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EMERGENT SPELLING SKILLS: A CASE OF CONTINGENCY ADDUCTION

DISSERTATION

Presented in Partial Fulfillment of the Requirements
for the Degree Doctor of Philosophy in the
Graduate School of The Ohio State University

By
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The Ohio State University
1999

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Contingency adduction occurs when separately established behaviors recombine to form new behaviors. The knowledge of contingency adduction provides understanding for how some complex behaviors may come to fruition. Also, it may lead to education and social practices that benefit a great majority of people (e.g., making new discoveries, learning curricular material in less time).

The purpose of the present experiment examined whether establishing five separate behaviors (a) see/say letter names, (b) see/say letter sounds, (c) hear/say/do segmenting words into sounds, (d) see/say letter names and letter sounds, and (e) hear/say/do segmenting words into letters, would combine or demonstrate contingency adduction. Four students in kindergarten, one girl and three boys, served as the experimental participants. The experiment took place in a rural school.

The method used for promoting contingency adduction, frequency building, called for establishing high rates of responding in the behavior elements (i.e., see/say letter names, see/say letter sounds, hear/say/do segmenting words into sounds, see/say letter names and letter sounds, and hear/say/do segmenting words into letters). A multiple baseline across behaviors formed the experimental design to analyze whether learning the five element behaviors produced a contingency adduced spelling repertoire in eight dependent variables, (a) correct and incorrect hear/say spelling real and
nonsense words made from instructed letters, and (b) correct and incorrect hear/say spelling real and nonsense words made form non-instructed letters.

One student received all five experimental conditions and demonstrated a contingency adduced spelling repertoire. She could spell real and nonsense words made from instructed letters with a high degree of accuracy though the experimenter never provided formal spelling instruction or feedback on the student's spelling performance. The other three participants did not receive all five independent variable conditions, and none of those students demonstrated a contingency adduced spelling repertoire. The data from this study demonstrate a method for producing contingency adduction by using frequency building with element behaviors.
Dedicated to my family
ACKNOWLEDGMENTS

I wish to thank first those who endured the most from my educational journey, my family. My wife and children freely gave, and forgave me for, many late night study sessions, long days at school, a limited income, and occasional complaints and grumpiness. I dedicate my academic accomplishment to my family and will forever owe them a debt of gratitude.

In the limited amount of space in this section I find trouble expressing my appreciation to Dr. Cooper. From a new Master's student to graduating doctoral candidate, Dr. Cooper has provided me with academic instruction, professional guidance, and a role model that I will strive to follow. These words hardly seem enough to convey my gratitude for all Dr. Cooper has done for me.

The three other members on my dissertation committee, Dr. Cowardin, Dr. Heron, and Dr. Sainato all deserve my thanks. I have learned so much from each one in my many conversations in class, during informal conversations in the office, conferences, social gatherings, and all the other places I have spent time with them. I feel very indebted to each member because they have shared so much with me.

I would also like to thank Becky Morrison. Throughout my tenure in the doctoral program I always had Becky. She helped me in many ways; studying, preparing for program events, writing and editing papers, and sharing all the milestones that occur along the way to graduation.
Along the way to finishing my dissertation many other people played a prominent role accomplishments. For example, Barry Morgenstern and Dave Bicard served as my independent observers with I thank both for. They did, however, offer so much more by making keen observations and good data based suggestions for improving the study. Dr. Kathy Sampson also helped greatly by helping me find a place to do my dissertation as well as offering a critical eye for examining data. And last, the students who participated in this dissertation and the teachers who kindly allowed me in and out of their classrooms deserve my sincerest thanks.

In addition, I would like to acknowledge the value of E-prime, or using English without any form of the verb "be." E-prime provides many advantages in both scientific and personal discourse. Although I cannot offer more information on E-prime in this limited amount of space, I would like to personally recommend E-prime to anyone interested in communicating with a more precise, and a less dichotomous, writing style. Readers will find this dissertation completely written in E-prime aside from where I quoted others.
<table>
<thead>
<tr>
<th>Year</th>
<th>Position and Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>1992</td>
<td>B.A. Psychology, Youngstown State University</td>
</tr>
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<td>1993</td>
<td>M.A. Special Education, The Ohio State University</td>
</tr>
</tbody>
</table>
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FIELDS OF STUDY

Major Field: Education
Studies in: Applied Behavior Analysis, Special Education, Precision Teaching, Direct Instruction
TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abstract</td>
<td></td>
<td>ii</td>
</tr>
<tr>
<td>Dedication</td>
<td></td>
<td>iv</td>
</tr>
<tr>
<td>Acknowledgements</td>
<td></td>
<td>v</td>
</tr>
<tr>
<td>Vita</td>
<td></td>
<td>vii</td>
</tr>
<tr>
<td>List of Tables</td>
<td></td>
<td>xii</td>
</tr>
<tr>
<td>List of Figures</td>
<td></td>
<td>xiii</td>
</tr>
<tr>
<td>Chapters:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. INTRODUCTION</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>1.1 Purpose</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>1.2 Research Questions</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>2. LITERATURE REVIEW</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>2.1 Contingency and Selection</td>
<td></td>
<td>7</td>
</tr>
<tr>
<td>2.2 Sources of Novelty</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>2.2.1 Imitation</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>2.2.2 Instructions</td>
<td></td>
<td>12</td>
</tr>
<tr>
<td>2.2.3 Variability</td>
<td></td>
<td>14</td>
</tr>
<tr>
<td>2.2.4 Contingency Adduction</td>
<td></td>
<td>16</td>
</tr>
<tr>
<td>2.2.5 Interconnection of Repertoires</td>
<td></td>
<td>23</td>
</tr>
<tr>
<td>2.2.6 Elements and Compounds</td>
<td></td>
<td>29</td>
</tr>
<tr>
<td>2.3 Spelling and Phonemic Awareness</td>
<td></td>
<td>36</td>
</tr>
<tr>
<td>3. METHOD</td>
<td></td>
<td>43</td>
</tr>
<tr>
<td>3.1 Students</td>
<td></td>
<td>43</td>
</tr>
<tr>
<td>3.2 Setting</td>
<td></td>
<td>45</td>
</tr>
<tr>
<td>3.3 Experimenter</td>
<td></td>
<td>45</td>
</tr>
<tr>
<td>3.4 Definition and Measurement of the Dependent Variable</td>
<td></td>
<td>46</td>
</tr>
<tr>
<td>3.4.1 Correct Real Words</td>
<td></td>
<td>46</td>
</tr>
</tbody>
</table>

ix
# LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1</td>
<td>Description of students by gender and age</td>
<td>44</td>
</tr>
<tr>
<td>4.1</td>
<td>Students Responses to the Social Validity Questions</td>
<td>99</td>
</tr>
<tr>
<td>4.2</td>
<td>Teacher Responses to the Social Validity Questionnaire</td>
<td>102</td>
</tr>
<tr>
<td>Figure</td>
<td>Description</td>
<td>Page</td>
</tr>
<tr>
<td>--------</td>
<td>-----------------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>4.1</td>
<td>Amy's hear/say spelling real words made from instructed letters</td>
<td>68</td>
</tr>
<tr>
<td>4.2</td>
<td>Amy's hear/say spelling nonsense words made from instructed letters</td>
<td>69</td>
</tr>
<tr>
<td>4.3</td>
<td>Tom's hear/say spelling real words made from instructed letters</td>
<td>70</td>
</tr>
<tr>
<td>4.4</td>
<td>Tom's hear/say spelling nonsense words made from instructed letters</td>
<td>71</td>
</tr>
<tr>
<td>4.5</td>
<td>Fred's hear/say spelling real words made from instructed letters</td>
<td>72</td>
</tr>
<tr>
<td>4.6</td>
<td>Fred's hear/say spelling nonsense words made from instructed letters</td>
<td>73</td>
</tr>
<tr>
<td>4.7</td>
<td>Bill's hear/say spelling real words made from instructed letters</td>
<td>74</td>
</tr>
<tr>
<td>4.8</td>
<td>Bill's hear/say spelling nonsense words made from instructed letters</td>
<td>75</td>
</tr>
<tr>
<td>4.9</td>
<td>Amy's hear/say spelling real words made from non-instructed letters</td>
<td>77</td>
</tr>
<tr>
<td>4.10</td>
<td>Amy's hear/say spelling nonsense words made from non-instructed letters</td>
<td>78</td>
</tr>
<tr>
<td>4.11</td>
<td>Tom's hear/say spelling real words made from non-instructed letters</td>
<td>79</td>
</tr>
<tr>
<td>4.12</td>
<td>Tom's hear/say spelling nonsense words made from non-instructed letters</td>
<td>80</td>
</tr>
<tr>
<td>4.13</td>
<td>Fred's hear/say spelling real words made from non-instructed letters</td>
<td>81</td>
</tr>
</tbody>
</table>
4.14 Fred's hear/say spelling nonsense words made from non-instructed letters .......... 82
4.15 Bill's hear/say spelling real words made from non-instructed letters ............... 83
4.16 Bill's hear/say spelling nonsense words made from non-instructed letters .......... 84
4.17 Amy's letter names, letter sounds, segmenting sounds and letters ................. 85
4.18 Tom's letter names, letter sounds, segmenting sounds and letters ................. 86
4.19 Fred's letter names, letter sounds, segmenting sounds and letters ................. 87
4.20 Bill's letter names, letter sounds, segmenting sounds and letters ................. 88
CHAPTER 1

INTRODUCTION

What accounts for dramatic displays of novel behavior that animals emit? When directing the question at animals such as rats and pigeons the answers may appear to reside in well-known principles of behavior such as imitation or shaping. When asking a similar question about human behavior, often a door opens for other explanations. For instance, people may use terms like creativity, insight, and intuition to describe extraordinary, unprecedented performances. Principles of behavior, however, can also account for novel human behavior (Skinner, 1957, 1974).

Applied researchers and practitioners have used principles of behavior to engineer environments that produce impressive productions of novel human behavior including: new block forms (Goetz & Baer, 1971, 1973), new forms in easel painting (Goetz & Salmonson, 1972), new forms of felt pen drawings (Lane, Lane, Friedman, Goetz, & Pinkston, 1982), different communicative gestures (Duker & Lent, 1991), increases in objective textuals (Glover, 1980), diverse and novel drawings and stories (Baker & Winston, 1985), and new verbal behavior (Issacs, Thomas, & Goldiamond, 1960) and unique motoric movements (Baer, Peterson, & Sherman, 1967). All of the
previous researchers and practitioners had something in common; they used procedures derived from basic principles of behavior to produce novelty.

Our society values novel, productive, or "creative" behaviors at the individual and societal levels (Sternberg & Lubart, 1996). Therefore, it would seem behavior analysis has much to offer those valuing novel behaviors. The research in behavior analysis, however, has yet to produce the dramatic novel behaviors highly valued by our society (e.g., a new symphony, a cure for AIDS). In deference to behavior analysis, the young science has evolved and offers a substantial body of research that provides a framework for understanding complex behavior (Donahoe & Palmer, 1994). One of the most recent behavior processes to gain attention, "contingency adduction" (Andronis, Layng, & Goldiamond, 1997; Johnson & Layng, 1992, 1994, 1996; Layng & Andronis, 1984) may one day lead to the understanding of dramatic productions of novel behavior.

Adduction comes from the Latin word "adducere" which means "to bring to" (American Hertiage, 1994). Interpreted literally the term contingency adduction refers to "...the act of bringing a repertoire established under one contingency to another" (Layng, 1999a). Johnson and Layng (1992) offer a technical definition describing contingency adduction as the process where repertoires established in certain conditions recombine with other repertoires to produce new behavioral forms and sequences. Contingency adduction has basic and applied experimental support (Andronis, et al, 1997, Johnson & Layng, 1992).

Johnson and Layng (1992) provide an example of contingency adduction. Four college students attending a summer program attempted fraction word problems as part of an instructional sequence. The best of all the
students scored 7 out of 14 correct, or 50%. These students demonstrated comparable deficiencies in word problems at a lower level involving whole number completion. As part of the students mathematics program, they all received instruction on problem solving and calculations with whole numbers and computation practice with fractions. They practiced these component behaviors until they reached a "fluent" level. The four students then took a test similar to the one they took before they reached fluency. The lowest of the scores afterwards: 13 correct and 1 incorrect. The other three students answered all questions at 100% accuracy. None of the students received instruction on fraction word problems. Johnson and Layng (1992) believe the students adduced new repertoires that allowed them to solve the problems correctly.

Little published research exists to fully delineate the parameters of contingency adduced behavior. A behavior analysis of contingency adduction may reveal many discoveries. Towards the more dramatic end of the continuum, a fuller understanding of the variables functionally related to adduced behavior may enhance the development of the behaviors many labeled as insightful, creative, or intuitive. Towards the more commonplace end, it may help explain what many have called "aha!" experiences, and other commonly occurring spontaneous, inventive behaviors. Further, the study of adduced repertoires may fall into categories such as "nonverbal, procedural, and metaphorical" (Andronis, 1998).

An experiment examining contingency adduction requires behavior elements that can combine into a compound or new behavior. One usual spontaneous event that may readily fall into a contingency adduction framework happens when many young children start to spell words
extemporaneously. The term "invented spellings" describes children's preliterate attempts at spelling (Read, 1971).

The basic element behaviors of spelling include a student's knowledge, or letter names, graphemes, and letter sounds, phonemes of (Ehri, 1989). Without such knowledge, a student would have great difficulty spelling words properly. Recently, much attention has centered on phonemic awareness in relation to students learning to read and spell (Adams, 1990; Blachman, 1984, 1989; Bradley & Bryant, 1978; Lieberman & Shankweiler; Lundberg, Olofsson, & Wall, 1980; Mann, 1984, 1993; Stanovich, 1985, 1986, 1988; Treiman, 1991; Wagner & Torgesen, 1987). "Phonemic awareness" describes a "Conscious ability to detect and manipulate sound... access to the sound structure of language....awareness of sounds in spoken words in contrast to written words" (Smith, Simmons, & Kameenui, 1995 p. 3). Thus, preliterate spelling skills, or invented spellings may reflect a contingency adduced repertoire of spelling.

**Purpose of this study**

This study investigated strategies that fostered contingency adduction of separate behaviors into a compound (i.e., oral spelling). This study used instructional methods for building academic fluency (i.e., accuracy, quality, and speed) to a level of learning where uninstructed, spontaneous, and novel behaviors have occurred. By developing elemental skills to fluent levels, compound behaviors may readily appear. Teachers may use the knowledge of this study to focus on elemental literacy skills before beginning formal instruction thereby increasing the success of children in the primary grades.
Research Questions

1. What effects will learning letter names, letter sounds, letter names and letter sounds together, segmenting words into sounds, and segmenting words into letters to fluent levels have on correct and incorrect oral spelling of real words?

2. What effects will learning letter names, letter sounds, letter names and letter sounds together, segmenting words into sounds, and segmenting words into letters to fluent levels have on correct and incorrect oral spelling of nonsense words?

3. What effects will learning letter names, letter sounds, letter names and letter sounds together, segmenting words into sounds, and segmenting words into letters to fluent levels have on correct and incorrect oral spelling of real words made up of letters students did not receive during instruction?

4. What effects will learning letter names, letter sounds, letter names and letter sounds together, segmenting words into sounds, and segmenting words into letters to fluent levels have on correct and incorrect oral spelling of nonsense words made up of letters students did not receive during instruction?

5. Will teachers and students find the procedures useful and effective in terms of generative spelling skills?
CHAPTER 2

LITERATURE REVIEW

Mark Twain once said, "A man who carries a cat by the tail learns something he can learn in no other way" (Lieberman, 1983, p. 130). This pithy quote allows people with knowledge of cats to create a vivid picture of the effects of a certain kind of learning. Skinner (1957, 1974) describes descriptions of learning, such as Twain's keen observation, as a verbal statement that describe a behavior and its consequences. Indeed, all people have engaged in some action that produced clear, straightforward consequences. Perhaps some people even hear advice "inside their heads" when they experience a negative straightforward consequences (e.g., "Look before you leap!"). A behavioral term, contingency, describes such discreet, linear, sequential learning episodes.

The science of behavior, or behavior analysis (Cooper, Heron, & Heward, 1987) has a generated a great deal of data regarding contingency learning. An examination, or even a cursory glance, at the leading behavioral journals (e.g., Journal of Applied Behavior Analysis, The Journal of Experimental Analysis of Behavior, The Analysis of Verbal Behavior) offers studies based on the fundamental concept of a contingency. This literature
review examines certain types of novel behavior not readily explained by a simple contingency. Rather this review focuses on how contingencies may combine with other contingencies transforming behavior into new, complex blends and patterns. The review consists of introducing contingency and selection, an inspection of sources of novelty, and extensive reviews of contingency adduction, interconnection of repertoires, behavioral elements and compounds, and phonemic awareness. This literature review constitutes a conceptual foundation for understanding how complex, novel behaviors develop.

Contingency and Selection

In its simplest form a contingency represents contiguous, temporal relationship among events. These events include a motivating condition, stimulus, behavior, and environmental consequences (Michael, 1993). Hearkening back to Twain's cat observation the following example illustrates a contingency. A person wants to put a plate of food into a microwave oven but his pet cat has planted herself in front of the door. The person decides to grab the cat by the tail, with a freehand, and pull her out of the way. Upon having her tail pulled the cat immediately turns around and bites and scratches the person's hand. If we had a chance to observe this contingency we could predict the person would act differently in the future when finding the cat in front of the microwave. Skinner (1969) explained the contingency relationship very clearly when he said:

An adequate formulation of the interaction between an organism and its environment must always specify three things: (1) the occasion upon which a response occurs, (2) the response itself, and (3) the
reinforcing consequences. The interrelationships among them are the "contingencies of reinforcement (p.7).

In the most general sense, contingency refers to "a relation in which the occurrence of one event depends on the occurrence of another event" (Donahoe & Palmer, 1994 p. 355). The analyses of contingencies set the precedent for analyzing behavior. Contingencies occur at phylogenetic, ontogenic, and cultural levels. Explicating these relations leads to a clear understanding of the phenomenon under study.

Researchers from other disciplines, such as Gould (1989), have noted the importance of contingency:

Historical explanations take the form of narrative: E, the phenomenon to be explained, arose because D came before, preceded by C, B, and A. If any of these earlier stages had not occurred, or had transpired in a different way, then E would not exist (or would be present in a substantially altered form, E', requiring a different explanation)... I am not speaking of randomness (for E had to arise, as a consequence of A through D), but of the central principle of all history- contingency. (p. 283).

In the previous excerpt, Gould (1989) discusses the importance of contingent relations as a part of a historical science. Behavior analysis, similar to sciences like paleontology and evolutionary biology, shares the distinction of using historical evidence to understand complexity and diversity. Past evidence combined with contemporary studies leads to a more accurate understanding of how complex phenomena come to evolve into their present form. Specifically, behavior analysis investigates complex behavioral repertoires by focusing on past and current contingencies of behavior.
The study of contingencies in behavior analysis has generated behavioral principles. One such contingent relation, the principle of positive reinforcement states that when a reinforcer follows a behavior, that response has a greater likelihood of occurring in the future with the relevant establishing operations present (Cooper, Heron, & Heward, 1987). In a selectionist account of behavior, reinforcement serves as the selection mechanism (Donahoe, 1991; Donahoe & Palmer, 1994).

A child obtaining a gum ball serves as an illustration of positive reinforcement's selecting action. In the past, the child put a quarter into a gum ball machine and a certain consequence occurred. The appearance of gum ball machine serves as the occasion for which a behavior, putting a quarter into the machine, produces a consequence. This simplified example takes into account the individuality of the child. Specifically, not all children will act the same way or have the same reinforcement history, when in the presence of gum ball machines. Further, even the child in the example will not act the same way in the presence of gum ball machine due to establishing operation and other contextually relevant variables (Michael, 1993). For instance, the child may have a full mouth of gum or just finished chewing some sweet candy. This illustration of reinforcement provides an example of a contingent relation that when similar conditions arise (i.e., an establishing operation) the probability that the child will act in a similar, manner increases. The environment selected a behavior.

