Assessing Segmenting with Computerized Testing

INTRODUCTION

Computerized Testing

In assessing the prereading skills of young children, there has long been a need to modernize. Traditionally, such tests have been given orally one-on-one. These types of tests are obviously time-intensive to administer. Additionally, there is an inherent variance between test conditions based on that particular administrator's delivery of the test. Factors such as dialect, speed, enunciation, and intonation can all factor into the student's score.

Computers are an obvious solution to the problem. By using recorded sounds, each child is guaranteed the exact same test conditions. Also, these recordings can be reviewed by linguistic experts to ensure the optimal delivery.

But computerized testing is not without its difficulties. In creating a battery of online tests to assess reading and prereading proficiency, innovation was required to design a test to accurately assess the segmenting skill—an important part of phonemic awareness.

Segmenting

Segmenting is one of the more advanced tasks in phonemic awareness. It refers to the act of isolating sounds. Assessment in phonemic segmentation identifies students who are not adequately acquiring beginning reading skills and monitors the progress of students in phonological awareness.

Children demonstrate segmenting by differentiating and identifying the individual phonemes in a word, such as *man* (/m/…/a/…/n/). Segmentation skills are taught by representing a word's sounds by tapping, counting the sounds or positioning a marker for each sound. Additionally, phonemic segmentation is taught and assessed by using pictures, objects, and Elkonin boxes—a method by which the student drops an item into a box for each individual phoneme in the word. A widely used method of assessing segmentation—used in both the Yopp-Singer Test and DIBELS—involves reading an auditory prompt to the student and requesting the student to articulate each phoneme in each word.

PHASE I: EXPLORATION

Methods

Participants

Sixty-four children ages four to six who were enrolled in after school programs in the greater Salt Lake City area participated in usability testing. The participants included 31 males and 33 females. This phase of the study tested children's reactions to an online adaptive reading test, which included segmenting as one of the skills assessed.

Materials

For the first phase of the project, one prototype was developed based on counting letter sounds.

COUNTING

The counting approach (see Figure 1) was based on a successful classroom technique in which the student was asked for the number of letter sounds in the word. This was one of the few techniques found which did not require the child to speak. In order not to skew the results towards those with higher math skills, the student was asked to click a button each time a letter sound was heard.

In order for the designers to have clear guidelines, a perfectly segmented word was agreed to have the following properties:

1. Correct sounds
2. Correct number of sounds (i.e. no extra sounds nor slurring together multiple letter sounds)
3. Correct order of sounds

Figure 1: Counting prototype. Rolling over the image at top repeats the word to be segmented. Stars appear in the central box as it is clicked, one for each letter sound. The icon below it clears all stars. The green arrow is clicked when the child is finished.

The table below restates the three criteria of a properly segmented word, and whether this testing method assesses that property.

Segmenting Property	Tested
Correct Sounds	No
Correct Number of Sounds	Yes
Correct Order of Sounds	No

Procedure

Researchers visited children at their respective after-school programs to administer the counting design of segmenting. Each child was invited to a computer room with an experimenter and a laptop computer. The child received questions for each reading skill being assessed, including the segmenting section, which had 8 questions. The researcher observed the child and wrote notes regarding the child's reactions and success in the assessment.

Results

Children had difficulty understanding what the segmenting task required. Most children followed the example, which had three phonemes, and clicked the box three times for each subsequent segmenting test question. Consequently, two additional segmenting designs were tested.

PHASE II: VALIDATION

Methods

Participants

Thirty children ages five to seven who were enrolled in after school programs in the greater Salt Lake City area participated in usability testing. The participants included 17 males and 13 females.

Materials

With the next round of prototypes, it was decided that a multiple choice method would be explored, as well as an entirely new approach based on the direct manipulation of letter sounds.

MULTIPLE CHOICE

This method (see Figure 2) was developed to mimic the other tests that would appear alongside segmenting in a test session. Nearly all tests in the larger reading test were of the multiple choice form. The selected distracters focused on the most common segmenting mistakes: slurring two letter sounds together and omitting a single letter sound.

Segmenting Property	Tested
Correct Sounds	No
Correct Number of Sounds	Yes
Correct Order of Sounds	No

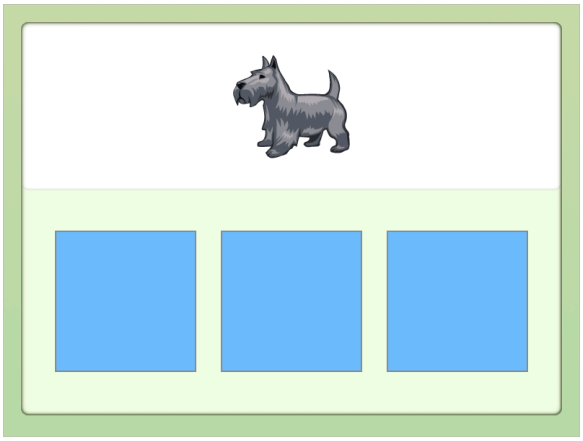

Figure 2: Multiple Choice prototype. Rolling over the image at top repeats the word to be segmented. The three buttons at the bottom of the screen each have rollover audio with the word segmented in a different way for each button. Clicking the button indicates the student's choice.

