The Use of Computer-Based Programmed Instruction as a Supplemental Tool to Train Behavior Analysis Concepts

Jason T. Otto
Western Michigan University

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THE USE OF COMPUTER-BASED PROGRAMMED INSTRUCTION
AS A SUPPLEMENTAL TOOL TO TRAIN
BEHAVIOR ANALYSIS CONCEPTS

by

Jason T. Otto

A Dissertation
Submitted to the
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THE USE OF COMPUTER-BASED PROGRAMMED INSTRUCTION
AS A SUPPLEMENTAL TOOL TO TRAIN
BEHAVIOR ANALYSIS CONCEPTS

Jason T. Otto, Ph.D.
Western Michigan University, 2004

The objective of this dissertation was to produce effective computer-based programmed instruction modules to serve as supplemental training for an ongoing college seminar in behavior analysis. Computer-based programmed instruction supplemented a checklist of a strategy for diagramming behavioral contingencies in the first study and supplemented difficult textbook material in the other studies. In all, the instruction involved 31 concepts, rules, or objectives. Microsoft® PowerPoint® and Macromedia Flash™ were the authoring tools used to develop these supplemental modules. The modules involved multiple-choice-branching programming, which students completed as homework assignments that were delivered with a compact disk (Studies 1-4) and the World Wide Web (Study 5). In general, the goal was to measure the benefit of adding computer-based programmed instruction to current materials with which students were having difficulty. In Study 1 comparing paper-based with computer-based programmed instruction, students first took a pretest, then completed either a chapter from a paper-based workbook or a similar computer-based programmed instruction module, and finally took a posttest. In Studies 2-5, students first read a textbook chapter (Malott & Trojan Suárez, 2004), then took a test, or provided an original example of the concept being trained; then after completing computer-based programmed instruction, students took another test or provided another original example. Among the five studies, all but one showed statistically
significant improvements following computer-based programmed instruction.

Study 1, involving a strategy for diagramming behavioral contingencies, showed large, statistically significant pretest-posttest improvement both when students completed paper-based programmed instruction by itself and the computer-based programmed instruction by itself. Study 2, involving behavioral-contingency diagrams of sick social cycles, showed no statistically significant improvement between students' original examples after reading the textbook and subsequent original examples after completing computer-based programmed instruction. Studies 3 through 5, involving stimulus equivalence, generalization gradients, and discrete-trial/free-operant procedures respectively, showed statistically significant improvements after completing the relevant computer-based programmed instruction. Social validity in the form of student evaluations indicated the computer-based programmed instruction was highly preferred compared to the paper-based programmed instruction workbook used throughout the seminar, primarily because the computer provided feedback on the correctness of answers.
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I dedicate this dissertation to my team members in the Behavior Analysis Training System for their contributions. Without the encouragement from both Elizabeth Trojan Suárez and Jacalyn Smeltzer, I might never have tried in this effort. Moira McGlynn and Mitch Fryling contributed to the development of the program and tests in the Study 1. Rebecca Kehe, Eric Chubb, and Mick Needham each authored programs (Study 3, Study 4, and Appendix C respectively) while Alex Lam created job aids for future programmers. Finally, I appreciate all the teaching assistants who helped administer and gave feedback on the programs and tests: Erin Seligson, Rachael Sautter, Nathalie Witt, Jean Clore, Amy Hund, Jenny Ramer, Osong Kim, Wayne Sager, Casey Corullo, Tracy Brandenburg, Jennifer Clayton, Rachel Skinner, Kristin Grumbine, Heather Cutler, and Erin Van De Hey.

Jason T. Otto
# TABLE OF CONTENTS

ACKNOWLEDGMENTS.......................................................................................... ii
LIST OF TABLES................................................................................................ vi
LIST OF FIGURES.............................................................................................. vii

CHAPTER

I. INTRODUCTION............................................................................................. 1

A Comparison of Instructional Methods.................................................. 1
Computer-based Programmed Instruction and the Seminar............. 6
Animation and Progressive Disclosure ............................................. 7
Authoring Tools ...................................................................................... 9
The Purpose of These Studies............................................................. 11

II. STUDY 1: THE CONTINGENCY-DIAGRAMMING CHECKLIST .......... 13
Introduction ............................................................................................. 13
Method ................................................................................................. 13
Results .................................................................................................. 18
Discussion .............................................................................................. 21

III. STUDY 2: THE SICK SOCIAL CYCLE.................................................. 24
Introduction ............................................................................................. 24
Method .................................................................................................. 25
Results and Discussion.......................................................................... 28

IV. STUDY 3: STIMULUS EQUIVALENCE.................................................. 34
Introduction ............................................................................................. 34

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Table of Contents—continued

<table>
<thead>
<tr>
<th>CHAPTER</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Method ................................................................................. 35</td>
</tr>
<tr>
<td></td>
<td>Results ................................................................................. 36</td>
</tr>
<tr>
<td></td>
<td>Discussion ............................................................................. 39</td>
</tr>
<tr>
<td>V.</td>
<td>STUDY 4: THE STIMULUS GENERALIZATION GRADIENT ....................... 42</td>
</tr>
<tr>
<td></td>
<td>Introduction ......................................................................... 42</td>
</tr>
<tr>
<td></td>
<td>Method .................................................................................. 43</td>
</tr>
<tr>
<td></td>
<td>Results .................................................................................. 43</td>
</tr>
<tr>
<td></td>
<td>Discussion ............................................................................. 46</td>
</tr>
<tr>
<td>VI.</td>
<td>STUDY 5: DISCRETE-TRIAL, FREE-OPERANT, AND HYBRID PROCEDURES .... 48</td>
</tr>
<tr>
<td></td>
<td>Introduction ......................................................................... 48</td>
</tr>
<tr>
<td></td>
<td>Method .................................................................................. 49</td>
</tr>
<tr>
<td></td>
<td>Results .................................................................................. 50</td>
</tr>
<tr>
<td></td>
<td>Discussion ............................................................................. 51</td>
</tr>
<tr>
<td>VII.</td>
<td>GENERAL EVALUATION AND DISCUSSION .................................... 54</td>
</tr>
<tr>
<td></td>
<td>General Evaluation .................................................................. 54</td>
</tr>
<tr>
<td></td>
<td>General Discussion of the Instructional Methods ...................... 58</td>
</tr>
<tr>
<td></td>
<td>Program Effectiveness and Opportunities for Improvement ........... 61</td>
</tr>
<tr>
<td></td>
<td>Definition-based Concept Training and Simple Concept Training .... 64</td>
</tr>
<tr>
<td></td>
<td>Labor Costs of this Computer-based Programmed Instruction ........ 65</td>
</tr>
<tr>
<td></td>
<td>Conclusions ........................................................................... 66</td>
</tr>
</tbody>
</table>
Table of Contents—continued

APPENDICES

<table>
<thead>
<tr>
<th>Appendix</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Research Protocol Clearance</td>
<td>67</td>
</tr>
<tr>
<td>B. The Value of Computer-based Programmed Instruction</td>
<td>69</td>
</tr>
<tr>
<td>C. Shaping Study</td>
<td>72</td>
</tr>
<tr>
<td>D. The Contingency-Diagramming Checklist</td>
<td>77</td>
</tr>
<tr>
<td>E. Paper-based Workbook Chapter for the Contingency-Diagramming Checklist</td>
<td>79</td>
</tr>
<tr>
<td>F. Pretests and Posttests</td>
<td>94</td>
</tr>
<tr>
<td>G. Analysis of the Sick Social Cycle Results</td>
<td>115</td>
</tr>
<tr>
<td>H. Checklists and Job Aids for Programmers</td>
<td>117</td>
</tr>
</tbody>
</table>

BIBLIOGRAPHY ........................................................................................................ 127
LIST OF TABLES

1. Training Conditions Between the Pretest and Posttest ................................. 17
2. Student's t-test for the Pretest-Posttest Means.............................................. 20
3. Effect Sizes and Pretest-Posttest Improvements.......................................... 62
LIST OF FIGURES

1. Contingency diagram ................................................................. 13

2. Mean pretest- and posttest-percentage correct, and the mean improvement (± SD) after the training conditions ........................................ 20

3. “How interesting was this workshop assignment compared to other assignments in other courses at WMU?” ........................................ 21

4. “Was the notes page to write question and comments helpful in discussing the workshop with your TA in the seminar?” ................. 21

5. The sick social cycle, victim’s escape model ........................................ 25

6. Escape model: Percentage of students passing on each measure after first reading the textbook and then again after completing the workshop ........................................................................................................ 28

7. Punishment model: Percentage of students passing on each measure after first reading the textbook and then again after completing the workshop ........................................................ 29

8. “The workshop had slides/screens that you ‘built’ by pushing the mouse button to reveal words, diagrams and images Was this helpful with reading and following along?” ...................................................... 33

9. Overall mean test-percentage correct (± SD) after first reading the textbook and then again after completing the stimulus equivalence workshop ........................................................................................................ 37

10. Mean test-percentage correct for individual concepts after first reading the textbook and then again after completing the stimulus equivalence workshop ........................................................................................................ 38

11. “Comparing the textbook’s treatment of stimulus equivalence and the workshop, which did you prefer?” ................................................................. 38

12. Overall mean test-percentage correct (± SD) after first reading the textbook and then again after completing the generalization gradient workshop ................................................................. 44
List of Figures—Continued

13. Mean test-percentage correct for individual concepts after first reading the textbook and then again after completing the generalization gradient workshop ........................................................................................................ 45

14. “Comparing the text’s treatment of the generalization gradient and the workshop, which did you prefer?” .................................................................................................................... 45

15. Overall mean test-percentage correct (± SD) after first reading the textbook and then again after completing the discrete-trial, free-operant, and hybrid procedures workshop ........................................................................ 50

16. Mean test-percentage correct for each procedure after first reading the textbook and then again after completing the discrete-trial, free-operant, and hybrid procedures workshop ...................... 51

17. “Which workshop do you think was the most valuable in terms of how much you learned?” ................................................................................................................................. 54

18. “Would you like to have more of your WMU course materials delivered in a workshop format?” .......................................................................................................................... 55

19. “Now that you’ve just about completed all the paper-based homework in this course, which did you prefer?” ........................................................................................................ 56

20. “If you prefer computer (to the paper-based workbook), why?” ................. 56

21. “Compared to the textbook, which did you prefer?” .................................. 57

22. “With regard to how you accessed the workshop, which did you prefer?” ................................................................................................................................. 58

23. Overall mean test-percentage correct before and after reading the textbook and the shaping workshop .................................................................................................................. 76
CHAPTER I
INTRODUCTION
A Comparison of Instructional Methods

Teachers in the United States primarily deliver education with textbooks (Elliot & Woodward, 1990), and lectures; however, perhaps textbooks teach less effectively than programmed instruction (Fernald & Jordan, 1991; Holland, 1965). Programmed instruction can be understood as instruction resulting from the six steps of behavioral systems analysis (Malott & Trojan Suárez, 2004). A behavioral systems analysis of instruction requires that the author validate the value of the instruction by testing and revising the instruction based on the performance of students. Regardless of programmed instruction’s potential to be more effective as a result of behavioral systems analysis, textbooks play a crucial role in education, possibly because they are less costly to produce. “In spite of the possible effectiveness of programmed instruction it has not replaced the textbook, and one reason is that the cost of programmed instruction development would have to be underwritten by the publisher, whereas the cost of textbook development is typically underwritten by the text author” (J. Michael, personal communication, November 2003). Indeed, textbooks are efficient tools for delivering education.

Before considering the quality of instructional methods, it should be noted that treatment-package comparisons such as programmed instruction versus textbook instruction might not have general implications beyond the specific parameters of the study (Holland, 1965). However, research indicates that the greater the number of instruction frames in programmed instruction materials, the more learning that will occur (Kritch & Bostow, 1998). Therefore, it is especially important to note a major difference between a textbook and programmed instruction is that textbooks do not
have instructional frames; however, learning from textbooks without instructional frames does occur, of course. An instructional frame is a unit of programmed instruction comprised of (a) the material to be learned, (b) the question and opportunity to write or select among choices, and (c) feedback for the answer or simply the answer to the question. The increase in learning resulting from increasing the number of frames in the Kritch and Bostow (1998) study suggests either that the students need to reread the textbook or the textbook could be improved by increasing the number of prompts for active student responding. Alternatively, programmed instruction could supplement a textbook when active responding is necessary.

Consider the textbook involved in this dissertation (Malott & Trojan Suárez, 2004). The textbook has section questions so the students can self-test their understanding of the material in each section of a chapter, but it does not require active responding as programmed instruction does, nor does it require that students even look at the section questions. A programmed-instruction workbook could provide necessary practice with difficult concepts.

Programmed instruction is an effective form of instruction (Holland, 1965); however, Vargas and Vargas (1992) say, “[t]he teaching machine and programmed instruction movement seems to have halted” (p. 50). Possible reasons for the halt are that the current tools to present programmed instruction are awkward because the engineering technology has lagged behind the science, or that the programs were not financially profitable (Vargas & Vargas, 1992). The computer is a tool that can provide the ideal engineering technology for programmed instruction. However, as with paper-based programmed instruction, computer-based instruction (e.g., page-turning program, computer-based programmed instruction) can be very expensive in that it costs many work-hours to produce (Senbetta, 1992). Computer-based,
multimedia instruction can take from 250-750 work-hours per hour of instruction (Lee & Owens, 2000). Recently, researchers have developed effective computer-based instruction\(^1\) in general (Kulik & Kulik, 1991) and effective computer-based programmed instruction in particular (Kritch & Bostow, 1998; Tudor, 1995; Tudor & Bostow, 1991). The development cost of computer-based instruction, however, is more costly than paper-based programmed instruction. The implicit costs of computer-based instruction are evident when software companies publicly compete to provide the most efficient authoring tool to create computer-based instruction (Chapman, 2003). In fact, companies compete to provide authoring tools that efficiently convert Microsoft® PowerPoint® content into interactive instructional content (Chapman, 2003) presumably because a subject matter expert wrote the original content without student-materials interaction. (See Appendix B for a discussion about the value of computer-based programmed instruction.)

In spite of development costs for computer-based programmed instruction, the computer might provide advantages over paper-based programmed instruction. For example, with paper-based programming, the author must replicate an instructional frame for each multiple-choice option, thus requiring more pages of text. However, with a computer, the programmer can produce immediate, response-specific branching feedback with hypertext linking to the page or slide that contains the feedback. The computer can control contingent response outcomes more eloquently than paper. Feedback on the correctness of the answer, also known as confirmation, is considered a crucial component of programmed instruction (Markle, 1964); however, research does not clearly show that confirmation of an answer is either necessary or

\(^1\) Computer-based instruction refers to any form of instruction delivered by a computer, including page-turning programs, but computer-based programmed instruction is the specific form developed with behavioral principles in mind.
effective, although the research has had methodological flaws (Silverman, 1978). One flaw in the research reported by Silverman (1978) is that the programs did not prevent peeking. Peeking occurs when the student looks down or ahead, seeing the answer, before answering the question in the instructional frame. When students peek, they are not answering or responding to the question in the instructional frame, another crucial component of programmed instruction (Markle, 1964). Computer programming can easily prevent peeking, though it is difficult in a book format. Research has shown that active-responding programmed instruction can be more effective than instruction with completed frames that do not require a response, as in a textbook (Tudor, 1995).

A computer can not only prevent peeking but the computer can also easily allow a student to correct an error. Skinner suggested that the computer could function as a private tutor (Skinner, 1972; 1986). A computer can deliver feedback for an incorrect response and a correct response, but the way the feedback is delivered might be important. Linear programs often reveal the answer to a question after the student answers, while a multiple-choice, branching program can provide details about why the answer is incorrect and then give an opportunity to answer again. Consider an application of linear, computer-based programmed instruction to train and control a student’s conceptual responding (i.e., to differentially reinforce the correct response in the presence of examples of the concept [Engelmann & Carnine, 1982]). A computer monitor displays an example of the concept and a blank that prompts the student to type the correct term. After reading the example of the concept, the student can push the enter key or click a submit button, which immediately produces feedback on the correctness of the answer; but the key and button work only if the student typed an answer in the blank. In this type of linear
programming, the student types an answer and neither has the opportunity to change
the answer nor the opportunity to do any remediation of the instructional frame.
Research has shown that instruction allowing remediation, or some form of correction
response, produces more learning than instruction not allowing remediation (Holland,
1965). Multiple-choice branching allows the student to remediate by choosing another
answer, and a computer can more easily accommodate this programming than paper-
based programmed instruction. In addition, Holland (1965) suggests that when the
goal is to train fine stimulus discriminations as with concept training, multiple-choice
might be preferable over writing out an answer.

Much of the writing about approaches to instruction contrasts programmed
instruction versus textbook instruction (e.g., Fernald & Jordan, 1991) and computer-
based instruction versus non-computer-based instruction (e.g., Kulik & Kulik, 1991).
Although, another possibility is to combine all of these for a maximally effective
instructional system, or in other words an intervention package (Malott & Trojan
Suárez, 2004), where computer-based programmed instruction supplements rather
than replaces traditional textbook instruction. In addition to the factors considered
thus far, computer-based programmed instruction has the potential to incorporate
motivating multimedia.

In summary, compared to paper-based programmed instruction, the relative
ease of using a computer to program for active responding, while preventing peeking,
suggests that it would be at least as effective, if not more effective than paper-based
instruction. Compared to a textbook, paper-based programmed instruction and
computer-based programmed instruction have the potential benefits of increasing
active engagement (Tudor, 1995; Tudor & Bostow, 1991). However, in this
dissertation, the goal was to improve the instructional system for sections of a
behavior-analysis course at Western Michigan University by using the motivating multimedia of the computer to deliver supplemental practice rather than to determine if it was the superior instructional method.

Computer-based Programmed Instruction and the Seminar

I supervised the behavior-analysis seminars involved in this dissertation. In these seminars, a workbook contained a modified form of programmed instruction that accompanied each textbook chapter reading assignment. The workbook chapters consisted of several pages, frequently presenting multiple-choice questions regarding preceding material, such as a behavioral scenario illustrating a concept in the textbook chapter; but feedback on the correctness of their answers was often not part of the instructional frame. Although after that time, teaching assistants went through some or all of the questions with the students in the following seminar, providing feedback on the correctness of the students' answers at that time. The workbook provided concept training in that it presented examples and nonexamples of concepts (Engelmann & Carnine 1982). The students learned to respond appropriately when presented with examples and nonexamples of the chapter's concepts, which in many instructional frames involved a behavioral-contingency diagram of the before condition, the behavior, and the after condition resulting from the behavior. Within each workbook assignment, the students also created their own original example by filling in a contingency diagram to demonstrate their mastery of the concept.

One problem the seminars' workbook avoids is that the students find much traditional programmed instruction boring, perhaps mainly because of the small informational increments from frame to frame, in an effort to keep the error rate low (R. W. Malott, personal communication, August 2003). However, Markle's (1964) Good Frames and Bad was intellectually stimulating for Masters students in our
program, possibly due to its relatively larger informational increments. In contrast to the boredom of programmed instruction, student and professional audiences find it very reinforcing to view our Microsoft® PowerPoint® lectures, using music, art, humor, real-life examples, and build-diagrams and build-slides. Additionally, students enjoy the style of *Elementary Principles of Behavior 4e* (Malott, Malott, & Trojan, 2000) that involves entertaining stories about fictional characters. (The text is in its fifth edition and future reference will be to the current edition, *Principles of Behavior 5e* [Malott & Trojan Suárez, 2004]). Therefore, I incorporated the multiple-choice feature of the workbook, the reinforcing multimedia of PowerPoint® lectures, and the entertaining style of *Principles of Behavior*, and used PowerPoint® to develop computer-based programmed instruction. The instruction dealt with some difficult concepts our students were still having difficulty mastering, even though they had the textbook, workbook, and follow-up discussion seminars. I called the computer assignments *workshows* because this not only paralleled the name *workbook* but both assignments provided supplemental work and practice. In contrast to a static book however, the shows added motivating multimedia such as music, art, and build-diagrams.

**Animation and Progressive Disclosure**

Behavior analysts have done considerable research on design variables in programmed instruction (Holland, 1965); and recently, programmed instruction research has involved computer-based instruction or computer-based programmed instruction (Kritch & Bostow, 1995; Tudor, 1995; Tudor & Bostow, 1991). The role of student-paced animation or student-paced progressive disclosure of diagrams in computer-based programmed instruction apparently has not been studied by behavior analysts. Students have performed better on problem-solving, transfer tests when their
first exposure to a several minute animation is segmented so that students control the pace of its disclosure, compared to students who could not control the pace in their first exposure, viewing the entire animation without any breaks (Mayer & Chandler, 2001). Cognitive psychologists such as Sweller (1999) explain the advantage of student-paced animation in terms of reducing cognitive load on working memory, allowing the student to build component models of each critical part of an entire animated process. One behavior-analytic view of the advantage of student-paced, progressive disclosure of an animation or perhaps a complex diagram might be that the programmer can arrange the stimuli, both visual and written, to control the learner’s successive observing responses so that each prerequisite stimulus is encountered before the next stimulus is encountered, in a logical stimulus-response chain.