What happens when we observe a person doing something novel that seems highly unlikely to have occurred from exposure to a simple contingency? For instance, a child solving a word problem, riddle, or mathematical equation without the benefit of instruction. If the child has
certain elements of the final response in their repertoire, or more specifically if the child has experiences contingencies related directly to the final response needed to solve some problem, those behaviors can recombine and form a fundamentally new response or sequence of behaviors. This process of the coming together, or recombinations, of previous contingency shaped behavior demonstrates contingency adduction (Andronis, Layng, & Goldiamond, 1997; Johnson & Layng, 1992, 1994, 1996; Layng & Andronis, 1984).

Sources of Novelty

Epstein (1986) identified four sources of novelty for study in the behavioral laboratory. The four sources consist of imitation, instructions, variation, and interconnection of repertoires. In addition, a fifth category, contingency adduction, also deserves consideration. All the categories yield novel behavior and allow a researcher to control the subject matter by understanding and identifying the sources of controlling variables. The following section will describe the five environment-behavior relations and provide an example of research done in the area.

Imitation. "The act or an instance of imitating" commonly defines imitation in many dictionaries. In behavior analysis, three states must occur to meet the specifications for the definition of imitation: (a) demonstration of a model, (b) after demonstration of the model imitative behavior ensues, and (c) reinforcement of the imitative behavior (Cooper, et al., 1987). Once an imitative repertoire has developed, the person can imitate behaviors may serve a variety of functions (e.g., avoiding danger, solving problems).

In addition, an imitative repertoire has obvious survival value. For instance, in our distant past a person might have successfully gathered
nourishment from grubs or mushrooms by uprooting logs and rocks. Another person imitating this behavior extends his or her ability to gather food. Without imitative responses, the person might have never discovered a particular method for gathering food. Here behaving like another behaves produces reinforcing consequences. This makes an imitative repertoire valuable and more likely to occur again in the future.

Baer, Peterson, and Sherman (1967) conducted an important study demonstrating the development of imitative behaviors in nonimitative children. In the first part of the procedures, children learned discriminated operants, or a contingency involving an occasion for response differentially correlated with reinforcement, a response, and a consequence. For instance, the experimenter said "Lift your arm" while she lifted her arm. If the child performed this behavior immediately following the command, the experimenter presented food as a consequence. Imitative behavior did not first occur spontaneously, so the experimenter shaped the response (e.g., successively guide and reinforcement to a terminal behavior).

After the children acquired imitation skills, new behaviors imitated correctly on the first trial did not receive reinforcement. This procedure allowed the experimenters to probe for development of an imitative repertoire. The experimenters proceeded to reinforce more complex chains of imitative behavior and eventually, verbal behavior. The research by Baer et al., (1967) has demonstrated an effect known as "generalized imitation" (e.g., Sherman, Clark, & Kelly 1977). Generalized imitation refers to the ability to imitate without direct instruction or reinforcement (Sherman et al., 1977).

Most typically developing children possess generalized, imitative repertoires and can readily imitate a wide variety of behaviors. This
environment-behavior relation forms a source of novel behaviors that appear limitless. In art class, a child may make a series of brush strokes that reveal a complicated, novel piece of work. A casual observation may lead some viewers to describe the piece as creative. A closer inspection, however, reveals the child has imitated a piece of work painted by an older child. Although the young child's piece of art qualifies as novel, many people would probably not classify this behavior as creative. Often we do not judge imitations or copies of preexisting work as creative.

Instructions. Instructions, or rule governed behavior, describe the use of communicating a thorough account of stimuli related to a contingency (Skinner, 1966). In the form of verbal rules, one person may tell another what to do, or not do, in certain situations (e.g., advice, warnings, directions). When given in textual format, a rule or instruction informs by specifying behavior leading to an outcome otherwise improbable, time consuming, or unlikely to occur through casual observation (e.g., lawnmower assembly instructions, maps, danger signs).

Instructions work because humans have the capacity for advanced verbal behavior. Instructions supply a substantial benefit by permitting a person to avoid making direct contact with certain contingencies of behavior (e.g., contingencies that take the form of dangerous situations). For example, a traveler in a big city hears from another not to travel down a certain street at during late hours. By following these instructions the person then increases her chances that she can avoid an area associated with criminal activity. The results benefit the person because he can act in ways that otherwise would only occur under the contingency shaping effects of a direct interaction with the stimuli inherent to the situation.
Baker and Winston (1985) investigated how instructions increase novel behavior. In their study, six children between the ages of 5 and 6 served as participants. Low scores on a pretest measuring diverse and novel drawings and stories functioned as a screening device for selecting children as research participants. Children drew pictures and wrote a story about what they created in the baseline condition. During intervention, the children learned to use self instructions in the form of asking themselves questions and answering their own questions before beginning their work (e.g., "What am I to do today? Draw a picture. What should I make? Maybe a new car driving around town). Results from the intervention, analyzed with a multiple baseline design, demonstrated that when the children used the self instructions they created more diverse and novel drawings and stories. A six-week follow up on the intervention indicated the results maintained.

Research such as the Baker and Winston (1985) study demonstrate one potential use of using instructions to increase novel behavior. Perhaps other types of instruction interventions may follow suit by specifying the steps needed to diversify or create novel behaviors related to a task. For example, a general writing strategy may involve coming up with a number of potential story lines or main ideas. Then, for each particular story line, writing down and analyzing the option that will produce the most, and best, ideas. Over time, these types of instructions may stay the same, improve, or generalize to other skills such as generating ideas and solutions to logic or math problems. In all, teaching general or specific instructions will provide a person with the ability to generate novel behavior in many situations.

Providing instructions has limitations. Namely, certain contingency shaped behavior does not lend itself to description (Skinner, 1966). Behaviors
involving motoric skills tend to oppose smooth translation into instructions. As an example, creating new steps or sequences to fashion a new dance. Although the instructions may allow a person to follow the steps in an established dance, the emergence of a new dance seems to defy codification. Rules and instructions state ways to diversify certain behaviors thus creating novel behaviors. The extent of rule success will always depend on the type and amount of contingency shaped behavior a person has in his or her repertoire.

Variability. In a selectionist paradigm, variability forms an essential characteristic of an account of behavior. Whether the contingencies happen at the level of phylogeny, ontogeny or culture, variation must take place first for selection to occur. Species that behaved in a stereotypical manner and did not exhibit variability in the face of fast-paced environmental changes no longer exist (Sidman, 1960).

Many behavior analytic researchers who study the emergence of novel behaviors, and specifically under the context of creativity, have used reinforcement to increase variability and novelty. Reinforcement, as noted before, describes an environmental relation where a stimulus increases the probability of a response it follows that occur in the context of relevant establishing operations (Cooper, et al., 1987). The use of reinforcement provides a means to produce variations in a widespread class of behaviors such as academic, vocational, social, and leisure pursuits.

Goetz and Baer (1973) performed a classic study in behavior analysis that used reinforcement to foster diversity and novelty with preschool children. The participants for the study involved three 4 year old preschool girls. During baseline, the teacher observed the children building blocks. The
children remained in baseline until new block constructions stabilized. In the intervention phase, teachers praised the appearance of new block forms. The children increased the form diversity of the block constructions when the teacher praised form diversity.

Fostering variability of responding has limits in terms of the scope of novel responses. Specifically, how much and in what ways, can a person's behavior vary? If we arrange appropriate conditions to foster variability, will a person eventually come up with the equation for Einstein's theory of relativity? It seems unlikely variability alone explains the full dimensions of novel behaviors. Rather variability demonstrates a method for increasing novel responses. The skills and information people have in their behavioral repertoire will ultimately circumscribe how many responses show up as a result of reinforcement procedures.

Through imitation, instructions, and variability, research has shown how novel behaviors appear. What distinguishes these forms of novel behavior? People ascribe credit, or give value, to behaviors by examining the conditions under which they occur (Skinner, 1971). For example, if knowing the boy scout received a payment for assisting an elderly person cross a street, we would not credit the boy scout with certain virtues. Indeed, we may question the boy scout's "intentions." On the other hand, if we discovered he performed his task because he enjoyed helping people, we would credit him with a noble deed and value his behavior.

How people attribute credit, or value, novel behavior follows a similar account. If we watch a person imitate a complex behavior we would qualify it as novel, but we may not give or value it very much because it does not demonstrate originality. If a person reads instructions and demonstrates a
novel behavior, we again would agree on the novelty of the behavior, but we may tend to value it less because of the derived source of originality.

Promoting variability alone does not ensure or explain the production of novel effects of all people. Interconnection of repertoires, and contingency adduction, provides a descriptive account of how more dramatic novel effects occur. Further, novel behavior resulting from interconnection of repertoires or contingency adduction promotes attributing value and credit due to the hidden nature of processes leading up to the behavior.


Technically speaking, contingency adduction refers to the process of recruiting behavior patterns or combinations of patterns (repertoires) by consequential contingencies that are different than the contingencies that shaped the original patterns.... In a selectionist account... frequency building may make component performance more probable and thus more likely to be prompted and selected by current contingencies (p. 286-287).

The Johnson and Layng (1996) quote highlights two important features emanating from the discovery of contingency adduction. First, the selectionist science of behavior now has a technical term that accurately labels how existing behaviors can rapidly combine and transform into meaningful new
behaviors. Second, behavior analysts have one means of producing contingency adduction, by behavior frequency building in both laboratory and applied settings.

A frequency, sometimes referred to as a "rate," of behavior signifies a count per unit of time (Johnston & Penneypacker, 1993; Penneypacker, Koenig, & Lindsley, 1972). In addition, frequency represents a standard unit of behavior (Johnston & Penneypacker, 1993). Typing 70 words in one minute, walking 400 paces in one hour, writing 2 books in a year, all represent a frequency count. In education frequency measures might include solving 30 math facts per minute, writing 100 words in 15 minutes, or 20 teacher/student interactions per hour. Thus, behavior frequency building simply means having a person practice a behavior until its frequency occurs in a specified range.

Johnson and Layng (1992) provide an applied example of using frequency building, or sometimes called fluency building, to produce contingency adduction. Four students attending a summer program at Malcolm X College in Chicago took tests that involved word problems containing fractions. All four of the students performed very poorly on the test. The best score, 7 correct out of 14 problems. The worst score, 3 correct out of 14 problems. The students took other tests as part of the mathematics sequence, and the results revealed similar deficiencies with fraction computation skills and solving whole number word problems. The students practiced fraction computation problems and solving whole number word problems until they reached high frequencies of correct responding.

What resulted by raising frequency of correct responses on fraction computation problems and solving whole number word problems? Students
re-tested with a fraction word problem test, similar to the original, now attained near perfect scores. The worst score in the group, 13 out 14 correct, while the other three students answers the problem with 100% accuracy. None of the four students received practice on fraction word problems making this demonstration very impressive. Now the students have a new behavior that could undergo selection by reinforcement.

Andronis, Layng, and Goldiamond (1997) published the only basic experiment in the literature demonstrating the effects of contingency adduction. The participants in the study included seven White Carneaux pigeons. Four birds received the designation of "referent birds" meaning they would undergo training on all components of the experiment. The other three birds, called "target birds," experienced only certain parts of the experimental procedures.

For the first experimental component the experimenters put the pigeons in an experimental chamber that had two chambers divided by a clear Plexiglas partition. All seven birds began training and experienced discrimination training with the house lights. The pigeons came under control of the house lights through successive approximations. When the white light came on the birds had to peck 50 times, a schedule called a "Fixed Ratio" or FR-50, to produce reinforcement. Under the red light, a FR-1, or one peck produced reinforcement while the green light required a FR-75 for reinforcement. Pigeons pecked "Food Keys" during each colored light condition to meet the programmed reinforcement schedule.

The second experimental component included training for the four referent birds. This component involved producing discriminative control over Switch Keys" affixed to the Plexiglas partition. By pecking on the Switch
Keys the pigeons would change the house lights which in turn changed the work requirements on the Food Keys. The two Switch Keys never provided direct reinforcement, rather it changed only the house lights. Meeting the requirements on one Switch Key, called Switch Key Far, would change the house lights to green thus raising the work requirement. The other Switch Key, call Switch Key Near, would have the effect of changing the house lights to red; thus, lowering the work requirement on the food key. The experimenters switched these relations so pigeons did not establish a position preference. Pigeons worked to avoid the high work requirements and activate the lowest work requirement by pecking the appropriate Switch Keys.

Concurrent to the establishing discriminative control on the Switch Keys Andronis et al., raised the requirement on the Food Keys so that now the lowest work requirement, during the red house light condition, required a FR-20 for reinforcement.

In the third component, Andronis et al., transferred behaviors previously acquired into the adjacent chamber. After switching the birds into the other chamber, the referent birds pecked the Switch Keys and changed the house lights in the adjacent chamber. The referent birds performed these tasks under the white house lights with a continual FR-50. After 4 or 5 sessions all referent birds stopped pecking the Switch Keys.

The next two conditions, called "Social Conditions" had the target birds placed in opposite chambers. In the first social condition both the referent and target birds had a FR-50 programmed on their Food Keys. Because of the Switch Keys in the referent birds chamber the food requirements for the target bird might increase or decrease depending on the referent birds pecking: high work requirements, associated with the green house light, equaled a FR-100
and low work requirements, associated with the red house light, equaled a FR-10. Referent birds, however, seldom pecked the switch keys. Only one referent bird ever pecked the Switch Keys. The target birds never pecked the Switch Keys.

The experimenters switched the schedule on the Food Keys from and FR-50 to a FI-40, or Fixed Interval 40 seconds, in the second social condition. Now the birds could peck the food key once and obtain food, but they would then need to wait for a 40 second interval before the next opportunity to peck a food key and receive food. All pecks in the interim did not produce food. Andronis et al., programmed the FI-40 on the referent and target birds Food Keys and associated the schedule with a yellow house light. Only the referent birds’ pecks on the Switch Keys could switch schedules of reinforcement; the target bird’s pecks only effected its own chamber. Even if the target birds met the requirements for a schedule of reinforcement, the referent birds could reset the target birds schedule by pecking the Switch Keys.

At this point the experimenters had established a baseline condition "Far Green," in which alternate experimental derivations could occur in the social conditions. The experimenters alternated such conditions as reversing the work requirements on Switch Key Near and Switch Key Far, having the referent birds in the same conditions active, but without the target birds, and changing the association of the colored house lights to different work requirements in the target birds chamber (e.g., green equaled a FR-10 and red equaled a FR-100). Andronis et al., changed this last procedure to determine if the changes in the target animals behavior maintained the referent birds use of Switch Keys and not just the association with the color.
A highlight of the results from the experiment reveals interesting findings. For example, referent birds showed a clear preference for imposing high work requirements on the target birds. Also, referent birds did not peck the Switch Keys without the target birds. Even after performing a series of reversal on Switch Key Far and Switch Key Near for one referent bird, he clearly demonstrated a preference for imposing the high work requirement for the target bird.

The experimental results reported by Andronis, Layng and Goldiamond (1997) demonstrated contingency adduction. Contingency adduction occurred when the referent birds encountered a situation where a past history of behaviors established in one context returned and recombined and formed a new class of behaviors that met the functional, or formal, requirements of a new contingency. Andronis, Layng, and Goldiamond (1997) explained:

...the pigeons in this study worked for food under conditions known to induce aggression, but were not given the opportunity to engage in conventional or species-typical aggressive behavior, previously trained nonsocial repertoires recurred and recombined in a way that eventually met the functional requirements of new, complex, apparatus-mediated (symbolic) social contingencies. These historical components included escaping from a stimulus (houselights that accompanied a high work requirement) that the birds would later work to produce when the stimulus occurred in an adjacent chamber with a conspecific present, and not in its own chamber. (p. 15, emphasis in the original)
The Andronis, Layng and Goldiamond (1997) experiment has important outcomes. First, the experimenters provided a convincing demonstration of contingency adduction. A second consequence concerns the latitude of contingency adduction. The Johnson and Layng (1992) report demonstrated contingency adduced academic behaviors whereas the Andronis et al., (1997) experiment demonstrated contingency adduced social behaviors.

The contingency adduction literature review brings forth immediate observations one of which concerns the paucity of research. Albeit the literature offers one experimental study and one applied report, the data do support the use of contingency adduction as a descriptive term used in behavior analysis. Later in the literature review section an examination of other behavioral phenomena will reveal that a variety of experiments supporting contingency adduction.

The contingency adduction literature also raises some important questions. For example, an observation Johnson and Layng (1992) stipulated that frequency building makes behaviors more probable for selection by consequences. Layng (1999) qualified this when he said: "Adduction does not require fluency. Classroom work appears to suggest that it may make behavior more likely for selection by contingencies other than those that selected it, but it is not required." This brings up the question, "What other variables promote contingency adduction?" Other questions about contingency adduction: How frequently does it occur? How do researchers and practitioners best study and apply contingency adduction? At this point, these questions may form the basis for further empirical investigations of contingency adduction.
Interconnection of Repertoires. The "interconnection of repertoires" forms a thematic line of research that demonstrates the effects of separately trained behaviors later combining into a new compound, or blend of behavior. When researchers describe "interconnection" studies their explanations resemble that of contingency adduction (The differences between interconnection and contingency adduction appear at the end of this section). Further, the functional effect appears germane; separate behaviors combine to form a novel, untaught behavior. In Epstein's (1985) words:

Interconnection is likely when multiple behaviors are made available, either through resurgence of previously reinforced behaviors during extinction...or by multiple controlling stimuli.... Multiple behaviors may combine to produce new sequences... behaviors that have new functions... or behaviors that have new topographies. Interconnections come about moment-to-moment in time through a variety of processes, any and all of which may be operating simultaneously. (p. 132)

Once combined, the novel sequences produce a new behavioral sequence available for selection by reinforcement. All the published research demonstrating interconnection of repertoires has occurred in basic research with pigeons serving as the experimental participants.

The first published study of interconnection of repertoires appeared in Nature (Epstein, Kirshnit, Lanza, & Rubin, 1984). The Epstein et al., research systematically replicated a study by Köhler (1925). Köhler used an experimental situation where a chimpanzee had to solve a problem. The problem, obtaining a banana suspended from a wire, required the
chimpanzee to move boxes on the ground, stack them on top of each other, and then climb the stack and reach for the banana.

Epstein, Kirshnit, Lanza, and Rubin, 1984 systematically replicated Köhler's experiment by placing pigeons in a cylindrical wire-mesh chamber that contained a box and a banana hung overhead. The goal of the experiment, similar to Köhler's experiment, called for a complex solution: pushing a box underneath a suspended banana, climbing up on the box, and then pecking the banana. Epstein et al., (1985) hypothesized that providing the pigeons with the appropriate "experiences," of component behaviors, the behaviors might recombine to form a composite behavior that would solve the problem.

Eleven pigeons, all adult males either a Racing Homer or White Carneaux, received different training histories. The first experiment had four birds learn the following behaviors: pushing a box towards a green spot placed randomly on the floor. Epstein et al., (1984) called this repertoire "directional pushing." Next the experimenters trained the birds to climb on a box and peck a banana. The experimenters changed the position of the box, which remained fixed, and the banana. After establishing the "climb on the box and peck the banana" repertoire the experimenters put the pigeons in a chamber with only a banana and no box and extinguished all the bird's attempts to jump or fly to peck the banana.

