Effects of Familiarity with a Sample-Stimulus in Selection-Based Learning of Verbal Behavior

Robert J. Wallander Jr.
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EFFECTS OF FAMILIARITY WITH A SAMPLE-STIMULUS IN
SELECTION-BASED LEARNING OF VERBAL BEHAVIOR

by

Robert J. Wallander, Jr.

A Thesis
Submitted to the
Faculty of The Graduate College
in partial fulfillment of the
requirements for the
Degree of Master of Arts
Department of Psychology

Western Michigan University
Kalamazoo, Michigan
April 1993
Selection-based verbal behavior involves indicating a stimulus in some way from a set of stimuli. Twenty undergraduates served as subjects in this study of familiarity with a sample stimulus in a selection-based paradigm. The study utilized twenty Japanese Kanji characters as the comparison stimuli to be selected. Half the subjects were presented English names of animals as sample stimuli and the other half of the subjects were presented Japanese Katakana symbols (which appear as little more than nonsense figures) as sample stimuli.

T-tests were performed on the average number of twenty-trial blocks needed to meet criterion (two consecutive blocks without error). The group with English names as sample stimuli took significantly fewer blocks to reach criterion. Average reaction times for the final two blocks were also analyzed with a t-test with little difference noted between the two groups.
ACKNOWLEDGEMENTS

I would like to thank Satoru Shimamune for making this level of research possible through his expertise of the magnificent tool that is the Macintosh computer. I would also like to extend my appreciation to Dr. Jack Michael for his extra time and continued patience with all my recurring needs during the execution of this thesis. Thanks also to Dr. Richard Malott and to Dr. William Redmon for their cooperation.

I must also express my thanks to the undergraduates who participated as subjects and made this research possible.

Robert J. Wallander, Jr.
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Effects of familiarity with a sample-stimulus in selection-based learning of verbal behavior

Wallander, Robert John, Jr., M.A.

Western Michigan University, 1993
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INTRODUCTION

According to Michael (1985, p. 2), there are several differences between topography-based and selection-based verbal relations. He suggests that these differences are likely to be overlooked or considered unimportant by those who are primarily interested in the effects of verbal stimuli on language "receivers." But from the perspective of the person producing the verbal stimuli for the receiver, the differences may be quite important.

With topography-based verbal behavior, the topography of the response is what distinguishes one response from another. This is the case for speakers, writers, and users of sign language. Writing "dog" consists of a different manual activity than writing "cat." Saying "dog" involves a different action of the vocal musculature than saying "cat." From the perspective of the listener, reader, observer, etc., the different actions of various muscles produce the noticeable distinctions in resulting stimuli.

Selection-based verbal behavior consists in pointing, touching, or indicating in some way a verbal stimulus in a set of available stimuli. Although the stimuli pointed at are quite different from the perspective of the viewer, for the organism doing the pointing, the movement of the point-
ing response is about the same regardless of the stimulus (Michael, 1985, p. 2).

Symbol boards and computers produce stimuli which often do not require special training on the part of the listener to understand. Many speech therapists favor selection-based training for this reason. A number of professionals also feel language is acquired easier with the boards and computers. However, as pointed out by Sundberg and Sundberg (1990), there are some limitations inherent in a symbol or picture system that can have a major impact on language acquisition.

First, with a pointing system the topography is similar for each response. No specific muscle movements become linked with specific controlling variables, a feature Michael (1985) considers may make learning more difficult and learned performance less stable. Also, selection-based verbal behavior involves a conditional discrimination (two primary controlling variables), whereas topography-based verbal behavior involves only a simple discrimination. As an example of a selection-based conditional discrimination, the presence of one stimulus (e.g., a clock) alters the controlling strength of another stimulus (e.g., the symbol for a clock) over the response of selecting that symbol.

Another difference is that with topography-based verbal behavior there is always point-to-point correspondence
between the response and the response product. For example, when talking, there is a correspondence between the details of the vocal responding and the relevant details of the auditory stimulus that can affect the listener (Michael, 1985, p. 3).

