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Administering Stimulus-Control Tests to Assess How Young Children Attend to Words

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Study 1

The purpose of this investigation was to use computer technology to administer multiple stimulus-control tests to provide greater precision in determining how young children attended to words. Assessing how young children attend to words is important because it can identify attentional deficits, such as overselective attention, which are interfering with the child's reading performance. Students with overselective attention respond to only restricted portions of complex stimulus displays. They demonstrate a type of "tunnel vision", as they attend to only a limited number of stimulus elements in a visual compound. They might, for example, attend to only color features in a visual compound display and ignore the size and shape features.

Chronic overselective attention can especially interfere with reading acquisition if a child is attending to only a limited number of letters when words are presented. By utilizing computer technology to administer multiple tests designed to assess how children attend to words, it can be determined whether children are attending to individual letters within whole words, which is critical for word identification.

Method

Subjects

Four young children of typical development, whose ages varied from six to seven years of age, participated in this study. A Macintosh desktop computer automated the sessions, and a touch screen was fitted to the monitor screen. A penny dispenser was located to the left of the computer.

General Procedure

Sessions consisted of approximately 80 to 100 trials in length. A trial began when letters or words appeared on two white illuminated backgrounds on the computer screen. The trial ended when the child touched either illuminated area. A 3-second intertrial interval followed, and then the next trial began. Each time the child made a correct choice, he was reinforced. If the child made an incorrect choice, reinforcement was not provided.

Word-Discrimination Test

Each child was presented a word-discrimination test composed of four word discriminations; CAT(+) CUT(-), CAN(+)MAN(-), CAB(+) COB(-), and CAP(+)SAP(-). The S+ and S- words were presented simultaneously. During the word-discrimination test, the children were required to select words containing both the letters (C) and (A) to obtain reinforcement. If words containing only one of the letters were selected, only the letter (C) or only the letter (A), reinforcement was not provided. The children were required, as a result, to attend to both letters (C) and (A) in the word-discrimination test to maintain continuous reinforcement, as attending to only one of the letters would produce errors.

The word-discrimination test was initially presented for 20 trials in order to determine baseline performance. The word-discrimination test continued to be presented for 20 trials after differing amounts of single-letter pretraining were provided to the children.

Pretraining

Single-letter pretraining for the letters (C) and (A), which predicted reinforcement in the word discriminations, was accomplished by teaching the children to attend to each letter when the letters were combined to form a compound (C-A). Stimulus control by the letter (C) was first obtained by making the letter (A) common to both the S+ (C-A) and S- (K-A) letter compounds and only consistently pairing the letter (C) with reinforcement. After criterion accuracy was achieved, stimulus control by the letter (A) of the (C-A) compound was next established. This occurred by making the letter (C) common to both the S+ (C-A) and S- (C-E) letter compounds, and now only the letter (A) was consistently paired with reinforcement until criterion accuracy was obtained.

Pretraining trials and the word-discrimination test trials were alternated in additional sessions until the word-discrimination test had been presented six times to each of the children.

Data Collection

In terms of data collection, two different stimulus-control tests were administered with computer technology. One test assessed stimulus control by determining response accuracy when the letter compounds and word discriminations were presented. The other stimulus-control test consisted of recording response topographies by using a touch screen to record which of the letters the children touched when the letter compounds and word pairs appeared on the computer screen.

Results

Single-letter pretraining and repeated exposure to the four word discriminations were effective in teaching three of the four children to attend to both pretrained letters throughout the word-discrimination test. Before single-letter pretraining was provided, none of the children attended to both letters throughout the word-discrimination test. Following single-letter pretraining, however, three of the four children now achieved high accuracy scores for all four word-discriminations.

Word-Discrimination Test: Accuracy Scores

Child 1. Prior to initial pretraining, Child 1 failed to achieve high accuracy (80% or higher) for all four word-discriminations. Following pretraining, however, Child 1 did obtain high accuracy for each of the word discriminations, and he persisted in achieving high accuracy for all four word-discriminations in all of the following test sessions, with one exception.

Child 2. Although the response accuracy of Child 2 did increase during the word-discrimination test following initial pretraining compared to baseline, she did not maintain high levels of accuracy for each of the four word-discriminations until pretraining was repeated. When pretraining was repeated, however, she achieved 100% accuracy for all four word-discriminations and continued to achieve 100% accuracy for all four word-discriminations in the following test sessions.

Child 3. Child 3 achieved high accuracy scores for all four word-discriminations following pretraining, which did not occur in baseline, and he continued to achieve accuracy scores at 80% and higher for all four word-discriminations in the following test sessions.