Even though this dissertation did not study the effects of self-paced animation or progressive disclosure as an independent variable, our hope was that programming self-paced build-slides in the presentation of contingency diagrams would make the details of the concepts more clear. For example, in the victim’s model of the sick social cycle (see Figure 3), the reinforcement contingency-diagram for the perpetrator’s behavior specifies conditions that are also part of the escape contingency-diagram for the victim. On paper, the entire complex cycle illustrates the before condition, behavior, and after condition for both the perpetrator and victim as box-diagrams, linked by arrows to indicate the chronological sequence of events. Several figures on paper could illustrate the order of the events represented in the diagram by adding the box-diagrams one at a time in each successive figure, with successive written descriptions, but to do this build-sequence would require several pages. On a computer screen, however, the student can not only observe the cycle
unfold but they can control the pace of the build-sequence.

Authoring Tools

Five authoring tools were evaluated: Microsoft® PowerPoint®, Astound Presentation 7.0, Macromedia Flash™, Macromedia Authorware™, and a linear, text-based program developed by Kritch and Bostow (1998). Factors considered in each authoring tool were the ease in developing rich multimedia, branching feedback, web-based or data-based, student-response recording, and the delivery format (i.e., web-based or compact disk).

All of the authoring tools tested, except for the linear, text-based program by Kritch and Bostow (1998) allowed for the multimedia involving sound, color, or images I required. PowerPoint® was the most cost-effective authoring tool in terms of both time to learn how to use it and time to produce complex frames containing a large amount of animation, music, and hyperlinking response-specific, branching feedback. In addition, compared to the other tools, it was a relatively easy authoring tool to teach to assisting programmers, especially for the large number of people already familiar with Microsoft® Office® tools. Both Flash™ and Authorware™ require unique programming skills to develop multimedia and branching feedback. However, later in the timeline of this dissertation, an instructional design course provided training for Flash™, and Study 5 describes the workshop created with Flash™.

Traditionally PowerPoint® is viewed as a lecture aid rather than an e-learning authoring tool, though surveys of training professionals indicate PowerPoint® is the primary e-learning authoring tool (Chapman, 2003). However, considering the broad definition of e-learning, professionals might view a PowerPoint® presentation consisting only of bulleted notes as a form of e-learning, especially if the presentation

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file were on the company website and included a video of a speaker, for example.

All of the authoring tools tested offered systems for automatically recording student-responses, though it takes much more time to learn and produce instruction with this recording. PowerPoint® has the limitation that its recording system requires the student to save a copy of the file to disk. The limitation arises because the multimedia-rich PowerPoint® files are large. Moreover, programming for hyperlinking, branching feedback in combination with response-recording was not possible. PowerPoint® also can record responses to a database file, but the programming involves Visual Basic® programming, adding more time to learn and produce instruction. Astound Presentation 7.0 provided a database to record responses on the company’s web server, but it would record only if the students connected to the WWW before beginning the compact-disk-delivered instruction. Flash™ can produce smaller file sizes, record student-responses online, and allow the students to complete the instruction on the WWW.

In general, the advantage of web-based training with automated response recording could be that the students would not have to write their answers on paper, and the automated recording system would rule out student’s recording or copying errors. While it might be valuable for a tool to record student-responding in the development of the instruction, it is less valuable in the long-term use of the instruction once it is developed. Therefore, gathering data with pencil and paper mark-sense forms in the short term is quicker because programming automatic student-response recording is time consuming. In addition, the tools either require the students to connect to the WWW (i.e., Flash™ and Astound Presentation) or save to compact disk the large files containing their answers (i.e., PowerPoint®). Moreover, the University scanning services produced functional database files from the mark-
sense forms available.

Finally, all the tools had the potential for web-based or compact-disk delivery. Considering the previous factors, compact disk delivery was the final choice because the PowerPoint® files would be so large that web-based training would be prohibitive considering students’ most frequent connection speed would be a 56-kilobyte phone modem.

The Purpose of These Studies

For this dissertation, computer-based programmed instruction was developed to improve the instruction for our seminars. I developed three computer-based programmed instruction workshows, supervised the development of three other workshows, then further developed and evaluated all six of the workshows for basic and advanced concepts presented in the textbook (Malott & Trojan Suárez, 2004). Altogether, the five workshows reported here involved 31 behavioral concepts, rules, or objectives (see Appendix C for the sixth workshow). After completing a pilot-project involving the first workshow, the subject matter of which was selected based on its high importance in the seminar, five additional areas of conceptual content were developed with workshows. Four of the conceptual areas (Studies 2-5) were chosen based on Suárez’ dissertation (2001), involving an evaluation of the textbook, and based on Malott’s informal observations of the difficulties students had in the seminars. Another workshow was chosen to replace a particular workbook chapter (Appendix C), based on frequent, yet informal student-complaints about that workbook chapter. The computer-based programmed instruction workshow in Study 1 was a revision of a workbook chapter for behavioral-contingency diagramming, and the workshows in Studies 2-5 were supplemental exercises for difficult concepts presented in the textbook (Malott & Trojan Suárez, 2004).
The development of these workshows entails the use of well established principles of programmed instruction (Holland, 1965), concept training (Engelmann & Carnine, 1982), computer-based programmed instruction (e.g., Krich & Bostow, 1995), and our previously highly evaluated PowerPoint® presentations to produce an intervention package (Malott & Trojan Suárez, 2004). In summary, the goal was to create motivational-multimedia instruction that provided supplemental practice questions with individualized, hyperlinked-sequencing feedback and remediation. Although there are two generally different approaches to research, applied- and basic-approaches, this work might be best described as research and development. The primary goal of the research and development in this dissertation was to produce a product to solve a problem, that is, the difficulties students were having with certain concepts in the textbook.

An additional goal in the development and implementation of the workshows was to integrate them into the ongoing college seminar, without disrupting the flow of the seminar, and measure the students' appreciation of this computer-based instruction. For Study 1, I wanted to determine if that workshow was effective on its own and then compare its effectiveness to the earlier paper-based version of the same subject matter. For Studies 2-5, I wanted to determine if those workshows added value above and beyond existing chapters in the textbook. Therefore, I sequentially spaced the assignments so that students read the textbook and accompanying workbook, in some cases, and then completed the workshows later as supplemental training.
CHAPTER II
STUDY 1: THE CONTINGENCY-DIAGRAMMING CHECKLIST

Introduction

Training all students to diagram behavioral contingencies to mastery is one of the main missions of the behavior-analysis seminars where this dissertation was conducted. The contingency-diagramming checklist is a job aid for diagramming and evaluating contingency diagrams (See Appendix D). See Figure 1 for an example of a contingency diagram.

![Contingency Diagram](image)

*Figure 1. Contingency diagram.*

The students make mistakes filling in the *before, behavior and after* conditions of the contingency diagram, even when they use the checklist; and they make mistakes even after completing the workbook chapter, “How to Use the Contingency-diagramming Checklist” (Emmendorfer, 1994; Johnson 1993). To further improve the instruction and thus the students’ diagramming skills, a workshop based largely on this workbook chapter was created.

Method

*Participants and Setting*

As with all the other studies in this dissertation, the participating students were self-selected undergraduate psychology majors from a course titled Concepts and Principles of Behavior Analysis, an introductory behavior-analysis course at Western Michigan University. Over this entire first study, 136 students participated. Teaching assistants, who ran the seminars, assigned the workshop and posttests to each student.
as a regular part of the course, but pretests and evaluation forms were optional. The students who opted to take additional tests and fill out evaluations signed informed consent forms in the first seminar, allowing me to use their confidential scores and evaluations in publications. The University's Human Subject Institutional Review Board approved the consent form, which applied to all the studies in this dissertation.

The specific setting for completing the workshop in this study and the workshops in all studies varied according to each student's access to a computer because the workshops were computer-based homework assignments. Students who did not have a home computer with MS PowerPoint® either downloaded the PowerPoint® viewer onto their computer from the compact disk (CD) or used a campus laboratory computer. In this and all the other studies, the students took the tests and completed the evaluations in Western Michigan University classrooms.

Materials

The contingency-diagramming checklist workshops was created based on paper-based programmed instruction that provided feedback for some but not all student-responses. Originally, Johnson (1993) developed the workbook chapter for the contingency-diagramming checklist as an undergraduate honors thesis, and then Emmendorfer (1994) revised it for another undergraduate honors thesis (See Appendix E).

This workshop teaches students to apply a strategy and identify whether behavioral-contingency diagrams meet all ten of the checklist criteria, so that they can ultimately self-evaluate their original, novel, behavioral-contingency diagrams. As with our paper-based programmed instruction workbook, the workshops presented examples and nonexamples of the criteria, or concepts, and multiple-choice questions to train these concepts (Engelmann & Carnine, 1982). In this study, the workshop
trained ten concepts for contingency diagramming. Here are the concepts:

- Behaver criterion
- Action criterion
- Specific behavior criterion
- Deadman criterion
- Reinforceable response-unit criterion
- Sixty seconds criterion
- Related-outcomes criterion
- Stimulus, event, or condition criterion
- Causality criterion
- Receiver criterion

The workshop for the contingency-diagramming checklist served as the independent variable of this study. In this study, the workshop was compared to the paper-based programmed instruction workbook chapter, and a control condition. In the seminars, there was a chapter quiz and workshop test, each counting toward the course grade. In our experience, because the tests and workbook count toward the seminar grade, essentially all of the students read essentially all of the chapters and complete the entire workbook.

_Dependent Variables_

_Pretest and Posttest Scores_

Each semester of this study involved a systematic replication of a pretest-posttest design. There were two versions of the test that served as both pretests and posttests (See Appendix F for all the tests for all studies). The test had 20 multiple-choice questions; each of the questions involved a description of a behavioral scenario, an erroneous contingency diagram analyzing the scenario, and four, multiple-choice answers. Only one of the four answers was correct, which named the checklist criterion the contingency diagram violated. Each student completed the training on his or her own and took an alternate version of the test at the beginning of the following seminar. To assess the effects of having taken the pretest on the posttest...
without having the intervening training, another group of students took a test, and the next day took the alternate test, during summer 2002. Then they completed the workshow and took a posttest.

*Evaluation Form*

For this and all the other studies, students in the winter semester of 2003 completed evaluations with open-ended and five-point, Lickert-scale questions after each workshow and then completed an overall evaluation at the end of the semester. Essentially all students volunteered to complete evaluations even though they may not have volunteered to take extra tests contributing to the empirical validation in this dissertation. Some of the individual evaluations are reported in each study, and the overall evaluations will be discussed later in the dissertation.

*Procedures*

In an effort to achieve continuous quality improvement, throughout the development of the workshows for each of the studies in this dissertation, the student-error-rates on the workshow and tests were used to make revisions. The general strategy was to improve the workshow by both revising the individual instructional frames with error rates of at least 10%, and by revising instructional frames to deal with test questions that had high error rates. In addition, one-to-one testing (Scriven, 1967) was completed to address program usability and confusions. Finally, individual test questions with high error rates were revised if they appeared to be poorly constructed rather than to be indicative of a lack of training from the workshow.

During the first seminar, the teaching assistants handed out the contingency-diagramming checklist and the two versions of the test, alternating the version for each student so that half of the students had one version and the other half had the other version. The teaching assistants gave the students time to read the checklist.
before beginning the pretest, and the students kept it during the tests. In various combinations over four semesters, the course syllabus instructed the students to complete the workshop, the workbook, and "Chapter 1, The Reinforcer" (Malott & Trojan Suárez, 2004) for the following seminar. Following the training condition (see Table 1 for the training conditions in each semester, marked by an X), the students took the other version of the test as a posttest at the beginning of the next seminar. The teaching assistants completed the assignments and made test keys as a common part of our teaching and testing procedure in this and all the other studies involving a pretest and posttest. I reviewed their test keys to confirm their answers were correct. Then the teaching assistants scored the students' tests.

Table 1

<table>
<thead>
<tr>
<th>Training Conditions Between the Pretest and Posttest</th>
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<tbody>
<tr>
<td>Training delivered</td>
</tr>
<tr>
<td>Workshop</td>
</tr>
<tr>
<td>Workbook</td>
</tr>
<tr>
<td>Chapter 1</td>
</tr>
</tbody>
</table>

To serve as a control group, two pretests were administered before training.

To measure the effectiveness of the workshop, I added it to the first seminar's reading assignment, chapter 1 from the textbook (Malott & Trojan Suárez, 2004). In the winter semester of 2002, 49 students completed the workshop and chapter 1. The chapter involved some contingency diagrams, and although I assumed it contributed little to the students' mastery of the concepts, I removed chapter 1 from the training conditions for the next two semesters.

To measure the effectiveness of the workshop and whether taking the pretest...
alone primed the students for the posttest, in summer 2002, I offered a second pretest. After students completed the first pretest, I randomly divided the students into two groups based on a matched-pair ranking of pretest scores. During the second seminar, the students in Group 1 ($n = 9$) took the other version of the test (as a second pretest), though they had not yet done the workshop. In the third seminar, students in Group 1 completed the workshop in the computer laboratory, under the supervision of the teaching assistants and me, and then immediately completed the other version of the test. The students in Group 2 ($n = 11$) also completed the workshop in the computer laboratory and then immediately completed the other version of the test. Then during the third seminar, students in Group 2 took the other version of the test again (as a second posttest).

To measure the effectiveness of the original, paper-based programmed instruction workbook (Emmendorfer, 1994; Johnson, 1993), in the fall semester of 2002, 35 students completed the original workbook chapter only.

To measure the combined effectiveness of the original workbook chapter, workshop, and chapter 1, 32 students in the winter semester of 2003 completed all of the materials as their assignment. To help facilitate seminar discussions about the workshop, students had the option of filling in a guided-notes sheet while they completed the workshop.

Results

Each semester, the instructional program produced a large, statistically significant pretest to posttest improvement regardless of training conditions (See Figure 2 and Table 2). An alpha level of .05 was used for all statistical tests in all the studies. In the summer semester of 2002, the control group that took two tests without intervening training, averaged 44.4% on the first pretest and 51.6% on the second
pretest; this difference was not a statistically significant, $t (8) = 1.46, p = .18$ (two-tailed). In order, the mean improvement in pretest-posttest percentages for each semester were 32.65, 32.50, 24.57, and 29.53 ($SDs = 18.57, 13.33, 16.38$, and 15.47 respectively). Furthermore, Cohen’s effect sizes ($d$), a standard measure to compare the improvements, were high for each semester. An ANOVA of the improvement scores did not show a statistically significant difference across training conditions, $F (3, 132) = 1.81, p = .15$. In addition to the ANOVA, a $t$ test comparing the workbook by itself with each of the three semesters when the workshow was used showed that in only one of those three semesters, the winter semester of 2002, was the improvement with the workshow significantly greater than the improvement with the workbook by itself $t (82) = 2.06, p = .04$. Therefore, I am reluctant to argue that the workshow was significantly superior to the workbook in its effect on pretest-posttest improvement. Regardless, there was room for further improvement.

Table 2

<table>
<thead>
<tr>
<th>Training condition</th>
<th>$df$</th>
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<tbody>
<tr>
<td>Workshop + Chapter</td>
<td>48</td>
<td>12.31***</td>
<td>1.51</td>
</tr>
<tr>
<td>Control (Pretest-Pretest)</td>
<td>8</td>
<td>1.46</td>
<td></td>
</tr>
<tr>
<td>Workshop</td>
<td>19</td>
<td>10.91***</td>
<td>1.77</td>
</tr>
<tr>
<td>Workbook</td>
<td>34</td>
<td>8.88***</td>
<td>1.12</td>
</tr>
<tr>
<td>Workshop + Workbook + Chapter</td>
<td>31</td>
<td>10.80***</td>
<td>1.65</td>
</tr>
</tbody>
</table>

***$p < .0001$
Figure 2. Mean pretest- and posttest-percentage correct, and the mean improvement (± SD) after the training conditions. W2 = Winter semester of 2002, S = Summer, F = Fall, W3 = Winter semester of 2003.

Table 2

Student's t-test for Pretest-Posttest Means

<table>
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<tr>
<th>Training condition</th>
<th>df</th>
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<tbody>
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<td>Workshop + Workbook + Chapter</td>
<td>31</td>
<td>10.80***</td>
<td>1.65</td>
</tr>
</tbody>
</table>

***p < .0001

Seventy-three percent of the students indicated the workshop was more interesting than other assignments at the University (Figure 3), while 25% was neutral. Only 30% indicated that the guided-notes were helpful during the seminar.
Figure 3. "How interesting was this workshop assignment compared to other assignments in other courses at WMU?" $N = 52$.

Figure 4. "Was the notes page to write question and comments helpful in discussing the workshop with your TA in the seminar?" $N = 52$.

Discussion

The workshop and workbook were both effective. On its own, students indicated the workshop assignment was much more interesting than other
assignments at this University, suggesting that it has value in terms of student interest, regardless of its effectiveness compared to the workbook. Two potential benefits of the workshop was that it both consistently provided response-specific feedback for student answers, and it also displayed build-diagrams. Of course, the addition of these variables did not result in significant increases in performance when compared to the workbook. Furthermore, we might have expected the workshop to be more effective because of the added continuous quality improvement in the form of error-analysis-based revisions to instructional frames when developing the workshop.

First, the building nature of the diagrams in the workshop might not have been relevant to understanding the individual checklist criteria. Also, a possible explanation that the workshop’s response-specific feedback was not relatively beneficial might be that the workbook contained a sufficient amount of imbedded feedback written after some, but not all, of the instructional frames. Another explanation might be that the workbook’s static text can more easily allow a student to scan previous and later instructional frames’ examples and diagrams, potentially allowing more learning opportunities. This scanning behavior is not the same as peeking behavior, when the student looks and finds the correct answer; scanning is a tactic for answering the frame correctly, when the frame’s material alone is not sufficient. For example, in the workbook, a lean frame with very little prompting for the correct answer might be difficult if the rest of the workbook were restricted or unexposed, though that was not the case in this study. A student might more effectively answer lean frames if information in other frames is used to answer the lean frame, and as a result the student learns more effectively than if she had answered the frame’s question incorrectly. In contrast, the students in this study could only view one screen during the workshop, though I added hyperlink buttons that

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allowed students to review the current instructional frame’s storyline. The exposure to sequential frames and examples in the workshop was relatively restricted compared to the workbook, although a menu slide allowed students to return to any checklist-criterion section. A restrictive format of the workshop was considered a benefit because it prevents peeking at the answer. However, the workshop could be programmed to prevent peeking yet allow more easy access to all of the instructional. A potential area for research in computer-based programmed instruction in particular and programmed instruction in general would be to control for this potentially beneficial type of peeking, or scanning.

In addition to training the students until they had mastered the concepts, we also find it valuable that students use the concepts with precision in discussing analyses of human behaviors. One limitation of the workshop was that the seminar discussions following the workshop assignment, even with the notes-page, did not appear to be as structured as the seminar discussion following the workbook assignments, which allowed the students to look at the frames and their answers during the seminar. Students also did not find their notes valuable in facilitating seminar discussion. In addition, to facilitate seminar discussion about the workshop content, I used a data projector to present a large view of the workshop for the students. Among other factors that made this arrangement cumbersome, it was difficult for the students to direct me to the point in the workshop they wanted to discuss. Alternatively, the teacher could present the workshop for the first time during the seminar, and the students could answer the questions using response cards. It would be interesting to see if future research involving multimedia classrooms could effectively incorporate seminar discussion with computer-based instruction homework.
CHAPTER II
STUDY 2: THE SICK SOCIAL CYCLE

Introduction

Based on the student’s evaluations of the sick social cycle sections of “Chapter 3, Escape” and “Chapter 4, Punishment” (Malott & Trojan Suárez, 2004) reported by Suárez (2001), the concepts for the sick social cycle needed a supplement. I also selected the sick social cycle based on Malott and Suárez’ informal observations of the seminars for the sick social cycle indicating there was significant room for improvement in the students’ ability to use the sick social cycle diagram in generating and analyzing original examples.

Consider an example of a sick social cycle (Figure 5). Megan is getting ready to go to the mall with her friends, when her little sister, Susie, starts begging to go. Susie’s begging is aversive to Megan, and Megan finally concedes, saying, “Okay, you can go.” Megan’s concession both reinforces Susie’s begging and terminates it; so the behavior of conceding is reinforced in an escape contingency.