Finally, selection-based verbal behavior requires an effective scanning repertoire. To point at the correct symbol requires finding it from among the set of symbols. This seems easy enough with only a few symbols, but as the number increases the time to find the correct symbol may become so long that the control by the conditional stimulus or other relevant independent variable is lost. These differences may make selection-based verbal behavior harder to acquire (Sundberg & Sundberg, 1990). In addition, the practical problem of behaving verbally when a symbol board is not present must also be considered.

Using developmentally disabled adults as subjects, Sundberg and Sundberg compared the acquisition of a simple topography-based verbal system with that of a similar selection-based system. The subjects were taught three topography-based tact relations (making a manual sign when shown a nonsense object), three topography-based intraverbal relations (making the same manual sign when hearing the nonsense name of the object spoken by the experimenter), three selection-based tact relations (pointing to a symbol
when shown a nonsense object), and three selection-based intraverbal relations (pointing to the same symbol when hearing the nonsense name of the object). The researchers found that the selection-based system required more trials than the topography-based system for the subjects to meet mastery criteria. Additionally, the terminal percentage of correct responses for the selection-based system was lower than the percentage of correct responses in the topography-based system. Sundberg and Sundberg considered the data from this study as partial support for teaching sign language rather than the use of a symbol board to low-functioning developmentally disabled clients. Wraikat (1991) and Wraikat, Sundberg, and Michael (1991), found similar results using the same kinds of subjects.

It becomes interesting to see if the same differences will be found with more verbally advanced learners. Michael (1985, p. 2) implied that these differences in the results of topography-based and selection-based training were at least partially due to the requirement of an effective scanning repertoire. If so, increasing the number of stimuli to be selected from would increase the amount of necessary scanning and should accentuate the difficulty of selection-based training. In other words, the size of the stimulus set should influence learning speed more in the selection-based than in the topography-based system.
However, it would be difficult to test this hypothesis with the developmentally disabled population because of their poor scanning and verbal repertoires.

Stratton (1992) compared ease of acquisition of a topography-based and a comparable selection-based system for college students who have already acquired good scanning and verbal repertoires. In the topography-based system, the subjects learned to say a Japanese word when the corresponding English word (the name of a common animal) was presented visually. In the selection-based system, subjects learned to pick a Japanese Kanji character from a list of English words that were presented visually. Four groups of subjects in a two-by-two design resulted from two verbal systems (topography-based and selection-based) and two numbers of relations to learn (five and twenty). Stratton's data clearly showed that when twenty relations had to be learned the topography-based system was considerably more difficult than the selection-based one. This is not consistent with the earlier results. When only five relations were to be learned the two systems were about equally difficult, but it is quite possible that this is the result of a basement effect, since both systems were learned in few trials with these subjects.

The difference in these results for the two populations may be due to the relevant history that the college
students have had with the sample stimuli, common animal names. The developmentally disabled subjects learned nonsense names for nonsense objects. Familiarity with the sample stimuli in the selection-based paradigm might have made the task easier for the college students because of mediating responses that such stimuli might evoke. For example, the learner looks at the correct Kanji character for "turtle" which might evoke responses that have in the past been associated with the word "turtle."

The purpose of the present study was to investigate the effects of familiarity with the sample in a selection-based paradigm. One group of subjects learned a 20-stimulus set of relations with the animal names as sample stimuli and the Kanji characters as comparison stimuli. The other group learned a 20-stimulus set with nonsense shapes (Japanese Katakana characters) as samples and the Kanji characters as comparison stimuli.
METHOD

Subjects

Twenty undergraduates from Western Michigan University participated in this study. Participants were randomly assigned to one of the two conditions: English words or Katakana symbols as sample stimuli. All subjects signed an informed consent form before entering the experiment. This research was previously reviewed and approved by the Human Subjects Institutional Review Board at Western Michigan University.