Child 4. Finally, Child 4 did not maintain high levels of accuracy throughout any of the word-discrimination test sessions, in contrast to the other three children. Although Child 4 achieved 100% or near 100% accuracy for each letter (C and A) during

pretraining, she did not maintain high accuracy (80% or higher) for all four word-discriminations during any of the test sessions, when each pretrained letter predicted reinforcement.

Word-Discrimination Test: Response Topographies

Although three of the children achieved high accuracy scores for all four word-discriminations following pretraining, their response topographies revealed individual differences in how they responded to the words, which were not revealed by their accuracy scores. By recording which letters the children touched during the word-discrimination tests, all of the children were discovered to respond to the word discriminations differently even though the accuracy scores of three children were similar.

Child 1. Following pretraining, Child 1 continued to reveal high levels of stimulus control for both pretrained letters in the word-discrimination test when his response topographies were examined. He consistently touched both the pretrained letter (C) and the pretrained letter (A), when each letter predicted reinforcement, at levels of 80% and higher in all of the word-discrimination test sessions, with one exception. Both his response accuracy and his response topographies indicated he attended to both pretrained letters in the word-discrimination test.

Child 2. While two other children also learned to maintain high levels of response accuracy when each pretrained letter predicted reinforcement in the word-discrimination test, their response topographies revealed letter preferences indicating unequal levels of stimulus control. Child 2 never touched the letter (C) when it predicted reinforcement in any of the word-discrimination test sessions. She did demonstrate a preference for the letter (A) in the final two word-discrimination test sessions, however, when she selectively touched the letter (A) in 80% or more of the test trials when the letter A predicted reinforcement.

Child 3. Child 3, which was also the case for Child 2, never touched the letter (C) when it predicted reinforcement in any of the word-discrimination test sessions. In contrast to Child 2, however, he did demonstrate a preference for the letter (A) in all of the word-discrimination test sessions following pretraining when he selectively touched the letter (A) when it predicted reinforcement in 100% of the test trials.

Child 4. While Child 4 touched both the letter (C) and the letter (A) at or near 100% levels when each letter predicted reinforcement in pretraining, she failed to reliably touch either pretrained letter when they predicted reinforcement in any of the word-discrimination test sessions. Both her accuracy scores and her response topographies revealed she did not attend to both pretrained letters in any of the word-discrimination test sessions.

Discussion

In summary, although accuracy scores revealed some variability in how young children attended to word discriminations, recording their response topographies was a more sensitive stimulus-control test in revealing individual differences.

Study 2

In phase two, the amount of single-letter pretraining that was needed before young children simultaneously attended to each individual letter of a word discrimination was determined to assess the intensity of their overselective attention to words. Multiple stimulus-control tests were again administered with computer technology.

Method

Subjects

Four young children (6-7 years of age) of typical development participated in this study.

Word Discrimination

Each child was presented a word discrimination in which the S+ word and the S- word were presented simultaneously on the computer screen. The children were required to select the S+ word (BAG) to obtain reinforcement. If the S- word (RED) was selected, reinforcement was not provided. The word discrimination was presented until criterion accuracy was achieved, and the word discrimination continued to be presented after differing amounts of single-letter pretraining were provided.

Single-Letter Pretraining

During single-letter pretraining, pretraining for the letter (B) in the S+ word (BAG) was obtained by making the letters (A) and (G) common to both the S+ word (BAG) and the S- word (RAG) and consistently pairing the letter (B) with reinforcement. Pretraining for the letter (A) in the S+ word was established by making the letters (B) and (G) common to both the S+ word (BAG) and the S- word (BEG) and consistently pairing the letter (A) with reinforcement. Pretraining for the letter (G) in the S+ word was obtained by making the letters (B) and (A) common to both the S+ word (BAG) and the S- word (BAD) and consistently pairing the letter (G) with reinforcement. Pretraining trials and the word discrimination were repeated in additional sessions until the word discrimination was presented a total of six times to each child.

Word-Discrimination Test

Each time criterion accuracy was achieved for the word discrimination, a test was administered. In the word-discrimination test, the S+ word (BAG) appeared with three comparison words (RAG, BEG, BAD) that differed by only one letter.

Word-Generalization Test

In a generalization test, the S+ word (BAG) appeared with three comparison words (TAG, BUG, BAN), which differed by one novel letter.