The sick social cycle has two models, the victim’s escape model, and the victim’s punishment model. Each model involves a perpetrator and a victim, and the two models illustrate the two types of sick social cycles. In the victim’s escape model, the perpetrator imposes an inappropriate behavior that is aversive to the victim, and the victim escapes that behavior, and in so doing, reinforces it. In the victim’s punishment model, the victim imposes a demand that is aversive to the perpetrator, and the perpetrator punishes that behavior, and in so doing, escapes the demand.

The objective was to develop a workshop that would provide supplemental practice for the students to become more skilled in analyzing the two sick social cycles. The ultimate goal was to teach students to identify the details and type of
behavioral-contingency diagrams in the models, so they could self-evaluate their original, novel sick social cycle diagrams.

![Diagram of sick social cycle, victim's escape model](image)

**Figure 5.** The sick social cycle, victim's escape model. The top three components illustrate the reinforcement contingency on the perpetrator's behavior. Below that contingency is the interrelated contingency on the victim's behavior.

**Method**

In the winter semester of 2003, 34 students completed the workshop and the assigned materials as part of their course requirements. The students completed the workshop and their original examples of the sick social cycles as homework assignments.

Like the workshop in Study 1, this program was designed to train a conceptual repertoire (Engelmann & Carnine, 1982). The performance measure was an original example that is a conceptual response; such a performance measure has not been investigated much in programmed instruction (Glaser, 1965).
The training objectives for this workshop involved the students’ accurate use of both models, and this entailed being able to discriminate between the victim and perpetrator. In order to accurately apply the model, the students also needed to know how to diagram the perpetrator’s and victim’s behaviors so that those behaviors also served as before and after conditions (e.g., Susie’s begging is the behavior in Susie’s contingency and the before condition for Megan’s contingency). Below were the training objectives.

For both models:

- Discriminate between the victim and the perpetrator

For the victim’s escape model:

- Identify that the behavior of the perpetrator is the before condition for the victim’s contingency diagram.
- Identify that the behavior of the victim is the after condition for the perpetrator’s contingency diagram.

For the victim’s punishment model:

- Identify that the behavior of the perpetrator is the after condition for the victim’s contingency diagram.
- Identify that the behavior of the victim is the before condition for the perpetrator’s contingency diagram.

For baseline measures, the students diagrammed one original example after reading “Chapter 3, Escape” and another after reading “Chapter 4, Punishment” (Malott & Trojan Suárez, 2004); the addition of the workshop involving both model diagrams served as the independent variable of this study. The materials in the baseline condition were designed to teach the same subject matter.

**Procedures**

In the first seminar relevant to this study, a chapter introduced escape contingencies and the victim’s escape model. In the second seminar, the next chapter introduced punishment contingencies and the victim’s punishment model. For each of
these seminar's homework assignments, the students completed the workbook for the relevant contingency, and diagrammed an original example of the relevant model before the seminar. For each model, the workbook involved two instructional frames guiding students' selection of the perpetrator and victim's contingency (e.g., "Please diagram the escape contingency for the victim in your example... Is it an escape contingency? [If not revise!]"). In the third seminar, the homework assignment included the workshop that dealt with both models of the sick social cycle, and students diagrammed another original example for each model before the seminar. Also for that third seminar, presumably irrelevant to this study, the students completed a chapter and workbook assignment that dealt with penalty contingencies.

Dependent Variables

The course pack and workbook provided blank model diagrams. The students' original-example diagrams of each model were scored in five categories. One point was recorded for each of these categories: (a) the perpetrator's contingency was reinforcement or escape in the victim's escape model and escape in the victim's punishment model; (b) the victim's contingency was escape in the victim's escape model and punishment in the victim's punishment model; (c) both contingencies passed all 10 criteria for diagramming contingencies; (d) the correct model was applied; and (e) the example was indeed a sick social cycle: either a punishment-based or an escape-based sick social cycle.

I personally scored each original example. One teaching assistant independently scored 30% of the original examples. I selected the original examples based on an earlier scoring system so that the sample included a majority of incorrect original examples. Interrater reliability was calculated by dividing the number of agreements by the sum of agreements plus disagreements and multiplying by 100%.
Mean agreement was 85%. Reliability was tested in this study because the open-ended and complex nature of the original examples required a reliable measurement system. In contrast, the other studies’ multiple-choice and fill-in tests are relatively obvious to score.

Results and Discussion

After reading the textbook that introduced the escape model and completed the workbook, the students completed an original example; then they did the workshop and followed by another original example. The original examples were evaluated on five measures; there was no significant improvement for any of the five measures, as tested with a $\chi^2(1, N = 34)$, from the original examples produced before the workshop to those produced after the workshop (Figure 6).

Figure 6. Escape model: Percentage of students passing on each measure after first reading the textbook and then again after completing the workshop. CM = The correct model was used. SSC = The example was indeed a sick social cycle. $N = 34$. 

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In a similar evaluation of the original examples for the punishment model, there was no significant improvement for any of the five measures, as tested with a $\chi^2$ (1, $N = 34$), from the original examples produced before the workshow to those produced after the workshow (Figure 7).

![Graph showing percentage of students passing each category after first reading the textbook and then again after completing the workshow. CM = The correct model was used. SSC = The example was indeed a sick social cycle. $N = 34$.](image)

**Figure 7.** Punishment model: Percentage of students passing each category after first reading the textbook and then again after completing the workshow. CM = The correct model was used. SSC = The example was indeed a sick social cycle. $N = 34$.

The workshow did not improve the students' performance perhaps because the baseline performance did not allow much room for improvement in terms of their accuracy of providing examples of a sick social cycle in general. The workshow's instruction dealt mainly with illustrating the sick cyclical interactions between two people, the fifth measure in Figures 6 and 7. Most of the students' examples correctly described such interactions after completing the textbook and workbook prior to the
workshop.

However, there is much room for improvement in terms of diagramming errors, as shown by the first four measures; before the workshop training, 38% of the students made diagramming errors in their escape models and 39% made diagramming errors in their punishment models. And the decrease in the percentage of students making errors after the workshop was only 6% for the escape model and 9% for the punishment model. There were no significant differences between the first and second sets of original examples as tested with $\chi^2 (1, N = 34)$.

We will now consider in detail some of those diagramming errors. Almost every student provided examples that captured the spirit of a sick social cycle; but before the workshop, 9% of the students diagrammed a punishment-based sick social cycle using the escape model diagram (See Figure 6, CM). In other words these students used the wrong model diagram. Similarly, Figure 7 shows that before the workshop 9% of the students diagrammed an escape-based sick social cycle using the punishment model diagram, the wrong diagram.

Many of the students’ diagramming errors occurred when diagramming the victim’s contingency. Before completing the workshop, 26% of the students provided an incorrect victim’s contingency for the escape model (Figure 6); and 30% of the students provided an incorrect victim’s contingency for the punishment model (Figure 7). Of those students who made errors for the victim’s contingencies, 84% of them failed the behaver or specific behavior criteria; they did not clearly specify the behavior of the victim in the victim’s contingency. However, the other students who made an error in their victim’s contingency met the checklist criteria, but their contingency was not the correct type of contingency; for example, they used the wrong model diagram and specified a punishment contingency when it should have
been an escape contingency. However, training with the workshow decreased neither the frequency nor any of the type of errors. (For an analysis of the students’ errors see Appendix G)

In contrast to my initial instructional objective, contingency-diagramming errors accounted for most of the errors in general and the victim and perpetrator’s contingencies in particular. In revisions to the workshow, I added instructional frames about meeting the be\textit{haviour criterion} and using the wrong model, but the workshow could have been improved if more nonexamples of diagrams failing the \textit{behaviour} and \textit{specific behaviour criteria}, were added. The few students who failed such criteria appeared to have directly copied the \textit{after condition} from the perpetrator’s contingency to the \textit{behaviour} in the victim’s contingency, keeping their language in passive voice and thus failing the \textit{behaviour} and \textit{specific behaviour criteria}.

One weakness of this study was the confounding variable of added structure in the workbook (e.g., “Please diagram the escape contingency for the victim in your example... Is it an escape contingency? [If not revise!]”) that was absent when the students provided original examples after completing the workshow. An additional weakness was that the students completed their original examples as homework, and consequently students could have used the textbook diagrams as models while creating their own. Furthermore, they could have asked for help from other students, unlike in a proctored test-setting, which would have more experimental control. Another weakness was that, although the reason for developing this instructional material was because of subjective impressions of students’ performance and comments in the seminar, no data from the seminar were actually collected before or after the intervention with the workshow. However, the students did evaluate this workshow positively, as will be discussed later.
After both reading the textbook and completing the workshop, 61% of the students found the animated, build-diagrams of the sick social cycle helpful, while 11% did not find it helpful at all and 28% was neutral. The large percentage of students who indicated the build-diagrams were helpful suggests that the static, paper-based version of the models were less clear (Figure 8). The cycle involved a complex diagram of two contingencies, with arrows to guide the students from one condition to another, but those arrows might not control the students observing responses as well as an animated diagram. In the workshop, the students were able to click the mouse button to reveal the sequence of the first contingency, such as the perpetrator in the victim’s escape model. Then the diagram would continue when the student clicked the mouse button again, and so forth, through the entire cycle diagram. The potential effects of this progressive disclosure might be that it can control the learner’s observing responses so that each prerequisite stimulus is encountered before the next stimulus is encountered, in a logical stimulus-response chain. However, even though students indicated the build-diagrams were helpful, this added feature did not have an effect on how well they diagrammed their own original examples. This lack of effect might mean the students need more detailed training on diagramming specific, active behaviors in both of the contingencies in the cycle.

In conclusion, an interesting study for the future might be to see if students’ contingency-diagramming accuracy, particularly their failure to clearly specify the behavior of either the victim or perpetrator in the diagram, was crucial in their analysis or application of an intervention to terminate a sick social cycle. It might be that the failure to explicitly identify a behavior in the diagram, even though the original example is obviously a sick social cycle, impedes a subsequent analysis of or recommendation for a corrective procedure.
Figure 8. “The workshop had slides/screens that you ‘built’ by pushing the mouse button to reveal words, diagrams and images. Was this helpful with reading and following along?” $N = 54$. 

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CHAPTER IV
STUDY 3: STIMULUS EQUIVALENCE

Introduction

Based on the students' evaluations of the stimulus equivalence section of "Chapter 13, Complex Stimulus Control" (Malott & Trojan Suárez, 2004) reported by Suárez (2001), the concepts for stimulus equivalence needed a supplement. The objective was to provide this supplemental practice for the unit that consisted of this chapter dealing with stimulus equivalence and the accompanying workbook chapter not dealing with stimulus equivalence.

Stimulus equivalence can be described by the equations stating if A = B and B = C, then A = C. Consider the chapter's example of a stimulus equivalence study (Cowley, Green, & Braunling-McMorrow, 1992). Al, a brain-injured adult, could not match the picture of his therapist with the written name of his therapist, Mark (A\text{picture} = C\text{written name}). However, Al could read Mark (C\text{written name} = B\text{spoken name}) and point to the word Mark if Mark said, "Mark" (B\text{spoken name} = C\text{written name}). As in the stimulus equivalence equation above, if B = C is true, then training A = B should result in A = C, demonstrating stimulus equivalence. After many trials of differentially reinforcing Mark's behavior of pointing to the picture after hearing the name (B\text{spoken name} = A\text{picture}), he could both say the name when he saw the picture (A\text{picture} = B\text{spoken name}) and match the picture to the written name (A\text{picture} = C\text{written name}). Although the behavior of matching the picture to the written name was not directly trained, it emerged, as a result of training the behavior of pointing to the picture after hearing the name. Stimulus equivalence involves a set of concepts that describes the emergence of the untrained relation (i.e., A = C). The theory presented in the textbook explains that covert verbal behavior may have also been reinforced during the training.
sessions, thus supporting transfer of stimulus control.

I supervised Masters students who created first drafts of the workshows addressing stimulus equivalence (Study 3) and the stimulus generalization gradient (Study 4). Before we began, the Masters students and I read and discussed the first two chapters of *Theory of Instruction: Principles and Applications* (Engelmann & Carnine, 1982) and all of *Good Frames and Bad* (Markle, 1964). After this reading, each Masters student and I met weekly to discuss the instructional objectives and frames, to ensure the workshows were uniform in style, and to do usability testing. This reading and the pilot-project research resulting from Study 1 helped define general rules about frame construction in terms of the principles of instruction and in terms of techniques for building those frames in PowerPoint®. With the help from an undergraduate assistant, I began using these general rules to develop the following job aids or checklists: One-to-one testing, PowerPoint®, and Instructional Frames (see Appendix H for examples of job aids and checklists).

**Method**

The workshow illustrated the same stimulus equivalence study as was in the chapter, but the workshow used build-slides to animate the stimulus matching procedures presented in the chapter. The textbook and workshow explained the following concepts, which served as the workshow’s objectives:

- Transitivity
- Reflexivity
- Symmetry
- Identity matching
- Symbolic matching
- Emergent relations
- Stimulus equivalence class
- Theory of covert verbal behavior aiding transfer of stimulus control

As in Study 1, the design was a counterbalanced, pretest-posttest design, using
two versions of the test. In the winter semester of 2003, 38 students who read the
chapter and completed the workbook volunteered to take a post-textbook/pre-
workshop test at the end of the seminar and received points that would count toward
part of a future assignment. As homework for the second seminar relevant to this
study, all the students in the seminar completed the workshop on stimulus
equivalence and took a test at the beginning of the seminar. The volunteer,
experimental group took an alternate version of the test.

The test scores following the assignment consisting of the chapter and
workbook served as the baseline measure. The workshop for stimulus equivalence
served as the independent variable. The test scores before and after the workshop
served as the dependent variables. Examples of stimulus matching diagrams were
presented on the test. Multiple-choice questions asked the students to select one or
two of the matching diagrams that illustrated specific types of equivalence relations.
Fill-in questions also required the students to provide an original example of an
equivalence class and then complete matching diagrams involving transitive,
symmetrical, and reflexive relations for their original example.

Results

The overall test scores improved from a mean of 47% (SD = 25%) prior to the
workshop to a mean of 76% (SD = 23%) after the workshop, a 29% improvement
(Figure 9). This was statistically significant, \( t(37) = 6.44, p < .0001 \) (two-tailed), \( d = 1.19 \).
Figure 9. Overall mean test-percentage correct (± SD) after first reading the textbook and then again after completing the stimulus equivalence workshow. N = 38.

Although the test scores improved, the accuracy of the students’ original examples after completing the workshow did not significantly improve as determined with a χ² (1, N = 38) = .10, p = .75 (Figure 10). In general, there was still considerable room for further improvement for all the concepts. However in comparing the textbook’s treatment of stimulus equivalence to the stimulus equivalence workshow, 61% of the students preferred the workshow’s treatment to the textbook’s treatment, and 14% preferred the textbook’s treatment. The remaining 25% was neutral (Figure 11). The large percentage of students who prefer the workshow suggests the workshow was valued as a supplement to the textbook section for stimulus equivalence.
Figure 10. Mean test-percentage correct for each concept after first reading the textbook and then again after completing the stimulus equivalence workshop. Labels on the ordinate are as follows. Reflex: Reflexivity. Sym: Symmetry. Trans: Transitivity. CVB: Covert verbal behavior. Identity: Identity matching. OE EQ: Original example of an equivalence class. Numbers in parenthesis indicate the number of test questions. $N = 38$.

Figure 11. "Comparing the textbook's treatment of stimulus equivalence to the workshop, which did you prefer?" $N = 51$. 

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Discussion

The workshow significantly improved the students’ understanding of an equivalence class, as measured by the post-textbook test and post-workshow test. If the students reread the chapter, they might have improved to the same extent as after completing the workshow; however, using building, graphic diagrams in the workshow compared to static, text-based diagrams in the textbook might have been crucial in the workshow’s effectiveness. A good follow-up study would be to have students read the chapter twice, as would be the case for the follow studies also. In addition, another study would be to have students complete the workshow without animation, to compare with this animated workshow. However, the objective of this study was to increase the students’ effectiveness dealing with the concepts rather than determining what variables were crucial in producing their effectiveness.

The accuracy of the students’ original examples was not improved by the workshow. The test asked students to give an original example (i.e., three stimuli that make up an equivalence class), but the workshow provided just one model example of an equivalence class, rather than a complete set of examples and nonexamples sampling the range of critical and variable attributes of an equivalence class. If the training had included multiple examples and nonexamples then more students might have produced correct examples of an equivalence class. However, the cost was considerable in terms of both the work required to develop the critical variables involved in just one example and the time for the students to complete the workshow for the one example.

When providing an example of an equivalence class, most of the students who answered incorrectly provided three examples of one stimulus class or an ambiguous combination of an equivalence class and stimulus class. The workshow provided few
examples to contrast equivalence classes and stimulus classes. A stimulus class is a set of stimuli that share some common physical property. An equivalence class is set of arbitrary stimuli that are a result of stimulus equivalence training, not a result of physical similarity. One student wrote, “red shirt, green shirt, and blue shirt,” and another student wrote, “blonde, brunette, and red head.” These students’ erroneous answers involved variable attributes of a stimulus class.

Other student-examples were more thoughtful, such as “jeans, shirt, and shoes,” or “cherry, orange, and apple,” each of which could be an equivalence class if respectively naming them “clothing” and “fruit” was trained such that each set became an equivalence class. In addition, jeans, shirts, and shoes could form a stimulus class to the extent that they all share natural physical properties such as covering people and being in dressers and closets. Furthermore, cherries, oranges, and apples could form an equivalence class, but they also have common physical properties of being sweet, edible plant-life. These examples are ambiguous, at least when judging whether the students understood how their example formed an equivalence class, because any stimulus class can benefit from equivalence training in addition to simple concept training. Of course, a stimulus class such as red shirt, green shirt, and blue shirt could also be formed as a result of equivalence training, but an experimental test for an emergent equivalence relation would be confounded by the physical similarities of the stimuli. The example in the textbook and workshop was a good, molecular model of an equivalence class because the written word Mark, spoken “Mark,” and a picture of Mark were obviously not physically similar. We were trying to get this example clear at the undergraduate level, but the middle-range of combined equivalence/stimulus class examples would be a good area for a graduate-level study objective. In conclusion, if the textbook and workshop trained
how some examples could be both a stimulus class and an equivalence class, students might not have provided such ambiguous examples to clearly illustrate an equivalence class.
CHAPTER V
STUDY 4: THE STIMULUS GENERALIZATION GRADIENT

Introduction

"Chapter 13, Complex Stimulus Control" (Malott & Trojan Suárez, 2004) also had a section that described a standard experiment on stimulus generalization. Based on Malott’s informal observations of difficulties that arose during the students’ discussions in the seminars, the concepts for the experiment needed a supplement. In part, the objective was to provide supplemental practice dealing with the phases of the standard stimulus generalization experiment, but the development of the worksheet evolved with some emphasis on describing examples of stimulus generalization gradients. The workbook chapter did not deal with the experiment or stimulus generalization gradients.

Consider the chapter’s example of an experiment on stimulus generalization (Guttman & Kalish, 1956). In the first phase, investigators trained pigeons to peck a key transluminated with a yellow-green light, and extinguished key pecks when the light was off. During this training phase, the investigators used intermittent reinforcement rather than continuous reinforcement so that key pecking would occur longer and more frequently during extinction later in the testing phase. Then, during the testing phase, the investigators transluminated the key with light of many different colors, including the yellow-green light. During this testing phase, no key pecks were reinforced. A graph of a stimulus generalization gradient shows the frequency of key pecks in the presence of each color; it shows that the highest frequency of responding occurs when the color is yellow-green, with the frequency of responding decreasing as the color departs from yellow-green.

42
Method

The chapter section presented the experiment described above. As in the chapter, the workbook also illustrated the experiment in terms of the phases of the experiment and in terms of generalization gradient graphs. The textbook and workbook explained the following concepts, which served as the workbook's objectives:

- Training phase was intermittent reinforcement in the presence of a yellow-green light.
- Testing phase was extinction in the presence of several colored lights.
- Intermittent reinforcement increased resistance to extinction.
- Given a gradient, identify the amount of generalization (i.e., little/much/complete/no generalization).
- Given a gradient, identify the amount of discrimination (i.e., little/much/complete/no discrimination).

In the winter semester of 2003, 23 students who read the chapter and completed the workbook volunteered to take a post-textbook/pre-workshow test and took an alternate test at the beginning of the following seminar, following the same procedure and design as Study 3.

The test scores following the assignment consisting of the chapter and workbook served as a baseline measure. The workbook for the generalization experiment served as the independent variable. The test scores before and after the workbook served as the dependent variables. The tests had multiple-choice questions and blank graphs as fill-in questions.