Setting

The experiment was conducted in the University Computing Center of Western Michigan University. Subjects sat at a Macintosh terminal (C.P.U., monitor, keyboard, mouse, and printer) which controlled the experiment and collected the data.

Apparatus

The monitor's screen served as the medium for stimulus presentation. A likeness of the screen which shows a stimulus configuration used in the selection-based system is depicted in Figure 1.
What is the Kanji symbol for
    Turtle

Figure 1. A Sample of the Computer Screen Used for Stimuli Presentation.

The subjects utilized the mouse of the Macintosh computer to select the correct stimulus from the screen. HyperCard 1.2.1 (Apple Computer, 1987-1988) software was used to develop a program which presented the stimuli and recorded data.

Stimuli

Twenty Kanji characters served as the stimuli to be selected in both conditions. No special effort was made to control for similarities between Kanji characters.

Additionally, twenty English names for animals (e.g., turtle, dog, bear) served as the sample stimuli for one
condition and twenty Japanese Katakana characters served as the sample stimuli for the other condition.

Procedure

The experiment consisted of an introduction to the experiment, a pre-training phase, and a training phase, all of which occurred in a single session. The introduction involved presentation and signature of informed consent and an explanation of using the Hypercard program in the two following phases. The pre-training phase exposed the subject to all twenty stimuli and the correct responses one time in a single block of twenty responses. The training phase consisted of blocks of twenty trials. Each trial involved the presentation of a single sample stimulus (English or Katakana depending on the experimental condition) and a layout of the twenty Kanji symbols from which the subject must select the correct symbol. In each trial, the subject had twenty seconds to make a selection. If no selection was made, the program presented "Incorrect" along with a "boing" auditory stimulus as feedback. The correct response was also revealed to the subject at that time. If an incorrect response was made during the twenty seconds, the program provided the same feedback as above. Upon making a correct response, the program presented the word "good" along with a "chime" auditory stimulus as feedback.
(see Figure 2; Words appearing in parentheses did not appear in the experiment). A new trial began when the participant made a correct response. The training phase continued until subjects reached the mastery criterion (two sequential blocks of twenty trials in which no incorrect responses occurred).

![Sample Stimulus, Comparison Stimuli, Model Stimulus, and Feedback on Response](image)

**Figure 2.** Screen Displaying Sample Stimulus, Comparison Stimuli, Model Stimulus, and Feedback on Response.

### Independent Variables

The study explored the difference between English words and Katakana characters as sample stimuli in the learning of selection-based verbal behavior. These two
values of the independent variable resulted in two experimental groups of ten subjects each.

Dependent Variables

**Ease of Acquisition**

Ease of acquisition was measured by the number of blocks required for a subject to meet the mastery criterion (two consecutive blocks without error) and the number of incorrect responses in each block for each condition.

**Reaction Time**

Reaction time was the time between the onset of the screen containing the sample stimulus and the depression of the button on the mouse indicating the subject's selection of a comparison stimulus. The computer program measured and recorded the reaction time in seconds to two decimal places. Only the average reaction time of the final two blocks for each subject was analyzed.
RESULTS

Inter-observer Agreement

The computer program furnished all necessary data-recording. Since human observation is not involved in the recording of data for this study, there was no need for inter-observer agreement evaluation in this study.

Ease of Acquisition

The average number of blocks was smaller with the English sample stimuli than with the non-sense Katakana sample stimuli (see Table 1 and Figure 3). An unpaired $t$-test on the number of blocks to reach mastery showed the effect of the different sample stimuli to be statistically significant; $t(\text{df} = 19) = 2.632; 0.005 < p < 0.01$. In other words, when the sample stimuli were English words, the task of acquiring selection-based verbal behavior was easier than when the sample stimuli were Katakana symbols.