The test situation called for the birds to solve a problem they never encountered before: a chamber that contained a box and banana suspended out of reach. When faced with this situation the pigeons exhibited behaviors similar to confusion; pigeons looked at the banana and then looked at the box, or the birds would try to stretch for the banana or turn underneath the
banana. At different intervals, the birds "suddenly" began to push the boxes towards the banana and then stopped at the appropriate place and climbed on the box and pecked the banana.

The experimenters conducted other variations of this experiment with the remaining pigeons. One experiment had two birds acquire directional pushing repertoires and pecking the banana, but without teaching the bird to climb on the box. Another experiment saw two pigeons learn to climb and peck the banana but not learn directional pushing. In yet another experiment, Epstein et al., (1984) trained birds to climb and peck a banana and to push a box around the chamber but not directed at a green spot or direction-less pushing. In all the experiments where Epstein et al., (1984) left out a critical element behavior the pigeons never emitted a compound behavior appropriate for solving the problem correctly!

One other derivation of the interconnection experiment did demonstrate a success, but the pigeon acquired the two relevant repertoires: directional pushing and climbing and pecking the banana. In this offshoot, the experimenters did not extinguish jumping and flying. When the pigeon first encountered the test situation, he tried to fly and jump at the banana repeatedly over a period of nearly seven minutes. Thereafter, the bird finally solved the problem. Epstein noted the bird's performance seemed closely related to the behaviors described by Köhler and the chimpanzees facing a similar task.

Epstein, Kirshnit, Lanza, and Rubin (1984) conducted an elaborate set of experiments establishing the phenomena called "interconnection of repertoires." The interconnection effect lays the groundwork for a behavior
analysis of complex behavior. Thus, behaviors that appear seemingly "out of nowhere" may have resulted from interconnection.

The experimenters also demonstrated some of the subtleties in interconnecting repertoires. For example, a bird must acquire all the pertinent element behaviors required to form a compound behavior. Even the slightest deviations will result in a bird with a repertoire that produces unsatisfactory attempts at solving problems predicated on applicable behavior elements.

Epstein (1985) systematically replicated the Epstein Kirshnit, Lanza, and Rubin (1984) study to examine the generality of interconnection. Epstein did this by changing the behaviors he trained. In the first demonstration of interconnection (Epstein et al., 1984) the pigeons learned to push a box to a green spot and then climb on top of the box and peck a banana, an interconnection of two repertoires. In the systematic replication, Epstein (1985) trained one adult male White Carneaux again to push a box to a green spot, placed randomly on the floor. The next two behaviors, however, he trained separately: climbing on a box and pecking a banana. This experimental arrangement would require the spontaneous interconnection of three repertoires.

As in the past interconnection experiment (Epstein et al., 1984) the pigeon faced a situation he never had before: a box in a chamber, absence of a green spot, and a banana the bird could not reach. The results demonstrated a similar outcome to the previous study (Epstein et al., 1984); the pigeon successfully solved the problem. Epstein observed that this pigeon's performance differed from the previous pigeons interconnection performances. As said by Epstein (1985):
All in all, the performance did not seem especially "insightful," which is to say that it did not fulfill one of Köhler's requirements for genuine insight, namely that once the performance begins, it occurs in a smooth, continuous fashion until it is complete. In this case, the pushing, climbing, and pecking were somewhat disjointed from each other; they appeared to be three "unrelated acts, as opposed to a single response unit. The final peck seemed to be "accidental".... (p. 138)

Epstein continues his observation and notes the term "accidental" conveys an inaccurate description because the interconnection process has order. Stated differently, the bird didn't climb on the box "in order" to peck because in the past this behavior did not produce reinforcement. Epstein's (1985) systematic replication provides more empirical support for interconnection of repertoires and extends the generality of this behavioral process.

The last published study demonstrating interconnection of repertoires came from the work of Epstein (1987). His study attested to the validity of interconnection by providing yet another systematic replication of the original Epstein Kirshnit, Lanza, and Rubin (1984) experiment. This time Epstein crafted a study to test whether four repertoires would combine and interconnect to form a new behavior.

Epstein used one adult male White Carneaux that he used in a previous problem solving study (c.f. Epstein & Medalie, 1983). This bird had already acquired directional pushing. After directional pushing Epstein trained the bird to open a door enclosure that "...was made of clear Plexiglas... It did not swing freely, its movement rotated a metal gear, the teeth of which caught a piece of metal that was fixed to the door frame" (Epstein, 1987, p 198.). Following door opening, the experimenter put a banana, actually a
yellow cloth covered facsimile, within reach of the pigeon and had him to peck the banana. A fixed box and the pigeon stepping onto it encompassed the last behavior Epstein trained.

After the pigeon separately acquired the four behaviors the experimenter put the bird in a situation he never faced before; an out of reach banana, and a box placed behind a door. The results show, in dramatic fashion, the interconnection of four repertoires. The pigeon tried to peck the banana unsuccessfully, then he pecked open the door and pushed the box out of the enclosure. Next the bird pushed the box towards the banana and twice climbed on the box in attempt to peck the banana. Finally the pigeon pushed the box close enough to where he could successfully climb on top of the box and peck the banana. This whole performance took 237 seconds.

Epstein's (1987) second systematic replication further established the generality of interconnection. The pigeon demonstrated that four separately trained behaviors could combine into one, novel behavior that resulted in a bird solving a very complex task. Epstein noted that although this bird demonstrated a large number of repertoires coming together, establishing many separate behaviors does not guarantee interconnection. Nevertheless this interconnection study supported the basic notion that behaviors established separately can come together in new situations and forms a novel blend.

As stated at the outset of this section contingency adduction appears similar to the interconnection of repertoires because in both cases established component repertoires combine to form novel composite repertoires. However, a difference between the two exists in the scope of each process. When component repertoires, or behaviors, interconnect, as in the Epstein
Kirshnit, Lanza, & Rubin, 1984, the repertoires come together and meet with the same reinforcement contingency as when shaped separately (Andronis, Layng & Goldiamond, 1997). When component repertoires adduce, they do not necessarily come from an "automatic chain" as in interconnection (Andronis, et al., 1997). Rather, a repertoire "...may be recruited by quite a different set of conditions into a new function and eventually into a radically new repertoire" (Johnson & Layng, 1992, p. 1487). Therefore, interconnection of repertoires reflects one facet of contingency adduction.

The interconnection of repertoires literature provides a rigorous scientific analysis of complex behaviors and supports, and reproduces an aspect of, contingency adduction. Yet the literature leaves many questions unanswered. Such as how many repertoires can combine? Can we always account for interconnection? What variables might impede interconnection and conversely what variables may promote interconnection? What effect will the sequence of the separately trained behaviors have on interconnection? And should we differentiate between interconnection and contingency adduction? These questions, and others, must await further empirical investigations and theoretical discussions of interconnection of repertoires.

Elements and Compounds. The literature review of behavior elements and compounds begins with an observation by Haughton (1981). Haughton believed that behaviors analogously shared a link with chemical elements. As written in the Data Sharing Newsletter (1981):

Eric Haughton brought us the analogy between modern chemistry and skill development by describing relationships between skill elements (the smallest identifiable movement cycle) and compounds. An
interesting extension of that analogy has to do with the ability of elements to form compounds. We know that the smooth combination of behavioral elements requires that they occur at relatively high performance frequencies. In chemistry the combinatory capacity of atoms is know as valence, and it is related to the number of electrons occupying the outer "shells" or orbits surrounding the nucleus. Such valence electrons are of relatively high-energy and orbit with comparatively high frequencies. Perhaps we can begin to speak of behavioral valence, in terms of the relationship between standard performance frequencies and existing frequencies of behavioral elements. (p. 3, underlined in the original)

Haughton's observation led to a significant realization in educational practice; students who do not possess minimal frequencies in certain behavioral elements will languish when instructed, or asked to perform a compound predicated on the element.

This performance of behavioral elements, or simple skills, relating to the acquisition and performance of compounds, or more complex skills (Barrett, 1979; Haughton, 1972, 1980) may fall under the category of other processes such as "transfer," "generalization," or "application." Haughton's (1981) chemical analogy of elements and compounds provides concise description of a particular relationship averting possible confusion among descriptive terms.

A wide variety of articles from classroom performances support the process of behavioral elements forming compounds, or "compounding" (Lindsley, 1999). Haughton (1972) reports an experience he had in school that demonstrated how behavioral elements affect compounds. Haughton and a
school principal discussed an academic problem. The two men could not understand why some students did not achieve the instructional aims in math even though the students practiced daily, and did not make many errors. The two tried a variety of typical educational interventions such as reinforcement. They found the problem. The students could not write more than 20 digits per minute making it impossible to achieve instructional aims set at a higher frequency. Allowing the students to practice writing digits allowed the students to break through the ceiling of 20 digits per minute.

An unpublished study by Van Houten and Sharman (reported in Van Houten, 1980) provides more empirical support for elements affecting compounds. Sharman taught two math classes in an "Intermediate Industrial Program." The students in the program, whose age ranged between 12 and 16, often counted on their fingers and asked the teacher for answers for math problems (e.g., "What is 7 x 9?"). When asked to do long division and multiplication problems the students worked very slowly and made many errors. Van Houten and Sharman decided to intervene.

Each day, Van Houten and Sharman gave the students an assessment sheet that contained long division and multiplication problems that increased in complexity on the sheet. On baseline days, the students received typical instruction and completed the assessment at the end of the period. On "drill session" days the students received drill on multiplication facts at the beginning of the class and completed the assessment at the end of the class. The experimenters used a "feedback system" to help students progressed on their multiplication facts.

Results from the intervention showed the students from both classes improved on the days with "drill sessions." During days without the "drill
sessions," students neither improved or worsened; their performance remained "stable." Also, the students question-asking declined drastically. These data suggest that students who practice elements can improve their performance on the compound skill (i.e., single digit multiplication fact knowledge used in long division and multiplication).

Evans, Mercer, and Evans (1983) demonstrated the effects of the element/compound process. Nine students with learning disabilities, who ranged from second to fifth grade, served as participants. The experimenters gave the students two assessment sheets. The first contained nineteen consonants and the "a" vowel (e.g., t, a, r). The second sheet had consonant-vowel-consonant trigrams (e.g., cat, tag, ham). For the first phase of the study, the experimenters gave each student an untimed pretest on the consonant-vowel-consonant trigram sheet. Students also did two one-minute timings on the trigram sheet. Last, the students did a one-minute timing on the letter sheet.

The next phase of the experiment called for randomly assigning students to a high, medium, or low frequency group. The high frequency group would see/say letter sounds to 80 correct per minute, the medium frequency group 60 sounds per minute, and the low frequency group 40 sounds per minute. The researchers controlled the number of total presentation for each group, so all received the same amount of practice.

During the last phase of the experiment, the students took an untimed post test on the consonant-vowel-consonant trigrams. The results of this experiment supported the requirement of building high frequencies in elements for competent performance in the compound. The students in the high frequency group improved the most in saying consonant-vowel-
consonant trigrams. This improvement occurred even though all students in each frequency group (i.e., high, medium, and low) received the same total number of presentations.

Johnson and Layng (1992) provided data that demonstrated the behavioral element/compound relationship. A student named Laurie could compute multiplication facts at 70 per minute. The teacher wanted Laurie to learn more complex, double digit multiplication facts. When the teacher measured how well Laurie could do the double digit multiplication facts she discovered after a week and a half of practice that Laurie could do, at best, 15 correct per minute. Rather than giving more double digit multiplication fact problems to practice, the teacher employed a "step back" procedure where she had Laurie build fluency on a behavioral element, in this case single digit multiplication facts. Once Laurie could do 100 multiplication facts per minute the teacher reintroduced Laurie to double-digit multiplication facts. The result, Laurie's performance on double-digit multiplication facts uniformly rose to 50 digits per minute.

Kubina, Aho, Mozzoni and Malanga (in press) offer an applied study that supports the practice of building frequencies in behavioral elements which later effect a behavioral compound. Byron, 14 years old, entered a post-acute neurorehabilitation center for outpatient services. Byron worked on a number of school related behavior while in therapy, but had a particularly hard time with his handwriting.

Byron had ataxia, a condition that results in poor control of voluntary muscles (Heward, 1996). When Byron used a pencil his hands would shake thus comprising how fast and how legibly Byron could write. The experimenters arranged practice sessions for Byron to strengthen four pre-
handwriting skills. The pre-handwriting skills included drawing four tally marks with a diagonal line through it, symbols that resemble connected cursive "c's," connected loops, and connected 70 to 80 degree sharp lines (c.f. Freeman & Haughton, 1993).

Byron practiced these pre-handwriting activities over several weeks and accelerated in each skill. Before Byron began his practice session, the experimenters gave Byron a pretest on a see/write measure. Byron would see text and write, or copy it. The see/write practice approximated what happens often in school settings where students must take notes from the chalkboard or overhead. Byron could see/write eight words per minute during his pretest. After the practice sessions ended, Byron doubled his performance and could see/write sixteen words per minute even though he received no direct practice on the compound behavior. The frequency building on the pre-handwriting elements facilitated an acceleration with the compound handwriting behavior.

The behavioral element/compound relationship pertains to many academic skills. Using a math example, if students have slow or underdeveloped basic computation skills (e.g., adding) the application to complex operations often will proceed awkwardly. This may occur because students must interrupt their flow of thoughts and recall math facts. When re-engaging in the complex operation students may have to remember where they left off, and possibly the work just completed (Johnson, 1996). Reading, writing, spelling, mathematics, and any other skill based on proficient element performances will sustain marked decrements in the compound form if basic foundational skills do not meet the required frequencies for a fluent performance.
Behavioral elements that form compounds bear out a pointed, linear component of contingency adduction. Namely, specific elements of a compound directly influence the performance on a compound. Therefore, building frequency in the elements will directly affect the compound. Sometimes, building frequency on the elements has resulted in spontaneous appearances of the compound (Binder, 1976, 1979; as cited in Binder, 1996; Binder, Malabello, Desjardins, & McManus, 1999; Pollard, personal communication, May 24, 1998; Pollard, 1979; Solsten & McManus, 1979 as cited in Binder, 1996) demonstrating contingency adduction. Contingency adduction, however, states that an unlimited range of behaviors could combine and form a new behavior. Behavioral elements that form compounds have encompassed a more limited, linear reach of behaviors, namely those that share direct relationships to the compound (e.g., handwriting speed and writing numbers to math problems).

Another issue surrounding the terms behavioral elements and compound and contingency adduction regards the audience. When speaking with people unfamiliar with the behavioral lexicon and particularly in educational contexts, the terms elements and compounds may fair better for a number of reasons. First, the definition for "elements" and "compounds" described in the dictionary accurate portray the terms and their intended usage whereas "contingency" and "adduction" do not (i.e., contingency as defined by Skinner, 1969 and other behavior analysts). The term "elements" and "compounds" reflect a chemical analogy suggesting that as behavioral elements reach a certain frequency they can form compound behaviors (Lindsley, 1999) thus describing part of the process to achieve "compounding." The intact dictionary terms "contingency" and "adduction" do not mirror
such a process. And third, using the terms "element" and "compound" facilitates the practice of using plain English (Lindsley, 1991). With a behavior analytic audience, or an audience that requires a technical term; however, contingency may suffice.

Although the literature review on the behavioral elements forming compounds presents the most published findings, the literature leaves open numerous questions. For instance, higher frequencies in behavioral elements have affected performance with the compound. But frequency may frame only one part of the picture for effective compounding. Other variables such as spaced practice (Dempster, 1988) cumulative practice, and sequence of practice (Johnson & Layng, 1996) may foster successful "compounding."

**Spelling and Phonemic Awareness**

As the title of this dissertation suggests "Emergent Spelling Skills: A Case of Contingency Adduction?" spelling may represent a case of certain type of novel responding, namely contingency adduction. Within the past 20 years, a phenomenon called "phonemic awareness" has received a tremendous amount of attention in the literature researching the development of reading because of the close association between those who have acquired "phonemic awareness" and subsequently learning to read and spell (Adams, 1990; Blachman, 1984, 1989; Bradley & Bryant, 1978; Lieberman & Shankweiler; Lundberg, Olofsson, & Wall, 1980; Mann, 1984, 1993; Stanovich, 1985, 1986, 1988; Treiman, 1991; Wagner & Torgesen, 1987). The focus of this dissertation, however, involves considering the emergence of spelling, and will concentrate on examining the phonemic awareness literature and how this skill relates to spelling.

36
"Phonemic awareness" describes a "Conscious ability to detect and manipulate sound... access to the sound structure of language....awareness of sounds in spoken words in contrast to written words" (Smith, Simmons, & Kameenui, 1995 p. 3). A child could demonstrate phonemic awareness in a number of ways such as by answering what sounds she heard when another says the word "rake." Another method would involve telling the student a word (e.g., hat) and asking her what word it would make if she took the /h/ sounds off the beginning.

How does phonemic awareness affect children's spelling? The answer to that question lies in understanding how children come to spell. Ehri (1989) describes three sources of information relating to learning how to spell. First, students must have knowledge about letters. Second, students must know about the spelling system such as phoneme-grapheme relationships or how a letter sound belongs to a letter name. Spelling system knowledge also includes understanding how to segment a word in its constituent sounds. Third, students must have "lexical" knowledge such as how letters follow a specific sequence or orthography and how the letters in the words represent certain phonemes. After students have acquired spellings, that information can fit into the lexical repertoire (Ehri, 1989).

Students who have not developed phonemic awareness have large gaps in their repertoires making spelling very difficult. Bradley and Bryant (1978) provided a study that demonstrated the link between "auditory perception," or the ability to hear sounds in words, and spelling performance. The experimenters compared two groups of children, one with normal intelligence and no reading problems and another group, called "backwards readers," with normal intelligence but with reading problems (i.e., 18 months
behind the typical reading ability for their age). Each group of students heard a set of four monosyllabic words, three of which shared a similar phoneme, and had to pick the word that differed from the others. Each presentation of the four words varied with the place of phoneme in the word (e.g., three similar sounds at the beginning of a word, middle of a word, or the end of the word) and the place of the word in the sequence said to the students.

The results of this comparative study displayed significant differences in "auditory perception." Ninety-two percent of the "backwards" reading group made errors on the test, and 85% of the students made two or more errors. Fifty-three percent of the students with no reading problems made an error on the test, and only 27% of the students made more than one error. This finding seems all the more substantial because the "backwards" reading group averaged three and a half-chronological years ahead of the children in the no-reading-problems group. Bradley and Bryant (1978) noted that of the "backwards" reading group only students who made one or no errors had considerably higher spelling age than others in the group. The spelling age finding suggests that students who have problems auditorily organizing sounds will also have problems spelling.

Can teaching phonemic awareness before children receive reading instruction facilitate their reading and spelling development? Lundberg, Frost, and Petersen (1988) answered this question providing Danish kindergartners with phonemic awareness instruction for a year. The students did not receive instructions on letters. The results from this study showed that the phonemic awareness instructed group, after seven months of first grade instruction, could spell considerably more words than the control group but they did not show a propitious reading advantage. After the second year
of instruction, however, the phonemic awareness group surpassed the control group. This finding suggests a phonemic awareness repertoire may combine with spelling repertoire and augment reading.

In a comparative study Bruck and Treiman (1990) compared "normal" first and second graders with students with dyslexia. The students with dyslexia averaged nearly three years older than the first and second graders, on spelling ability. The experimenters gave both sets of students phoneme recognition and deletion tasks and with real and nonsense words. The results from the study show the "normal" group and the students with dyslexia performed similarly on phoneme recognition tasks. On the phoneme deletion task students with dyslexia performed more poorly than the other group. Also, the students with dyslexia performed markedly worse on the spelling tasks than the "normal" children. Bruck and Treiman's (1990) data show that poorer phonemic awareness skills, as with the students with dyslexia, may result in poorer spelling ability. Another finding from the data suggest that when creating phonemic awareness programs for children phoneme recognition has more value than phoneme deletion tasks.

