The Effect of Stimulus Presentation Modality and Verbal Response on Preschool Children's Judgment of Length in an Unanchored and Anchored Condition

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Young children's judgments of physical dimensions, such as length, tend to be quite inaccurate and labile, even when the differences among the values to be judged are well above the sensory difference threshold. How does one account for this? If one views judgment as a form discriminative behavior then the approaches of a number of investigators become relevant. Some, like Garner (1970) and the Gibsons (1955), believe that it is primarily the stimulus that controls the emission of a discriminative response. Others, like the Kendlers (1970), stress the importance of the response itself, particularly the mediating response. And finally there is work which stresses the interaction between the two sets of variables.

These latter studies have derived from Kuenne's (1946) paper on transposition learning with young children where she offered the hypothesis "...that the child's responses in the discrimination-learning situation become keyed to words relating to the cue aspect of the stimuli." Consistent with this approach, subsequent work by Wyckoff (1952) on the observing response, and later by Zeaman and House (1963) on attention, has taken the position that children learn to make responses (often verbal) which focus their attention on the relevant dimension, or critical aspects of the stimulus, thereby enabling them to sort out the relevant from the irrelevant stimulus cues and thus to discriminate among the values of the stimulus.

Caste in this framework, the present two experiments set out to measure the combined effect of selected stimulus and response variables, both on the acquisition of a scale of judgment of length, and on its resistance to shift under anchored conditions.
Prior work of our own (1970) has indicated that between the ages of 2 and 5 children judging length using ordinal verbal response terms (i.e., numbers) were increasingly able to resist the effect of a physical anchor on their length judgments, whereas children using nominal terms (i.e., color) were not.

The current work offers a further test of this finding, and of the effect of the verbal response upon acquisition of the initial unanchored length discrimination. It also examines the effect of a multiple vs. single stimulus mode of presentation on acquisition and shift under anchored conditions.

The following hypotheses were tested:

1) For the stimulus effect on acquisition it was predicted that a multiple rather than a single stimulus array would facilitate acquisition. Allowing the child to view the target stimulus in relation to all the others as he renders his judgments would be expected to enhance the conspicuousness of the critical dimension, namely, the relative aspect of a scale of length. Furthermore, only the multiple stimulus array permits the child immediately to scan, and then to compare the target to the other stimuli — in the case of the single stimulus array the child must also retrieve the comparison stimuli from memory before comparing the target with them.

2) For the response effect on acquisition it was predicted that the use of an ordinal rather than a nominal verbal response for rendering judgments would enhance acquisition since it would function to direct the child's attention to the critical aspect of the stimulus — again, the relational nature of a scale of length. In other words the use of the ordinal rather than the nominal scale would produce an appropriate observing response.

3) Two alternative hypotheses were offered concerning the effect on shift of having acquired the discriminations with the multiple vs. the single stimulus array. One was that the multiple stimulus array would enhance shift by encouraging
stimulus generalization, since during acquisition the stimuli were always viewed in relation to each other. The generalization would operate in the anchor condition where the target stimulus was displayed alone without the contextual support of the other scale stimuli to oppose the effect of the new anchor stimulus.

The other was that shift in the presence of an anchor would be enhanced by acquisition with the single stimulus array because that condition might not have produced as stable a discrimination originally.

4) Two alternative hypotheses were tested regarding the effect on shift of the use of the ordinal vs. the nominal response class. One was that the ordinal response scale, because of its relational nature, would produce more shift because the children might more easily generalize from one response to another under conditions of an anchor.

The other was that the use of the ordinal response class would facilitate resistance to shift because it is more clearly associated with judgments of length. It would act as an observing response for the appropriate dimension (i.e., relative size) thus producing a correct discriminative response which would encourage mediation by enabling the children to view the anchor in perspective (i.e., as off the scale) and allowing them to discount it.

Method

Subjects:

53 preschool children were subjects in the first study and 30 in the second. The children ranged in age from 3-6 years and can be characterized as urban, white, Jewish and middle-class.

Procedure:

The prototype for the procedure in both studies was the same and followed 5 steps:
1 - Stimulus familiarization — The children were first acquainted with 4 rods, 4, 6, 8 and 10 cm. long, by calling them signposts and embedding them in the context of a story. Children receiving a multiple stimulus presentation mode were shown the stimuli simultaneously, whereas children receiving a single stimulus mode viewed them one at a time.

2 - Verbal response training — Next, the children were conditioned to emit four verbal responses in the absence of any physical stimuli. In the first study all the children learned 4 nonsense syllables (TAT, SOS, BEN, DUB) and the ordinal response half of the group learned, in addition, that each syllable was associated with its own relative size term, i.e., they were told that TAT was teeny, SOS was small, BEN was medium and DUB was big.

