EFFECTS OF SYSTEMATICALLY DEPRIVING ACCESS TO A NON-INGESTIVE STIMULUS ON CHOICE RESPONDING WITH ADULTS WITH INTELLECTUAL DISABILITIES

by

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A dissertation submitted to the Graduate Faculty in Psychology
in partial fulfillment of the requirements for the degree of Doctor of Philosophy,
The City University of New York

2009

This manuscript has been read and accepted for the
Graduate Faculty in Psychology in satisfaction of the
dissertation requirements for the degree of Doctor of Philosophy.

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Abstract

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Howard S. Reyer

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Three adults with intellectual disabilities participated to investigate the effects of reinforcer deprivation on choice responding. The experimenter administered two, separate paired-stimulus preference assessments for potential reinforcers. The first identified the most preferred audio-visual (A-V) stimulus. The second identified the least preferred (i.e., nonpreferred) visual-only (freehand) stimulus. During daily 10-min baseline sessions, responses (using a laptop mouse) produced 1-s access for either the preferred (p) A-V stimulus or nonpreferred (n) freehand stimulus on a concurrent continuous reinforcement (CONC CRF_p CRF_n) schedule. A deprivation phase followed baseline and consisted of four components per session. First, during sole access to the preferred A-V stimulus, which lasted 5 min, responses produced 1-s access to the preferred A-V stimulus on a CRF_p schedule. Second, during the deprivation period, participants did not have subsequent access to the A-V stimulus for 5 min, 5 hr, or 24 hr prior to a choice evaluation. Third, during sole access to the nonpreferred freehand stimulus, which lasted 5 min and occurred immediately prior to a choice evaluation, responses produced 1-s access to the nonpreferred freehand stimulus on a CRF_n schedule. Fourth, during the choice evaluation, which lasted 10 min, responses produced 1-s access to either stimulus

on a CONC CRF_p CRF_n schedule. A combination multi-element / multiple-baseline-across-participants design showed that at least one and, possibly, two participants emitted fewer responses for the preferred A-V stimulus following 5-min deprivation relative to 5-hr and 24-hr deprivation. For two participants, 5-min deprivation reliably resulted in diminished levels of within-session overall responding for the preferred A-V stimulus relative to 5-hr and 24-hr deprivation. Higher values of deprivation did not increase the proportion of choice responses allocated to the A-V stimulus relative to total responses for any participant. However, compared with the results from the separate paired-stimulus preference assessment, a combined A-V/freehand paired-stimulus preference assessment conducted in one session at the end of the study showed that preference for the A-V stimulus decreased for two participants and might have affected the proportion of choice responses. Future research should assess the combined effects of preference and deprivation on choice responding within concurrent schedules.

Acknowledgements

First and foremost, I want to thank the love of my life -- my wife, Arianne. She has stood by me during this long, arduous, and seemingly never-ending, yet rewarding journey – despite, I'm sure, of having had fleeting thoughts of giving me swift hits on the back of my neck. I love you with all my heart!

I also want to thank my girls, Ava and Dylan, who are too young to understand what Daddy has been doing to provide them with a better future, but have been aware enough to know that the sight of my laptop evoked the phrase, "Daddy, you working on the computer . . . again?" and, if I wasn't home in time, "Daddy went to see Dr. Peter . . . again?" Daddy will now have more time to spend with you.

To my parents, Mark and Doris (mom and dad), who have provided me with the pillars of support from the very first day of kindergarten (and I'm sure even before then). I promised I would mention *Gershwin* somewhere in this paper, but not quite sure how to do that. I love you guys!

To my family, especially my sister, Amy, as well as my Aunt Jean, and sisters-in-law Michele (the other PhD) and Helen, all of whom have been never-ending sources of encouragement.

To my mother-in-law, Debra; my grandfather, Poppy; and, my Aunts Shirley and Barbara, all of whom could not be here to witness this milestone in my life, yet have been supportive in my academic endeavors and have expressed this to me on many occasions.