Other studies show that phonemic awareness helps spelling performances. For example, Griffith (1991) gave identical 40 item hear/write spelling tests to first graders and third graders assigned to high and low phonemic awareness groups. The results of her tests revealed that first graders relied more heavily on phonemic awareness to spell words than did the third graders. Also, the children with high phonemic awareness spelled more words correctly in both groups. Griffith hypothesized that the third graders make use of "memorized orthographic units" (p. 225).
Ball and Blachman (1991) asked, "Can groups of Kindergarten children learn segmentation?" "What effects does segmentation have on spelling with kindergarten children?" and "What effects does letter name and letter sound training have on segmentation and spelling ability?" To answer these questions, they took 151 kindergarten children and assigned them to one of three groups.

Group 1 received phonemic awareness instruction (e.g., segmenting words into sounds, sound categorization, and letter name and sound practice), Group 2 received language activities (e.g., listening to stories, general vocabulary development, semantic categorizations, and letter name/sound instruction like Group 1) and Group 3 received no intervention. Group 1 learned to segment words better than the other two groups. Group 1 also performed better at segmenting novel phonemes, and they spelled better than the other groups.

Another study providing empirical support for phonemic awareness and subsequent ability to spell came from Castle, Riach, and Nicholson (1994). These experimenters took one group of children and gave them phonemic awareness training twice a week, while another group of children experienced "process writing" (e.g., children write their own stories and use invented spellings). The results showed that both groups of children gained on measures of phonemic awareness. The phonemic awareness group, however, gained significantly more phonemic awareness and spelled better than the other group on two experimental measures.

Although all the previous studies show relationships between phonemic awareness and spelling performances, the presence of phonemic awareness alone does not guarantee that spelling ability will develop. For
instance, Bradley and Bryant (1983) conducted a longitudinal study that looked at 118, four year old participants and 285, five year old participants on categorizing sounds. At the end of three years, a high correlation emerged between the ability to hear sounds in words and learning to read and spell.

Next, these experimenters selected 65 children randomly from their sample and assigned them to one of four groups. Group 1 received instruction on categorizing sounds. Group 2 received instruction on categorizing sounds and, with plastic letters, learned how the sounds represented letters. Group 3 learned how to categorize conceptual class (e.g., pigs, cows, as farm animals). Group 4 received no intervention. The results showed that Groups 1 and 2 outperformed Groups 3 and 4 on reading and spelling tasks but that Group 2 did significantly better than all three groups. This finding indicates that a repertoire that includes phonemic awareness, and knowledge of letter names and letter sounds may optimize spelling performance.

The literature bears witness to a highly predictable occurrence. Students who have acquired phonemic awareness become better spellers than those deficient in the skill. Studies have demonstrated effective strategies to help students deficient in phonemic awareness to learn to read (e.g., Ball & Blachman, 1988). Strategies that help children acquire phonemic awareness and learn to read also help them learn to spell.

Tangel and Blachman (1992) investigated whether segmenting words into sounds would affect children's invented spellings. The experimenters worked with children from kindergarten in low socio-economic status inner city schools. Seventy-seven children formed an intervention group whereas 72 children comprised a control group. For 11 weeks, the intervention group
received instruction on segmenting words into sounds, categorizing sounds, and on letter names and letter sounds. Tangel and Blachman (1992) applied a developmental rating scale indicated the students in the intervention group produced substantially better-invented spellings (e.g., wrote more phonetically related letters, represented more letters from in the internal structure of words) than the children in the control group.

Tangel and Blachman's data (1992) contribute an important addition to the invented spelling literature. Previous research with invented spellings has centered on examining the skills of precocious pre-readers (Bissex, 1980; Burns & Richgels, 1989; Durkin, 1989; Read, 1971). Tangel and Blachman's (1992) children came from low socio-economic status urban schools. One association of children with such profiles (i.e., low socio-economic status) indicates that the children have less experience with language than do children from middle or high socio-economic status (Hart & Risley, 1995), making the acquisition of phonemic awareness a very important component in any early literacy program.
CHAPTER 3

METHOD

Students

Four children from a typically developing kindergarten classroom served as students in this study. Three boys (i.e., Fred, Bill and Tom) and one girl (i.e., Amy) met the criteria for selection by having parental consent (Appendix C), teacher consent, and by meeting the prescreening qualifications. The academic prescreening systematically replicated those procedures used by Tangel and Blachman (1992), which included demonstrating a one-to-one correspondence counting sounds (e.g., child hears 3 sounds such as a beep and the child can count three sounds or beeps), an absence of severe articulation problems, and the inability to read or spell. Additionally, the students did not exhibit behaviors that interfered with the systematic application of the experimental procedures and demonstrate learning performance not typical of students that age (e.g., noncompliance, disruptive behaviors, "atypical learning patterns," physically aggressive behaviors). Table 3.1 describes students in terms of gender and age at the beginning of the experiment.
<table>
<thead>
<tr>
<th>Student</th>
<th>Gender</th>
<th>Age</th>
</tr>
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<tbody>
<tr>
<td>Amy</td>
<td>Female</td>
<td>5-6</td>
</tr>
<tr>
<td>Tom</td>
<td>Male</td>
<td>5-11</td>
</tr>
<tr>
<td>Bill</td>
<td>Male</td>
<td>6-0</td>
</tr>
<tr>
<td>Fred</td>
<td>Male</td>
<td>6-2</td>
</tr>
</tbody>
</table>

Table 3.1: Description of students by gender and age.
Setting

The dissertation setting occurred in a rural public school in the greater Columbus, Ohio area. The kindergarten classes, all in annexed building that sat apart from the rest of the school, also had one first grade classroom in the building. The experimenter used a 8' by 10' room that the school psychologist used. The room had a desk, a filing cabinet, and four chairs set in a circular pattern. When students entered the experimenter pulled in a child sized desk and chair and put an adult sized chair next to the student. Additionally, the experimenter applied the procedures of the dissertation in coordination with the classroom teacher's day schedule so that students did not miss important classroom activities. The teachers decided the best time for students to attend sessions.

Experimenter

The experimenter has achieved the status of a doctoral candidate in Special Education and Applied Behavior Analysis at The Ohio State University. He has a Bachelor of Arts degree in psychology and a Master of Arts degree in Special Education with an emphasis on applied behavior analysis. As a counselor, direct care staff, special education teacher, and behavior analyst, the experimenter had nine years of teaching experience with a variety of students with disabilities.

While in the Ohio State doctoral program, he served as an assistant to a doctoral candidate conducting research investigating reading comprehension. The experimenter has also participated in research aimed at increasing arithmetic fluency and investigating novel responding in multiplication facts with a group of second grade students identified as academically at-risk. In
addition, the experimenter has served as a mentor for Master's students doing thesis research.

Definition and Measurement of the Dependent Variable

Four dependent variables, counts of correct and incorrect orally spelled real words with instructed letter and sound correspondences, and counts of correct and incorrect orally spelled nonsense words with instructed letter and sound correspondences, appeared in this study. The counts of correct and incorrect letters entailed a student hearing a consonant-vowel-consonant, consonant-vowel, or vowel-consonant word and saying the spelling. The words the students heard consisted of real and nonsense words (Appendix D).

Correct Real Words

A correct response for a real word occurred when a student said a letter that corresponded with the letter in the spelling word. Additionally, the correct response followed the proper letter sequence in a word. For a student to correctly spell the word "rod" he or she would say "r-o-d." Any deviation did not count as a correctly spelled real word. The experimenter then counted each individual letter in the word as correct or incorrect. If the student ended the spelling on the right letter sequence he or she also received a correct count of one. For a student spelling "rod" correctly the experimenter would count 4 correct responses. One correct for each letter said correctly and one correct for ending on the correct letter in the orthographical sequence.

Incorrect Real Words

An incorrect response occurred when a student said a letter name that did not correspond to the letter name in a word, omitted a letter, inserted a letter, repeated a letter, said a letter name out of the proper sequence, or said a letter sound. For example, if a student spelled the word "not" as "n i s" the
experimenter did count the "n" as a correct but the "i" and the "s" as an incorrect. Because the student ended the spelling with the proper orthographical sequence he or she received another count of one. Thus, the student received a score of 2 correct and 2 incorrect for spelling "not" as "nis." If the student spelled "not" as "o t" the experimenter would record 2 incorrects. An incorrect for each spelling letter. The student did not received an extra incorrect for not stopping on the correct letter sequence.

Correct Nonsense Words

A correct response for a nonsense word occurred when a student said a letter that corresponded with the letter in the spelling word and ended at the proper place. Again, the correct response followed the proper letter sequence in a word. For instance if a student spelled the word "nom" as "n o m" the experimenter record 4 correct responses. Any derivation from the nonsense spelling represented in Appendix D did not constitute a correct nonsense word spelling.

Incorrect Nonsense Words

An incorrect response occurred when a student said a letter name that did not correspond to the letter name in a nonsense word, omitted a letter, inserted a letter, repeated a letter, said a letter name out of the proper sequence, or said a letter sound. For example, if a student spelled the word "tas" as "2 a c " the experimenter counted the "2" as an incorrect, the "a" as a correct, the "c" as an incorrect, and a correct for stopping at the proper place in the word.

The experimenter separated the counts of correct letters and incorrect letters for each real and nonsense word and reported the total correct letters and total incorrect letters for each set of words. Each oral spelling word list
Appendix D) contained 14 consonant-vowel-consonant, consonant-vowel, and vowel-consonant real and nonsense words. The potential for correct and incorrect responses for each list remained consistent from trial-to-trial (e.g., set 8 consonant-vowel-consonant, 6 consonant-vowel, and vowel-consonant real and nonsense words represent a static number of 36 letters or 18 letters for each dependent variable). The experimenter alternated each oral spelling word list.

The experimenter measured the occurrence of dependent variables at the beginning of the session. He told the student to listen as the experimenter said the spelling word and then to orally spell the word. The experimenter repeated any word not heard by the student. The experimenter had a sheet with the correct spelling and wrote beneath the word all verbal responses the students made. An example of this appears in Appendix D. The experimenter audiotape recorded the students' oral spelling. After the session ended the experimenter tallied the number of correct and incorrect letter names. The experimenter graphed the daily correct and incorrect number of spelling words on a standard celeration chart (Penneypacker, Koenig, & Lindsley, 1972). He put the corrects and incorrects in time by summing the durations for each word. The experimenter did this by listening to the tape recorded spelling and beginning a timer when the student said the first letter for a particular spelling word and ended the timer after the student said the final letter. The total of all of the individual durations equaled the sum of durations. This sum of durations formed the record floor on each chart.

Accuracy of Measurement

The experimenter assessed the accuracy of measurement by using three procedures. First he audiotaped the student spelling words and compared the
audiotape true value of student spellings against the experimenters real time transcription of student spellings. The transcription data sheet appears in Appendix D. The experimenter counted the number of his correct and incorrect transcriptions against the tape recorded performance and calculated the percentage of correct transcriptions.

Next, the experimenter gave 20% of all the audiotaped spelling performances of the students to independent observers who followed the same procedures as did the experimenter for comparing the audiotape true value of student spellings against the experimenters real time transcription of student spellings. The experimenter then compared his score against the score of the independent observers. If a discrepancy of more than 2 seconds in the sum of durations, or an incorrectly transcribed word, appeared the experimenter would review the audiotape containing the data in question to verify the accuracy of measurement.

The experimenter also assessed accuracy by comparing spellings of the real words with a dictionary spelling. The nonsense words compared against the experimenter's spelling list of nonsense words. The percentage of measurement accuracy for correct and incorrect spelling words documented the quality of measured spelling occurrences for each session.

Materials

Practice cards. The experimenter made practice cards that contained letter names (Morrell, Morrell, & Kubina, 1995). Each card contained a letter printed on one side and a blank backside. A computer software program for creating a sheet of 12 individual frames on one sheet (Graf, 1995) developed the practice cards, with one letter per frame. Each letter appeared in a 60 point "Times" font printed on white sheet of paper (Appendix E). The experimenter

49
laminated all of the cards. The front of the practice card sheet contained the actual 10 letters that the experimenter cut into 10 individual practice cards. The experimenter produced three copies of the same sheets that made a deck of 30 practice cards. The students used the same deck of cards for the letter name and sound conditions.

Students who did not possess the manual dexterity, or for other reasons had problems with, the practice cards, used a "practice sheet" as an alternative to practice cards. The practice sheets contained a set of the instructional stimuli but on one page. The practice sheet for the students included all of the letters, in size 30 font, placed in random order (Appendix J). Practice sheets appeared in landscape view, as opposed to portrait, so the students had the opportunity to respond to more letters before moving to the next row.

**Instructional materials.** Instructional materials for segmentation came from the Haughton Learning Center. The specific instructional materials, "Learning Success: Segmentation and Blending of Syllables and Words" (Freeman & Haughton, 1996) contained a standard set of instructions for segmenting words. Additional words made from the letter names not included in the "Learning Success: Segmentation and Blending of Syllables and Words" appear in Appendix F.

**Timer.** A "Big Digit Timer" (Radio Shack® catalog number 63-897) signaled the beginning and endings of instructional trials. The "Big Digit Timer" could stand on its own and had a size of 2 and half inches by 3 inches. The digital display on the front had the capacity to show 99 minutes and 59 seconds. When the countdown timer reached 0 it beeped.
Cassette recorder and tapes. The experimenter used an Optimus® "AC/DC Cassette Recorder," (Optimus® catalog number 14-1116) to record the one-minute oral spelling assessments. The cassette recorder had a built-in microphone, tape counter, tone control and carry handle. The cassette recorder also had an AC plug that the experimenter used to power activate the machine. The students one-minute oral spelling assessments, as permanent products, appeared on BASF® "Ferro Extra I" 135 minute audiotapes.

Other. Other materials included 2' x 3' pieces of colored felt for use during instruction for segmentation. Participants also received pencils, standard celeration charts (Penneypacker, Koenig, & Lindsley, 1972), and individual folders. Finally, the experimenter used hand held digital counters that displayed counts up to 9999. The experimenter pushed a lever on the hand held counter that activated one count. A knob on the side of the counter allowed the experimenter to reset the counter to zero. The experimenter used the hand held counters during the implementation of the independent variable conditions.

Experimental Design

A multiple baseline across behaviors formed the experimental design used in analyzing the effects of the independent variable on the dependent variable (Cooper, et al., 1987). A multiple baseline design offers an appropriate analysis for experiments that study irreversible dependent variables (Cooper, et al., 1987). Students learned behaviors to fluent levels, producing irreversible behaviors, thus making the multiple baseline an appropriate experimental design for this research. By graphically displaying each student's responses to the first set of spelling words (i.e., the real words), and the second
set (i.e., the nonsense words), a total of two sets of behaviors experienced the effects of the independent variable. The standard celeration chart (Pennypacker, Koenig, & Lindsley, 1972) graphically displayed all data.

Johnston and Penney packer (1993) have developed a notation system for pictorially representing experimental arrangements. The multiple baseline across different behaviors (Appendix G) shows this study's experimental design pictorially represented according to the Johnson and Penney packer (1993) notation system. Also, Appendix G shows the multiple baseline across behaviors with an add/subtract convention.

Procedures

General Procedures

A standard set of procedures pervaded all conditions of the study. The experimenter prepared all the instructional materials in advance that he used in the study. These materials appear in Appendix D, E, and H. The experimenter uses the appropriate set of materials corresponding with the condition (e.g., spelling words for dependent variable condition). The experimenter also (a) audiotape recorded and transcribed the students responses; (b) at the end of the session gave the student general feedback on correct and incorrect words they spelled (e.g., "Today you spelled 9 words correct and 11 incorrect."); and (c) praised the students (e.g., "You worked very hard today. Good job!").

In addition, the experimenter worked independently with each student by taking him or her to the room outside the classroom. The student and experimenter sat next to each other, the student in a desk and the experimenter in a chair. The experimenter charted all scores on a standard
celeration chart with the student at the end of each practice session. The experimenter delivered praise and encouragement for each charted score.

**No Instruction (Baseline).** In the No Instruction condition the experimenter measured the correct and incorrect occurrences of two behaviors (i.e., the four dependent variables). The student heard a real or nonsense word and then said the spelling. The set of words the students attempted to spell came from real and nonsense words using the following set of letter sounds: a, m, s, o, r, d, f, i, t, n (Appendix H). This set of words came from letter names and sounds the student eventually learned in (a) see/say letter names, (b) see/say sounds, (c) hear/say/do segmentating words into sounds, (d) see/say letter names and letter sounds, and (e) hear/say/do segmentating words into letter names conditions. The words differed from the see/say/do segmentation conditions so as to avoid the confound of students spelling words they had segmented.

The experimenter sat with each student individually, at separate times, and gave the following instructions: "I will say a word, and I want you to say the spelling as best as you can. If you need me to repeat the word ask me, and I will say it again. Try to spell the words as best as you can. If you do not know how to spell a word say, 'I don't know.' Do you have any questions?" After these instructions the experimenter said the word, and the student said the spelling. The experimenter recorded exactly what the students said on a list of the target words (Appendix D). All students began with the baseline condition (i.e., "No Instruction").

After a period of two calendar days, students who displayed they could not spell moved to the see/say letter names condition. The experimenter chose to move the students forward quickly for two reasons: (a) the study
began midway through the academic year and the students could not spell, two days demonstration of the students not spelling, also with the intake measures, sufficed for believability that students could not spell; (b) the students would sometimes make comments saying "Is it all right if I don't know how to spell?" This led the experimenter to infer that the students had negative feelings with their lack of spelling skill therefore asking them to demonstrate this daily would produce a needlessly uncomfortable situation for the students.

See/Say letter names. The experimenter met individually with the students and gave instruction on a set of 10 letters. The letters of the first set "a, m, s, o, r, d, f, i, t, and n" appeared in "Times" font size 60 on an individual sheets of paper (Appendix H). The experimenter initially instructed the students on the letter names by pointing under a letter and saying: "This letter name says 'a.' Your turn. When I touch the letter again you say the letter name." Then the experimenter said "Get ready," and touched under the letter. Touching under the letter served as a cue for the student to respond.

After one presentation of all letters, the experimenter asked the student: "What does this letter name say?" The experimenter praised correct letter names (e.g., Great job, you got it right!) and immediately corrected the incorrect letter names. For example, if the student said the letter name "b" to the letter "a" the experimenter said: "This letter name says 'a.' Your turn, what letter name?" When the students gave the correct answer, the experimenter praised the correct response. The experimenter repeated the previously mentioned correction technique if the student made another incorrect response. The experimenter gave praise statements less frequently,
at his discretion, as the student began to answer more items correctly. The experimenter repeated the format of modeling the correct response, leading the response, testing for the correct answer, and praising as appropriate throughout the see/say letter names condition.

The students began the study with the practice cards to build fluency when they reached 80% correct accuracy on saying letter names during the first instructional trial of a session. Before the students begin using the practice cards, the experimenter determined if they had the manual dexterity to attain the fluency aim of 10 to 14 letters per 10 seconds. The experimenter did this by having students hold the deck of cards and slide each card off the top of the deck while saying "go" when they saw each individual card. As the study progressed and the students demonstrated no progress towards the fluency aim, the students used a shorter counting time (e.g., 6 seconds or 4 seconds) with a reduced fluency aim of 6 to 8 letters. Students began practice after determining their ability to use the practice cards. All students began with 10-second timings.

The student held the deck of practice cards and saw the letter name on the front of the card and said the letter name. The experimenter modeled this procedure for the student and then allowed the student to practice. The experimenter gave corrective feedback to the student until he or she could use the practice card deck efficiently. After the experimenter determined the students could use the practice card deck appropriately, he began to measure student performance with the deck of letter names.