Results

The overall test scores improved from a mean of 58% ($SD = 24\%$) prior to the workshop to a mean of 71% ($SD = 25\%$) after the workshop, a 13% improvement (Figure 12). This was statistically significant, $t (22) = 2.40, p = .03$ (two-tailed), $d = .51$. 

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Figure 12. Overall mean test-percentage correct (± SD) after first reading the textbook and then again after completing the generalization gradient workshop. N = 23.

However, this improvement was primarily due to performance on one question about the training phase (Figure 13) because when the question about the training phase was removed from the analysis, the test scores improved from a mean of 62% (SD = 25%) prior to the workshop to a mean of 71% (SD = 25%) after the workshop, a 9% improvement. This was not statistically significant, t (22) = 1.65, p = .11 (two-tailed). Furthermore, the training phase was the only concept that had significant improvements by itself, χ² (1, N = 23) = 4.90, p = .03. The training phase concept and all the other concepts still had considerable room for improvement. However in comparing the textbook’s treatment of the generalization gradient to the generalization gradient workshop, 55% of the students preferred the workshop’s treatment to the textbook’s treatment, and 12% preferred the textbook’s treatment. The remaining 33% was neutral (Figure 14). Again, the large percentage of students who prefer the workshop suggests the workshop was valued as a supplement.
Figure 13. Mean test-percentage correct for each concept after first reading the textbook and then again after completing the generalization gradient workshow. Discrim: Discrimination. Gen: Generalization. Training: Intermittent reinforcement is used during training. Testing: Extinction procedure is used during generalization testing. ResistExt: What procedure results in more or less resistance to extinction? Numbers in parenthesis indicate the number of test questions. $N = 23$.

Figure 14. “Comparing the textbook’s treatment of the generalization gradient to the workshow, which did you prefer?” $N = 33$. 

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Discussion

The workshop was effective because it primarily trained the training phase of the generalization gradient experiment. In contrast, the workshop was ineffective in training the testing phase, possibly because the pre-workshop performance showed less room for improvement, even though all the concepts had room for improvement after the workshop.

The concept of what makes a response more or less resistant to extinction was the most difficult concept based on both pretest and posttest scores. In the testing phase, Guttman & Kalish (1956) used intermittent reinforcement because intermittent reinforcement produces more resistance to extinction than continuous reinforcement. However, with a brief hypothetical example, an attempt also was made to train that continuous reinforcement makes responding less resistant to extinction than intermittent reinforcement. Students were relatively more effective answering the posttest question about what makes responding more resistant to extinction, and they were relatively less effective answering the test question about what makes responding less resistant to extinction. Regardless of whether the test question asked what procedure made responding “more” or “less” resistant to extinction, the students answered intermittent reinforcement, possibly because that was the procedure of the model example. Additional nonexamples of procedures that involve continuous reinforcement leading to less resistance to extinction might improve the workshop.

For similar reasons, the workshop was less effective in preparing students to answer the discrimination and generalization questions that asked the student to respond in a novel way. In other words, the workshop provided practice in identifying pictures of graphs by asking students to click from answers such as, “This shows much generalization,” or click on a graph that show much generalization, for
example. However, one test question asked the students to select the correct fill-in, written descriptions; for example, one question asked “If there is much generalization shown on a generalization gradient, then the rate of responding ____ as the stimuli are physically different from the training stimulus. Answer: Decreases.” Students could select among multiple descriptions to fill in the blank. Although the goal of the workshop was to train a conceptual repertoire, which is demonstrated by identifying novel examples of a stimulus class, it would be desirable to add practice for the behavior of describing the rates of responding shown on gradient graphs.

The original objective was to provide training on the experiment with respect to its phases and procedures. This was done to some extent, but much of the focus from the original author and me drifted into concept training of gradient graphs. Even so, there is room for improvement in describing gradient graphs. The workshop provided some training on the experiment’s procedures only with one model example of the experimental procedures. Students might have mastered the testing phase if the workshop included practice identifying nonexamples, or erroneous testing phase procedures where reinforcement rather than extinction was used.
CHAPTER VI

STUDY 5: DISCRETE-TRIAL, FREE-OPERANT, AND HYBRID PROCEDURES

Introduction

"Chapter 17, Time-dependent Schedules" (Malott & Trojan Suárez, 2004) had a section on discrete-trial, free-operant, and hybrid discrete-trial/free-operant procedures. Suárez (2001) reported that the section needed a supplement, based on the students' evaluations of that section.

A discrete-trial procedure involves an opportunity to respond (an $S^D$), the response, and an outcome, which could be a reinforcer or a correction. For example, Jimmy's Mom points to a dog and asks him, "What's this?" ($S^D$). Jimmy responds by saying, "Dog," and Mom says, "You're right" (the outcome). After the outcome, the trial is over; then there is an intertrial interval ($S^{\delta}$), during which, Mom asks no questions and does not reinforce behavior related to this task. The dependent variable is percentage of correct responses, not rate of responding. However, in a free-operant procedure, a reinforcer follows a response continuously or intermittently, but there are no intertrial intervals. For example, Jimmy can call the dog and occasionally it will come. The dependent variable is rate of responding, not a percentage correct. A hybrid discrete-trial/free-operant procedure is a free-operant procedure, but each response involves a discrete trial; therefore, like the free operant, there is no intertrial interval, but like a discrete trial, each response follows a distinct $S^D$. For example, when Jimmy is at the zoo, he can point and name the animals continuously, as in a free operant, but each animal is an $S^D$ for a particular naming response, as in a discrete trial. The dependent variable can be both in terms of percentage correct and rate of responding.
Method

The chapter's section on discrete-trial, free-operant, and hybrid, discrete-trial/free-operant procedures included one or two fictional examples of each of the three procedures. Before making the workshop in this study, I completed a concept analysis for this set of concepts (Tiemann & Markle, 1978). Therefore, the workshop provided examples and nonexamples that represented a broad range of critical and variable attributes of the concepts (Engelmann & Carnine, 1982). These served as the workshop's objectives:

- Identify the example as a discrete-trial procedure when the example includes a discriminative stimulus, an intertrial interval, and an outcome.
- Identify the example as a free-operant procedure when the example includes no intertrial interval and no discrete discriminative stimuli for each response.
- Identify the example as a hybrid, discrete-trial/free operant procedure when each behavior in the example is a discrete-trial but includes no intertrial interval.
- Identify whether there is an intertrial interval.

Unlike the previous studies, students completed this workshop on the World Wide Web (WWW) because the authoring program, Macromedia Flash™, produced a relatively smaller file that students could easily download and complete over a dial-up phone modem.

In the winter semester of 2003, 51 students who read the chapter and completed the workbook volunteered to take a post-textbook/pre-workshop test and took an alternate test at the beginning of the following seminar, following the same procedure and design as in Study 3.

The test scores following the chapter dealing with the discrete-trial, free operant, and hybrid discrete-trial/free operant served as a baseline measure. The workshop for these procedures served as the independent variable. The test scores served as the dependent variable. The test-questions provided an example of one of
the behavioral procedures and the students could select one of the procedures among three multiple-choices.

**Results**

The overall test scores improved from a mean of 57%, ($SD = 20\%$) prior to the workshop to a mean of 73% ($SD = 19\%$) after the workshop, a 16% improvement (Figure 15). This was statistically significant, $t(50) = 4.55, p < .0001$ (two-tailed), $d = .80$.

![Figure 15](image)

*Figure 15.* Overall mean test-percentage correct after first reading the textbook and then again after completing the discrete-trial, free-operant, and hybrid procedures workshop. $N = 51$.

However, the overall test scores for neither the free-operant procedure nor the hybrid procedure showed significant improvements, $t(50) = 1.88, p = .07$ and $t(50) = 1.95, p = .06$ respectively (Figure 16). There was still considerable room for further improvement in the free-operant and hybrid procedures.
Figure 16. Mean test-percentage correct for each procedure after first reading the textbook and then again after completing the discrete-trial, free-operant, and hybrid procedures workshow. $N = 51$.

Discussion

On the post-workshow test, students identified hybrid procedures the least effectively, identifying them either as discrete-trial or free operant procedures. The most common misconception of identifying a hybrid procedure as a free operant could be explained by the inconspicuous nature of the $S^D$s in those procedures. This test question is an example of that misconception: "Bob looks at part of a cartoon briefly and then draws that part on his paper, making sure his picture matches the cartoon—the match is a reinforcer. After repeatedly working on his picture, it is coming together, and his Mom says, 'your picture looks really good.'" I assumed the students would effectively identify $S^D$s, such as the subtle ones involving the cartoon drawing, because the $S^D$ was already introduced in the seminar. The training earlier in the
seminar was apparently not sufficient for students to identify the cartoon as the $S^D$ for reinforcement of the behavior of copying. Interestingly, students performed best when presented with examples of discrete-trial procedures, of which an $S^D$ is a critical attribute. However, there is reason to believe some students did not consider the $S^D$ when identifying a procedure as a discrete trial. Based on comments in the seminars, some students considered all examples that had a single response to be a discrete-trial procedure. A single response in an example might have been a conspicuous prompt for identifying it as a discrete trial, regardless of an $S^D$ in the example.

The hybrid discrete-trial/free-operant procedure is an advanced, original concept presented in the textbook. Some of the examples of hybrid procedures required teaching assistants, Malott, and me to consider carefully what the procedure was. In fact, the high rate of student errors might indicate not that we need to do a better job programming but that we need to do a better job analyzing and defining those hybrid procedures.

A potential benefit in the design of this study's workbook was that each procedure served as a nonexample of the other procedures, thus increasing the nonexamples trained for each procedure. However, based on the common misconceptions between the free-operant and hybrid procedures, the workbook might be improved if it included more examples of free operants and contrasted them with hybrid procedures.

An additional attribute in discriminating the procedures is the correct way to measure the response in each procedure. You can rightfully measure the frequency of the response in a free-operant and a hybrid procedure while only a percentage-correct measure of the response is appropriate for a discrete-trial procedure. Whereas, both forms of measurement are acceptable for a hybrid procedure. In an attempt either to
keep the instruction lean, or possibly simple, I did not consider the measurement
distinction a critical attribute of the procedures, and moreover, I thought it might add
confusion if it were added to the workshop, particularly if it thus required
prerequisite training on why a frequency measure is not appropriate for a discrete-trial
procedure and why a percentage-correct measure is not appropriate for a free operant.
However, measurement might be a critical variable because naming the appropriate
measure consistently helps confirm my own identification of the procedures.
CHAPTER VII
GENERAL EVALUATION AND DISCUSSION

General Evaluation

Students indicated that the sick social cycle and discrete-trial workshows were most valuable in terms of learning (Figure 17). The students’ high evaluation of the sick social cycle workshow is interesting considering their high scores on original examples before they completed the workshow and the insignificant improvements after the workshow.

![Bar chart](image)

*Figure 17.* "Which workshow do you think was the most valuable in terms of how much you learned?" Not shown, 16% chose the shaping workshow (See Appendix C). $N = 57$.

Forty-eight percent of students indicated they would like to have more Western Michigan University course material delivered as computer-based programmed instruction like the workshows, and only 16% would rather not have more workshows at WMU (Figure 18). The remaining 36% was neutral. Sixty-six percent of the students preferred the computer-based workshow to the paper-based workbook, and only 5% preferred the workbook (Figure 19). The remaining 29% was
neutral. Furthermore, 75% who preferred the computer-based workshop to paper-based workbook indicated the reason was that the workshop provided feedback on the correctness of answers (Figure 20). Among the small number of students who preferred the workbook, 45% indicated that the reason was because it was mobile and they could do it anywhere. Thirty-three percent preferred the workshops to the textbook in general, which was preferred by only 14%; however, 52% indicated no preference for either of the materials in general (Figure 21).

![Bar chart](image)

*Figure 18.* “Would you like to have more of your WMU course materials delivered in a workshop format?” *N* = 56.

Students also indicated that interactivity was a reason they preferred the workshop to the workbook (Figure 20). One hope was that the build-slides and build-diagrams would facilitate learning. Fifty-six percent of the students indicated building the slides and diagrams helped them read and follow along, and 11% indicated this building was not helpful at all (*N* = 53). The remaining 33% was neutral. However, 42% of the students indicated that the mouse-clicking required to build the slides and diagrams was bothersome, and 33% indicated it was not bothersome at all (*N* = 53).
Figure 19. “Now that you’ve just about completed all the paper-based homework in this course, which did you prefer?” $N = 44$.

Figure 20. “If you prefer computer (to the paper-based workbook), why?” Students often select more than one category, though I instructed them not to. These data represent only the 29 students who preferred computer-based instruction.
Figure 21. "Compared to the textbook, which did you prefer?" $N = 57$.

Forty-six percent of the students preferred completing the workshow on the WWW (Figure 22). Among the 37% who strongly preferred accessing the workshow with the CD instead, their explanations indicate they either had difficulty with their internet connection or the CD workshows were more entertaining, with its music and colorful graphics, for example. The WWW-based, Flash$^{\text{TM}}$ workshow presented relatively fewer colors, build-animations, and had no music. These students' reasons for preferring CD-access suggest that if I had programmed the WWW, Flash$^{\text{TM}}$ workshow with music and animation and students had a reliable internet connection, more of students might have chosen the WWW to complete computer-based programmed instruction.
General Discussion of the Instructional Methods

The work in this dissertation might best be described as research and development rather than either applied or basic research. The primary goal of the research and development in this dissertation was to produce a product to solve a problem. The product can sooner meet improvement goals if the programmer devotes time to developing an intervention package (Malott & Trojan Suárez, 2004) rather than devoting time to developing a product with sufficient control to answer whether one or more instructional variables are the most effective.

The goal to improve the students’ mastery of the concepts was achieved in four out of five workshows, and the evaluations indicate students preferred the workshop format more than the workbook in this seminar; students indicated they preferred the computer-based programmed instruction because it provided feedback. Therefore, one option for future research and development might be to convert the workbook into workshows, thus adding response-contingent feedback and

Figure 22. “With regard to how you accessed the workshop, which did you prefer?” N = 57.
interactivity, such as build-diagrams. Another future study could add feedback for the answer to each question in the workbook to see if more students would then prefer the workbook, and this addition could be a more cost-effective alternative to converting the workbook into workshows because adding feedback to the workbook could be accomplished with fewer work hours than producing computer-based programmed instruction to replace the workbook as was done in the first study. However, as discussed earlier, it is more difficult to prevent peeking with paper-based programmed instruction; and students' peeking at the feedback might reduce the effectiveness of a workbook that provided feedback. In spite of this, the general comparison between the effectiveness of the workshow and workbook in Study 1 does not show that the potential to peek is a disadvantage in this particular instance.

A workbook or a workshow can provide students with more or more appropriate practice with the concepts when a section of a textbook is not sufficient. As Study 1 showed, the learning results for the workshow were not significantly different from the workbook. However, the students' preference for the workshow to the workbook suggests that computer programs that are entertaining, interactive, and provide response-specific-feedback should be used in further efforts to supplement the textbook, particularly if favorable social validity of the instructional materials is of value.

In comparison to the textbook immediately after completing the stimulus equivalence and generalization gradient workshows, students indicated the workshow's treatment of those particular concepts was more preferred than the textbook's treatment of those concepts. The textbook covered a comprehensive review of the principles of behavior, and thus could not devote the extensive number of pages that might be necessary to master such difficult concepts. Moreover, the
textbook is as big as practicality and the publishers will allow. The students' might have indicated they preferred those particular workshops because the textbook's treatment alone was not sufficient for the complexity of the concepts or because reading the textbook only once was not sufficient for the complexity of the concepts. Alternatively, their preference for those workshops over those textbook sections could be because the workshop provided interactivity and response-contingent feedback for questioned they answered. However, on the overall evaluation at the end of the semester, students did not indicate a strong preference for either the workshop in general or the textbook in general (Figure 21). The students' tendency not to prefer the textbook over the workshops further supports our goal of using them in combination.

One limitation of these evaluations was that they did not involve absolute measures of the value of how the workshops reduced students' confusions, as was done in Suárez' (2001) dissertation. Thus students still might find each of the concepts just as confusing as was reported in that study. Furthermore, if asked, the students might have indicated each of the materials was valuable in terms of learning. Instead of asking them if each of the materials were valuable in terms of learning, empirical testing was used to measure the effectiveness of the workshops; and social validity evaluations of the relative value of the types of instruction were used to find out which instructional material was preferred. Although the students might still have confusions, most of the studies described here achieved statistically significant improvement in performance on post-tests. It would have been interesting if the students indicated they highly preferred the textbook over the workshops or the workshops over the textbook, but those data might have little value in that it would remain impractical to replace the textbook with workshops.
A limitation of the methodology in the final four studies is that reading the textbook twice might also have produced significant improvements, although most students are not likely to read textbooks twice. Students might reread particularly difficult material, but as indicated by the low post-textbook performance in Studies 3-5, students either did not reread the textbook section or the section alone was not highly effective in teaching the concepts. Moreover, rereading the textbook might not have the social validity for the students, compared to the social validity of reading the textbook once and then going through an engaging workshop over the same material.

In contrast to the difficult concepts in these studies, the relatively simple concept of shaping (Appendix C) was illustrated in a workshop using the same example as was used in the textbook, and some students complained that the example was boring and redundant with the textbook. The students' evaluation of this repetitiveness indicates that they do not like to review relatively simple material, even if it is in a workshop. Whereas, students had to deal with the same example of stimulus equivalence in both the textbook and workshop, and they did not indicate the repetition was redundant or boring because of the difficulty of the concepts.

Program Effectiveness and Opportunities for Improvement

As shown in Table 3, there was great variability in the amount of improvement in the studies that produced improvement. In addition, there is still room for improvement in each of the five workshows. The contingency-diagramming-checklist workshop in Study 1 has the greatest number of instructional frames, which might be why it has the highest effect sizes. Its high effect sizes could also be because the paper-based workbook chapter from which the workshop was drafted has had more revisions and development as a result of two honors theses dealing with that original workbook chapter (Emmendorfer, 1996; Johnson, 1993). As also indicated by
Study 2 on the sick social cycle, the *specific behavior, action, and deadman criteria* on the checklist all still need more revision.

Table 3

Effect Sizes and Pretest-Posttest Improvements

<table>
<thead>
<tr>
<th>Study</th>
<th>Pretest</th>
<th>Posttest</th>
<th>Improvement</th>
<th>Effect size</th>
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</thead>
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<tr>
<td>1. The Contingency-Diagramming Checklist</td>
<td>41.4&lt;sup&gt;a&lt;/sup&gt; 50.8&lt;sup&gt;b&lt;/sup&gt;</td>
<td>74.1&lt;sup&gt;a&lt;/sup&gt; 83.3&lt;sup&gt;b&lt;/sup&gt;</td>
<td>32.7&lt;sup&gt;a&lt;/sup&gt; 32.5&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.51&lt;sup&gt;a&lt;/sup&gt; 1.77&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>2. The Sick Social Cycle</td>
<td>61.6&lt;sup&gt;c&lt;/sup&gt; 60.6&lt;sup&gt;d&lt;/sup&gt;</td>
<td>67.6&lt;sup&gt;c&lt;/sup&gt; 69.7&lt;sup&gt;d&lt;/sup&gt;</td>
<td>6.0&lt;sup&gt;c&lt;/sup&gt; 9.1&lt;sup&gt;d&lt;/sup&gt;</td>
<td>N/A</td>
</tr>
<tr>
<td>3. Stimulus Equivalence</td>
<td>47.0</td>
<td>75.8</td>
<td>28.8</td>
<td>1.19</td>
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<tr>
<td>4. The Stimulus Generalization Gradient</td>
<td>58.1</td>
<td>70.7</td>
<td>12.6</td>
<td>0.51</td>
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<tr>
<td>5. Discrete-trial, Free-operant, and Hybrid Procedures</td>
<td>56.9</td>
<td>72.8</td>
<td>15.9</td>
<td>0.80</td>
</tr>
</tbody>
</table>

<sup>a</sup>Winter semester of 2002, <sup>b</sup>Fall semester of 2002, <sup>c</sup>Escape model, <sup>d</sup>Punishment model

No effect size was calculated for Study 2 involving the workshop for the sick social cycle because that workshop had no statistically significant effects on the accuracy of diagramming the models. However, the reason I developed this workshop was not because of the students' diagramming accuracy but because the students indicated that this topic was confusing; and after the workshop, the students indicated that, in terms of learning, this was the most valuable workshop. Their high rating of this workshop suggests that it reduced their confusions, but I do not have any evaluation data to show the extent to which the workshop reduced confusions, or what those confusions were.