Table 1
Average Number of Blocks and Range to Demonstrate Mastery for Each Group

<table>
<thead>
<tr>
<th>Sample Stimulus</th>
<th>n</th>
<th>Mean</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>English</td>
<td>10</td>
<td>8.6</td>
<td>5 - 16</td>
</tr>
<tr>
<td>Katakana</td>
<td>10</td>
<td>15.6</td>
<td>7 - 32</td>
</tr>
</tbody>
</table>
Figure 3. Number of Errors in Each Block Across Blocks of Training Trials.
Reaction Time

The average reaction times for each of the two groups are shown in Table 2. An unpaired $t$-test on the reaction times for each of the two groups showed the effect of the different sample stimuli upon the reaction times to be statistically insignificant; $t(\text{df} = 19) = 2.632; 0.1 < p < 0.375$. In other words, after mastery, when the sample stimuli were familiar to the subjects, the time needed for finding and selecting the correct answer was about equal in difficulty if unfamiliar sample stimuli were used.

Table 2

Reaction Time for the Two Experimental Conditions

<table>
<thead>
<tr>
<th>Sample Stimulus</th>
<th>n</th>
<th>Mean</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>English</td>
<td>10</td>
<td>3.534</td>
<td>2.7 - 3.97</td>
</tr>
<tr>
<td>Katakana</td>
<td>10</td>
<td>3.694</td>
<td>2.66 - 4.26</td>
</tr>
</tbody>
</table>
DISCUSSION

Before Stratton's findings (1992), previous research (Sundberg & Sundberg, 1990; Wraikat, 1991; Wraikat et al, 1991) had repeatedly shown that topography-based paradigms required fewer trials for subjects to learn than selection-based paradigms. A possible explanation for Stratton's different results may be related to familiarity with the sample stimuli in the selection-based paradigm. Such familiarity might have made the task easier for the verbal adults because of other responses that such stimuli might evoke in these subjects. In particular, the learner might look at a Kanji character and note a similarity between the shape of the animal named and some aspect of that symbol. Some of Stratton's subjects reported such behavior on their parts.

While it is true that the sample stimuli in the topography-based condition of Stratton's experiment were also familiar animal names, the correct response of saying a Japanese word did not involve selecting a stimulus which might remind the subject of some aspect of the sample. Therefore, it is possible that this familiarity did not facilitate the learning of the topography-based verbal relations as much as it did the selection-based ones.
The present study indicates that when a familiar sample stimulus is used in a selection-based paradigm, learning is accelerated as compared to a selection-based paradigm in which unfamiliar sample stimuli are employed. Therefore, a condition in which similarities may be present between sample stimuli and their corresponding comparison stimuli could have a sizable advantage over a condition in which no such similarities are present.

Such a discrepancy seems highly likely in Stratton's study. In future research, a training situation should be engineered so that the two training paradigms are similar in this respect. For example, one might use the same nonsense shapes presented one at a time as sample stimuli for both conditions. Additionally, unfamiliar nonsense words would serve as the learning material for both topography-based and selection-based conditions. All words would be presented simultaneously for the selection-based condition. The correct answer would be spoken to the experimenter for the topography-based condition. In such a setting, neither situation would have the advantage of permitting the correct response to remind the subject of some aspect of the sample stimulus. The equivalence of the two paradigms on this level might more easily permit their analysis and investigation of effects of other factors such as number of
stimuli used (as was the original intent of Stratton's study).
Appendix A