Before beginning each session in the see/say letter names, the experimenter gave the oral spelling assessment. The experimenter followed this pattern of beginning the sessions with the oral spelling assessment for all
the see/say letter names and sounds, and hear/say/do segmentation conditions. After the oral spelling assessment the experimenter told the student that he or she would now begin to practice letter names.

The experimenter used two hand-held digital counters to record correct and incorrect responses while the student did see/say letter names. When beginning the practice time the experimenter said in a calm voice "Please begin." The experimenter depressed a lever on the hand-held counter in either his right or left hand. Depressing the lever in the right hand represented correct letter names while the left represented incorrect letter names. At the end of each 10-second practice time, the experimenter shared this score with the student and then recorded it on a data sheet.

The experimenter encouraged students to beat their last score and conducted 6, 10-second timings each session. Once the students could see/say 10 to 14 correct letter names in a 10-second practice time for two consecutive sessions, he or she proceeded to the next condition, see/say letter sounds. For those students who did not progress with the 10 second record the experimenter reduced the timing to 6 or 4 seconds. The shorter interval helped children learn more quickly because they have less exposure to a large set of instructional stimuli. Additionally, students who do not have endurance (Binder, 1996), or the ability to perform a task over some period of time, benefit by working for short bursts where they do not tire as quickly or show endurance problems.

If the timing interval did not produce an acceleration in the learning, the students used a practice sheet rather than the practice cards. As described in the materials sections the practice sheets contained all the letters, in size 30 font, placed in random order (Appendix J). The students would see the letter,
point to the letter, and say the letter name. The see/point/say letter name task produces acceleration in learning because it has the same instructional stimuli in the same position. Therefore, the students have repeated exposure with the same letter names. Once the students met their instruction aim, they demonstrated mastery of the same set of letters in a different order. This practice guarded against the students demonstrating serial memory effects, or students memorizing a pattern or sequence of letters.

See/Say letter sounds. Participants learned the letter sounds in the same manner as they learned letter names. The experimenter used the same work sheet with the "Times" 60 font of the letter: a, m, s, o, r, d, f, i, t, and n and gave the same instruction except inserting letter sounds for the names (Appendix H). For instance, when introducing the letter sound "s" the experimenter pointing under the letter "s" and said: "This letter makes the sound "ssssss." Your turn. What letter sound does this make?" The experimenter then pointed to the letter and listened for the correct response. If the student made the correct response, the experimenter praised the correct response and moved onto the next letter sound. If the student made and incorrect response, the experimenter immediately corrected the response by saying: "That sound says 'ssssss.' Your turn, say the sound. Get ready." The experimenter pointed under the sound and again evaluated the student’s response. He followed the correction procedure until the student could make the correct response. The experimenter also modeled how long to say each sound. Each sound presentation took 1 or less seconds to say.

After the students could make 80% or more correct responses on the first trial of the letter sheet (Appendix H), they began fluency building. The students used the same deck of 30 cards as they used during the see/say letter
sound condition. The students practiced by seeing the front of the card and saying the sound that corresponded with the letter. As explained in the see/say letter name condition, the experimenter used two hand-held counters to record correct and incorrect responses. For the fluency building condition, students said all the sounds quickly and did not have to abide by the three-second rule as in the establishing phase. Once the students could see/say 10 to 14 correct letter sounds in a 10-second practice time for two consecutive days, they proceeded to the next condition, hear/say/do segmenting words into sounds. Again, as in the see/say letter condition, if students did not progress and a reduced record floor did not accelerate learning students used practice sheets. The students would see/point/say letter sounds, however, instead of letter names.

Hear/Say/Do segmenting words into sounds. In the segmenting words into sounds condition the students learned to segment real and nonsense consonant-vowel-consonant, consonant-vowel, and vowel-consonant words into sounds. Segmenting means breaking down, or "pulling apart" a word into its constituent sounds (Ball & Blachman, 1988; Engelmann, 1999; Smith, Simmons, & Kameenui, 1995). The experimenter instructed segmentation skills by following the script and procedures found in "Learning Success: Segmentation and Blending of Syllables and Words" (Freeman & Haughton, 1996).

Students had five different pieces of colored felt in front of them. The experimenter said a word at a routine pace. The student heard the word then moved pieces (i.e., the do in the hear/say/do task) of colored felt and said the sound each felt piece signified. For example, the experimenter said "cat," and the student moved three pieces of different colored felt forward, each color
representing a sound (e.g., /c/ /a/ /t/). After the student had moved forward the felt pieces, the experimenter asked a series of questions, but in varied order. The experimenter pointed to the first piece of felt and asked the student "What sound?" The experimenter also pointed, as separate questions, to the middle or last sound and ask "What sound?" The experimenter asked other questions such as "What sound before, or after, X?" with "X" representing the sound the experimenter chose. For instance in the "cat" example the experimenter asked, "What sound before /a/?" Finally, the experimenter told the student to point to sounds. For example: "Point to the /c/.

The experimenter started a countdown timer set for 10 seconds. In each trial, the experimenter asked as many questions as he could. For instance, he asked three questions about what sound each colored felt represents (e.g., experimenter points to a colored piece of felt and says "What sound?"), two questions about which sounds precede or follow sounds (e.g., "What sounds follows 'X'" or "What sound before 'X'?") and so on. He counted correct and incorrect responses with hand-held counters in each hand. Corrects occurred when the students answered the question correctly by saying the proper sound, pointing to the correct sounds, and moving the appropriate felt pieces. Each discreet action, saying or moving a sound counted as a correct. If the student said an incorrect sound, moved a felt piece, or moved and additional felt piece the experimenter recorded it as an error. Once the students could hear/say/do 7 to 10 correct felt pieces or oral responses in a 10-second practice time for two consecutive days, they finished with the segmentation condition and move on to the next condition, see/say letter names and letter sounds.
See/Say Letter Names and Letter Sounds. In the see/say letter name and sounds conditions the experimenter explained to the students that they would say the letter name and then say the letter sound upon seeing the letter. For instance, the students see the letter "a" and says "a" and then says the short "a" sound. If the students said the letter name correctly, and then the letter sound correctly, he or she received a score of two correct responses. The experimenter also accepted correctly stated letter names and letter sounds out of order. So if the student said the letter sound first (e.g., sound for "a") and then said the correct letter name (e.g., "a") he or she would receive credit for two correct responses. The experimenter would count an incorrect only if the students said the wrong letter name or incorrect letter sound.

The experimenter did not provide initial instruction, as in the see/say letter names and see/say letter sounds conditions, because the students had already demonstrated mastery of the material. In other words, by meeting the performance standard of 10 to 14 correctly identified letter names or letters sounds in the past the students had shown mastery. If the students began this task with practice cards and had difficulty accelerating learning, they would move to practice sheets. After meeting the performance standard of 10 to 14 correctly identified letter names and letter sounds the students would move onto the last condition, hear/say/do segmenting words into letters.

Hear/Say/Do Segmenting Words into Letters. In the hear/say/do segmenting words into letters, the experimenter followed the same steps as in the hear/say/do segmenting words into sounds condition. The main difference, however, occurred when the students pushed the felt pieces forward and said a letter name rather than a letter sound. For example, the experimenter would say "cat," and the student would move three pieces of
different colored felt forward, each color representing a letter name (e.g., cat). After the student had moved forward the felt pieces, the experimenter asked a series of questions in varied order. The experimenter pointed to the first piece of felt and asked the student "What letter name?" The experimenter also pointed, as separate questions, to the middle or last letter name and ask "What letter name?" The experimenter asked other questions such as "What letter name before, or after, X?" with "X" representing the letter name the experimenter chose. For instance, in the "cat" example the experimenter asked, "What letter name before /a/?" Additionally, the experimenter told the student to point to letter names. For example: "Point to the letter 'c.'"

The experimenter started a countdown timer set for 10 seconds. In each trial the experimenter asked as many questions as he could and he counted correct and incorrect responses with hand-held counters. Corrects occurred when the students answered the question correctly by saying the appropriate letter name, pointing to the correct letter name, and moving the appropriate felt pieces. Each action, saying letter name or moving a piece of felt counted as a correct. If the student said an incorrect letter name, said a letter sound, or moved and additional felt piece the experimenter recorded it as an error. Once the students could hear/say/do 7 to 10 correct felt pieces or oral responses in a 10-second practice time for two consecutive days, they finish with the segmentation condition.

**Reward System**

For any occasions where the experimenter needed to "motivate" a student, he used a reward system. To motivate a student, or technically speaking to create an establishing operation (Michael, 1983), the reward system called for the student to emit a behavior targeted for acceleration. Each
time the student emitted the targeted behavior, the experimenter placed a star sticker on a sheet of paper. After the student accumulated a predetermined amount of stars, he or she received access to a "treasure box." The treasure box contained stickers, crayons, scissors, pencils, pens, and other school related, teacher-approved, items.

**Procedural Integrity**

Two arranged events transpired for assessing procedural integrity, or the consistent application of the independent variable. First, the experimenter reported correct and incorrect responses per minute for each session of the see/say letter names, see/say letter sounds, hear/say/do segmenting words into sounds, see/say letter names and letter sounds, and hear/say/do segmenting words into letters. Second, independent observers marked a procedural integrity checklist corresponding to the baseline, see/say letter names, see/say letter sounds, hear/say/do segmenting words into sounds, see/say letter names and letter sounds, and hear/say/do segmenting words into letters (Appendix J), either "yes" or "no" specifying the experimenter performed the prescribed steps in the five independent variable conditions (i.e., see/say letter names, see/say letter sounds, hear/say/do segmenting words into sounds, see/say letter names and letter sounds, and hear/say/do segmenting words into letters). The experimenter reported the procedural integrity score for the checklists as a percentage of adherences across sessions for following procedural steps correctly.
Chapter 4 presents the results of the study by conditions of the independent variable on dependent variables. First, the experimenter reports the accuracy of measurement of the dependent variables. Second, the experimenter describes the procedural integrity of the independent variable. Third, the experimenter presents celerations and frequency jumps of correct and incorrect responding in both the independent and dependent variable conditions from the student (i.e., Amy, Tom, Fred, Bill) for each condition in the study (i.e., no instruction, see/say letter names, see/say letter sounds, hear/say/do segmenting words into sounds, see/say letter names and letter sounds, hear/say/do segmenting words into letters). Fourth, the experimenter addresses the results of social validity questionnaires given to the students and teachers.

**Accuracy of Measurement**

The experimenter assessed the accuracy of measurement by using three procedures. First, by audiotaping the student spelling words and comparing the audiotape true value of student spellings against the experimenter's real time transcription of student spellings. Second, by giving 20% of all the
audiotaped spelling performances of the students to independent observers who followed the same procedures as the experimenter for comparing the audiotape true value of student spellings against the experimenter's real time transcription of student spellings. Third, assessing accuracy by comparing spellings of the real words with a dictionary spellings and comparing the nonsense words against the experimenter's spelling list of nonsense words.

When the experimenter compared the real time transcriptions of student spellings against the audiotape true value of student spellings, he did so with 100% accuracy across all conditions. Next, the experimenter compared 20% of the audiotaped spelling performances with the independent observers. The independent observers and the experimenter agreed 100% of the time. Finally, the experimenter compared the spellings of real words with dictionary spellings and nonsense words with the experimenter's list of nonsense words. The comparisons produced 100% accuracy across all sessions.

**Procedural Integrity**

The experimenter set two conditions for assessing procedural integrity across experimental conditions. The first arranged events occurred when the experimenter reported the number of correct and incorrect responses per minute for each session of the see/say letter names, see/say letter sounds, hear/say/do letter sound segmentation, see/say letter names and letter sounds, and hear/say/do letter name segmentation conditions.

The second arranged event took place when two independent observers came on set days of the week and took data on the experimenter by checking a procedural integrity checklist. All four students generated 140 individual sessions across all phases of the study. The independent observers evaluated 57 of those sessions which equals 41% of procedural integrity.
measures taken during all experimental sessions. The independent observers collected data that indicated the experimenter performed procedural integrity with 99.9% stability across all sessions. The one instance where the experimenter failed to obtain 100% procedural integrity occurred when Bill ran out of the room before the experimenter could display Bill's data on a standard celeration chart. Bill did not miss story time that day!

**Experimental Results**

The charts in the results section follow the standard conventions outlined by in the *Handbook of the Standard Behavior Chart: Preliminary Edition* (Penneypacker, Koenig, & Lindsley, 1972). The conventions include the following: dots (i.e., •) represent acceleration targets or correctly answered items; "X's" represents deceleration targets or incorrectly answered items; pluses (i.e., +) represent the record floor or time the experimenter observed the behavior. In the *Handbook...* Penneypacker et al., (1972) recommend using a straight line (i.e., -) to display the record floor but the computer program used by the experimenter did not allow that convention, thus, he opted for the plus. Other conventions include celeration lines (i.e., a line drawn through a minimum of 4 days) with a numeric value indicating the acceleration (e.g., \(x \times 1.2\) or times 1.2) or deceleration (e.g., \(\times -2.1\) or divide by 2.1) and phase change lines (e.g., horizontal lines with a slanted line at its top) that indicate the beginning of a new condition.

Frequency "jump ups" and "jump downs" also appear in the results section. A jump up or jump down refers to the performance change between frequency points. For example, a \(x 2.0\) jump up would mean from one frequency point to another the frequency multiplied by a factor of \(x 2.0\) or a doubling of frequency. Conversely, a jump down of \(+3.0\) would mean the
frequency of a behavior now occurs at a frequency divided by 3.0 times less than before (e.g., a behavior occurring at 12 per minute that jumps down -3.0 would occur at 4 per minute).

The standard celeration chart automatically displays all counts in per minute form. When conducting timings the experimenter never had the students perform any tasks beyond 10 seconds. Some students performed tasks for shorter intervals (e.g., 6 seconds and 4 seconds). In this results section, the experimenter reports frequencies in the per minute form. For instance, 3 correct and 1 incorrect in a 15 second floor equals 45 correct and fifteen incorrect per minute. Three correct and 1 incorrect in a 6 second floor equals 30 correct and 10 incorrect per minute. Reporting frequencies as occurring per minute minimizes confusion in interpretation while also standardizing all of the reported performances.

**No Instruction**

During pretesting the experimenter determined that Amy, Tom, Fred, and Bill could not spell or read words. The four dependent variable conditions, correct and incorrect hear/say spelling real words and nonsense words (i.e., No Instruction for Figures 4.1 - 4.8), showed that all students did not spell any words.

Amy and Tom. Amy's charts show (Figures 4.1 and 4.2) that her record floor in hear/say spelling real and nonsense words jumped up by x 2.5 and x 2.8 respectively. The jump in her record floor meant that Amy took less time to say "I don't know," which the experimenter recorded as a "0" for both corrects and incorrects. Tom (Figures 4.3 and 4.4) also did not attempt to spell any words in the hear/say spelling real and nonsense word conditions. His
record floors show a jump down in frequency of +1.3 with real words and no change in the nonsense words condition.

Fred and Bill. Fred and Bill both performed similar to Amy. Specifically, for Fred (Figures 4.5 and 4.6) his record floor jumped in frequency up by \( x \) 1.8 in the real words condition and jumped up in frequency by \( x \) 2.2 in the nonsense word condition. Also, Bill's (Figures 4.7 and 4.8) record floors jumped up in frequency in both the real words and nonsense words by \( x \) 1.7 and \( x \) 1.8. The "No Instruction" condition did not occur in the hear/say spelling real and nonsense words with non-instructed letters because of (a) time constraints, (b) the apparentness that none of the students could spell, (c) attempts to minimize students' potential negative feelings, and (d) their performances would appear in the subsequent conditions verifying they could not spell.
Figure 4.1: Amy's hear/say spelling real words made from instructed letters.
Figure 4.2: Amy's hear/say spelling nonsense words made from instructed letters.
Figure 4.3: Tom's hear/say spelling real words made from instructed letters.
Figure 4.4: Tom's hear/say spelling nonsense words made from instructed letters.
Figure 4.5: Fred’s hear/say spelling real words made from instructed letters.
Figure 4.6: Fred's hear/say spelling nonsense words made from instructed letters.
Figure 4.7: Bill's hear/say spelling real words made from instructed letters.
Figure 4.8: Bill's hear/say spelling nonsense words made from instructed letters.
See/Say Letter Names.

Figures 4.9 - 4.16 show the 4 next dependent variables for the four students: hear/say spelling real and nonsense words with non-instructed letters. The independent variables (Figures 4.17 - 4.20), show the students performances with the conditions they achieved during the study. All four students' successfully completed the condition during see/say letter names. Amy entered the study with the highest demonstrated proficiency for see/say letter names: she could name them all on sight. Tom, Fred and Bill could not see/say letter names.

Amy. On the first day Amy (Figure 4.17) could see/say letters at 50 correct per minute and her frequency quickly jumped up in frequency by x 1.2, and she met the aim of 60 correct per minute. In the first four dependent variable conditions, hear/say spelling real and nonsense words with instructed letters (Figures 4.1 and 4.2) Amy could not spell words. In the real words condition Amy's record floor jumped down in frequency slightly by +1.1 and in the nonsense words condition her record floor jumped up in frequency by x 1.2. In the second four dependent variable conditions, hear/say spelling real and nonsense words with non-instructed letters (Figures 4.9 and 4.10) again Amy did not attempt to spell any words.

Tom. Tom learned to see/say letter names at a correct celeration of x 1.4 (Figure 4.18). Said another way his weekly learning multiplied by 1.4 times a week. For the month that Tom engaged in the independent variable condition, he did not attempt to hear/say spell real or nonsense words with

76
Figure 4.9: Amy's hear/say spelling real words made from non-instructed letters.
Figure 4.10: Amy's hear/say spelling nonsense words made from non-instructed letters.
Figure 4.11: Tom's hear/say spelling real words made from non-instructed letters.
Figure 4.12: Tom's hear/say spelling nonsense words made from non-instructed letters.
Figure 4.13: Fred's hear/say spelling real words made from non-instructed letters.
Figure 4.14: Fred's hear/say spelling nonsense words made from non-instructed letters.
Figure 4.15: Bill's hear/say spelling real words made from non-instructed letters.
Figure 4.16: Bill's hear/say spelling nonsense words made from non-instructed letters.
Figure 4.17: Amy's letter names, letter sounds, segmenting sounds and letters.
Figure 4.18: Tom's letter names, letter sounds, segmenting sounds and letters.
Figure 4.19: Fred's letter names, letter sounds, segmenting sounds and letters.
Figure 4.20: Bill's letter names, letter sounds, segmenting sounds and letters.
the instructed letters (Figures 4.3 and 4.4). Those first four dependent variable condition show that Tom took varying degrees of time to indicate he did not know how to spell the target words. A similar pattern developed for the second four dependent variables, hear/say real and nonsense words made from non-instructed letters (Figures 4.11 and 4.12). Tom did not attempt to spell words, but his record floors lessened from the first day to the last day in the condition.

