rectangle containing a symmetrical distribution of dots. The size of the character was equivalent to the size of a stimulus letter, and four of these characters presented horizontally effectively masked the four-letter stimulus.

Materials

A total of 64 four-letter words were chosen from Kucera and Francis' (1967) corpus of one million English words as word stimuli for the experiment. These words were selected so that even though each was unique, it was closely equivalent to the other chosen words in terms of those parameters that may differentially influence the response measures recorded in the study. Four-letter words were chosen because they have been found to show superior performance over nonwords in forced-choice tasks (Reicher, 1969; Wheeler, 1970), and, in the case of matching experiments, shorter reaction times (Eichelman, 1970; Kroll, 1977). The frequency of occurrence of a word in the English language has been found to strongly affect performance (Bruder, 1978; Krueger, 1975), and this frequency was made as equivalent as possible.

The words selected had an overall mean frequency of 57.8 occurrences per million, $\underline{SD}$ = 17.4. The means for the individual alternative frequencies were 56.1, 58.2, 58.9, and 58.1 occurrences per million for positions 1 through 4, respectively. None of the words appeared to have strong emotive content (Broadbent, 1973). Finally, none of the words had more than one syllable, had a repeating letter, or were obvious proper nouns. After the list of words was obtained, it was placed randomly in a 64-item, 8 x 8 array.

Each nonword was made up from a word so as to control both for overall letter frequency and alternative letter frequency. If, for example, a word was KING, followed by the first letter alternatives, $\frac{R}{K}$ — — —, then the nonword would be KGNI, followed by $\frac{R}{K}$ — — —. In addition, the alternatives were reversed for one-half of the subjects in each condition (e.g., KING would be $\frac{K}{R}$ — — — for one half of the subjects, and similarly for KGNI. After the alternative choices were determined for the appropriate conditions, the remaining letters were scrambled so as to be as unwordlike as possible (Gibson & Levin, 1975). Appendix A contains the list of words and nonwords used in the study.

Five different conditions were developed from the word and nonword arrays. Three experimental conditions--75% words, 50% words, and 25% words--were developed by proportionately changing the words to nonwords in each condition. This proportioning constraint was continued over eight trial blocks within each condition. That is, if the 50% condition was being prepared, one-half of the eight stimuli presented would be words and one-half would be nonwords.

The computer program to present the stimuli operated by first