All Stimuli Including English, and Japanese Words, and Kanji Characters
<table>
<thead>
<tr>
<th>日文</th>
<th>英文</th>
<th>翻译</th>
</tr>
</thead>
<tbody>
<tr>
<td>いん</td>
<td>Pig</td>
<td>五</td>
</tr>
<tr>
<td>うえ</td>
<td>Dog</td>
<td>九</td>
</tr>
<tr>
<td>おぼ</td>
<td>Bear</td>
<td>気</td>
</tr>
<tr>
<td>きけ</td>
<td>Cow</td>
<td>事</td>
</tr>
<tr>
<td>さし</td>
<td>Horse</td>
<td>好</td>
</tr>
<tr>
<td>しそ</td>
<td>Alligator</td>
<td>楽</td>
</tr>
<tr>
<td>すつ</td>
<td>Puma</td>
<td>容</td>
</tr>
<tr>
<td>つよ</td>
<td>Bee</td>
<td>思</td>
</tr>
<tr>
<td>たよい</td>
<td>Turtle</td>
<td>伝</td>
</tr>
<tr>
<td>とた</td>
<td>Clam</td>
<td>見</td>
</tr>
<tr>
<td>にに</td>
<td>Tiger</td>
<td>敎</td>
</tr>
<tr>
<td>なに</td>
<td>Eagle</td>
<td>翻</td>
</tr>
<tr>
<td>にま</td>
<td>Shark</td>
<td>体</td>
</tr>
<tr>
<td>みも</td>
<td>Monkey</td>
<td>生</td>
</tr>
<tr>
<td>めも</td>
<td>Cat</td>
<td>元</td>
</tr>
<tr>
<td>もも</td>
<td>Spider</td>
<td>元</td>
</tr>
<tr>
<td>もら</td>
<td>Elephant</td>
<td>国</td>
</tr>
<tr>
<td>られ</td>
<td>Bird</td>
<td>文</td>
</tr>
<tr>
<td>わぞ</td>
<td>Snake</td>
<td>千</td>
</tr>
<tr>
<td>わぞ</td>
<td>Mouse</td>
<td>万</td>
</tr>
</tbody>
</table>
Appendix B

Approval Letter From Human Subjects
Institutional Review Board
Date: August 21, 1992
To: Robert J. Wallander Jr.
From: Mary Anne Bunda, Chair
Re: HSIRB Project Number: 92-08-05

This letter will serve as confirmation that your research protocol, "Effects of familiarity with the sample in selection-based learning of verbal behavior" has been approved under the exempt category of review by the HSIRB. The conditions and duration of this approval are specified in the Policies of Western Michigan University. You may now begin to implement the research as described in the approval application.

You must seek reapproval for any changes in this design. You must also seek reapproval if the project extends beyond the termination date.

The Board wishes you success in the pursuit of your research goals.

xc: Michael, Psychology

Approval Termination: August 21, 1993
Appendix C

Copy of Form for Informed Consent
I am Robert Wallander, a graduate student in the Department of Psychology at Western Michigan University. I am doing a study on selection-based learning systems. You are invited to participate in this research.

The purpose of this research is to investigate the effectiveness of two language systems when teaching the corresponding Japanese words or Kanji characters to English words. If you decide to participate in this research, you will be requested to participate in a session of approximately one half hour to an hour and a half. In the session, you will use the computer to learn the correct corresponding Japanese word or symbol to a sample stimulus and then be tested on it. The session will take place at the University Computing Center.

Your participation in this research will not expose you to much risk. Although there is a chance that you will experience an increase in stress when you have trouble understanding the material or answering the questions in the test. If you find the task too difficult, you can quit the session anytime.

In order to protect your confidentiality when the results of this research are presented publicly (for example when they are presented in the written report of the research, or are presented at a professional meeting) your data will be identified only by a code number which will randomly assigned to you. A master list of participant names and code numbers will be stored in a locked file cabinet and will be destroyed at the conclusion of this research.

Your participation in this research is completely voluntary and you may withdraw at any time by telling me in person or by phoning me. You can stop at any time during the session by telling me that you do not want to continue. Please note that if you withdraw before completion of the research, I will not be able to use your data. Therefore, please do not volunteer unless you think you can complete the session.

If you have any questions regarding this research, please feel free to contact me, at 342-2350 (Home). If you would like to participate in this study, please sign this form in the space provided below.

Your signature below indicates that you understand the above information and have decided to voluntarily participate.

(Please Print Your Name)

(Your Signature) (Date)

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BIBLIOGRAPHY