Fred. Similar to Tom, Fred (Figure 4.19) also learned to see/say letter names in approximately one month with a correct acceleration of x 1.4. The experimenter changed the record floors from 10 seconds to 6 seconds. This produced an acceleration in learning. The student, however, requested that we lower the record floor again which the experimenter did. That alteration did not produce a meaningful change in learning. The experimenter switched the record floor back to 6 seconds after which Fred achieved his fluency aim. Fred did not attempt to spell words in the hear/say spelling real and nonsense words made from instructed letters (Figures 4.5 and 4.6). Also, Fred did not attempt to try to spell any words in the hear/say spelling real and nonsense words made from non-instructed letters (Figures 4.13 and 4.14). A review of Fred's charts that show the eight dependent variables (Figures 4.5, 4.6, 4.13, 4.14) display stability in these conditions. This stability in responding resulted from Fred's response "No," which the experimenter accepted for "I don't know" that occurred immediately after the experimenter asked Fred to spell a word. Often, Fred said "No" within one-second of the experimenter saying "Spell 'X.'"
Bill. Bill took the longest of the students to learn to see/say letter names. Bill learned to see/say letter names at a x 1.2 celeration (Figure 4.20). During the see/say letter name condition the experimenter noticed that Bill had trouble flipping the cards. He could do so at a rate necessary to meet the fluency aim, but often times would drop the cards and fumble the deck. Therefore the experimenter used a practice sheet with Bill, and he then would see/point/say the letter names. Bill did attempt to spell a word in the hear/say real words made with instructed letters (Figure 4.7). He did not, however, attempt to spell words in the hear/say spelling nonsense words made with instructed letters (Figure 4.8). Bill also tried to spell words in both the hear/say real and nonsense spelling words made with non-instructed letters (Figures 4.15 and 4.16). Bill used the same strategy in these conditions when attempting to spell words, he word hear the first letter and associate that with the picture alphabet poster in his classroom. For example, when the experimenter asked Bill to spell "at" he said "a, apple." Or when the experimenter asked Bill to spell "fan" Bill would say "f, frog."

See/Say Letter Sounds.

Figures 4.1 - 4.16 show all the dependent variables for the four students: hear/say spelling real and nonsense words made with instructed and non-instructed letters. The independent variables, Figures 4.17 - 4.20, show the students performances with the see/say letter sound conditions. During see/say letter sounds, all four students successfully completed the condition. Again, Amy entered the study with the highest demonstrated proficiency for see/say letter sounds, she could say all the sounds when she saw them. Tom, Fred and Bill could not see/say letter sounds.
Amy. Amy's chart (Figure 4.1) shows a x 1.0 celeration with see/say letter sounds. She entered the study knowing how to see/say letter sounds and her charts displays her mastery. The experimenter tried to accelerate Amy's learning but did not succeed. Throughout all the dependent variable conditions (Figures 4.1, 4.2, 4.9, 4.10) Amy did not try to spell words. Although Amy's record floors varied, the longer or shorter time periods did not associate with Amy attempting to hear/say spelling words.

Tom. Tom demonstrated the most agility in learning among the students for see/say letter sounds condition (Figure 4.18). "Agility" refers to how quickly a person can learn a new skill which precision teachers measure with celerations (Lindsley, 1996). Tom's correct responses accelerated by x 1.9. Tom also made very few errors when responding. In the dependent variable conditions hear/say real and nonsense words made with instructed letters (Figures 4.3 and 4.4 ) Tom did not attempt to spell words. Tom's responding appears very stable, with little variation in his record floors. Almost identical to the previously mentioned dependent variables, Tom responded in the same manner to hear/say spelling words made from non-instructed letters (Figures 4.11 and 4.12). Again, Tom's record floors remained stable.

Fred. The experimenter moved Fred to a practice sheet to evoke see/point/say letter sounds. The experimenter made this change because Fred, at times, had difficulty handling the deck. Fred's corrects accelerated by x 1.3 while his incorrects decelerated by /1.6 (Figure 4.19). After one month of Fred failing to reach his goal, the experimenter changed the floor from 10 seconds to 6 seconds and allowed Fred to learn the letter sounds one "slice" at a time (A "slice" means taking a part, or a slice of, problems or tasks from a set of set instructional stimuli). In Fred's case, he worked on learning 3 letter
sounds in 6 seconds (i.e., a, r, d; Appendix K). This proved an effective strategy as Fred responded by meeting his aim in one week with his corrects accelerating by x 3.0 and his incorrects maintaining at x 1.0. Fred showed even more favorable gains for the next slice (i.e., f, t, n; Appendix K) when the experimenter further reduced the record floor to 4 seconds. Fred's corrects accelerated by x 6.0 and his incorrects maintained at 1.0. In the third slice (i.e., i, m, s, o; Appendix K), Fred reached the fluency aim of 60 to 80 letter sounds per minute. His chart shows that from the first data point to the last data point his frequency of corrects jumped up in frequency by x 2.0.

The dependent variable hear/say spelling real words made from instructed letters, shows that Fred did not spell words in the see/point/say letter sounds condition (Figure 4.5 and 4.6). When Fred entered the Slice condition, he began to attempt spelling a word. A x 4.3 jump up in the frequency of corrects occurs during slice 3. Fred did not attempt to spell words in the hear/say spelling real and nonsense words made with non-instructed letters (Figures 4.13 and 4.14).

Bill. In the Slice 1 (Figure 4.20), the frequency of Bill's correct responding to see/say letter sounds jumped up by x 2.8. Indeed, Bill's last response in Slice passed the fluency aim of 60-80 per minute by almost doubling it: 120 per minute! In Slice 2, Bill continued his progress in Slice 2 with the frequency of his corrects jumping up by x 2.0. During Slice 3, Bill did the see/point/say letter sounds condition in a week and a half by learning at a acceleration of x 1.6. In the last part of the see/point/say letter sounds condition Bill displayed that he could say all the letters. He surpassed the fluency aim and did so with an x 1.4 acceleration. Figures 4.7, 4.8, 4.15, and 4.16 show all
the hear/say spelling data. Bill did not attempt to spell words during see/point/say letter sounds condition.

**Hear/Say/Do Segmenting Words into Sounds.**

Figures 4.1 - 4.4 show all the dependent variables for two students: hear/say spelling real and nonsense words made with instructed and non-instructed letters. The independent variables, Figures 4.17 and 4.18, show the students performances with the hear/say/do segmenting words into sounds conditions. During hear/say/do segmenting words into sounds, only Amy and Tom successfully completed the condition. Both Amy and Tom entered the condition unable to segment words into sounds.

**Amy.** Figure 4.17 shows Amy’s growth during the hear/say/do segmenting words into sounds condition. For the first two weeks Amy made sporadic improvement segmenting words into sounds. The experimenter acted on the sporadic performances and selected a core of 3 real, and 3 nonsense words made from instructed letters. Each day Amy would practice these same words and receiving immediate feedback on those same words. Then the experimenter asked Amy to segment other words and recorded the correct and incorrect performance on Amy’s chart. The results show that Amy progressed and eventually met her frequency aim of 40 to 60 word segmented correctly per minute.

After six weeks of saying "I don't know" to the spelling prompts in both the see/say letter names and see/say letter sounds conditions, Amy began to spell words. Figure 4.1, displaying hear/say spelling of real words with instructed letters, shows Amy’s correct spelling responses accelerating weekly 1.2 times. Her incorrect responses also accelerated x 1.1.
Amy tried to spell markedly less words than in the real words condition during the hear/say spelling nonsense words made from instructed letters (Figure 4.2). The experimenter instituted a reward system and Amy attempted to spell all of the words. After implementing the reward system Amy's frequency of incorrects jumped up by an acceleration of x 20.0! The correct responses decelerated after the reward system by ±1.1.

Amy's responding in the hear/say spelling real and nonsense words, made with non-instructed letters, closely paralleled Amy's performance in the real and nonsense words made with instructed letters (Figures 4.9 and 4.10). For instance in the real words condition Amy's corrects accelerated x 1.6, and the frequency of her incorrect responses jumped up x 3.0. Further, Amy attempted very few spellings in the nonsense word condition and attempted more after implementation of the reward system: corrects jumped up x 2.0 and incorrects jumped up x 2.8.

Tom. Tom demonstrated high learning agility again by learning to hear/say/do segmenting words into sounds by doubling his weekly performance, or x 2.0 learning (Figure 4.18). Tom made relatively few incorrect responses and generally progressed very rapidly in the hear/say/do segmenting words into sounds condition.

Tom began attempted to spell words in hear/say spelling real words made with instructed letters (Figure 4.3). His performance shows that he made very few correct responses and relatively more incorrect responses. Tom responded similarly in the hear/say spelling words with non-instructed letters although the last data point in that condition shows a x 3.1 jump in the frequency of correct responses and a x 8.5 jump up in the frequency of incorrect responses (Figure 4.4).
Like the previous four dependent variables, Tom made very few correct responses while making comparatively more incorrect responses (Figures 4.11 and 4.12). The last data point for incorrect responses in hear/say spelling words made from instructed and non-instructed show jump ups in frequency, x 1.4 and x 4.0.

See/Say Letter Names and Letter Sounds.

Figures 4.1 - 4.4 show all the dependent variables for Amy and Tom (i.e., hear/say spelling real and nonsense words made with instructed and non-instructed letters). The independent variables, figures 4.17 and 4.18, show the students performances with the see/say letter names and letter sounds conditions. During see/say letter names and letter sounds, only Amy successfully completed the condition. Tom neared the end of the condition but could not finish it because the school year ended. In the previous independent variable conditions, see/say letter names and see/say letter sounds (Figures 4.1 and 4.2), both Amy and Tom reached their fluency aims. Though this happened for both students, the experimenter did not assume each student could act upon the connection that a letter name has a corresponding letter sound.

Amy, Figure 4.17 shows Amy see/say letter names and letter sounds performance. Amy's data point represents 75 correct, and 0 incorrect performance of see/say letter names and sounds. The experimenter did not require Amy to do see/say letter names and sounds to meet the required two days at aim criterion for advancing to the next condition because Amy performed in the frequency aim on her first try, and due to time constraints.

Amy's data points in the hear/say spelling real and nonsense words with instructed letters shows a similar pattern, significantly more incorrect
than correct responses (Figures 4.1 and 4.2). The experimenter did not collect data for Amy on hear/say spelling real and nonsense words with non-instructed letters because of the previously mentioned reasons (Figures 4.9 and 4.10).

Tom. Tom (Figure 4.18) began the see/point/say letter names and letter sounds condition with Slices and with a lower record floor (i.e., 4 seconds). The experimenter made this change after he observed that Tom had difficulty with the 10-second floor and the large set of 10 letters. Slices and a lower record floor worked for Tom. On Slice 1, Tom exceeded the fluency aim of 60 to 80 by getting 120 correct and 0 incorrect on the see/point/say exercise. During Slice 2 Tom performed very well again by getting 105 correct and 0 incorrect. Before Tom could finish the last Slice, the school year ended.

The frequency of correct responses in hear/say spelling real words made from instructed letters jumped up × 2.3 from Tom's last data point in the hear/say/do segmenting sounds condition while incorrects slightly accelerated by × 1.2 (Figure 4.3). Correct and incorrect responses both jumped down in frequency, +1.3, +1.8 from Slice 1 to Slice 2. A similar pattern occurred in hear/say spelling nonsense words made from instructed letters (Figure 4.4). A × 1.6 jump up in the frequency of correct letters and a × 1.4 jump up in the frequency of incorrect letters from the hear/say/do segmenting sounds condition. Also, both correct and incorrect responses jumped down in frequency by +1.8 and +3.2 in Slice 1 to Slice 2.

In hear/say spelling real and nonsense words made from non-instructed letters, Tom's frequency of corrects decelerated in both conditions +1.3 and +1.6 (Figures 4.11 and 4.12). The frequency of incorrects in hear/say spelling real, and nonsense words made from non-instructed letters both
showed jump ups. In the real words condition by x 2.5 and in the nonsense words by x 2.9.

**Hear/Say/Do Segmenting Words into Letters**

Figures 4.1 and 4.2 show all the dependent variables for one student, Amy, hear/say spelling real and nonsense words made with instructed and non-instructed letters. The independent variables, figure 4.17, shows Amy's performances with the hear/say/do segmenting words into letters conditions. During hear/say/do segmenting words into letters, only Amy successfully completed the condition.

**Amy.** Because of time limitations, Amy had only two days in which to complete the last condition, hear/say/do segmenting words into letters. Amy, however, showed agility in learning and the frequency of her corrects jumped up x 2.3 and the frequency of her incorrects jumped down ÷ 2.0 (Figure 4.17). During the last day of the experiment Amy correctly segmented words into letters at a frequency of 42 correct and 0 incorrect per minute. Thus, Amy entered the frequency aim: 40 to 60 corrects per minute.

Amy's frequency of correct responses jumped up x 2.2 and the frequency of incorrects jumped down ÷ 2.8 (Figure 4.1) in the hear/say spelling real words made from instructed letters. The hear/say spelling nonsense words made from instructed letters her frequency of correct responses jumped down ÷1.3 and the frequency of incorrects jumped down ÷3.0 (Figure 4.2). The hear/say spelling real words made from non-instructed letters condition saw Amy's frequency of correct responses jumped down ÷1.2 and the frequency of incorrects jumped down ÷1.4 (Figure 4.9). In the hear/say spelling nonsense words made from non-instructed letters her frequency of correct responses
jumped up x 1.4 and the frequency of incorrects jumped down x2.0 (Figure 4.10).

**Social Validity**

The experimenter met with individual students and asked them social validity questions and transcribed their answers after the study ended (Appendix L). For all four children, the experimenter had to explain to the students that a "study" meant the procedures they did with the experimenter. The experimenter explained "procedures" by describing what the students did while in the study such as seeing practice cards, saying the letter name and trying to spell words.

**Student Responses to the Social Validity Questions**

All of the students made positive comments when asked about the study. By reviewing the students comments, appearing in Table 4.1, it becomes clear that the students identified different likes when recalling what they thought regarding the study. Answers ranged from positive comments about engaging in the experimental tasks to receiving "stars." None of the students identified activities that they did not like during the study.
<table>
<thead>
<tr>
<th>Questions</th>
<th>Student Response</th>
</tr>
</thead>
</table>
| 1. What did you like about the study? | (Amy) The stars.  
(Tom) It was fun. It helped me learn.  
(Bill) Working on the letters and spelling. Also giving me stuff. I also liked getting high five's and shaking hands.  
(Fred) Doing the sounds. Doing the letters. Helping me. |
| 2. What didn't you like about the study? | (Amy) Nothing.  
(Tom) Nothing. I didn't like the one thing when we did the letters (Tom meant the segmentation task). It wasn't fun.  
(Bill) Nothing.  
(Fred) Fred did not reply orally, even when prompted. He shook his head which the experimenter interpreted as meaning "nothing." |
| 3. What have you learned during this study? | (Amy) Letters and the sounds.  
(Tom) It helped me learn because, so I can tell letters.  
(Bill) Spelling.  
(Fred) Count to 100. |

Table 4.1 continued...
Table 4.1 continued...

4. Has doing this study helped you in school? (Amy) Yes. By doing the sounds it helped me read. (Tom) Yes. Because my teacher might say "Tom, do that," and then I know how to do that (Tom referred to his ability to spell and read) (Bill) Yes. Spelling, working on the sounds, and the letters. (Fred) Yes. The sounds. Teacher calling me up to do the sounds and I almost got them all right.

5. Would you do this study again if asked? (Amy) Yes. (Tom) Yes (Bill) Yes (Fred) Yes

Table 4.1: Social validity questions asked to the students.
Teacher Responses to the Social Validity Questions

The teachers also responded favorably when asked about the study. The teachers, however, had less access to the experimental methods and some stated they would have liked to see "...what was going on." The review of the teacher's comments, appears in Table 4.2. Teachers responded differently to the questions and a general theme to their answers seemed to include a desire for more access to the study and the experimenter including more students. All of the teacher agreed the study had positive benefits and did not have any negative components to it. The experimenter gave the teachers a form and they responded by writing their own opinions (Appendix M).
<table>
<thead>
<tr>
<th>Questions</th>
<th>Teacher Response</th>
</tr>
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<tbody>
<tr>
<td>1. Have you noticed any benefits in the classroom from participating in this study? If yes, please describe them.</td>
<td>(Amy's Teacher) Amy was very eager to participate and I am sure that much of her excitement was generated by all the positive encouragement Mr. Rick brought to this study. He was and is an enthusiastic and helpful teacher wanting to help Amy to value and enjoy reading by leading her to &quot;own&quot; the alphabet by naming letters and making their sounds to spell orally and to count the sounds. This practice and extension of learning for Amy helped her gain in confidence to want to do more with her new learned skills—especially in the area of writing in her journal on her own. She was more motivated to want to do more reading activities in the classroom. Amy's confidence increased from being with Mr. Rick in a one-on-one learning environment. She liked all the attention and looked forward to his coming. She was not as anxious about trying new things. (Tom's Teacher) The student's self confidence level has increased both academically and socially. The student participates in class activities and</td>
</tr>
</tbody>
</table>

Table 4.2 continued...
2. Have you noticed anything negative in the classroom from your student participating in this study. If yes, please describe.

(Amy's Teacher) No.

(Tom's Teacher) No I have not noticed a negative effect. The student was always excited when greeted by Mr. Kubina at the door.

(Bill and Fred's Teacher) No.

3. Can you think of a way to make this study better in the future?

(Amy's Teacher) I would have liked Mr. Rick do some activities in my classroom so I could see first hand what his study was all about. It would have been interesting to have had two children in the same group—one quieter and slower to catch on like Amy and another child very eager and ready to explode with excitement over learning. This would be interesting to see how each child progressed individually as well as if they were of any help to each other.
Table 4.2 continued...

4. Do you have any general comments about the study?

(Tom’s Teacher) Opening the study to include a larger group of students. This was an additional intervention for the classroom teacher which also gave the student one-on-one direction.

(Bill and Fred’s Teacher) No response given by the teacher.

(Amy’s Teacher) I was able to discuss with Mr. Rick some teaching methods that I was developing in my classroom and he so eagerly and willingly shared with me what he was wanting to accomplish and how I could implement and extend on what I was introducing. As a result, I did more orally blending and spelling of words. The children spelled for me and then I would write what they spelled for all of us to read. Before I was writing words for them to sound out. As a result, the children were able to spell many three letter words on their own in their writing journal. They could make sounds, count the sounds, and knew the letter names to write the sounds to write the words in list and in sentences that they could read. This was a worthwhile learning experience for all of us. Thank you for sharing with Amy and with me.
4.2 continued...

(Tom's Teacher) This was a first involving research in this area with my children. It was difficult to narrow down the subject choice. It was handled very professionally with respect given to the Table classroom teacher. Student updates were timely and helpful to the teacher. I know how my student was doing and what types of activities were being presented.

(Bill and Fred's Teacher) The two children that participated were behind in letter skills. Both children now recognize all the letters and know many sounds. This study gave them a good start on spelling.

Table 4.2: Social validity questions given to the classroom teachers.
This dissertation looked at establishing five separate behaviors—see/say letter names, see/say letter sounds, hear/say/do segmenting words into sounds, see/say letter names and letter sounds, and hear/say/do segmenting words into letters, to determine whether those separate behavior would combine or demonstrate contingency adduction.

**Research Question One and Two**

*What effects will learning letter names, letter sounds, letter names and letter sounds together, segmenting words into sounds, and segmenting words into letters to fluent levels have on correct and incorrect oral spelling of real words and nonsense word made from instructed letters students received instruction on?*

*Amy.* Did contingency adduction occur with hear/say a spelling words made for instructed letters? The results from Amy suggest an affirmative answer. Only Amy’s data can answer the research question because she alone received all five independent variable conditions.

To satisfy the definition of contingency adduction, a behavior must meet the requirements of a new contingency that differs from the
requirements established for individual behavioral elements (Johnson & Layng, 1992; Andronis, Layng, & Goldiamond, 1997). In Amy's case, only after she learned see/say letter names, see/say letter sounds, hear/say/do segmenting word into sounds, see/say letter names and sounds, and hear/say/do segmenting word into letters, to the performance standards could she emit a behavior that met the functional requirements of a new behavior (i.e., spelling).

The experimental procedures in this experiment differ from other reports of adduction (Andronis, Layng, & Goldiamond, 1998; Johnson & Layng, 1992) and interconnection (Epstein, 1985, 1987; Epstein, Kirshnit, Lanza, & Rubin, 1984) in the measurement and detection of the novel behavior. The adduction and interconnection experiments tested for the presence of the novel behavior at one point in time, typically after the experimental participants had acquired all of the relevant behaviors. In the present study, the experimenter probed for the presence of the novel behavior throughout all experimental conditions.