DIRECT MANIPULATION

For the last prototype, an entirely new approach was explored (see Figure 3). The focus for this design was on students who had never been formally taught to segment. Using a metaphor of "building a word," students were asked to drag a set of letter sounds into boxes to create the word. One extra letter sound was always given as a distracter in order to check for correct sound choice. Since the letter sounds could be assembled in any combination, there was also a possibility of mixing up the order.

Segmenting Property	Tested
Correct Sounds	Yes
Correct Number of Sounds	Yes
Correct Order of Sounds	Yes

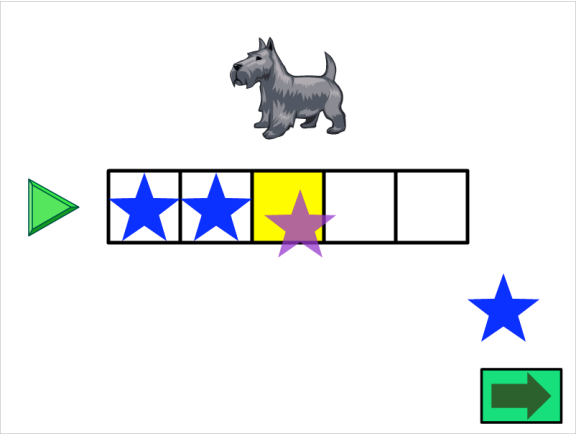

Figure 3: Direct Manipulation prototype. Rolling over the image at top repeats the word to be segmented. The stars at the bottom each have a rollover letter sound. The child builds the word by moving the stars into the boxes in the right order. There is always one extra star. The arrow at the bottom right is clicked when the child is finished.

Procedure

Researchers visited children at their respective after-school programs to administer both the multiple choice design and the direct manipulation design of segmenting. Each child was invited to a computer room with an experimenter and a laptop computer. The child received 8 segmenting questions for the direct manipulation design as well as for the multiple choice design. The number of correct answers for each design was recorded as well as the total amount of time it took to complete the test. In addition, children were tested on segmenting and reading nonwords using the phonemic segmentation section of DIBELS.

Results

Paired T tests were conducted comparing the number of correct responses in the multiple choice design versus the direct manipulation design. The number of correct responses was significantly higher for the multiple choice design in comparison with the direct manipulation design ($T(1,30)=-2.17$, $p<.05$). In addition, paired T Tests were conducted comparing the amount of time spent on the assessment in the multiple choice design versus the direct manipulation design. The amount of time spent on the assessment was significantly longer for the direct manipulation design in comparison with the multiple choice design ($T(1,30)=13.40$, $p<.01$).

Correlational analysis was conducted to examine the relations of the segmenting multiple choice design and direct manipulation design to DIBELS. Results indicate that while the direct manipulation design related to DIBELS phonemic segmentation as well as to DIBELS non words reading, the multiple choice design did not relate to DIBELS measures.

Table 1.

	DIBELS Segmenting	DIBELS NonWords	Multiple Choice Design	Direct Manipulation Design
DIBELS Segmenting	1.0			
DIBELS NonWords	.96**	1.0		
Multiple Choice Design	.28	.24	1.0	
Direct Manipulation Design	.57**	.50**	.47*	1.0

CONCLUSIONS

Despite the higher number of correct answers and the higher speed of the multiple choice design, the direct manipulation design was the only one that proved to be valid when tested in conjunction with DIBELS. The success of this design is attributed to several factors:

1. *Test Structure Affords Correct Usage*. With each of the prototypes, a large concern was whether the student understood what was being asked. This is not a simple matter of clear instruction—all prototypes started with an explanation and guided example. It is a matter of design—the very nature of the design lent itself to proper usage. The metaphor of building a word out of its sounds was very accessible to the students. Even those who didn't know how to segment seemed to grasp the basic concept.
2. *Question Difficulty Removes Correct Guesses*. With the direct manipulation design, getting the correct answer by pure guesswork was nearly impossible.
3. *Longer Test Time Not Necessarily A Flaw*. A main concern with this test was length of time to complete it. In retrospect, the slower nature of this test may have helped contribute to its success. The multiple interactions required to build a word which slowed down the test may have forced the student to stop and think.

Based on the findings of the National Reading Panel and the No Child Left Behind Act, phonemic awareness will continue to be a key skill for emergent reading. The development of accurate tools to assess phonemic awareness is essential in order to aid children in their pursuit of reading. As mentioned earlier, segmenting is traditionally assessed one-on-one. Considering the drawbacks inherent to one-on-one testing, this iterative design process resulted in a segmenting test design that includes the strengths of one-on-one administration combined with the advantages of computerized testing.