In the second study, half the children were conditioned to emit the ordinal responses 1, 2, 3, and 4 and the other half nominal responses of green, blue, red, and yellow.

3 - Labeling the stimuli (Acquisition) — The children were then positively reinforced for emitting the proper verbal response (in the first study the appropriate nonsense syllable and in the second study the correct color or number) in the presence of stimulus slides showing 4, 6, 8 or 10 cm. target lines. For the ordinal response group children in the first study, E stated the appropriate relative size term along with the verbal reinforcement. For half the children in each study the slides displayed the target stimuli simultaneously with the other 3 stimuli and for half, singly. Acquisition continued till the children labeled the sequence of 4 stimuli twice in a row without error.

4 - Unanchored condition — Without informing the children of a change in the condition, all the children were then presented with an identical series of 16 slides (the four target stimuli presented in four different orders, one stimulus at a time). They were required to label each one with the appropriate response. No reinforcement or other feedback was given.
5 - Anchored condition — The children were then shown a 20 cm. anchor rod and told that they would see a picture of this signpost just before they were shown each picture of the regular signposts. They were told that it was a tricky signpost, to look at it, not label it, and then to give the proper name to the regular signpost which followed. The same ordered sequence of 16 stimuli was then presented with the anchor stimulus shown prior to each one.

Results

Two measures were taken of the children's performance. Acquisition was gauged as the proportion of errors during learning, and shift was taken to be the summed difference in cm. between the length of the stimuli to which the children assigned the same judgments in the unanchored and anchored conditions. All the children in both studies exhibited a contrast shift effect.

Insert Table 1 about here

The acquisition means show that for both groups the single stimulus-nominal response condition was most difficult, the single stimulus-ordinal response condition next, the multiple stimulus-nominal response condition next, and the multiple stimulus-ordinal response condition easiest. The likelihood that the means for the two independent groups would distribute themselves in the identical order was tested by a nonparametric test of an ordered hypothesis for k independent samples (Sky & Monkin, 1970) and found to be statistically significant (p < .05).

The order is consistent with the hypotheses that were advanced regarding the effect of the stimulus and response variables on initial acquisition.

Insert Table 2 about here

The shift data order the various experimental groups differently from the acquisition data; the order is, however, identical for the nonsense syllable and word-
response groups (p < .01) (Vay & Konkin, 1970). The shift means show that shift is most pronounced where the children have been trained in the multiple stimulus-nominal response condition, next in the multiple stimulus-ordinal response condition, next in the single stimulus-nominal response condition, and least pronounced in the single stimulus-ordinal response condition.

Of the two alternative hypotheses advanced concerning the stimulus array effect on shift, the data are consistent with the one that states that learning to render judgments in the presence of a multiple stimulus array is conducive to producing stimulus generalization during the anchored condition.

The data on the verbal response effect on shift, on the other hand, are consistent with the hypothesis that resistance to shift is enhanced by the use of the ordinal response, which apparently promotes an observing response for the appropriate dimension (i.e., relative size).

Some additional evidence on this point comes from a prior study (Salzinger et al., 1970) which utilized only a single stimulus condition and found that mean shift was greater (13.7 cm) when the child used the nominal response of color than the ordinal response of number (6.6 cm) (p < .01).

Because the order of the means was the same for the two independent groups, and the variances comparable and in no way systematically related to either the groups or conditions, the variance estimates were combined in testing for the main effects of single vs. multiple stimulus and nominal vs. ordinal responses on acquisition and shift.

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Insert Table 3 about here

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The acquisition means showed that it was significantly more difficult to acquire the initial discriminations under the single stimulus condition than the multiple stimulus condition (t = 3.740, p < .01).
There was a trend for the ordinal response to facilitate acquisition more than the nominal response ($t = 1.764$, $0.05 < p < 0.10$).

Insert Table 4 about here

The shift means showed that the children shifted significantly more when they had acquired the discriminations under the multiple stimulus condition than under the single stimulus condition ($t = -2.317$, $0.02 < p < 0.05$).

The children shifted significantly less when they used an ordinal verbal response than when they used a nominal response ($t = 1.973$, $0.02 < p < 0.05$). Adding the shift data as a function of verbal response from our previous single stimulus study, lends further support to the finding that children shift less when using the ordinal verbal response ($t = 3.475$, $p < 0.01$).

Discussion

In summarizing the results it was found first that acquisition of the discriminations involved in establishing a scale of length with young children was significantly affected by the arrangement of the stimuli. Where the stimuli were presented in a multiple array rather than singly, the children apparently found the discriminations easier to learn.