What variables may have contributed to Amy's adduced spelling repertoire? One strategy capitalized upon in this study: frequency building. The efficacy of frequency building in contingency adduction, "...may make component performance more probable and thus more likely to be prompted and selected by current contingencies" (Johnson & Layng, 1996, p. 287). Amy did not demonstrate that she could spell accurately until after she reached the performance standards for each of the five component behaviors.

Another variable pertinent to this experiment, "agility" of learning, may also play an important role in producing adduction. As defined earlier, agility refers to how quickly a person learns a skill measured by celeration.
Lindsley says an agile learner can quickly switch directions and swiftly learn new skills and unlearn old skills while balancing "more and more rapid information age changes" (Lindsley, 1996, p. 13). Amy demonstrated agility of learning in hear/say/do segmenting words into letters.

The last of the five elements contributing to the hear/say spelling words adduced repertoire, hear/say/do segmenting letters into words, closely approximated the terminal behavior. To spell, a student hears a word, segments the word into sounds, matches the sound, or phoneme, to a letter, or grapheme, and says the letters in the correct sequence or orthography of the word. In the hear/say/do segmenting letters into words the experimenter said "tell me the letter names in "rat"?" The student then pushed forward a piece of felt and said the letter each felt piece represented. The experimenter then asked a series of questions regarding the letters (e.g., Experimenter pointed to the letter "a" and asks "What letter comes before this letter?").

The ability to segment words into their constituent letters, however, differs from the compound act of spelling just as the ability to segment phonemes differs from the compound act of reading. Amy's data show that after she reached the frequency standard for hear/say/do segmenting words into letters, she orally spelled words with a high degree of accuracy. This outcome appears remarkably similar to those reported by Johnson and Layng (1992):

This new repertoire was not a product of gradual shaping but appeared fully established as a function of establishing its constituent parts and placing the student in an environment where the behavior, correctly solving word problems involving fractions, has been absent. With no
fraction problem solving instruction necessary, fluency building was prescribed to ensure the retention of this new variant. (p. 1488)

In the hear/say spelling real words with instructed letters Amy demonstrated a "fully established" spelling repertoire without the benefit of formal spelling instruction. Amy's frequency of corrects jumped up x 2.0, and the frequency of her incorrect jumped down ÷3.0 (Figure 4.1). On the last day, the experimenter noted that the incorrects Amy made occurred because she spelled the words word. For instance, when the experimenter said, "Spell 'rat,'" Amy spelled it "r a n." When asked what word she spelled Amy replied "ran." Amy did this with three words which accounted for most the incorrects she made. Therefore for the hear/say spelling real words made from instructed letters Amy clearly demonstrated a contingency adduced spelling repertoire. In the three and a half months, Amy never received corrective feedback, or instruction of any type in the experiment, on how to spell. After reaching her fluency aims in each condition, Amy demonstrated that she could reliably spell real consonant-vowel-consonant, vowel-consonant, and consonant-vowel words made from instructed letters.

A potential negative effect from applying multiple measurements of the novel behavior may occur in shaping. Specifically, the participant may gain some additional practice or information that transforms the present behavior into a successive approximation of the novel, target, behavior. For example, a experiment examines how to foster a contingency adduced repertoire of solving a polynomial equation (e.g., -3x = 2y + 4). The experimental procedures call for a number of individually taught behaviors (e.g., addition, multiplication, factoring, explaining a coefficient has a corresponding real number). If the experimenter first taught a monomial,
how to factor it, then how to add measuring for the presence of the novel behavior each step may create a successive approximation wherein the student learns to solve the polynomial equation in a stepwise fashion.

Three experimental procedures can control for shaping. First, by measuring for the presence of the novel behavior after establishing all the separate behaviors. Second, by providing no feedback for the novel behavior. Third, by measuring the behavior in temporally distant intervals. The present study employed the second and third controls, Amy did not receive feedback specific to the spelling task and the experimenter assessed the presence of spelling at weekly intervals.

The experimenter noticed that on days when independent observers watched the session Amy did not respond as frequently as when alone. The experimenter hypothesized that Amy's shyness might have served to limit her attempts to spell. So the experimenter implemented a reward system. Specifically, Amy received stars after each attempt to spell a word. If she acquired 10 stars in a session, she could pick something from the "treasure box." The treasure box contained school supplies like crayons, pens, scissors, markers and so on. On the day of implementing the reward system, Amy attempted to spell every word presented to her. Her errors jumped up by $x \times 3.0$ (Figure 1), and her correct decelerated by $+2.0$. Never did the experimenter provide critical feedback to Amy concerning her spelling performance, he only gave her stars for attempts despite whether she spelled the word correctly or incorrectly.

Amy could see/say letter names, and letter sounds at the fluency aim, but this component, along with the others, did not produce contingency adduction. In the hear/say spelling real words made with instructed letters
Amy's correct and incorrect responses stayed very close to the previous frequencies. In the hear/say spelling real words made with non-instructed letters (Figure 4.2) Amy's correct frequencies jump up x 2.0 and her incorrect frequency of responses jumped up x 2.0 also. Although Amy now tried to spell more words, indeed she tried to spell almost everyone, she employed a faulty strategy. When asked to spell "mat" Amy would give the letter sounds for the word (e.g., "/m/ /a/ /t/"). Amy employed this strategy with near perfect accuracy, she would say all the correct sounds for the letter names and would stop at the right place in each word. She did this when spelling both real and nonsense words. Because Amy reached her aim very quickly and the end of the school year loomed close, the experimenter moved Amy onto the next condition and did not collect data for Amy's performance in see/say spelling words made with non-instructed letters.

Other students. Although the other students did not experience the five independent variable conditions or achieve a contingency adduced spelling repertoires some parts of their data warrant discussion. For instance the results from Tom, Fred, and Bill, demonstrate that learning to see/say letters and see/say sounds at a fluency aim (i.e., an established performance standard) does not promote hear/say spelling real or nonsense words with instructed and non-instructed letters. This finding, like those of Ball and Blachman (1988, 1991) demonstrate that learning letter names and letter sounds will not necessarily result in spelling ability. The spelling performances of Fred and Bill (Figures 4.5, 4.6, 4.7, 4.8, 4.13, 4.14, 4.15, 4.16) especially substantiate the notion that knowledge of, and fluency in, letter names and letter sounds alone do not always result in a spelling repertoire.
Although Tom did not demonstrate a fully adduced spelling repertoire in both the hear/say spelling real and nonsense word made with instructed letters (Figure 4.3 and 4.4) Tom began to employ the same strategy as Amy used. So, when the experimenter said "Spell fit," Tom gave the letter sounds in the place of letter names. For example, Tom replied "/f/ /i/ /t/." On two occasions Tom did say a letter name, but mostly Tom said letter sounds. This result seems peculiar since Tom could say the letter sound equivalents for six letter names.

Tom's development in the hear/say/do segmenting sounds condition had an interesting effect on both the hear/say spelling of real and nonsense words made with instructed letters. As Tom became more proficient in segmenting words into sounds, he started to attempt to spell words (Figures 4.3 and 4.4). Although Tom made more errors than corrects in both conditions he demonstrated that he could spell some letters correct and that he understood something about spelling. Tom's performance established a significant precedent: after nearly 3 months of saying "I don't know" Tom suddenly did know something and acted upon it!

Fred's data imply that he began to spell words during Slice 1, Slice 2, and Slice 3 (Figure 4.5 and 4.6). The experimenter discovered that Fred's sister taught him how to spell the word "Matt," the name of Fred's friend. Each time the experimenter said, "Spell 'mat,'" Fred responded with some derivation of "Matt." In Slice 3, Fred finally succeeded in spelling "mat" the way his sister taught him: "Matt." This produced 3 corrects and 1 incorrect for his score. A casual look at these data may seem to suggest seeds, or the beginnings of, contingency adduction. A look at the other dependent variable conditions offer an alternative explanation.
Fred's responding in the hear/say spelling nonsense words made with instructed letters show a remarkable consistency in Fred stating "No" or he did not know how to spell the words. Further, in Slice 1, 2, and 3 Fred continued his pattern of immediately saying "No," after hearing the spelling prompt from the experimenter. In the other dependent variable conditions, Fred exhibited the same response patterns of saying "No" immediately when he heard the experimenter say "Spell...." A contingency adduced repertoire of spelling showed a more pronounced degree of spelling attempts. Fred's data indicate that he learned to say a sequence of letters in response to a specific name (i.e., Matt), which confirms that Fred did not acquire a contingency adduced spelling repertoire.

Research Question Three and Four

What effects will learning letter names, letter sounds, letter names and letter sounds together, segmenting words into sounds, and segmenting words into letters to fluent levels have on correct and incorrect oral spelling of real and nonsense words made up of letters students did not receive during instruction?

Amy. During the hear/say spelling nonsense words (Figure 4.10) made from non-instructed letters Amy demonstrated that she could spell words but not as well as in the real words condition. For example, the frequency of Amy's correct jumped down +1.2 but her incorrects jumped down +3.0. The experimenter noted that Amy spelled words incorrectly for the word the experimenter prompted, but spelled words correctly for what Amy thought she heard (e.g., Experimenter said, "Spell 'ut,'" and she spelled "up" because she heard "up" and not "ut"). This same pattern occurred with hear/say spelling real and nonsense words made from instructed letters.
Amy displayed an ability to spell words correctly in the hear/say spelling words made with non-instructed letters (Figures 4.9 and 4.10). With the real words the frequency of Amy's corrects slightly decelerated by +1.1 and her incorrects decelerated +1.4. With the nonsense words the frequency of Amy's corrects jumped up x 1.5, and the frequency of her incorrects jumped down +2.5. The frequency jumps indicate that Amy had improved her spelling skills with non-instructed letters. It did not surprise the experimenter that a carry over effect occurred with Amy because she entered the study knowing all the sounds and letters. Interestingly, though, she performed better in the spelling tasks that used words made from instructed words.

The experimenter chose the multiple baseline across behaviors to determine if adduction would occur with a set of letters practiced and a corresponding set of words, not practiced, would not adduce. Amy's data show that (Figures 4.9 and 4.10) when she adduced spelling with the words made from instructed letters she also spelled real and nonsense words made from non-instructed letters. This finding also does not come as a surprise because Amy could identify the letter names and letter sounds at the beginning of the experiment.

Other students. Tom showed a different, and perhaps more predictable, response in the hear/say spelling real and nonsense words made with non-instructed letters (Figures 4.11 and 4.12) from the performance of Amy. Tom attempted fewer spellings, and incorrectly spelled words he attempted. This makes sense because Tom did not learn the letter names and letter sounds in these words during the experiment. Therefore, without having achieved the fluency aim Tom did not have the requisite element behaviors in his repertoire to create a compound behavior. A contingency adduced spelling
repertoire, in the context of non-instructed letters, could not occur because Tom lacked the necessary skills for the terminal behavior.

Tom's performance in the second set of dependent variable also has meaning for the third and fourth research questions. In the hear/say spelling real and nonsense words made with non-instructed letters Tom attempted to spell words when he became more proficient with segmenting just as he had in the spelling words made from instructed letters. In the words made with non-instructed letters, however, Tom's ratio of incorrects to corrects appeared more decided. It would seem that because Tom reached the fluency aims for see/say letter names and see/say letter sounds, those elements of behavior laid the ground work for a compound behavior. Said differently, a connection between letter names, letter sounds, and the way those sounds and letters relate to words, might have started to adduce.

Research Question Five
Will teachers and students find the procedures useful and effective in terms of generative spelling skills?

Students. When asked "What did you like about the study?" the students all gave different answers. The answers reflected the diversity of the students' preferences. Three of the four students named something intrinsic to the outcome of the procedures (i.e., learning something). Two of the students also picked something solely an extrinsic part (i.e., the stars, getting high fives). Even though Amy received stars for one portion of the study, the procedures appear salient enough to induce students to participate without the need for extrinsic consequences. The use of stars for Amy had more to do with creating an establishing operation for her to spell more words, part of
the experimental procedures, rather than having her participating in the experiment which she did so freely and enthusiastically.

The second question asked the students what they did not like about the study. Three of the four students did not identify dislikes relating to the experiment. One student, however, did indicate a dislike. Tom said he did not like the segmentation task, although he did not call it that by name. One reason why Tom disliked the segmentation exercise stems may stem from the nature of each task.

The see/say letter names, see/say letter sounds, and the see/say letters names and letter sounds fall into a category call associative learning (Tiemann & Markle, 1990). In association learning the student learns one response to one stimulus. In the case of see/say letter names and letter sounds two responses for one stimulus. The hear/say/do segmentation task falls into the category of applying a principle (Tiemann, & Markle, 1990). A principle calls for understanding a verbal relation that "sets forth a relationships between two or more concepts" (Tiemann & Markle, 1990, p. 11). In this experiment learning a set of simple associations did not tax the learners as much as learning to apply a principle. Conceivably Tom's comment may have reflected the difference in the learning tasks.

The experimenter asked the students a third question, "What have you learned from this study?" Amy and Tom both said "letters." Interesting enough, Bill said "spelling" even though he never demonstrated that he could spell words aside from "Matt." Fred said he learned to "Count by 100." The experimenter did not instruct Fred in counting. His response most likely originated from confusing the extra help he received from parent, in which the parent took Fred out of class to practice identifying numbers and
counting, with when the experimenter took Fred out of class to instruct letter names and letter sounds.

When asked if the experiment's outcomes helped the students in school all responded affirmatively. Tom and Amy noted that the outcomes helped them read and spell. Bill and Fred said they knew answers when the teacher called on them. Bill and Fred referred to class situations where the teacher asked then students letter names or letter sounds. The last question, "Would you do this study again" attempted to confirm the students really liked the study. All students said they would participate again.

Teachers. The experimenter asked the teachers if they noticed student benefits from the experimental procedures. All teachers expressed a general theme of "motivation" across their responses. They stated that as a result of working with the experimenter individually, the students had more confidence in other tasks (e.g., journal writing, social skills). It seems the teachers found the individual attention the students received coupled with the instructional content a good combination for the students' increased academic and social participation. The teachers all indicated they did not perceive anything negative about the experimental procedures when asked.

"Can you think of a way to make this study better?" The two teachers that responded to that question both stated they would have liked to have this experimenter include more children. One teachers' comment came from an intellectual curiosity; what would happen if the participants had heterogeneous levels of success rather than homogenous (e.g., students beginning to understand print versus students struggling to understand print). The other teachers' comment heeds a more pragmatic position; opening up the study to more students would allow more students to benefit.

117
from the procedures. Although Bill and Fred's teacher did not give a written response, often times, during the course of the experiment, the teacher remarked to the experimenter that many of her students had difficulty learning to read and spell and would jokingly ask if the experimenter could instruct additional students. It appeared the teachers valued the experiment such that they would all have liked to have a larger group of students participate.

The fourth social validity question asked of the teachers, "Do you have any general comments about the study?" evoked additional positive comments regarding the experiment. Amy's teachers modified the experimenters procedure and gave more blending, segmenting, and spelling instruction. Amy's teacher reported that these strategies worked very well for other students in the class (i.e., the learned to spell more words).

Tom's teacher reported that she felt pleased the experimenter communicated student progress and as explained the procedures he used with the students. Keeping teachers abreast of experimental procedures and student progress may form a particularly important goal for experimenters who take students out of the classroom and away from view of the teacher.

Bill and Fred's teacher responded to the fourth social question that she thought the students now would benefit from spelling instruction. Her comment reflect the progress made by Bill and Fred, both mastered a set of letter names and letter sounds thus preparing them for learning how those letters form words.

Limitations

As stated earlier, Amy entered the study with knowledge of letter names and letters sounds. When assessed individually for each skill (i.e.,
see/say letter names and see/say letter sounds) Amy performed at the fluency aim. Apparently, Amy also could match a letter name with the letter sound. When given a practice sheet Amy could see/point/say 70 correct letter names and letter sounds with no incorrects per minute (Figure 4.17). No other students completed all five independent variable conditions and demonstrated a contingency adduced repertoire. Therefore, a systematic replication would determine if a student had a fully formed repertoire of letter names and letter sounds affects the emergence of a contingency adduced spelling repertoire.

In the general education classroom, all teachers attempted to teach the students how to read and spell. Each teacher, however, taught the students differently exposing them letter names and letter sounds in different manners. Amy received spelling instruction and may factor into her adduced spelling repertoire. It seems unlikely that the spelling instruction had a direct effect on Amy's spelling because she did not spell the entire school year and only spelled at the end of the experiment after she became fluent on the element behaviors of spelling. Further, Fred, Bill, and Tom received formal spelling and never acquired a contingency adduced spelling repertoire. Nevertheless, the instruction Amy received might have had some effect, but it appears the robust strength of the five element variables contributed most to Amy's adduced spelling skill.

Future Research

Preschool children without knowledge of letter names, letter sounds would form a very good group of participants in which to further study the effects of a contingency adduced spelling repertoire. The preschool students would have a repertoire that could more clearly establish adduction because
they would unlikely have received any type of spelling instruction, and limited exposure to letter names and letter sounds.

Also the experimenter should vary the procedures used in further adduction experiments. For example, experimental conditions should begin with low record floors intact judging from the success that the students made by slicing the overall task and lowering the record floor. Additionally, lessening the amount of letter names and letter sounds to 4 or 5 rather than the 10 may foster contingency adduction quicker.

The element behaviors could also vary. For example Epstein, Kirshnit, Lanza, and Rubin (1984) performed a series of variations in an interconnection experiment. When the pigeons missed a critical element they could not perform the compound behavior. The spelling elements in this experiment may change along certain lines because the critical elements identified appear tentative. For instance, the students could learn letter names and letter sounds simultaneously rather than separately. Also, further replications could examine varying the order in which the students learn the skill elements (e.g., hear/say/do segmenting words into letters, then letter names and letter sounds).

Summary

Contingency adduction occurs when separately established behaviors recombine and form new behaviors. The knowledge of contingency adduction provides understanding for how some complex behaviors may come to fruition. Also, it may lead to education and social practices that benefit a great majority of people (e.g., making new discoveries, learning curricular material in less time).
The purpose of the present experiment examined whether establishing five separate behaviors (a) see/say letter names, (b) see/say letter sounds, (c) hear/say/do segmenting words into sounds, (d) see/say letter names and letter sounds, and (e) hear/say/do segmenting words into letters, would combine or demonstrate contingency adduction. Four students in kindergarten, one girl and three boys, served as the experimental participants. The experiment took place in a rural school.

The method for promoting contingency adduction used frequency building of these elements. A multiple baseline across behaviors formed the experimental design to analyze whether learning the five element behaviors produced a contingency adduced spelling repertoire in eight dependent variables, (a) correct and incorrect hear/say spelling real and nonsense words made from instructed letters, and (b) correct and incorrect hear/say spelling real and nonsense words made from non-instructed letters.

One student received all five experimental conditions and demonstrated a contingency adduced spelling repertoire. She could spell words with a real and nonsense words made from instructed letters with a high degree of accuracy though the experiment never provided formal spelling instruction or feedback on the student's spelling performance. The other three participants did not receive all five independent variable conditions, and none of those students demonstrated a contingency adduced spelling repertoire. The data from this study demonstrate a method for producing contingency adduction by using frequency building with element behaviors.
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124


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130
SCRIPT TO PRINCIPAL

Hello and nice to meet you. Please call me Rick. I have entered my third year in the doctoral program in the College of Education at The Ohio State University, and would like to do a study at your school investigating a method to increase emergent literacy skills with young children. I believe you may have some students, particularly those in kindergarten, who could use additional instruction in letter name, letter sound identification, and segmenting words into sounds. I would like to know whether you think one of your teachers, and some of the students in his or her class, would like to participate in this study?