To Dr. Peter Sturmey, thank you for taking me under your wing. I will not let you down! Because of you, I now have three more lines on my CV!

To Dr. Bruce Brown, thank you for being a part of my committee at the last moment. Also, many thanks for the ideas and wisdom you have provided me while completing both my predissertation and dissertation.

To Dr. Bob Lanson, thank you for being a part of my committee during my entire time at QC and for cutting out the extra five minutes from your class to ensure that my defense went off without a hitch.

A special thanks to my outside readers, Dr. Robert Allan and Dr. Patrick Progar, both of whom did not owe me anything and had absolutely no reason to serve on my committee, yet provided me with everything that I needed.

Thanks to Dr. Lanny Fields who provided me with invaluable ideas on how to make my project work better, especially the need to use only one laptop and not two. Also, a very special thanks to John Zhu who designed the computer program that served as the backbone of this project.

Thanks to Dr. Claire Poulson who served on my committee for nearly seven years and retired prior to seeing me off.

Thanks to Dr. Howie Kaplan, my first supervisor in the field and, himself, a former graduate of the Learning Processes program, for laying the groundwork to having me apply and succeed in the field of psychology.

To Mary Anne Schimatz, the lifeblood of the program, who never questioned any favor that I requested.

Last and certainly not least, thanks to the participants and staff at BDC without whom, this project would not have been possible.

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EFFECTS OF SYSTEMATICALLY DEPRIVING ACCESS TO A NON-INGESTIVE STIMULUS ON CHOICE RESPONDING WITH ADULTS WITH INTELLECTUAL DISABILITIES

by

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Choice refers to how organisms distribute operant behavior by allocating either their time or responses among concurrently available stimuli (Baum & Rachlin, 1969). For persons with developmental disabilities, the opportunity to make choices not only improves one's quality of life (e.g., choosing own food or clothing), but is also socially valued. Reviews of research on choice in individuals with intellectual disabilities have focused on such issues as building choice into areas of daily living (Lancioni, O'Reilly, & Emerson, 1996), teaching choice-making skills (Kearney & McKnight, 1997), assessing preferences for stimuli (Cannella, O'Reilly, & Lancioni, 2005; Fisher & Mazur, 1997; Hagopian, Long, & Rush, 2004; Ivancic, 2000; Kearney & McKnight, 1997, Lancioni et al., 1996), and determining the effects of presenting choices on problem behavior (Cannella et al., 2005; Kern et al., 1998; Lancioni et al., 1996; Martin, Martin, Spevack, Verbeke, & Yu, 2002; Romaniuk & Miltenberger, 2001; Shogren, Faggella-Luby, Bae, & Wehmeyer, 2004). Although these reviews are useful, only one review systematically evaluated the effects of such variables as reinforcement schedule, reinforcer quality, response effort, delay to reinforcement, reinforcer magnitude, setting events, and motivating variables (i.e., deprivation and satiation) on choice responding. Reyer (2005) conducted a comprehensive review of the effects of these variables on choice responding

and found a dearth of published literature on the effects of satiation and deprivation on choice in individuals with intellectual disabilities.

Satiation and deprivation could be conceptualized as lying along opposite ends of a continuum where the reinforcing effects of a stimulus are strongest under conditions of deprivation and increasingly weaken as the stimulus is presented repeatedly. McGill (1999) and Michael (1982, 1993) have termed the effects of satiation and deprivation on behavior as *establishing operations*. The effects of establishing operations are important in understanding operant behavior for two reasons. First, establishing operations affect the likelihood that a response occurs by altering the reinforcing effectiveness of a stimulus. Second, the effects of establishing operations are either evocative or abative by affecting the frequency of behaviors associated with either obtaining or avoiding stimuli (Laraway, Snycerski, Michael, & Poling, 2001). For example, food deprivation increases the value of food as a reinforcer and evokes behavior associated with obtaining food. In the absence of food deprivation (i.e., satiation), food may still be available in the environment, but the value of food as a reinforcer is decreased. Therefore, behavior associated with obtaining food is abated.