Table 3 shows the percentage of students who accurately diagrammed an original example of a sick social cycle. The insignificant results as indicated by their
original examples might be explained by the workshop’s lack of training for accurately diagramming examples. Adding illustrations of diagramming mistakes for the sick social cycle examples already in the workshop might reduce these contingency-diagramming checklist errors.

The second highest effect size was in Study 3, involving the stimulus-equivalence workshop; this high effect size might be explained by the greater room for improvement the stimulus equivalence concepts had, because the post-textbook mean was only 47%. As shown in Table 3, this percentage was the lowest among the studies involving post-textbook measures (i.e., all the studies except Study 1). The high effect size might also result from a potential benefit of the build-diagrams illustrating the theory of stimulus equivalence that was presented in a static format in the textbook. This workshop might be improved by illustrating not only simple examples of equivalence classes and stimulus classes as was done in this study, but also adding examples that are both an equivalence class and a stimulus class.

Study 4, involving the generalization gradient workshop had a low effect size relative to the other studies (Table 3). The workshop might be improved with additional examples of testing procedures or nonexamples of testing procedures that erroneously use reinforcement. Additionally, the instruction might be improved if it provided more practice in what procedure is less resistant to extinction than continuous reinforcement.

Finally, Study 5, involving the discrete-trial, free-operant and hybrid procedures workshop, had a relatively high effect size, possibly because it included many examples and nonexamples of each procedure (Table 3). However, the concept of a hybrid procedure appears to require further analysis so that the workshop has more, clear examples that illustrate the critical attributes of the hybrid procedure. In
addition, the workshop might be improved by including the attribute of whether the response in any procedure should be measured by its rate or percentage correct.

**Definition-based Concept Training and Simple Concept Training**

In general, the above recommendations follow rules described by others suggesting that concept training is achieved by presenting examples and nonexamples of a concept (Engelmann & Carnine, 1982; Malott & Trojan Suárez, 2004). In contrast, Markle (1964) suggests rewriting and developing current instructional frames before adding more frames, as a programmer might do by adding more examples and nonexamples. In revisions to improve the workshops, I followed Markle’s suggestion by making additions, such as prompts, to existing frames with high error rates more often than adding more examples and nonexamples as new frames.

The instruction in these studies involved a combination of definition-based concept training and simple concept training (Shimamune & Malott, 1994). Definition-based concept training might involve only one example, a model example that clearly illustrates the critical attributes of a concept, along with statements describing the critical attributes. Simple concept training involves presenting examples and nonexamples of the concept until the students achieve mastery. Most of my recommendations for improving the workshops involve adding more examples, as with the stimulus equivalence workshop for instance, or more nonexamples, as with the sick social cycle workshop for instance. However, the discrete-trail/free-operant procedures workshop had more examples and nonexamples than the other workshops; and I suggest that the definition of the hybrid procedure needs further analysis and thus more definition-based concept training. Interestingly, some students reported this example-intensive workshop needed more examples, while no students

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suggested the other workshows needed more examples. However, their suggestion might also indicate the definitions of the procedures were too complex or not clear enough. When choosing a strategy in the initial draft and later revisions, it might be useful to understand whether or how much definition-based concept training or simple concept training to use in the instruction. Clearly, with students who can follow rules, definition-based concept training would be an efficient way to train a concept, but as shown in this dissertation, multiple examples and nonexamples might still be necessary for students to master the concepts.

**Labor Costs of this Computer-based Programmed Instruction**

With regard to programming efforts in general, let us consider the work-hours required to produce the added improvement resulting from supplemental, computer-based programmed instruction. Senbetta surveyed experts in computer-based training (CBT) and reported that, “the average number of hours to develop one hour of CBT for mainframe CBT, microcomputer CBT with limited graphics, and microcomputer CBT with extensive graphics were 160, 180, and 230 hours per hour respectively” (1992, Abstract). More recently Lee and Owens (2000) reported that computer-based, multimedia instruction can take from 250-750 work-hours per hour of instruction. These hours could include an extensive revision and validation process, though it is not clear. Certainly, it is costly to produce an initial draft of computer-based instruction, but programmed instruction in particular might be even more costly, and more effective, as a result of the programmer working through the six steps of behavioral systems analysis. It took approximately 600 hours to produce the testable initial drafts of all five workshows combined, and the versions reported here required approximately 390 additional hours of research and development, totaling 990 hours in all. The five workshows totaled approximately four hours of instruction, which
means one hour of workshop instruction required approximately 247 hours of work. Considering these labor costs, efforts toward definition-based concept training versus adding more examples and nonexamples, as with simple concept training, might be important in that a programmer must find the most efficient approach.

Conclusions

Regardless of whether the intervention has high social validity in terms of student evaluations, whether it costs a reasonable number of work-hours, or whether we can answer what instructional variable was the most beneficial (e.g., response-specific feedback, prevention of peeking, build-diagrams), this added computer-based instruction has come closer to meeting the ultimate goal of training students until they have mastered the concepts.

In conclusion, four of the five workshops showed statistically significant improvement in the learning of difficult concepts; and three of the four workshops that followed the textbook reading assignments further improved students' mastery of those concepts over the results obtained from merely reading the textbook. In addition, a large percentage of the students would like more of their course materials at the university in the form of workshops, suggesting that the effort to produce an interactive, graphic, colorful, engaging version of programmed instruction has high social validity. The results of these studies do not suggest computer-based programmed instruction like these workshops should replace either the textbook or workbook, or that it is practical to do so, especially because of the labor required; but workshops appear to be a valuable component of an instructional system when active responding or further practice is necessary for students to master particularly difficult concepts.
Appendix A

Research Protocol Clearance
Date: February 26, 2001

To: Richard Malott, Principal Investigator
    Jason Otto, Student Investigator for dissertation
    Amy Hund, Student Investigator

From: Michael S. Pritchard, Interim Chair

Re: HSIRB Project Number 01-01-12

This letter will serve as confirmation that your research project entitled “Behavior Analysis Training System (BATS)” has been approved under the exempt category of review by the Human Subjects Institutional Review Board. The conditions and duration of this approval are specified in the Policies of Western Michigan University. You may now begin to implement the research as described in the application.

Please note that you may only conduct this research exactly in the form it was approved. You must seek specific board approval for any changes in this project. You must also seek reapproval if the project extends beyond the termination date noted below. In addition if there are any unanticipated adverse reactions or unanticipated events associated with the conduct of this research, you should immediately suspend the project and contact the Chair of the HSIRB for consultation.

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

Approval Termination: February 26, 2002
Appendix B

The Value of Computer-based Programmed Instruction
The Value of Computer-based Programmed Instruction

Computer-based programmed instruction is more costly to produce than paper-based programmed instruction. A programmer needs about 100 hours to create one hour of paper-based programmed instruction (Markle, 1990). For experts in computer-based training (CBT), “the average number of hours to develop one hour of CBT for mainframe CBT, microcomputer CBT with limited graphics, and microcomputer CBT with extensive graphics were 160, 180, and 230 hours per hour respectively” (Senbetta, 1992, Abstract). Like the CBT with extensive graphics, the workshows were multimedia-rich, computer-based programmed instruction rather than simple text-based programmed instruction.

The value of computer-based programmed instruction involves the quality of the instruction, as measured by its effectiveness and the social validity of the instructional material. The cost effectiveness of computer-based programmed instruction involves the value described above divided by the cost to develop the instruction; we can also view this formula in terms of Gilbert’s (1978) leisurely theorem, Value / Cost = Worth. An additional factor that can increase the overall worth of a program is the number of students who will receive the instruction; the more students affected by the instruction, the more value added by the instruction, thus reducing the impact of development cost. Our behavior analysis seminars enroll approximately 200 students per year; so the workshow, though it might be costly in terms of the hours of work to develop it, would affect a large number of students.

Consider an example of the worth or cost-effectiveness of two methods of instruction. With 100 hours for the development of paper-based programmed instruction, we might generate training for ten concepts that improve performance from 50% before to 70% mastery after training (a 20% increase). With 200 hours for
the development of a jazzy, PowerPoint® workshop, we might also generate training for ten concepts but improve performance from 50% before to 90% mastery after training (a 40% increase); with much higher social validity based on student-evaluations of the instructional process. So the worth of paper-based programmed instruction (Value, based on percentage increase / Cost, based on hours to develop the instruction = Worth) would be 20 / 100 = .20, and for the workshop it would be 40 / 200 = .20. In this example, the value gained would be the increase in social validity, based on student-evaluations. In work environments, as opposed to a university setting, it might be more difficult to get a high level of engagement with job-related training, and thus social validity is a particular concern.
Appendix C

Shaping Study
SHAPING

INTRODUCTION

In our efforts for continuous quality improvement of our behavior analysis course, the seminar instructors and system managers evaluate informal feedback from seminar discussions and formal feedback from course evaluations. "Chapter 8, Shaping" (Malott & Trojan Suárez, 2004) accompanied a worksheet, which used the example of shaping successively faster typing. Both Suarez, who was the previous system manager of the seminar, and seminar teaching assistants reported that students said the example was confusing. One solution to deal with the student evaluation could have been to rewrite the worksheet with an alternative, simple example; but this dissertation allowed us to develop and evaluate a workshop using an example already explained in the textbook. The purpose of this study was to develop and evaluate the workshop replacing the worksheet assignment.

METHOD

The goal of the shaping workshop did not address an apparent deficit in the students' performance on the chapter test or the worksheet, but the workshop addressed the poor, yet informal evaluations of the worksheet. An example of shaping the speech of a mute, institutionalized resident presented in "Chapter 8, Shaping" (Malott & Trojan Suárez, 2004) was the example in the workshop. These were the learning objectives:

- Identifying the response class and response dimension of interest
- Discriminating between shaping and shaping up (i.e., building muscle tissue)
- Diagramming and identifying initial, intermediate, and terminal behaviors

In the winter semester of 2003, 33 students volunteered to take a test before completing the workshop and reading "Chapter 8, Shaping" (Malott & Trojan Suárez, 2004) that served as a baseline measure. Then students completed the workshop and
read the chapter, which served as the independent variables. Finally, the students took an alternate test at the beginning of the following seminar. The test had six multiple-choice and one short-answer contingency diagram. The error percentage for each concept provides details about the effectiveness of the workshop and chapter. Each student who took the optional test earned five points to make up part of a future missed assignment.

RESULTS AND DISCUSSION

Students improved the most in identifying whether a scenario was an example of chaining or shaping, going from a pretest mean of 39% to a posttest mean of 73%, a 34% improvement (Figure 23). However, also indicating further room for improvement, some students’ original examples were examples of a behavioral chain rather than the differential reinforcement along a dimension of a single response class. In identifying whether a behavior being shaped was an initial, intermediate, or terminal behavior (i.e., the behavioral steps), students went from a pretest mean of 76% to a posttest mean of 94%, an 18% improvement (Figure 23). Students performed well on the prerequisite concept of a response dimension, with a pretest and posttest mean of 91%. When completing the differential reinforcement diagram that involved the reinforcement of a successive response while not reinforcing a previously reinforced response, students went from a pretest mean of 52% to a posttest mean of 70%, an 18% improvement, and there is still room for considerable improvement (Figure 23). In identifying whether a scenario was an example of shaping or physically shaping-up, students went from a pretest mean of 70% to a posttest mean of 79%, a 9% improvement, the lowest improvement except for the concept of a response dimension (Figure 23).
I was not attempting to compare the textbook to the worksheet because, unlike the other studies, students did not report the concept of shaping was difficult. However, the methodology of combining the worksheet and chapter assignment is undesirable because it is not clear whether the worksheet, the textbook, or the combination resulted in the improvements. However, it is apparent that the combination of the two materials was not sufficient in training the students to mastery in diagramming a shaping step, identifying whether an example is chaining or shaping, and identifying whether an example is shaping or physically shaping-up.

The original objective was to improve student evaluations compared to the paper worksheet, but I never got evaluative comparisons, except for one one-to-one tester, who said the worksheet was much better.
Although the goal was also to simply create the workshop so that students would get practice filling in the shaping diagram, it became apparent over several field tests that the students also provided examples of chaining and physically shaping-up when completing their original examples. These problems are represented as questions on the tests and the workshop also was revised to include training in these distinctions.

In conclusion, even where informal observations do not make apparent that the students are having difficulties with the concepts, further measurement and analysis can show need for improvement.
Appendix D

The Contingency-Diagramming Checklist
Contingency-Diagramming Checklist

A. Whose behavior are you analyzing?

1. BEHAVIOR TEST

Is the behavior in the behavior box performed by the person who you are analyzing? If not, redo the example.

Before
A._
B._
C._
D._

After
A._
B._
C._

Behavior

D. What is the condition before the response?

10. RELATED OUTCOMES TEST

Is the before condition related to the after condition? (Often the relationship is one of opposition). If not, change one or both of the conditions.

Use this checklist for every contingency diagram you do and you'll save yourself some headaches and impress your TA during transparency time.

Simply place the answer to each of the 10 questions for the corresponding blank in the contingency diagram above it.

Turn the checklist over to determine which type of contingency you have.

In learning these criteria for a test, you need only know such nouns and sentence that's bold.

B. What is the behavior being analyzed or diagrammed?

2. DEADMAN TEST

Can a dead man do it? If he can, then you haven't properly specified the behavior. So roll over the dead man.

3. ACTION TEST

Does the behavior involve an action? [Hint: Existing, occurring, being, hearing, seeing, and feeling are not actions]. If not, then change this behavior.

4. SPECIFIC BEHAVIOR TEST

Is it perfectly clear exactly what action is involved in the behavior? [Hint: If not, then re-word the behavior.

5. RESPONSE-UNIT TEST

Are there a response-unit? If not, then change the behavior.

C. What is the outcome that follows the response?

6. STIMULUS TEST

Is the before & after a stimulus or condition and not a behavior of the behavior? If it's not a stimulus then change your condition.

[Hint: If the before or after is another behavior of the behavior, you probably don't have a correct condition.
Exception: self-reinforcement, seeing, hearing, or the opportunity for activity.

7. CAUSALITY TEST

Is the outcome caused by the response? [Hint: If not, change the outcome.

8. 60 SECONDS TEST

Does the outcome follow the response by more than 60 seconds? [Hint: If not, change the outcome.

9. RECEIVER TEST

Is the behavior receiver of the outcome (after condition)? If not, reword the example. [Hint: Make sure the diagram passes the behavior test first.
Appendix E

Paper-based Workbook Chapter for the Contingency-Diagramming Checklist
Chapter 01
Conceptual Work Sheets
Optional Assignment (Up to 25 OAPs): How to use The Contingency-Diagramming Job Aid

Behaver Test

As you enter the wonderful world of PSY 360, you'll see that not all examples are quite as simple as they may look. To help you along the way, we've designed a job aid (The Contingency-Diagramming Job Aid) of all the concepts and general rules you need to keep in mind while analyzing and creating behavioral contingencies. You should have it in hand as you read this, and while you work on your upcoming assignments. This homework is intended to show you how to use the Contingency-Diagramming Job Aid in analyzing behavioral contingencies.

First, write the time you begin this assignment here:

And don't forget to write the time when you finish here:  . Thanks.

Let's go through the tests one by one.

Whose behavior are you analyzing? This may seem Mickey Mouse to you, but you wouldn't believe how many people come up with contingencies in which this isn't clear. If we have the problem, "How can we get Bobby Brat to study?" we want to analyze Bobby's behavior, so the behavior we fill in must be his.

Incorrect:

Before Behavior After
Bob doesn't study The teacher smiles Bob does study

Correct:

Before Behavior After
Bob doesn't get attention Bob studies Bob gets attention

1. The behaver is the person whose behavior you are analyzing.

A. True
B. False
Receiver Test

If we are analyzing Bobby’s behavior, he should be the receiver of the outcome.

Incorrect:

- Before: Teacher doesn’t get praise
- Behavior: Bob studies
- After: Teacher gets praise

Correct:

- Before: Bob doesn’t get praise
- Behavior: Bob studies
- After: Bob gets praise

2. The behaver should be the receiver of the outcome (after condition)?
   A. True
   B. False

Specific-Behavior Test

Remember to be concrete in your examples. Would anyone reading your example come to the same understanding of what this behavior consists of?

Incorrect:

- Before: Bob gets praise
- Behavior: Bob is lazy
- After: Bob gets no praise

Correct:

- Before: Bob gets praise
- Behavior: Bob sleeps at his desk
- After: Bob gets no praise
It is very easy to use vague, potentially confusing descriptions of behavior. Try to envision exactly what the person is doing and write that in the behavior box. Here are some more examples of concrete descriptions vs. wishy-washy ones:

Concrete: Bobby raises his hand. Not Concrete: Bobby seeks attention. Why isn't seeks attention good enough? Because it does not describe the specific-behavior in which Bobby is engaging. Is he jumping up and down? Screaming? Turning cartwheels? We don't know. Let's try one more. . . Concrete: Bobby throws his papers on the floor. Not Concrete: Bobby misbehaves. Again, the problem is that we don't know exactly what form his "misbehaving" is taking. He could be standing on his desk, pinching other students, etc. Obviously, in our everyday conversations, we don't always need to describe in exact detail what someone is doing, but this is behavior analysis - and it never hurts to be precise!

Here's your chance to practice your new skills! Try these questions.

Jennifer's roommate Sue loves to borrow her clothes, but often leaves them in a pile on the floor. This really bothers Jennifer and, one day, she told Sue she couldn't borrow clothes anymore. Sue quickly apologized, and Jennifer immediately reinstated her borrowing privileges. Analyze Sue's behavior to form a correct reinforcement contingency.

<table>
<thead>
<tr>
<th>Before</th>
<th>Behavior</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sue can't borrow Jen's clothes</td>
<td>?</td>
<td>Sue can borrow Jen's clothes</td>
</tr>
</tbody>
</table>

Decide if each of the following is a correct behavior, or if it violates one of the contingency diagram tests. Circle an answer for each question (only one behavior is correct).

3. Jen yells at Sue.
   A. correct behavior
   B. violates receiver test
   C. violates behaver test
   D. violates specific-behavior test

4. Sue is repentful.
   A. correct behavior
   B. violates specific-behavior test
   C. violates behaver test
   D. violates receiver test

5. Sue apologizes.
   A. correct behavior
   B. violates receiver test
   C. violates behaver test
   D. violates specific-behavior test

Because you have all been paying very close attention to this worksheet, I am sure everyone got the correct behavior, Sue apologizes. Jen yells at Sue violates the receiver test, because her yelling will not be reinforced by Sue getting to borrow clothes. Sue is repentful violates the specific-behavior test because it is vague (what exactly is repentful?). Keep on reading, you're doing great!
Dead-Man Test

If a dead-man can do it, it isn’t behavior. This trap is also easy to fall into at first, but after a little practice, you’ll know how to word your examples so the subject is doing something. Look for key words like doesn’t (i.e.: doesn’t listen, doesn’t answer, doesn’t do his homework, etc.) to decide if the so-called behavior is truly behavior.

Incorrect:

Before | Behavior | After
--- | --- | ---
Bob gets no approval | Bob doesn’t interrupt | Bob gets approval

Correct:

Before | Behavior | After
--- | --- | ---
Bob gets no approval | Bob studies quietly | Bob gets approval

Action Test

In keeping with the dead-man test, we want to make sure the behavior we are analyzing is something the person does, not something that is done to the person. It is also worth noting that whenever a behavior fails the dead-man test, it will also fail the action test. However, the reverse of that may not always apply; if a behavior fails the action test, it might still pass the dead-man test.

Incorrect:

Before | Behavior | After
--- | --- | ---
Bob knows next to nothing | Bob is taught a lot | Bob knows mucho

Correct:

Before | Behavior | After
--- | --- | ---
Bob knows next to nothing | Bob reviews his flashcards | Bob knows mucho

In the first diagram *Bob is taught a lot*, fails the action test but because a deadman can not be taught, it passes the dead-man test. It may sound tricky, but we’re just pointing out a time-saver for you to use in your arsenal of behavior-analytic weapons. Here’s another scenario.
Tommy and his mother are driving down Stadium, and Tommy sees the donut shop. He starts screeching, “Donuts, Mommy! Donuts!” and doesn’t stop screaming until he has a donut in his hand. Determine if each of the following is a correct reinforcement contingency, or which criterion is violated if it is incorrect. Circle an answer for each question (only one contingency is correct).