Two explanations may be advanced: First, it may well be that the critical aspect of a scale of length — namely, its relative nature — is made more salient for the children. And second, when the stimulus to be judged is displayed in relation to the other stimuli, it puts less of a burden on the child’s memory. Unlike the single stimulus presentation, which requires the child to store the four stimuli and then scan his memory before being able to render a judgment, he need only scan the immediately presented stimuli and match the correct label. The multiple stimulus array, therefore, provides the child with more immediately available discriminative stimuli that serve to evoke the correct label.
To a lesser degree than in the case of the stimulus array, it was found that
the verbal responses the children used during acquisition affected learning the
initial discriminations. Specifically, the use of responses which stressed the
relational, rather than the nominal, aspect of the stimuli facilitated learning
(i.e., number as opposed to color responses, and nonsense syllables having associations with relational terms as opposed to nonsense syllables without such asso-
ciations.) In other words, the use of the ordinal rather than the nominal scale
produced an appropriate observing response.

From the present data on facilitating acquisition of the discriminations, it
appears that although the stimulus effect is the stronger, the response effect
complements it, thus jointly producing the predictably ordered pattern of perform-
ance that we found among the four experimental groups.

The effects of stimulus presentation and verbal response are somewhat different with respect to shift, and apparently work in opposite directions. The present results show that learning with a multiple stimulus array enhances shift, whereas
the use of a relational verbal response allows the child to resist shifting.

The results of the stimulus effect on shift indicate that of the two alterna-
tive hypotheses advanced initially, the one that postulated that stimulus generaliz-
ation would be facilitated by the multiple array is the more likely. The effect of
stimulus generalization showed itself as a contrast effect of the anchor, i.e., as
an increase in the probability of the child consistently selecting other stimuli
on the scale which lie further away from the long anchor stimulus than the one
which would be correct. The child, having viewed all the scaled stimuli many times
in their ordered relationship to each other, incorporated the anchor into the scale
and moved more easily along the already familiar continuum.

The advantage that resulted from the use of an ordinal verbal response in
resisting the anchor, indicates support for that hypothesis which postulated that
the response class most clearly associated with judgments of length (i.e., numbers
or relative size terms) would promote an observing response for the appropriate
dimension (relative size of the scaled stimuli to each other.) This would, in turn,
act to mediate the child's response to the anchor by enabling him to view it in
perspective, i.e., as being off the scale (not a discriminative stimulus) — and
thereby to discount it in judging the scale lengths.

To conclude, we feel that for judgment problems, both stimulus and response
variables must be considered to have significant effects on the children's perform-
ance — a conclusion that tends to find support in the work of those investigators
in the perceptual-discriminative-cognitive area who stress the interaction of the
two sets of variables.

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Table 1

**Mean** Proportion of Errors in Acquisition under Single or Multiple Stimulus Presentation Combined with Nominal or Ordinal Verbal Responses

<table>
<thead>
<tr>
<th>Stimulus-Response Conditions</th>
<th>Nonsense Syllable Group</th>
<th>M</th>
<th>N</th>
<th>Word-Response Group</th>
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<th>N</th>
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<tr>
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<td>.33</td>
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<td>.31</td>
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<tr>
<td>Multiple-Nominal</td>
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<td>.23</td>
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<td>.19</td>
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Table 2
Mean Shift (in cms.) under Single or Multiple Stimulus Presentation Combined with Nominal or Ordinal Verbal Responses

<table>
<thead>
<tr>
<th>Stimulus-Response</th>
<th>Nonsense Syllable</th>
<th>Word-Response</th>
</tr>
</thead>
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<tr>
<td></td>
<td>Group</td>
<td>Group</td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>N</td>
</tr>
<tr>
<td>Single-Orinal</td>
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<tr>
<td>Single-Ordinal</td>
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<td>Multiple-Ordinal</td>
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Table 3
Mean Proportion of Errors in Acquisition under Two Modes of Stimulus Presentation and Two Types of Verbal Responses

<table>
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<th>Groups</th>
<th>Stimulus Presentation</th>
<th>Verbal Response</th>
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</thead>
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<tr>
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<td>Nonsense Syllable</td>
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<tr>
<td>Word-Response</td>
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<td>0.23</td>
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</table>


Table 4

Mean Shift (in cm.) under Two Modes of Stimulus Presentation and Two Types of Verbal Responses

<table>
<thead>
<tr>
<th>Groups</th>
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<th>Verbal Response</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Single M  N</td>
<td>Multiple M  N</td>
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<tr>
<td>Nonsense Syllable</td>
<td>11.1 26 14.0 27</td>
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<tr>
<td>Word-Response</td>
<td>12.5 40 16.4 40</td>
<td>16.5 40 12.3 40</td>
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