If so I would instruct students individually, on letter name, letter sound identification, and segmenting words into sounds, for approximately 15 minutes a day. I would begin, at the earliest, in February and will end in the middle of May, or sooner. Each day I will provide each student systematic practice, immediate corrective instruction, and charted feedback for letter name, letter sound identification, and segmenting words into sounds. In addition, I will communicate closely with the teacher and share all accomplishments of each student.

For this study, I will accept students who consent to participate on a strictly voluntary basis with the understanding that they may leave the study at any time and without penalty. Those students who agree to participate will also enjoy complete confidentiality with the students' name never appearing in any oral or written reports. If you feel some of your students might want to participate in this, I will arrange to speak with the teachers, parents and students. I will also provide permission slips to send home. Thank you for
taking time out of your busy day and talking with me this afternoon. I look forward to hearing from you.
SCRIPT TO TEACHER

Hello and nice to meet you. Please call me Rick. I have entered my third year in the doctoral program in the College of Education at The Ohio State University and plan to do a study at your school investigating a method to increase emergent literacy skills with young children. I believe you may have some students in class who could use additional instruction in letter name, letter sound identification, and segmenting words into sounds. I would like to know whether you have any students in class who would want additional instruction on developing literacy skills?

If so I would instruct students individually, on letter name, letter sound identification, and segmenting words into sounds for approximately 15 minutes a day. I would begin, at the earliest in February and will end in the middle of May, or sooner. In addition, I will communicate closely with you and share all the accomplishments of each student.

For this study, I will accept students who consent to participate on a strictly voluntary basis with the understanding that they may leave the study at any time and without penalty. I will keep all information confidential and protected. Additionally, I will not make the data part of a permanent record. If you feel some of your students might want to participate in this, I will arrange to speak with the students and their parents. I will also provide permission slips to send home. Thank you for taking time out of your busy day and talking with me this afternoon. I look forward to hearing from you.
SCRIPT TO PARENT

Hello and nice to meet you. Please call me Rick. I have entered my third year in the doctoral program in the College of Education at The Ohio State University, and I plan to do a study at your child’s school investigating a method to increase emergent literacy skills. During this study I will instruct students on letter name, letter sound identification, and segmenting words into sounds. I have called you to find out if you believe your child would want this additional instruction on developing literacy skills? If so I would instruct your child individually, on letter name, letter sound identification, and segmenting words into sounds, for approximately 15 minutes a day. I would begin, at the earliest, in February and will end in the middle of May, or sooner.

For this study, I will accept students who have parental consent to participate with the understanding that students may leave the study at any time, and without penalty. I will keep all information confidential and protected. Additionally, I will not make the data part of a permanent record.

If you believe your child might want to participate in this instruction, I will send a permission slip home. Please read it carefully, and if you agree with it, sign it, and send it back to your child’s teacher the next day. Thank you for taking time out of your busy day and talking with me this afternoon. I look forward to instructing your child.
SCRIPT TO STUDENTS

Hello and nice to meet you. Please call me Rick. I go to school at The Ohio State University. I plan on teaching in your classroom. Your teacher said some of you might want to learn more about alphabet letter names, alphabet letter sounds, and hearing sounds in words. I came here today to find out if any of you would want to work with me?

If you do want to work with me, I would teach you for about 15 minutes a day. We would learn how to say alphabet letter names, alphabet letter sounds, and how hear sounds in words. We would have fun because we could make a game out of it. Each day you will have a chance to beat your last score.

To work with me you have to volunteer. That means if you want me to teach you, you must say "OK." If you do say "OK" and you find out you don't want to do it anymore you can quit and you won't get into any trouble with me, your teachers, or your parents. If you want to work with me talk with your parent about what I have said and take this permission slip home for your mom or dad to sign. Does anyone have any questions? Thank you for talking with me today.
February 22, 1999

Dear Parent:

We, Dr. John Cooper and Rick Kubina, would like to extend an opportunity to your child to participate in a study that would teach early literacy skills. Recent research has demonstrated promising findings that show children who learn letter names, letter sounds, and how to segment words into sounds also learn to read and spell. The children who learn these early literacy skills have an advantage learning to read and spell once the teacher begins formal literacy instruction.

Rick Kubina, a doctoral candidate at The Ohio State University in the School of Physical Activity and Educational Services, will conduct an informal assessment to determine if your child will benefit from instruction with early literacy skills. We will choose those students who cannot spell or read because they will have the most to benefit from our instruction. Although the selected students cannot read or spell, something not uncommon to many kindergarten children, the students we choose for this study will have the opportunity to further enhance their existing literacy skills.

During the study Rick Kubina will teach your child three skills. First your child will learn a set of letter names, specifically a, m, s, o, r, d, f, i, t, n. Next your child will learn the sounds to each letter name he or she just learned. Finally, your child will learn to segment words into sounds. Segmenting words into sounds means your child will hear a word and move pieces of felt or colored paper in response to each sound the letter has. For
example, if the child heard "cat" then he or she would move one piece of felt forward for the /c/ sound, one piece of felt for the /a/ sound and one piece of felt for the /t/ sound.

The instruction in this study will not directly teach spelling or reading but as mentioned earlier, students who participate will benefit by developing skills that facilitate learning to read and spell. Throughout the study Rick Kubina will keep in close contact with your child's teacher communicating his or her progress. We hope to begin this study, at the earliest, in February and end it in the middle of May, or sooner.

If you give your permission for your child to participate in this study please sign the parent consent form attached to this letter and return it to your child's teacher. If you give consent for child to participate, you can withdrawal that consent at anytime without penalty to either your child or yourself. In addition, we will maintain your confidentiality. Your child's name will never appear in any oral or written reports. If you have any questions regarding this study please call Rick Kubina at (614) 850-0128 or John Cooper at (614) 292-3270. Thank you for your prompt attention to this request. We appreciate the opportunity to work with your and your child.

Sincerely,

----------------------------------
John O. Cooper                                        Richard M. Kubina, Jr.
Faculty Adviser                           Graduate Research Assistant
School of Physical Activity        PAES
and Educational Services (PAES)        College of Education
APPENDIX C

PARENT/GUARDIAN CONSENT FORM
CONSENT FOR PARTICIPATION IN SOCIAL AND BEHAVIORAL RESEARCH

I consent to participating in (or my child's participation in) research entitled:

Emergent Spelling Skills: A Case of Contingency Adduction

______________________________________________________________

John O Cooper, Ph. D. or his/her authorized representative has...

(Principal Investigator)

explained the purpose of the study, the procedures to be followed, and the expected duration of my (my child's) participation. Possible benefits of the study have been described as have alternative procedures, if such procedures are applicable and available.

I acknowledge that I have had the opportunity to obtain additional information regarding the study and that any questions I have raised have been answered to my full satisfaction. Furthermore, I understand that I am (my child is) free to withdraw consent at any time and to discontinue participation in the study without prejudice to me (my child).

Finally, I acknowledge that I have read and fully understand the consent form. I sign it freely and voluntarily. A copy has been given to me.

Date: 2/18/99

Signed: ______________________

(Participant)

Signed: ______________________

(Principal Investigator or his/her authorized representative)

Signed: ______________________

(Person authorized to consent for participant - if required)
APPENDIX D
HEAR/SAY SPELLING RECORDING FORM
Oral Spelling Scoring Form 1

Students name: ___________________  Observer: ___________________

Date: ___ / ___ /1999  Session #: _____________

na  Student response: ____________________________

fot  Student response: ____________________________

mat  Student response: ____________________________

fa  Student response: ____________________________

mid  Student response: ____________________________

at  Student response: ____________________________

nom  Student response: ____________________________

in  Student response: ____________________________

ad  Student response: ____________________________

tas  Student response: ____________________________

rod  Student response: ____________________________

os  Student response: ____________________________

fan  Student response: ____________________________

rit  Student response: ____________________________

143
Oral Spelling Scoring Form 2

Students name:_________________________ Date:_____/_____/1999
Observer:_____________________________ Session #:________________

sim  Student response:_________________________

if  Student response:_________________________

ras  Student response:_________________________

am  Student response:_________________________

mod  Student response:_________________________

on  Student response:_________________________

sit  Student response:_________________________

ran  Student response:_________________________

rot  Student response:_________________________

si  Student response:_________________________

tad  Student response:_________________________

rof  Student response:_________________________

id  Student response:_________________________

om  Student response:_________________________
Oral Spelling Scoring Form 3

Students name: ___________________________  Date: __________ / __________ /1999
Observer: _________________________________  Session #: ______________________

bi(e)  Student response: ____________________________
gô  Student response: ____________________________
ku  Student response: ____________________________
jug  Student response: ____________________________
côz  Student response: ____________________________
hup  Student response: ____________________________
gip(e)  Student response: ____________________________
bo(k  Student response: ____________________________
bug  Student response: ____________________________
cub  Student response: ____________________________
hi(e)  Student response: ____________________________
lôw  Student response: ____________________________
wup  Student response: ____________________________
up  Student response: ____________________________
APPENDIX E

SHEET OF PRACTICE CARDS
<table>
<thead>
<tr>
<th>a</th>
<th>m</th>
</tr>
</thead>
<tbody>
<tr>
<td>s</td>
<td>o</td>
</tr>
<tr>
<td>r</td>
<td>d</td>
</tr>
<tr>
<td>f</td>
<td>i</td>
</tr>
<tr>
<td>t</td>
<td>n</td>
</tr>
</tbody>
</table>
APPENDIX F

ADDITIONAL WORDS FOR SEGMENTATION PRACTICE
<table>
<thead>
<tr>
<th>Real Words</th>
<th>Nonsense words</th>
</tr>
</thead>
<tbody>
<tr>
<td>as, an,</td>
<td>af</td>
</tr>
<tr>
<td>it, is</td>
<td>im,</td>
</tr>
<tr>
<td>of</td>
<td>ot</td>
</tr>
<tr>
<td>mad, man</td>
<td>ma</td>
</tr>
<tr>
<td>mot</td>
<td>mi, mif, min</td>
</tr>
<tr>
<td>Sam, sad, sat</td>
<td>mo, mon, mof</td>
</tr>
<tr>
<td>Sid, sin</td>
<td>sar, saf, sa</td>
</tr>
<tr>
<td>sod</td>
<td>sif, si</td>
</tr>
<tr>
<td>ram, rat</td>
<td>so, sot, som</td>
</tr>
<tr>
<td>rid, rim</td>
<td>ra</td>
</tr>
<tr>
<td>Ron</td>
<td>ri, rif, rin, ris</td>
</tr>
<tr>
<td>fat, fad</td>
<td>ro, rom, ros</td>
</tr>
<tr>
<td>fit, fin</td>
<td>fam,</td>
</tr>
<tr>
<td></td>
<td>fi, fis, fid, fim</td>
</tr>
<tr>
<td>tan,</td>
<td>fo, fos, fom, fon</td>
</tr>
<tr>
<td>tin, Tim</td>
<td>ta, taf, tam</td>
</tr>
<tr>
<td>ton, Tom</td>
<td>tid, tis, tid,</td>
</tr>
<tr>
<td></td>
<td>to (pronounced &quot;taw&quot; not too)</td>
</tr>
<tr>
<td></td>
<td>tod, tof</td>
</tr>
<tr>
<td></td>
<td>nas, naf, nat</td>
</tr>
<tr>
<td></td>
<td>nid, nis, nit, nif</td>
</tr>
<tr>
<td></td>
<td>no, nos, nof</td>
</tr>
</tbody>
</table>

149
APPENDIX G

EXPERIMENTAL DESIGN
Notation system (Johnson & Penneypacker, 1993) for multiple baseline design across across behaviors

Solid horizontal lines indicate the independent variable (IV), described directly below it, will come into contact with the dependent variable during measurement.

Dotted lines indicate the independent variable will not come into contact with the behavior even though measurement has occurred.

Vertical lines extending downwards or upwards a prescribed distance indicate the start of another experimental condition or phase, whether new or repeated.

Braces enclose the experimental participant, behavior, and setting for the IV.
Amy, Tom, Fred, Bill
- See/say letter name
- See/say letter sound
- Hear/say/do segment words into letters
- See/say letter names and sounds
- Hear/say/do segment words into letters

Classroom

Hear/say spelling real words with instructed letters
Hear/say spelling nonsense words with instructed letters
Hear/say spelling real words with non-instructed letters
Hear/say spelling nonsense words with non-instructed letters

Hear/Say/Do segmenting words into sounds
Hear/say letter names and letter sounds
Hear/Say/Do segmenting words into sounds
Hear/say letter sound
Hear/say letter name

No instruction
Multiple baseline across subjects: a highly flexible experimental design used to analyze the effects of an independent variable across subjects, behaviors, and/or settings. Used with irreversible behaviors or when returning to baseline levels is undesirable.

<table>
<thead>
<tr>
<th>Amy</th>
<th>No Instruction</th>
<th>See/say letter names</th>
<th>See/say letter sounds</th>
<th>Hear/say/do segmenting words into sounds</th>
<th>See/say letter names &amp; sounds</th>
<th>Hear/say/do segmenting words into letters</th>
<th>Prediction of future behavior</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tom</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pred</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bill</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX H

SEE/SAY LETTER NAMES AND SOUNDS
APPENDIX I

PROCEDURAL INTEGRITY CHECKLIST
Procedural Integrity Checklist

No Instruction

Students name: _______________________________ Date: ____/____/1999
Observer: _________________________________ Session #: ________________

Oral Spelling

Experimenter greets student and bring him or her to designated area ____________________ Yes No
Experimenter sits next to student ____________________ Yes No
Experimenter orally presents words ____________________ Yes No
Experimenter audiotape records the session ____________________ Yes No
Experimenter fills out oral spelling recording sheet ____________________ Yes No
Experimenter writes down student responses ____________________ Yes No
Experimenter gives student feedback on student's performance ____________________ Yes No
Experimenter gives praise for students performance ____________________ Yes No

157
Procedural Integrity Checklist

See/Say Letter Names

<table>
<thead>
<tr>
<th>Students name: ___________________________</th>
<th>Date: __________ / ______ / 1999</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observer: _______________________________</td>
<td>Session #: ________________</td>
</tr>
</tbody>
</table>

**See/Say Letter Names**

- Experimenter greets student and bring him or her to designated area: Yes/No
- Experimenter sits next to student: Yes/No
- Experimenter begins session with oral spelling assessment: Yes/No
- Experimenter audiotape records the oral spelling assessment: Yes/No
- Experimenter fills out oral spelling recording sheet: Yes/No
- Experimenter gives feedback and general praise on spelling performance: Yes/No
- Experimenter measures see/say letter names with hand held counters: Yes/No
- Experimenter gives feedback on see/say letter names: Yes/No
- Experimenter conducts 6 practice timings: Yes/No
- Experimenter gives student feedback on student's performance: Yes/No
- Experimenter graphs students performance on a standard celeration chart: Yes/No
- Experimenter gives praise for students performance: Yes/No
Procedural Integrity Checklist

See/Say Letter Sounds

Students name: ___________________________ Date: _____/____/1999
Observer: ___________________________ Session #: _____________

See/Say Letter Sounds

Experimenter greets student and bring him or her to designated area
Yes No
Experimenter sits next to student
Yes No
Experimenter begins session with oral spelling assessment
Yes No
Experimenter audiotape records the oral spelling assessment
Yes No
Experimenter fills out oral spelling recording sheet
Yes No
Experimenter gives feedback and general praise on spelling performance
Yes No
Experimenter measures see/say letter sounds with hand held counters
Yes No
Experimenter gives feedback on see/say letter sounds
Yes No
Experimenter conducts 6 practice timings
Yes No
Experimenter gives student feedback on student's performance
Yes No
Experimenter graphs students performance on a standard celeration chart
Yes No
Experimenter gives praise for students performance
Yes No

159
Procedural Integrity Checklist
Hear/Say/Do Segmenting Words into Sounds

Students name: ___________________________ Date: _____ / ____ /1999

Observer: ___________________________ Session #: __________

**Hear/Say/Do Segmenting Words into Sounds**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimenter greets student and bring him or her to designated area</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experimenter sits next to student</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experimenter begins session with oral spelling assessment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experimenter audiotape records the oral spelling assessment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experimenter fills out oral spelling recording sheet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experimenter gives feedback and general praise on spelling performance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experimenter measures hear/say/do segmentation with hand held counters</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experimenter gives feedback on hear/say/do segmentation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experimenter conducts 6 practice timings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experimenter gives student feedback on student's performance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experimenter graphs students performance on a standard celeration chart</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experimenter gives praise for students performance</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Procedural Integrity Checklist

See/Say Letter Names and Letter Sounds

Students name: ________________________________ Date: ________/_____/1999
Observer:____________________________________ Session #: _______________

See/Say Letter Names and Letter Sounds

Experimenter greets student and bring him or her to designated area
Experimenter sits next to student
Experimenter begins session with oral spelling assessment
Experimenter audiotape records the oral spelling assessment
Experimenter fills out oral spelling recording sheet
Experimenter gives feedback and general praise on spelling performance
Experimenter measures see/say letter sounds with hand held counters
Experimenter gives feedback on see/say letter sounds
Experimenter conducts 6 practice timings
Experimenter gives student feedback on student's performance
Experimenter graphs students performance on a standard celeration chart
Experimenter gives praise for students performance

Yes No Yes No

Yes No Yes No

Yes No Yes No

Yes No Yes No

Yes No Yes No

Yes No Yes No

Yes No Yes No
Procedural Integrity Checklist

Hear/Say/Do Segmenting Words into Letters

Students name: ___________________________________ Date: _____ / _____ / 1999
Observer:________________________________________ Session #: ______________

Hear/Say/Do Segmenting Words into Letters

Experimenter greets student and bring him or her to designated area  Yes  No
Experimenter sits next to student  Yes  No
Experimenter begins session with oral spelling assessment  Yes  No
Experimenter audiotape records the oral spelling assessment  Yes  No
Experimenter fills out oral spelling recording sheet  Yes  No
Experimenter gives feedback and general praise on spelling performance  Yes  No
Experimenter measures hear/say/do segmentation with hand held counters  Yes  No
Experimenter gives feedback on hear/say/do segmentation  Yes  No
Experimenter conducts 6 practice timings  Yes  No
Experimenter gives student feedback on student's performance  Yes  No
Experimenter graphs students performance on a standard celeration chart  Yes  No
Experimenter gives praise for students performance  Yes  No
APPENDIX J

PRACTICE SHEET CONTAINING ALL LETTERS
<table>
<thead>
<tr>
<th>d</th>
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<th>d</th>
<th>d</th>
<th>d</th>
<th>d</th>
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</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>r</td>
<td>a</td>
<td>r</td>
<td>a</td>
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<td>a</td>
<td>r</td>
<td>a</td>
<td>r</td>
</tr>
<tr>
<td>d</td>
<td>p</td>
<td>d</td>
<td>p</td>
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<td>p</td>
<td>d</td>
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<td>r</td>
<td>a</td>
<td>r</td>
<td>a</td>
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<td>r</td>
<td>a</td>
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<td>d</td>
<td>p</td>
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<td>d</td>
<td>p</td>
<td>d</td>
<td>p</td>
<td>d</td>
<td>p</td>
</tr>
</tbody>
</table>
APPENDIX L

STUDENT SOCIAL VALIDITY QUESTION TRANSCRIPTION FORM
1. What did you like about the study?

2. What didn't you like about the study?

3. What have you learned during this study?

4. Has doing this study helped you in school?

5. Would you work in this study again?
APPENDIX M

TEACHER SOCIAL VALIDITY QUESTIONNAIRE FORM
1. Have you noticed any benefits in the classroom from participating in this study? If Yes, please describe them.

2. Have you noticed anything negative in the classroom from participating in this study? If Yes, please describe them.

3. Can you think of a way to make this study better in the future

4. Do you have any general comments about the study?