### 6.

<table>
<thead>
<tr>
<th>Before</th>
<th>Behavior</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tommy screeches</td>
<td>Mom drives into the lot</td>
<td>Tommy gets a donut</td>
</tr>
</tbody>
</table>

A. correct contingency  
B. violates receiver test  
C. violates action test  
D. violates dead-man test

### 7.

<table>
<thead>
<tr>
<th>Before</th>
<th>Behavior</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tommy has no donuts</td>
<td>Tommy is driven into the lot</td>
<td>Tommy has donuts</td>
</tr>
</tbody>
</table>

A. correct contingency  
B. violates action test  
C. violates specific-behavior test  
D. violates receiver test

### 8.

<table>
<thead>
<tr>
<th>Before</th>
<th>Behavior</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tommy has no donuts</td>
<td>Tommy screeches</td>
<td>Tommy has donuts</td>
</tr>
</tbody>
</table>

A. correct contingency  
B. violates receiver test  
C. violates dead-man test  
D. violates specific-behavior test
Did you understand that diagram 8 is correct? And did you understand why diagrams 6 and 7 are incorrect? Number 6 violates the receiver test - Mom is the behaver, but Tommy receives the reinforcer. Number 7 violates the action test: being driven is not a behavior. In fact, that would also fail the dead-man test.

**Compare and Contrast**  
**Specific-Behavior Test vs. Action Test**

The specific-behaver test is an effort to get rid of vagueness. Statements that violate this test are often in the form of attempts to specify personal attributes or characteristics, like *Tom is lazy, Tom is dishonest, or Tom is intelligent*. The problem is that *lazy, dishonest, and intelligent* are too vague; they're not specific enough. Also, they may fail the action test in that the verb "is" *isn't an action verb. (As our man, Bill Clinton, put it, It depends on what your definition of "is" is.)*

Now, you can get around the action problem by restating our examples like this: *Tom acts lazily, dishonestly, and intelligently. And "acts" is an action verb. But this workaround still doesn't pass the specific-behavior test. The adverbs lazily, dishonestly, and intelligently are still too vague. You're still going to get a lot of disagreement about what "lazy" means. Does it mean the person doesn’t pick up her clothes and put them away, when she gets ready for bed; or does it mean she hasn’t had a job for the last two years? Adjectives and adverbs are often risky; they’re often too vague to get reliable agreement among independent observers.*
Related-outcome Test

When we talk about the outcomes of a behavioral contingency being related, we mean that the before condition is somehow changed by the behavior, resulting in the after condition. The behavior causes the after condition (the consequence) and the before condition can typically, but loosely, be considered the opposite of that after condition. The before condition is the way things would have remained had the particular behavior not occurred. It is not simply anything that occurred right before the behavior; it must somehow be related to the after condition. This seems like a vague concept, but a couple of examples will help you understand.

Incorrect:

<table>
<thead>
<tr>
<th>Before</th>
<th>Behavior</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bob will not get his allowance</td>
<td>Bob gives his dinner to the dog</td>
<td>Bob gives his dinner to the dog</td>
</tr>
<tr>
<td>Mom makes liver for dinner</td>
<td>Bob gives his dinner to the dog</td>
<td>Bob will not get his allowance</td>
</tr>
</tbody>
</table>

While this incorrect example seems like a likely order of events, it is not a correct contingency. It is important for the behavior to cause the after, and the before helps reflect the change caused by the behavior. If we don’t know how things were before, we can’t determine the effects or consequences, of the behavior, and we can’t see how the after is different from the before. Let’s look at another example or two.

Incorrect:

<table>
<thead>
<tr>
<th>Before</th>
<th>Behavior</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher announces nap time</td>
<td>Bob calls the teacher a jerk</td>
<td>Bob is in time-out</td>
</tr>
<tr>
<td>Bob is in time-out</td>
<td>Bob calls the teacher a jerk</td>
<td>Bob is in time-out</td>
</tr>
</tbody>
</table>

Correct:

<table>
<thead>
<tr>
<th>Before</th>
<th>Behavior</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher announces nap time</td>
<td>Bob calls the teacher a jerk</td>
<td>Bob is in time-out</td>
</tr>
<tr>
<td>Bob will get his allowance</td>
<td>Bob gives his dinner to the dog</td>
<td>Bob will not get his allowance</td>
</tr>
</tbody>
</table>

Without the appropriate before condition, we wouldn’t know for sure that Bobby would have gotten his allowance had he not fed his dinner to the dog.

Try this question; it’s a pretty easy one.

Bobby Brat wants some of Nice Norman’s candy, so he demands it. When Norman refuses, Bobby immediately picks up Norman’s lunch box and throws it. Norman cries, and Bobby picks up all the candy.
Sixty-Second Test

For an outcome to reinforce or punish a response it must pass the 60 second test; it must follow the behavior by no more than 60 seconds.

9. Which of the following is the correct Before condition?
   A. Bobby demands candy
   B. Norman refuses to give Bobby candy
   C. Bobby has no candy

   And the answer is... **Bobby has no candy**. The other two choices fail the related-outcome test. See, I told you it was a simple one.

Incorrect:

<table>
<thead>
<tr>
<th>Before</th>
<th>Behavior</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>?</td>
<td>Bob throws the lunchbox</td>
<td>Bob has candy</td>
</tr>
</tbody>
</table>

First of all, the behavior of studying occurs several hours before the test and, even if he studies up until three seconds before he gets the test, even the quickest of teachers will not have Bobby’s test graded within 60 seconds of the end of studying. Even though, when you do well on a test after studying you seem to study more in the future, this is not a direct-acting reinforcement contingency. Don’t give up on behavior analysis yet because, later on, you will learn that this is an example of an analog to reinforcement. But now, you have to get the basics down.

Incorrect:

<table>
<thead>
<tr>
<th>Before</th>
<th>Behavior</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bob does not have an A in psych.</td>
<td>Bob studies the night before a test</td>
<td>Bob has an A in psych.</td>
</tr>
</tbody>
</table>

Correct:

<table>
<thead>
<tr>
<th>Before</th>
<th>Behavior</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bob has no tokens</td>
<td>Bob answers a question in class</td>
<td>Bob immediately gets a token</td>
</tr>
</tbody>
</table>
Reinforceable Response-Unit Test

This test is designed to help ensure the behavior you are analyzing is actually one reinforceable response-unit.

When we talk about the reinforceable response-unit we are only concerned with the behavior box; keep this in mind. Often students confuse this test with the Sixty Second test. When checking the behavior listed in the behavior box, ask yourself "Are there any interruptions of greater than 60 seconds during the response? If there are, you don't have a true reinforceable response-unit, you actually have something else, an analog to a reinforceable response-unit (you'll get to that starting in chapter 22).

Jaci has an entire research paper to write and one day she gets a burst of energy and begins writing for 20 minutes without taking any breaks at all .

Incorrect:

<table>
<thead>
<tr>
<th>Before</th>
<th>Behavior</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jaci has no intrinsic high</td>
<td>Jaci writes an entire research paper</td>
<td>Jaci has an intrinsic high</td>
</tr>
</tbody>
</table>

Correct:

<table>
<thead>
<tr>
<th>Before</th>
<th>Behavior</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jaci has no intrinsic high</td>
<td>Jaci writes on research paper for 20 minutes</td>
<td>Jaci has an intrinsic high</td>
</tr>
</tbody>
</table>

Writing the entire research paper is not a reinforceable response-unit because it will take her many days to write a research paper. She will be taking all kinds of breaks of greater than 60 seconds. Even the best of students will have to take a break from the glaring computer screen for at least a few minutes. However, it might be possible to write on a research paper for 20 minutes without any breaks. Even though the behavior lasts longer than 60 seconds, it is still a reinforceable response-unit because there are no breaks greater than 60 seconds during the response. And yes, she does get an intrinsic high after she has done some quality writing.

Just to make sure you are getting this concept down, let's try out your behavior-analytic repertoire. Decide which of the following is a correct reinforceable response-unit.

Jaci is craving a healthy pizza with fresh vegetables made on a low-fat crust, so she sets out to make herself a pizza. She prepares the veggies and mixes the dough. While the dough is rising she takes a break and checks her e-mail. A few minutes later she is ready to finish making the pizza, so she puts on the veggies and low-fat cheese. Finally with the pizza made, she puts it in the preheated oven and immediately she can smell the delicious aroma of the pizza baking to perfection.

<table>
<thead>
<tr>
<th>Before</th>
<th>Behavior</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jaci smells no baking pizza aroma</td>
<td>?</td>
<td>Jaci smells baking pizza aroma</td>
</tr>
</tbody>
</table>

10. Jaci makes pizza from scratch
   A. correct reinforceable response-unit
   B. violates reinforceable response-unit test
11. Jaci puts pizza in oven  
   A. correct reinforceable response-unit  
   B. violates the reinforceable response-unit test

Right on! *Jaci puts pizza in oven*, is the correct reinforceable response-unit. *Jaci makes pizza*, violates the reinforceable response-unit test because there will be a break while the dough rises.

By the way, note that the pizza contingency still violates one of our criteria, the 60-second rule, because more than 60 seconds will probably elapse between the time Jaci puts the pizza in the oven and the time she sniffs that heavenly aroma of baking pizza.

The difference between the 60 second test and the reinforceable response unit test is where the >60 second break is - during the response (reinforceable response unit test), or between the response and the outcome (60 second test).

Also, note that it’s ok if the behavior itself lasts more than 60 seconds, as long as it doesn’t stop for more than 60 seconds at a time.

O.K. let’s try out your behavior-analytic repertoire one more time. Decide which of the following is a correct contingency or which contingency-diagramming test is violated. Be sure to circle an answer for each question.

Jaci is a high-paid administrator in a residential facility for the developmentally disabled population. It’s Monday and she goes to work for a full day, which includes a lunch break. She stays after work to conduct a one hour training workshop for which she will receive extra money on her paycheck. Friday comes and she picks up her pay check. She then treats herself to an evening of shopping for new clothes before going home to sip some warm Earl Gray tea.

| Before Behavior After |
|-----------------------|-------------------|------------------------|
| Jaci conducts a one hour training workshop Monday | Jaci will have extra money on Friday's check |

12. Is this a correct contingency or does it violate a test?  
   A. correct contingency  
   B. violates action test  
   C. violates 60 second test  
   D. violates reinforceable response-unit test

| Before Behavior After |
|-----------------------|-------------------|------------------------|
| Jaci has not worked one day | Jaci works Monday | Jaci has worked one day |
13. Is this a correct contingency or does it violate a test?
   A. correct contingency
   B. violates 60 second test
   C. violates reinforceable response-unit test
   D. violates receiver test

<table>
<thead>
<tr>
<th>Before</th>
<th>Behavior</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jaci does not taste Earl Grey tea</td>
<td>Jaci sips Earl Grey tea</td>
<td>Jaci tastes Earl Grey tea</td>
</tr>
</tbody>
</table>

14. Is this a correct contingency or does it violate a test?
   A. correct contingency
   B. violates reinforceable response-unit test
   C. violates 60 second test
   D. violates related-outcome test

<table>
<thead>
<tr>
<th>Before</th>
<th>Behavior</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jaci does not have new additions to wardrobe</td>
<td>Jaci shops for new clothes</td>
<td>Jaci has new additions to wardrobe</td>
</tr>
</tbody>
</table>

15. Is this a correct contingency or does it violate a test?
   A. correct contingency
   B. violates 60 second test
   C. violates reinforceable response-unit test
   D. violates action test

<table>
<thead>
<tr>
<th>Before</th>
<th>Behavior</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bob is losing at the roulette wheel</td>
<td>Bob changes his bet</td>
<td>Paul wins at the slot machines</td>
</tr>
</tbody>
</table>

Now, we can all see that Bobby’s betting did not cause Paul to win at the slot machines. Sometimes, however, the distinction is not so obvious, and the result is superstitious behavior - behavior that is accidentally reinforced by coincidental outcomes. For example,

<table>
<thead>
<tr>
<th>Before</th>
<th>Behavior</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bob is losing at the roulette wheel</td>
<td>Bob crosses his fingers</td>
<td>Bob wins the next spin</td>
</tr>
</tbody>
</table>
In this instance, it is likely that Bobby will cross his fingers more often in the future because winning has immediately followed it in the past, but we still don't have a behavioral contingency because Bobby's winning is not contingent on - it is not caused by - his finger crossing.

Correct:

<table>
<thead>
<tr>
<th>Before</th>
<th>Behavior</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bob has a low video game score</td>
<td>Bob aims carefully</td>
<td>Bob has a high video game score</td>
</tr>
</tbody>
</table>

There you go - causality. Bob's aiming carefully causes him to have a high video game score. Sure, there may be other factors that contributed to the high video game score but this response (and what it causes) is what we're interested in right now.

Let's try another problem:

Paul's softball teammates get annoyed when he's up to bat because he has an elaborate series of movements he goes through every time. Paul says this ritual brings him good luck, but it really doesn't.

<table>
<thead>
<tr>
<th>Before</th>
<th>Behavior</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paul has no home runs</td>
<td>Paul performs his ritual</td>
<td>Paul gets a home run</td>
</tr>
</tbody>
</table>

Well, those of you who chose the causality test are correct. It doesn't fail the action test because Paul is the one performing the ritual (no one is performing it on him or anything), and Paul's ritual behavior has increased (he performs the ritual every time he is up to bat). This is an example of accidental reinforcement.

Warning: Don't be a casualty of mispronouncing causality. It's easy to misread causality as casualty, but then the "casualty" criterion doesn't make a heck of a lot of sense.

16. Which criterion does this violate?

A. violates action test  
B. violates causality test  
C. violates receiver test  
D. None - this is a correct contingency.
Stimulus, Event, or Condition Test

This rule says the after condition cannot be a behavior of the behaver. The person (or animal) whose behavior we're analyzing is the behaver. So we're saying that the after condition cannot be any form of the behaver's behavior. However, the after condition can be behavior of someone (or thing) else; which makes it a stimulus, event, or condition, to the behaver. Sound confusing? Check out these diagrams, and if you're still unsure, bother your seminar instructor!

Incorrect:

<table>
<thead>
<tr>
<th>Before</th>
<th>Behavior</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bob is having trouble with his assignment</td>
<td>Bob asks for help</td>
<td>Bob does his assignment</td>
</tr>
</tbody>
</table>

Correct:

<table>
<thead>
<tr>
<th>Before</th>
<th>Behavior</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bob is having trouble with his assignment</td>
<td>Bob asks for help</td>
<td>Bob is not having trouble with his assignment</td>
</tr>
</tbody>
</table>

Here is an example of an after condition that is a behavior, but it passes the stimulus, event, condition test because it is not the behavior of the person we are analyzing (we want that to be in the behavior condition, not the after condition). Remember, other people's behavior can be a stimulus, event, or condition to the behaver.

Remember, Bobby receives, is not Bobby's behavior, so it's fine in the after condition.

Correct:

<table>
<thead>
<tr>
<th>Before</th>
<th>Behavior</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bobby doesn't receive help</td>
<td>Bobby asks for help</td>
<td>Bobby receives help</td>
</tr>
</tbody>
</table>

Here's another problem:

Remember the problem about Tommy and his mom at the donut shop? He didn't stop screeching until he had a donut in his hands. Analyze this contingency with respect to Tommy's behavior, and circle an answer for the following question.
Remember the problem with Jennifer’s roommate throwing clothes on the floor? Look at that description again. Now, analyze Jen’s behavior.

17. Is this contingency correct, or does it violate a criterion?
   A. violates dead-man test
   B. causality test
   C. violates stimulus, event or condition test
   D. correct contingency

This example violates the stimulus, event, condition test. Tommy is the behaver - it is his behavior we are analyzing - but the after condition is also a behavior of Tommy’s, and that’s not cool.

18. Sue apologizes
   A. violates related-outcomes test
   B. violates causality test
   C. violates stimulus, event or condition test
   D. correct after

19. Clothes not on floor
   A. violates related-outcomes test
   B. violates 60 second test
   C. violates causality test
   D. correct after

How did you do? I hope you didn’t forget everything you’ve been learning up until now. For Sue apologizes, you should’ve recognized the violation of the related-outcome test. Clothes not on floor, is the correct after.

Now go back and write in the time, now that you’ve finished.
Appendix F

Pretests and Posttests
Quiz on Chapter 1 Homework (V1)

The Contingency-Diagramming Checklist

Write in the correct multiple-choice. Choose the answer that best describes the box diagrams, not the descriptions above the diagrams. (There are questions on both sides of the page.) You should use the Pink Sheet to take the quiz.

1. Jaci has a painful headache. Beth sees Jaci holding her head and consoles her. Analyze Jaci’s behavior. (1)

   - Before
     - Jaci doesn’t hear kind words
   - Behavior
     - Jaci is feeling bad
   - After
     - Jaci hears kind words

   a. Correct contingency
   b. Fails the action test
   c. Fails the causality test
   d. Fails the 60” test

2. Jen runs the Campus Classic and comes in first place. The next day, her picture is in the school newspaper. Analyze Jen’s behavior. (1)

   - Before
     - No picture in the Herald
   - Behavior
     - Jen comes in first in the Campus Classic
   - After
     - Picture in the Herald

   a. Correct contingency
   b. Fails the related outcomes test
   c. Fails the dead-man test
   d. Fails the 60” test

3. Bobby the brat is pestering his Dad for an ice cream cone. If Bobby pesters his Dad he loses the opportunity for the cone. He will get the ice cream cone only if he is not pestering. Analyze Bobby’s behavior. (1)

   - Before
     - Bobby doesn’t have a cone
   - Behavior
     - Bobby doesn’t pester his Dad
   - After
     - Bobby has a cone

   a. Correct contingency
   b. Fails the receiver test
   c. Fails the dead-man test
   d. Fails the behaver test

4. Tim the TA asks the students in the seminar a question about reinforcement. All the students show green cards, and Tim smiles and says they’re all correct. Analyze the students’ behavior. (1)

   - Before
     - Student doesn’t see Tim smiling
   - Behavior
     - Tim asks for a show of cards
   - After
     - Student sees Tim smiling

   a. Correct contingency
   b. Fails the response-unit test
   c. Fails the dead-man test
   d. Fails the behaver test

5. Brian the architect takes three days to draw for a section of bleachers of Comerica Park. At the end, seeing the perfectly scaled drawing on the finished print gives him a sense of accomplishment, a powerful reinforcer. Analyze Brian’s behavior. (1)

   - Before
     - Brian doesn’t have the drawing and have a sense of accomplishment
   - Behavior
     - Brian draws the entire section of bleachers
   - After
     - Brian has the drawing and has a sense of accomplishment

   a. Correct contingency
   b. Fails the response-unit test
   c. Fails the action test
   d. Fails the stimulus test

6. Beth is working on her homework assignment when the phone rings. She stops
doing her homework and picks up the phone. Analyze Beth's behavior. (1)

Before
Phone doesn't ring

Behavior
Beth answers question 5 on the assignment

After
Phone rings

a. Correct contingency
b. Fails the related outcomes test
c. Fails the specific-behavior test
d. Fails the causality test

7. Jon has been procrastinating on registering for classes. He needs to take psychology 460, so he calls registration and enters the call number. Unfortunately, the section that he wanted is full. Analyze Jon's behavior. (1)

Before
Not signed up for Psy 460

Behavior
Calls registration and enters call number

After
The class is full

a. Correct contingency
b. Fails the related outcomes test
c. Fails the stimulus test
d. Fails the receiver test

8. Amy goes shopping for gifts to give her niece and nephew. She goes to the store and looks at lots of potential presents, thinking of their reaction to those clothes or toys. When she picks the right gifts, she immediately feels better. Analyze Amy's behavior. (1)

Before
Amy doesn't have thoughts of having the right gift

Behavior
Amy is considerate

After
Amy has thoughts of having the right gift

a. Correct contingency
b. Fails the behavior test
c. Fails the receiver test
d. Fails the specific-behavior test

9. Kip is training Rudolph the rat to pull the chain, using the light as a reinforcer.

When Rudolph pulls the chain, Kip turns on the light, which reinforces chain pulling. When the light is on the rat presses the lever. Analyze Rudolph's chain pulling behavior. (1)

Before
Rudolph doesn't press the lever

Behavior
Rudolph pulls the chain

After
Rudolph presses the lever

a. Correct contingency
b. Fails the dead-man test
c. Fails the stimulus test
d. Fails the response-unit test

10. When Bobby has a tantrum, Bobby immediately receives attention from the teacher. Analyze Bobby’s behavior. (1)

Before
Teacher hears no screaming

Behavior
Bobby screams and kicks

After
Teacher hears screaming

a. Correct contingency
b. Fails the action test
c. Fails the related outcomes test
d. Fails the receiver test

11. Dicky's glasses are uncomfortable on the bridge of his nose, so he rarely puts them on. Every time Sid sees Dicky put on his glasses he praises him. Analyze Dicky’s behavior. (2)

Before
No praise from Sid

Behavior
Dicky wears his glasses

After
Praise from Sid

a. Correct contingency
b. Fails the receiver test
c. Fails the dead-man test
d. Fails the behavior test

12. Susie is practicing asking nicely at the dinner table, with the help of her clever Mother. Only when Susie says, "may I have
some milk," does her Mother quickly give it to Susie. Analyze Susie’s behavior. (1)

13. Kip is working at the greenhouse when he gets a call from Tawnya. Kip answers the phone and immediately hears Tawnya’s voice. Analyze Kip’s behavior. (1)

14. Beth is walking to the beach where the sun is setting. The sight of the yellow sun and orange sky are very reinforcing for Beth to see. Analyze Beth’s behavior. (1)

15. Brian can’t get along with his roommates. He starts looking for a new place and eventually moves into a new apartment over a long weekend, leaving the difficult roommates behind. Analyze Brian’s behavior. (1)

16. Jim has missed several days of work this year, and his employer has a tough policy. The next time he calls in a message that he’s sick he’ll get a pink slip with Friday’s check, which will mean he’s lost his job. Analyze Jim’s behavior. (1)

17. Dawn tries to reduce Sid’s eye scratching by using a punishment procedure. Each time Sid scratches his eye Dawn startles Sid, which is a reinforcer for Dawn. Analyze Sid’s eye scratching. (1)

18. When Bobby screams and kicks, he always immediately receives attention from the teacher. As a result, Bobby continues to scream and kick. Analyze Bobby’s behavior. (1)
Before & Behavior & After
No attention from the teacher & Bobby is out of line & Attention from the teacher

a. Correct contingency
b. Fails the behavior test
c. Fails the receiver test
d. Fails the specific-behavior test

19. When Kip sees Yukiko’s rat pressing the lever as she’s training the rat using water as a reinforcer, Kip says "looking good" to Yukiko. Analyze Rudolph the rat’s behavior.