During the tests, the three word pairs were presented ten trials each in an unpredictable mixed sequence and nondifferential reinforcement was employed during the test trials. The purpose of the tests was to determine how many letters of the S+ word each child was attending to. Because a touch screen was employed, which of the letters the children touched each time word pairs appeared on the computer screen was also recorded.

Results

The children responded identically to the individual letters during pretraining, but they displayed a variety of attentional patterns when the same letters appeared in a word-discrimination task.

Child 1

Child 1 exhibited high levels of stimulus control for each letter of the S+ word during the word-discrimination test before and after single-letter pretraining was provided. He demonstrated overselective attention, however, in the initial word-generalization test session when he exhibited stimulus control for only two letters of the S+ word (BAG). After single-letter pretraining was repeated, however, he now simultaneously attended to each letter of the S+ word. All three letters of the S+ word now exhibited high levels of stimulus control in the second word-generalization test.

When the response topographies of Child 1 were examined, in contrast, letter preferences were observed in all six sessions. In each session, he selectively touched the same letter in the S+ word (BAG) when he achieved criterion accuracy for the word discrimination. The response topographies of Child 1 revealed letter preferences, and these letter preferences were not evident in any of the word test sessions.

Child 2

Prior to single-letter pretraining, Child 2 did display overselective attention. Only two letters of the S+ word (BAG) exhibited stimulus control in her initial word-discrimination test. After single-letter pretraining was administered, however, the word-

discrimination test indicated that Child 2 now attended simultaneously to all three letters of the S+ word, as each letter of the S+ word now exhibited high levels of stimulus control. Child 2 continued to attend simultaneously to each letter of the S+ word in all of the subsequent test sessions and even in the word-generalization test sessions when comparison words containing novel letters were presented.

Although Child 2 attended simultaneously to each letter of the S+ word in all of the word test sessions when single-letter pretraining was provided, her response topographies also demonstrated letter preferences, which were not shown in the word tests. She too selectively touched the same letter in the S+ word when she achieved criterion accuracy for the word discrimination, and this occurred in all six sessions as had also occurred for Child 1.

Child 3

Single-letter pretraining did not eliminate the overselective attention of Child 3, but it did increase the number of letters in the S+ word that Child 3 attended to. Prior to single-letter pretraining, Child 3 did not exhibit stimulus control for any of the individual letters of the S+ word (BAG) during the word-discrimination test. After single-letter pretraining was administered and repeated, Child 3 eventually exhibited stimulus control for two of the three letters of the S+ word as demonstrated in the fourth test session. Even though single-letter pretraining did not eliminate his overselective attention, it did reduce it.

The response topographies of Child 3 demonstrated letter preferences in five of the six sessions where he selectively touched the same letter in the S+ word when he achieved criterion accuracy. Although the response topographies of Child 3 revealed letter preferences, as had occurred for Child 1 and Child 2, the selective attention of Child 3 was more intense. When Child 3 displayed letter preferences, his letter preferences prevented him from simultaneously attending to each letter of the S+ word as demonstrated in his word tests. In contrast, Child 1 and Child 2 also revealed letter preferences but their letter preferences did not prevent them from simultaneously attending to all three letters of the S+ word.

Child 4

The word test results of Child 4 revealed that following single-letter pretraining, Child 4 either continued to exhibit overselective attention or did not exhibit stimulus control for any of the individual letters of the S+ word.

When the response topographies of Child 4 were examined, he too demonstrated letter preferences in five of the six sessions where he selectively touched the same letter in the S+ word when he achieved criterion accuracy. The intensity of the letter preferences of Child 4 also prevented him from simultaneously attending to each letter of the S+ word as revealed in his word tests, which had also been the case for Child 3.

Discussion

Young children differed in how they attended to a word discrimination even after they were pretrained to attend to each letter of the S+ word. Overselective attention was eliminated for two of the four children, however, and reduced for a third child after single-letter pretraining was provided.

The prevalence of overselective attention to words in young children depended on the type of response measurement. While two of the four children persisted in displaying overselective attention when word choice was assessed, all four children consistently exhibited selective attention to words when their response topographies were recorded. The intensity of their selective attention differed, however, as only two of the children exhibited letter preferences intense enough to prevent them from simultaneously attending to each letter of the S+ word.

Utilizing multiple tests in both of these studies provided a fine-grained analysis of how young children attended to words and identified individual differences that accuracy scores alone would not have discovered. Employing computer technology to administer similar procedures to identify and eliminate overselective attention to words could result in more effective reading instruction. This is especially important for children with developmental disabilities and autism where improving their visual attention in their early years is critical in enhancing their later development.