Before & Behavior & After
Kip is not pleased & Rudolph presses the lever & Kip is pleased

a. Correct contingency
b. Fails the action test
c. Fails the related outcomes test
d. Fails the receiver test

20. Mark watches comedies from the video store every Sunday. He continually searches the comedy section, looking at all the covers thoroughly until he sees what looks like a good movie. Analyze Mark’s behavior.

Before & Behavior & After
Mark wants a good comedy & Mark searches for 15 straight minutes & Mark sees a funny cover

a. Correct contingency
b. Fails the related outcomes test
c. Fails the 60” test
d. Fails the action test
Quiz on Chapter 1 Homework (V2)

THE CONTINGENCY-DIAGRAMMING CHECKLIST

Write in the correct multiple-choice. Choose the answer that best describes the box diagrams, not the descriptions above the diagrams. (There are questions on both sides of the page.) You should use the Pink Sheet to take the quiz.

1. ____ Josh wants to go out with his friends tonight, but he doesn’t have any money. Luckily, his birthday is next week and he finds $20 from his grandparents in the mail. Analyze Josh’s behavior. (1)

   Before: Josh has no money
   Behavior: Josh receives $20 in the mail
   After: Josh has money

   a. Correct contingency
   b. Fails the action test
   c. Fails the causality test
   d. Fails the 60" test

2. ____ Beth is at a party with friends when she asks some of them to look for a picture. She pushes the red-eye reduction button, and a few days later, she gets the pictures back from the drug store and sees her friends have no red eyes. Analyze Beth’s behavior. (1)

   Before: Will see red eyes in a few days
   Behavior: Beth pushes the red eye reduction button
   After: Will not see red eyes in a few days

   a. Correct contingency
   b. Fails the related outcomes test
   c. Fails the dead-man test
   d. Fails the stimulus test

3. ____ Marcy’s friends wish she would stop smoking cigarettes. So, whenever they are around her and she doesn’t smoke, they praise her. Analyze Marcy’s behavior. (1)

   Before: No attention from friends
   Behavior: Marcy doesn’t smoke
   After: Attention from friends

   a. Correct contingency
   b. Fails the receiver test
   c. Fails the dead-man test
   d. Fails the behaver test

4. ____ Mae and Juke are at a concert and Juke is singing out loud, but he doesn’t know the words. This annoys Mae, so she elbows him in the ribs and he stops. Analyze Juke’s behavior. (1)

   Before: Juke is enjoying himself
   Behavior: Mae elbows Juke
   After: Juke is not enjoying himself

   a. Correct contingency
   b. Fails the response-unit test
   c. Fails the dead-man test
   d. Fails the behaver test

5. ____ Megan needs a new dress for an upcoming party. She decides to sew one herself. It takes her three weeks to make, but the satisfation of having made it herself was well worth the effort. Analyze Megan’s behavior. (1)

   Before: No new dress or feeling of satisfaction
   Behavior: Megan sews a dress from scratch
   After: New dress and feeling of satisfaction

   a. Correct contingency
   b. Fails the response-unit test
   c. Fails the action test
   d. Fails the stimulus test
6. Bob and his mom are having an argument when Bob calls his mom a dirty name. Immediately afterward, the sky darkens and it starts thundering and lightening. Analyze Bob's behavior. (1)

a. Correct contingency
b. Fails the related outcomes test
c. Fails the specific-behavior test
d. Fails the causality test

7. Becky sees dirty dishes in the sink, and decides to be nice and wash them. Immediately after she finishes, her roommate comes in and thanks her for cleaning. Analyze Becky's behavior. (1)

a. Correct contingency
b. Fails the related outcomes test
c. Fails the 60" test
d. Fails the action test

8. When Casey picks up his book when his teacher asks, she praises him. As a result, Casey follows her directions more often. Analyze Casey's behavior. (1)

a. Correct contingency
b. Fails the behavior test
c. Fails the receiver test
d. Fails the specific-behavior test

9. Jeff is having dessert with his family when he suddenly grabs his sister's ice cream sundae and starts to eat it. His Dad immediately takes both desserts away from him and sends him to his room. Analyze Jeff's behavior. (1)

a. Correct contingency
b. Fails the dead-man test
c. Fails the stimulus test
d. Fails the response-unit test

10. Jessica is training her dog Barney to sit. When she says, "sit," the sight of Barney sitting is a reinforcer. Analyze Barney's behavior. (1)

a. Correct contingency
b. Fails the action test
c. Fails the related outcomes test
d. Fails the receiver test

11. Sean is starting rat lab for the day. When he goes to get his rat out of its home cage, his rat is biting the other rat in the cage. Analyze the rat's behavior. (1)

a. Correct contingency
b. Fails the causality test
c. Fails the specific behavior test
d. Fails the action test
12. Sam needs to find a topic for his thesis. So, over the course of a few weeks, he researches behavior analysis at the library and talks to various professors. After much thought, reading, and discussion, he finally decides upon a topic. Analyze Sam's behavior. (1)

<table>
<thead>
<tr>
<th>Before</th>
<th>Behavior</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>No thesis topic</td>
<td>Sam does research and talks to professors</td>
<td>Thesis topic</td>
</tr>
</tbody>
</table>

a. Correct contingency  
b. Fails the stimulus test  
c. Fails the behavior test  
d. Fails the response-unit test

13. Heather takes her Lean Cuisine out of the freezer and puts it in the microwave. She pushes in three minutes on the timer and sees her lunch begin to cook. Analyze Heather's behavior. (1)

<table>
<thead>
<tr>
<th>Before</th>
<th>Behavior</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>No numbers pushed into the timer</td>
<td>Heather pushes in three minutes</td>
<td>Sight of lunch cooking</td>
</tr>
</tbody>
</table>

a. Correct contingency  
b. Fails the related outcomes test  
c. Fails the 60" test  
d. Fails the action test

14. Kelly's hair is getting too long, so she goes to the salon and asks for a cut. Afterward, she feels more self-confident. Analyze Kelly's behavior. (1)

<table>
<thead>
<tr>
<th>Before</th>
<th>Behavior</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hair is too long, Kelly does not feel self-confident</td>
<td>Kelly is fashionable</td>
<td>Hair is just right, Kelly feels self-confident</td>
</tr>
</tbody>
</table>

a. Correct contingency  
b. Fails the specific behavior test  
c. Fails the related outcomes test  
d. Fails the behavior test

15. Kyle is at the Secretary of State office during his lunch hour. It's busy, so he takes a number and five minutes later, they call him to the front. Analyze Kyle's behavior. (1)

<table>
<thead>
<tr>
<th>Before</th>
<th>Behavior</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not able to talk to attendant</td>
<td>Take a number</td>
<td>Able to talk to attendant in a few minutes</td>
</tr>
</tbody>
</table>

a. Correct contingency  
b. Fails the action test  
c. Fails the 60" test  
d. Fails the causality test

16. Alicia is speeding down Stadium Drive, when suddenly a cop car pulls out behind her with its lights flashing. She pulls over to the side of the road, her heart beating quickly because she's so nervous. Analyze Alicia's behavior.

<table>
<thead>
<tr>
<th>Before</th>
<th>Behavior</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alicia is not nervous</td>
<td>Alicia sees the police</td>
<td>Alicia is nervous</td>
</tr>
</tbody>
</table>

a. Correct contingency  
b. Fails the action test  
c. Fails the 60" test  
d. Fails the causality test

17. Jodi's boyfriend likes it when she wears the necklace he gave her for Christmas. Whenever he sees her wearing it, he immediately compliments her. Analyze Jodi's behavior. (1)

<table>
<thead>
<tr>
<th>Before</th>
<th>Behavior</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jodi has no compliment from boyfriend</td>
<td>Jodi wears necklace</td>
<td>Jodi has compliment from boyfriend</td>
</tr>
</tbody>
</table>

a. Correct contingency  
b. Fails the deadman test  
c. Fails the behavior test  
d. Fails the stimulus test
18. **Erik's Mom asked him to clean his room after dinner.** The sight of Erik cleaning his room is pleasing to her. Analyze Mom's behavior. (1) Erik's Mom asked him to clean his room. He immediately started cleaning, which was very pleasing to her.

- **Before:** Mom does not see Erik cleaning his room
- **Behavior:** Erik cleans his room
- **After:** Mom sees Erik cleaning his room

a. Correct contingency  
b. Fails the behaver test  
c. Fails the 60" test  
d. Fails the stimulus test

19. **Cindy is dancing at the Wayside when she suddenly steps into a puddle on the dance floor and falls.** Analyze Cindy's behavior. (1)

- **Before:** Cindy is dancing  
- **Behavior:** Cindy steps into puddle and falls  
- **After:** Cindy is not dancing

a. Correct contingency  
b. Fails the action test  
c. Fails the related outcomes test  
d. Fails the stimulus test

20. **Miss Clark is reading a Roald Dahl book to her 3rd grade class, which her students find very enjoyable.** Analyze Miss Clark's behavior. (1)

- **Before:** Students do not hear about Charlie and the chocolate factory  
- **Behavior:** Miss Clark reads to the students  
- **After:** Students hear about Charlie and the chocolate factory

a. Correct contingency  
b. Fails the receiver test  
c. Fails the 60" test  
d. Fails the related outcomes test
Quiz on Chapter 8 Homework (V1)

SHAPING

Write in the correct multiple-choice.

1. Dawn taught Jimmy to use the microwave, which involved first reinforcing his opening the door, then putting in the food, closing the door, and finally pushing in the time and start buttons. What is this example? (1)
   a. Shaping
   b. Chaining

2. When shaping the behavior of walking for a child who has yet to walk at all, what would the terminal behavior? (1)
   a. Standing
   b. Taking one step
   c. Walking
   d. Running

3. When shaping the behavior of walking for a child who has yet to walk at all, what might be an intermediate behavior? (1)
   a. Taking one step
   b. Running
   c. Walking
   d. Standing

4. If you’re shaping the behavior of throwing a ball farther, then on what response dimension are you shaping (assuming you throw the ball with perfect form)? (1)
   a. Intensity or Force
   b. Topography
   c. Rate
   d. Latency
   e. Duration

5. If you’re shaping Rudolf’s behavior of holding the lever down for longer and longer periods of time, then you’d be shaping on what response dimension? (1)
   a. Intensity or Force
   b. Topography
   c. Rate
   d. Latency
   e. Duration

6. You’re goal is to shape Mick’s key pecking behavior (typing) along the rate dimension (words typed per minute—WPM) using praise as a reinforcer. You’ve been giving praise only for 30 WPM and better. Now you’ve got him typing 30 WPM almost every minute, and many times he’s typing 35 WPM. Fill in the diagram for a good next step in the shaping procedure. Be sure it passes all 10 tests on the Pink Sheet. (4)

Reinforcement

No Reinforcement

7. In the Skinner box, Rudolf is pressing the lever with 3 grams of force. The trainer knows that Rudolf is physically capable of much more with the muscles he has today. In other words, Rudolf has the muscle strength but is not currently pushing the lever harder than 3 grams. If the trainer shaped lever presses up to 10 grams of force, then what do we have? (1)
   a. Shaping
   b. Shaping up (building muscle)
Score_________ / 10 TA_________ Date_________
First Name_________________________ Last Name_________________________
Pretest/5OAPS □ Posttest □

Quiz on Chapter 8 Homework (V2)

**SHAPING**

Write in the correct multiple-choice.

1. Dawn taught Jimmy to purchase a snack, which involved first reinforcing his selecting the snack, then putting it on the cashier’s counter, and finally handing the cashier the correct change. What is this example? (1)
   a. Shaping
   b. Chaining

2. When shaping the behavior of throwing for a child who has yet to throw at all, what would be a good initial behavior to begin with? (1)
   a. Releasing the ball
   b. Walking with the ball
   c. Throwing the ball
   d. Holding the ball

3. When shaping the behavior of throwing for a child who has yet to throw at all, what might be an intermediate? (1)
   a. Holding the ball
   b. Walking with the ball
   c. Raising the ball
   d. Throwing the ball

4. If you’re shaping the behavior of talking louder, then on what response dimension are you shaping? (1)
   a. Intensity or Force
   b. Topography
   c. Rate
   d. Latency
   e. Duration

5. If you’re shaping Rudolf’s behavior of pressing the lever down sooner after the light turns on, then you’d be shaping on what response dimension? (1)
   a. Intensity or Force
   b. Topography
   c. Rate
   d. Latency
   e. Duration

6. You’re goal is to shape Mick’s key pecking behavior (typing) along the topography dimension (words correctly) using praise as a reinforcer. You’ve been giving praise only for 4 or more complete sentences without errors. Now you’ve got him typing 4 complete errorless sentences in almost every attempt. Fill in the diagram for a good next step in the shaping procedure. Be sure it passes all 10 tests on the Pink Sheet. (4)

7. At the warehouse, Ralph the rookie is picking up boxes weighing 40 lbs but he can’t pick up anything heavier. The manager knows that Ralph’s form is perfect, but Ralph just can’t do better than 40 lbs the first day. After the manager differentially reinforced box lifting up to 70 lbs over a few months, Ralph was able to lift them. What do we have here? (1)
   a. Shaping
   b. Shaping up (building muscle)
Quiz on Chapter 13 Worksheet/Advanced Enrichment Section (V1)

1. _____Which diagram shows reflexivity? (1)

2. _____ & _____Which set of matching diagrams show symmetrical stimulus control? Two relations are necessary to show symmetrical stimulus control) (2)

3. _____If Al could already perform C, and Dawn trained B, then which relation emerges as transitive stimulus control (make sure your answer is not just a symmetrical relation to C or B)? (1)

4. Circle. (Yes or No): For Q #3, was covert behavior necessary for transitive stimulus control to emerge? (1)

5. _____Which matching diagram is symmetrical to the A diagram? (1)

6. _____If Al could already perform F, and Dawn trained A, then which relation emerges as transitive stimulus control (make sure your answer is not just a symmetrical relation to F or A)? (1)

7. _____Which matching diagram shows identity matching? (1)
8. Give an original example of a group of stimuli that could be an equivalence class (i.e., a group of arbitrary stimuli, like the vocal word “dog,” the written word, DOG, and the actual dog).(3):

Stimulus 1: _______________________
Stimulus 2: _______________________
Stimulus 3: _______________________

Read your diagrams from left to right (e.g. example A is Dawn saying “Dog” then Mark pointing to the written word dog—Spoken word : “dog” ⇒ Written word : DOG—)

9. Using the stimuli in your answer to #8, provide examples of diagrams of the following relations (matching diagrams):

Reflexivity (1): ______________ ⇒ ______________:
Symmetry (2): ______________ ⇒ ______________:
________________ ⇒ ______________:
________________ ⇒ ______________:

10. Using your example’s stimuli again, provide this example of how you could train for emergent transitive stimulus control—transitivity.

a. Previously learned (1):
Written word: ________ ⇒ Says: “__________”

b. Then you train (1):
Point to: ________ ⇒ Says: “__________”

c. Then this is the emergent transitive stimulus control (untrained, novel stimulus control) (1):
________________ ⇒ ______________:

11. Covert behavior theorized in your emergent transitive relation (1):
Covertly saying: ”__________”
Quiz on Chapter 13 Workshow/Advanced Enrichment Section (V2)

Stimulus Equivalence

Write in the correct multiple-choice. Read the matching diagrams/stimulus-response relations from left to right (e.g. example A is Dawn saying "Dog" then Mark pointing to the written word dog.)

1. Which diagram shows reflexivity? (1)

2. & Which set of matching diagrams show symmetrical stimulus control? Two relations are necessary to show symmetrical stimulus control? (2)

3. Which relation is symmetrical to A? (1)

4. If Al could already perform A, and Dawn trained B, then which relation emerges as transitive stimulus control (make sure your answer is not just symmetrical relation to A or B)? (1)

5. Circle. (Yes or No): For Q #4, was covert behavior necessary for transitive stimulus control to emerge? (1)

6. If Al could already perform D, and Dawn trained C, then which relation emerges as transitive stimulus control (make sure your answer is not just a symmetrical relation to D or C)? (1)

7. What is the emergent symmetrical relation to the answer for Q #6? (1)

8. Which matching diagram shows identity matching? (1)
9. Give an original example of a group of stimuli that could be an equivalence class (i.e., a group of arbitrary stimuli, like the vocal word “dog,” the written word, DOG, and the actual dog). (3):

Stimulus 1: ___________________________
Stimulus 2: ___________________________
Stimulus 3: ___________________________

Read your diagrams from left to right (e.g. example A is Dawn saying “Dog” then Mark pointing to the written word dog: __________)

10. Using the stimuli in your answer to #9, provide examples of diagrams of the following relations (matching diagrams):

   Reflexivity (1): ___________________    _______________
   Symmetry (2): ___________________    _______________
   ___________________    _______________

11. Using your example’s stimuli again, provide this example of how you could train for emergent transitive stimulus control—transitivity.

   a. Previously learned (1):
      Written word: ___________________    Says: “__________________”

   b. Then you train (1):
      Point to: ___________________    Says: “__________________”

   c. Then this is the emergent transitive stimulus control (untrained, novel stimulus control) (1):
      ___________________: ___________________    ___________________:

12. Covert behavior theorized during your emergent transitive relation (1):

   Covertly saying: “__________________”
Quiz on Chapter 13 Workshop/Intermediate Enrichment Section (V1)

THE GENERALIZATION GRADIENT

Write in the correct multiple-choice and drawing of a graph. Read the titles and descriptions of the graphs carefully. QUESTIONS ON BOTH SIDES.

1. Draw a bar graph with the following results (2):
   - 0 blue key pecks,
   - 0 green key pecks
   - 300 yellow-green key pecks, and
   - 0 orange key pecks
   - 0 red key pecks.

2. What does the graph above show? (1)
   a. Much discrimination
   b. Much generalization
   c. Complete discrimination
   d. Complete generalization

3. During testing (not training), what procedure is used in a stimulus generalization experiment? (1)
   a. Intermittent reinforcement
   b. Continuous reinforcement
   c. Punishment
   d. Extinction

4. Draw a bar graph with the following results (2):
   - 200 blue key pecks,
   - 250 green key pecks
   - 300 yellow-green key pecks, and
   - 250 orange key pecks
   - 200 red key pecks.

5. What does the graph above show? (1)
   a. Much discrimination
   b. Much generalization
   c. Complete discrimination
   d. Complete generalization

6. Draw a bar graph with the following results (2):
   - Much, but not complete discrimination

A pigeon’s key pecks were reinforced in the presence of a yellow-green light and then tested in the presence of yellow-green and other colors.

A pigeon’s key pecks were reinforced in the presence of a yellow-green light and then tested in the presence of yellow-green and other colors.
7. During training (not testing), what procedure is used in a stimulus generalization experiment? (1)
   a. Extinction
   b. Continuous reinforcement
   c. Intermittent reinforcement
   d. Punishment

8. Which procedure makes responding less resistant to extinction? (1)
   a. Continuous reinforcement
   b. Noncontingent delivery of reinforcers
   c. Intermittent reinforcement

9. Which procedure makes responding more resistant to extinction? (1)
   a. Continuous reinforcement
   b. Noncontingent delivery of reinforcers
   c. Intermittent reinforcement

10. If there is a little discrimination shown on a generalization gradient, then the rate of responding _____ as the stimuli are physically different from the training stimulus (1)
    a. Increases rapidly
    b. Decreases rapidly
    c. Increases gradually
    d. Decreases gradually
    e. Stays the same

11. If there is no generalization shown on a generalization gradient, then the rate of responding _____ as the stimuli are physically different from the training stimulus (1)
    a. Increases rapidly
    b. Decreases entirely
    c. Increases gradually
    d. Decreases gradually
    e. Stays the same
Quiz on Chapter 13 Workshop/Intermediate Enrichment Section (V2)

THE GENERALIZATION GRADIENT

Write in the correct multiple-choice and drawing of a graph. Read the titles and descriptions of the graphs carefully. QUESTIONS ON BOTH SIDES.

1. Draw a bar graph with the following results (2):
   - 75 blue key pecks,
   - 125 green key pecks
   - 300 yellow-green key pecks, and
   - 75 red key pecks.

2. What does the graph above show? (1)
   a. Much discrimination
   b. Much generalization
   c. Complete discrimination
   d. Complete generalization

3. During testing (not training), what procedure is used in a stimulus generalization experiment? (1)
   a. Intermittent reinforcement
   b. Continuous reinforcement
   c. Punishment
   d. Extinction

4. Draw a bar graph with the following results (2):
   - 300 blue key pecks
   - 300 green key pecks
   - 300 yellow-green key pecks, and
   - 300 orange key pecks

5. What does the graph above show? (1)
   a. Much discrimination
   b. Much generalization
   c. Complete discrimination
   d. Complete generalization

6. Draw a bar graph with the following results (2):
   - Little discrimination
7. During training (not testing), what procedure is used in a stimulus generalization experiment? (1)
   a. Extinction
   b. Continuous reinforcement
   c. Intermittent reinforcement
   d. Punishment

8. Which procedure makes responding less resistant to extinction? (1)
   a. Continuous reinforcement
   b. Noncontingent delivery of reinforcers
   c. Intermittent reinforcement

9. Which procedure makes responding more resistant to extinction? (1)
   a. Continuous reinforcement
   b. Noncontingent delivery of reinforcers
   c. Intermittent reinforcement

10. If there is much, but not complete discrimination shown on a generalization gradient, then the rate of responding _____ as the stimuli are physically different from the training stimulus (1)
    a. Increases rapidly
    b. Decreases rapidly
    c. Increases gradually
    d. Decreases gradually
    e. Stays the same

11. If there is complete generalization shown on a generalization gradient, then the rate of responding _____ as the stimuli are physically different from the training stimulus (1)
    a. Increases rapidly
    b. Decreases rapidly
    c. Increases gradually
    d. Decreases gradually
    e. Stays the same
Quiz on Chapter 17 (V1)
Discrete Trial vs. Free Operant

Write in the correct multiple-choice. The behavior of interest is specified before the description.

1. "There." Objects on table, Mom says, "Bob, where is your glass?" When Bob says, "there" she fills it up with milk and gives it back. (1)
   a. Free operant
   b. Discrete trial
   c. Hybrid discrete trial/free operant

2. Drawing. Bob looks at part of a cartoon briefly and then draws that part on his paper, making sure his drawing matches the cartoon—the match is a reinforcer. After repeatedly working it is really coming together when his Mom says, "your picture looks really good." (1)
   a. Free operant
   b. Discrete trial
   c. Hybrid discrete trial/free operant

3. Signing "me." Dawn shows the sign for "Me." Fred also signs "Me," and Dawn gives Fred a piece of cookie. (1)
   a. Free operant
   b. Discrete trial
   c. Hybrid discrete trial/free operant

4. Eating. Jimmy is eating an apple, and for each bite he gets the sweet taste of apple. (1)
   a. Free operant
   b. Discrete trial
   c. Hybrid discrete trial/free operant

5. Giving the blue block. Three blocks are presented to Jimmy, and Sue asks Jimmy to give her the blue block. Jimmy gives her the red block and Sue says, "No, give me the blue block." (1)
   a. Free operant
   b. Discrete trial
   c. Hybrid discrete trial/free operant

6. Piling blocks. Jimmy is picking up blocks and putting them in a pile in no particular order, when Sue walks by and says, "Good boy, Jimmy." (1)
   a. Free operant
   b. Discrete trial
   c. Hybrid discrete trial/free operant

7. Putting the puzzle together. Sue asks Jimmy to put a puzzle together for a treat. He puts each piece together based on the puzzle's shape and the piece's shape, and Sue gives him the treat after he's put together the whole puzzle. (1)
   a. Free operant
   b. Discrete trial
   c. Hybrid discrete trial/free operant

8. "Yellow." Sue asks what color the pencil is (yellow) and Jimmy says, "blue." So Sue says, "no" and asks again. (1)
   a. Free operant
   b. Discrete trial
   c. Hybrid discrete trial/free operant

9. Putting toys away. Dawn asks Jimmy to put the toys in the toy box, so he does, one by one, which takes about 15 minutes because he takes a few breaks to play with them. Whenever he's finishes Dawn gives him his favorite dinner. (1) (Hint: the toys and the box are operands like the lever, not S^o_s.)
   a. Free operant
   b. Discrete trial
   c. Hybrid discrete trial/free operant

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Quiz on Chapter 17 (V2)
Discrete Trial vs. Free Operant

Write in the correct multiple-choice. The behavior of interest is specified before the description.

1. ______ Cutting out newspaper articles. 
   Sid’s scrapbook has a several 4x4 inch spaces free. He cuts several articles to fit those spaces. After each one is done he has one more to add to his scrapbook. (1)
   a. Free operant
   b. Discrete trial
   c. Hybrid discrete trial/free operant

2. ______ Throwing. Sam is throwing a paper airplane repeatedly, and he gets to see the cool sight of each flight. His Mom walks by and says, “That’s neat, Sam.” (1)
   a. Free operant
   b. Discrete trial
   c. Hybrid discrete trial/free operant

3. ______ Signing “two.” Dawn shows the sign for “two.” Fred also signs “two,” and Dawn gives Fred a piece of candy. (1)
   a. Free operant
   b. Discrete trial
   c. Hybrid discrete trial/free operant

4. ______ Watching/looking. Adam is watching TV, and for each looking response he gets the continuous stimulation of television programming. (1)
   a. Free operant
   b. Discrete trial
   c. Hybrid discrete trial/free operant

5. ______ Giving the truck. Adam’s classmate asks Adam to hand him the truck from the toy box. Adam gives him the car and the classmate says, “No, that’s a car.” (1)
   a. Free operant
   b. Discrete trial
   c. Hybrid discrete trial/free operant

6. ______ “On top.” Objects on top of the table, Mom says, “Bob, where is your glass?” When Bob says, “on top” she fills it up with milk and gives it back. (1)
   a. Free operant
   b. Discrete trial
   c. Hybrid discrete trial/free operant

7. ______ “Dog.” Jimmy sees a cat run by for just one moment, outside the window and he says, “Dog.” So Sue says, “No” and the cat is gone. (1)
   a. Free operant
   b. Discrete trial
   c. Hybrid discrete trial/free operant

8. ______ Getting groceries. Phil looks at his grocery list for the next item and then at the store aisle, finding and taking each item, one after the other. After repeatedly getting groceries on his list, he is all done and with the cart full (reinforcer) he stops. (1)
   a. Free operant
   b. Discrete trial
   c. Hybrid discrete trial/free operant

9. ______ Raking leaves. Dawn asks Jimmy to rake the leaves in the yard, which takes him about an hour to complete because he needs a break or two. When he’s finished Dawn says, “thanks,” and gives him his favorite cookie. (1) (Hint: the leaves are operands like the lever, not S's.)
   a. Free operant
   b. Discrete trial
   c. Hybrid discrete trial/free operant
Appendix G

Analysis of the Sick Social Cycle Results
In the escape model (Figure 6), there were sizable differences between the students’ performance diagramming the perpetrator’s and victim’s contingencies. The students had higher averages on the perpetrator’s contingencies before and after the workshop (post-textbook $M = 91\%$, post-workshop $M = 88\%$) than they did on the victim’s contingencies before and after the workshop (post-textbook $M = 74\%$, post-workshop $M = 71\%$). One possible explanation might be that the students diagrammed the perpetrator’s contingency first because it is at the top of the model; and correctly followed the checklist criteria in the first contingency. Then without using the checklist criteria, they could have completed the victim’s contingency with the perpetrator’s contingency above by copying the conditions from the perpetrator’s contingencies, without changing the language into active voice and to clearly specify the behavior of the victim.
Appendix H

Checklists and Job Aids for Programmers
The Instructional Frame Checklist

**Guided observation:** Is your first model example simply talking about crucial elements while stating the rule or definition of the concept?

**Novel Items:** Are all of the dimensions of a novel item illustrated carefully?

**Model Example:** Is your example familiar to the audience and will it clearly exemplify all criteria for the current concept or principle?

**Rule:** Is there a written rule in the same sequence to accompany your example?

**Logical order:** Are your frames presented in a logical order? Make sure that the instruction and prompts come before the question items.

**Guided practice:** Is your program designed for active responding? Remember, preachin’ ain’t teachin’.

**Forcing discriminations:** Do you present a range of examples that exemplify the crucial elements of the concept/example and do you force the student to discriminate whether the element is present? (E.g., by using a binary – yes/no type question)

**Knowledge of results:** Have you provided the knowledge of the correct response within every frame that has a question item? Have you given descriptive feedback about why their answer is correct or incorrect?

**Blocking:** Is there sufficient information in part your frame that allows the student to answer correctly, while the student need not consider crucial information you want to train? If yes, then trim the instructional frame down to the crucial information only.

**Copy frame:** Is the form of the answer within the instructional frame, so all the student needs to do is copy the answer? If so remove the answer in the instructional frame.

**Over-prompting:** Is it a review or terminal frame? If yes, then don’t provide any prompts. Are you giving away the answer?

**Strength of prompts:** Is there a high probability of your prompts controlling the desired behavior? If not, consider revising. (Is enough information given to answer the question items?)

Prerequisite frames or training present?
**The rate of progression:** The progress of the sequence towards the terminal frame should be in large enough steps so that the program is not too repetitive or boring. Make each frame as large a step as possible. Let evaluation tell you whether the step is too large (i.e. Too many students making errors at a particular question item).

**Necessity:** Are all the frames in the sequence necessary for the student to produce the desired response? If not, let testing show you which ones are unnecessary, and exclude all unnecessary frames. Similarly, are there frames that are necessary that are omitted? During testing, if students are consistently missing a question item, then not enough information was given.

**Demonstration of mastery:** Is a terminal frame of a sequence placed far enough from the training sequence? If no, then move it back.

**Pride:** Were you too proud to revise or discard an item that the students found to be unclear?

**Production response:** If the student cannot respond correctly to a fill-in test item similar to a model example in multiple-choice training then there may be a response forming problem instead of or in addition to a discrimination difficulty. (Markle 1964, p.167)

Acknowledgement: This checklist was developed by Alex Lamb as part of his undergraduate honors thesis.
The One-to-one Testing Checklist

❖ **Ultimate Goal:** To gain feedback on what works and what doesn’t on your program.

❖ **Sub Goal:** Shape student’s behavior of overt responding.

<table>
<thead>
<tr>
<th>Check</th>
<th>Before: Check and double check!</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Is your program a completed draft that is ready for testing?</td>
</tr>
<tr>
<td></td>
<td>Have you timed how long an average student will take to complete your program? (You might need to plan breaks, and inform the student the approximate length of the session)</td>
</tr>
<tr>
<td></td>
<td>Have you arranged a time and place for evaluation?</td>
</tr>
<tr>
<td></td>
<td>Did you double check to see whether the program runs smoothly?</td>
</tr>
<tr>
<td></td>
<td>Have you asked for the student’s consent for an audio recording?</td>
</tr>
<tr>
<td></td>
<td>Do you have some means of taking notes during the testing session?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Check</th>
<th><strong>Student arrives: Smile!</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Have you made the environment comfortable for all parties involved? (The key is to get the student relaxed and ready to talk!)</td>
</tr>
<tr>
<td></td>
<td>Have you briefly discussed the subject matter of your program? (At least the title of your program should be communicated)</td>
</tr>
<tr>
<td></td>
<td>Have you communicated with the student the purpose of testing? (That this is an evaluation process; the idea is for them to tell us what’s good and what’s bad about the program. They should either think aloud or answer your questions, but otherwise try to do well on the program)</td>
</tr>
<tr>
<td></td>
<td>Did you tell the student to never guess an answer? Tell the student that it is better to ask, and not make a guess.</td>
</tr>
<tr>
<td></td>
<td>Try to remember that everything that comes out of the student’s mouth is noteworthy. Each student will find different parts of your program either interesting or difficult to understand. It is important to address all of the students’ needs.</td>
</tr>
<tr>
<td>Check</td>
<td><strong>Testing begins</strong>: Please leave your pride at home!</td>
</tr>
<tr>
<td>-------</td>
<td>---------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>Golden Rule #1: No Tutoring! That is the job of the program right now, not yours! If there is something that a student cannot understand, it's the best indicator that a change needs to be made.</td>
</tr>
<tr>
<td></td>
<td>Golden Rule #2: Keep the student talking if you are doing a <strong>think aloud</strong> approach. Don’t be afraid to probe the student. You can only obtain feedback through overt responses. As an alternative to having them think aloud, you can choose to only prompt discussion on particular frames you suspect need work, or only after errors.</td>
</tr>
<tr>
<td></td>
<td>Look for nonverbal cues. Facial expressions, hesitations, silence, or errors might lead to these questions:</td>
</tr>
<tr>
<td></td>
<td>- What did you notice in this example, question, diagram, etc?</td>
</tr>
<tr>
<td></td>
<td>- What did you like/dislike about this example, question, diagram, etc?</td>
</tr>
<tr>
<td></td>
<td>- Tell me why you chose B (the wrong answer) instead of A (the desired response). Note: Only use this line after the student has obtained the correct response on her/his own. Never accept &quot;Oh, I was just careless&quot; as a reason for a mistake; ask what would have made it clearer, the students' answer might be just what the frame needs.</td>
</tr>
<tr>
<td></td>
<td>- Ask the student which parts of the example, description, or question led the student to believe that was the right answer.</td>
</tr>
<tr>
<td></td>
<td>Are you taking notes and thinking about possible revisions?</td>
</tr>
<tr>
<td></td>
<td>Be sure to verbally reinforce the student's feedback behaviors that are useful to you.</td>
</tr>
<tr>
<td>Check</td>
<td>After: Don’t just think about it, do it!</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Have you read your notes and started revising problem frames? It’s</td>
<td>It’s demanding, but make all revisions before your next testing, and see if those problems we solved.</td>
</tr>
<tr>
<td>If there was an additional observer/note taker, have you arranged a</td>
<td>time to meet with her/him to compare notes?</td>
</tr>
<tr>
<td>Did you forget a particular comment that you or the student made?</td>
<td>Listen to the recording.</td>
</tr>
<tr>
<td>Have you revised the draft so that you have considered every student’s</td>
<td>concerns and problems without sacrificing the goal of the program?</td>
</tr>
<tr>
<td>Has your entire sequence worked relatively flawlessly?</td>
<td></td>
</tr>
<tr>
<td>- If not, time for revising and rewriting and on with more testing!</td>
<td></td>
</tr>
<tr>
<td>- If yes, then it may be time for the next phase of testing! (Either</td>
<td>small group or large group)</td>
</tr>
<tr>
<td>Perhaps you can evaluate the student’s performance as a “critic,” so</td>
<td>you can inform your fellow programmers what they have to look out for when working with this particular</td>
</tr>
<tr>
<td>Acknowledgement: This checklist was developed by Alex Lamb as part of</td>
<td>student. A critic can be very helpful for usability testing, they will offer lots of good feedback;</td>
</tr>
<tr>
<td>the undergraduate honors thesis, Fall 2001.</td>
<td>but they might not help with the instructional aspects if they are not behaving as a student would.</td>
</tr>
</tbody>
</table>
Animation Effects

A *Left-click your answer* prompt with the mouse icon should be on all question slides.

Whenever you’re presenting an example and a non-example, you need to clearly show the crucial component that the non-example fails. Animate with red pen “cross out editing” to point out the specific component that makes it a non-example.

Animation: Have things simply appear unless there’s a good reason to use other animations such as fly from left. Text should always simply appear. You can have clip art fly but, again, if it serves a purpose. Arrows should wipe in the direction where it’s pointing.

When useful, magnify or zoom crucial parts of diagrams/illustrations, which you are describing in text.

Feedback slide: Keep a minimal difference from the question slide to the feedback slide. The multiple-choice options must stay the same on each feedback slide, except the chosen option or target slide must change color. The only other thing to change or appear on the feedback slide should be the clip art character and its feedback balloon. The character that gives the feedback does not need to be animated. Only the feedback box should appear after an answer is chosen. The feedback should automatically appear within one second.
Controlling students' looking responses: Use animations, arrows, super-sized
diagrams, circling things, crossing things out, give proper/clear instructions...etc.)
Use arrows often to make sure the student is looking at what you're telling a rule
about. Use the "wipe" animation for arrows, circles and cross outs.

Have the question and the multiple choices appear at the same time. For example, the
student clicks the mouse to see the question, and then the multiple-choice array comes
up automatically without an additional mouse click.

Text

The background and the text and animation should have high
contrast.

Bubble text or call outs need to be the rectangular ones with the rounded corners. The
border thickness should be approximately 4, or similar to the font size.

Font: At least 28

Program Organization and File Management

Breaks: Build in prompts for breaks or literally
write a break in the program (i.e. "if you don't
have 30 minutes, stop here.").

Time: Give time approximations at the
beginning of the program and following breaks.

Table of contents: If there are multiple concepts
and the overall show has multiple 20-30 minutes sections, make a table of contents.
Make units and hyperlinks to these divided small units/sections
Turn off Fast Saves:

Choose Options from the Tools menu. In the Options dialog box, click the Save tab. Remove the checkmark.

NEVER open from or save to a diskette directly. Always copy presentations to your hard drive, open them, save them to your hard drive, and then copy them back to diskette if necessary.

If you use PowerPoint 2000:
Choose Tools, Customize then click the Options tab. Remove the checkmark next to Menus Show Recently Used Commands First. This prevents PowerPoint from "hiding" menu items you don't use often.

Slide Building

Build a slide that you intend to “talk about” (i.e. topic slide) if instructing on diagram (especially the first time), build-on this diagram/slide. Have more Q&A content about that particular diagram or slide. Find a useful diagram or model that covers the concept and is crucial to the learning objective (e.g., the pink sheet program has the contingency diagram and multiple choice array in the same format across the majority of the slides.) The advantage is that the student does not see a lot of inconsistency in the presentation. Another advantage is that you refine a particular look or master and you can roll it out across many frames.

Build template slides with contingency diagrams and other diagrams.

The feedback slides must be identical to the question slides, except for the incorrect answers turn red and the correct answers turn green or blue. Then textual feedback animates automatically after a second—like a callout text box.
Don’t group objects unless you’re sure the final grouped object is not going to need further revision. The trouble is if you have to ungroup the object you lose the animation order, which must then also be recreated after you edit and regroup the objects into one. It’s much better to leave objects ungrouped if there’s a chance you will need to adjust something in the group (like text).

If you have an important diagram, arrange a diagram/questions slide and reuse the diagram. (Perhaps use a diagram as a template and use it to build on other material that is related)

“Hit ESC to turn off music now” should be placed as an instruction on one of the slides.
When selecting music, make sure there are no lyrics in the songs you select, unless it serves a meaningful purpose. (At least not in a language the audience will readily understand)

Copy and paste: Keep diagrams

When managing question slides, with their hyperlinks to the mostly identical feedback slides, use ctrl c to copy and ctrl v to paste. For example, when you have four multiple choices as hyperlinks, you’ll need to first create the feedback slides by going into slide sorter view and ctrl c the main question slide with it's hyperlinks. Then you’ll ctrl v 4 more times so you have feedback slides. Then you'll go to the slide view for the question slide and create the correct hyperlinks to the feedback slides. Then you'll use ctrl c to copy the hyper-linked text on the question slides, and ctrl v to create the hyperlinks on the feedback slides.

Style

Art: Stay with one theme and on topic, and do your own art if possible (i.e. using a digital camera to take pictures) the art must be relevant to the show.

Malott’s rule: Pictures with every slide

Clipart: Use copyright free stuff. (Shareware)

You can use one piece of art in many different ways (i.e. using one subject or photo and zooming in on crucial parts and different poses) use Photoshop or similar software to “modify” pictures.

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BIBLIOGRAPHY