Studies in the applied literature have described the effects of deprivation and satiation of ingestive and non-ingestive stimuli, such as activities and social reinforcers (i.e., attention) on behavior in individuals with intellectual disabilities (McGill, 1999; Smith & Iwata, 1997). For example, Vollmer and Iwata (1991) investigated the evocative effects of depriving food, music, and attention on simple motor responses, such as placing blocks in a hole. Five adults with intellectual disabilities participated. Control conditions consisted of performing the response without programmed consequences. Deprivation

conditions involved no access to either food or music for 30 min, or no attention (i.e., social praise) from others for 15 min prior to the start of the reinforcement session. During satiation conditions, participants had free access to either food for 10 min or music for 30 min before the reinforcement session. For social praise, the experimenters delivered response-independent attention every 15 s for 15 min prior to the start of the session. During reinforcement sessions, the researchers reinforced participants' responses on various fixed-ratio schedules, depending on the type of reinforcer. The researchers found that deprivation evoked more responses than satiation for each participant across all types of reinforcers. Hence, the effects of depriving ingestive and non-ingestive stimuli affected responding in individuals with intellectual disabilities.

Many subsequent studies on the effects of deprivation on engagement in individuals with developmental disabilities have focused on problem behavior, but relatively few have focused on appropriate behavior. For example, Klatt, Sherman, and Sheldon (2000) conducted a systematic evaluation of deprivation of various leisure activities in three men with intellectual disabilities. Participants initially engaged in 10 activities during a single-stimulus preference assessment. The researchers selected the highest-preferred activity (the activity with the longest engagement) for the deprivation analysis. Participants had access to the high-preferred activity 15 min, 2 hr, or 1 to 4 days after the last time they engaged in the activity. All participants engaged in the high-preferred activity for the shortest time when they last had access to the activity 15 min prior to the session. The researchers observed little systematic difference in engagement between the 2-hr and the 1- to 4-day conditions.

As noted earlier, researchers have published only a few studies investigating the effects of deprivation on choice responding in individuals with developmental disabilities. Reyer (2005) identified only two such studies (i.e., Gottschalk, Libby, & Graff, 2000; McAdam et al., 2005). Gottschalk et al. (2000) initially conducted a preference assessment by presenting eight edibles to four children with developmental disabilities. For each participant, the investigators identified four middle-ranked edibles to avoid ceiling and floor effects for inclusion in the following three conditions: (a) control, (b) deprivation, and (c) satiation. In the control condition, the participants had scheduled access to each edible 24 hr prior to a follow-up preference assessment. In the deprivation condition, the participants had scheduled access to three of the four edibles 24 hr prior to a follow-up preference assessment. Participants had no access to the fourth stimulus 48 hr prior to the assessment. The investigators presented each stimulus under deprivation conditions only once. In the satiation condition, participants had scheduled access to all four edibles 24 hr prior to the follow-up assessment. Participants then had free access to one of the edibles 10 min prior to the assessment. Likewise, the investigators presented each stimulus under satiation conditions only once. For each participant, the investigators conducted four follow-up assessments under deprivation conditions, four assessments under satiation conditions and three assessments under control conditions. Each follow-up assessment consisted of 24 paired-stimulus combinations. Deprivation evoked more participant choices for edibles than satiation and control conditions.

McAdam et al. (2005) conducted a partial replication of Gottschalk et al. (2000) by evaluating the effects of deprivation on preferences for activities. Three teenagers with

intellectual disabilities participated. The researchers conducted forced-choice preference assessments for each participant to identify two high- and two medium-ranked preferred leisure items, which included Legos®, keyboard and a slinky. The researchers included these items in one of three conditions: (a) control, (b) deprivation, and (c) satiation. During the control condition, the participants had 10-min equal access to each of the four items immediately prior to a follow-up preference assessment. During the control as well as all subsequent conditions, the study did not describe whether the investigators presented the items separately or simultaneously during 10-min equal access. During the deprivation condition, 10-min equal access was provided to three of the four items immediately prior to the start of the follow-up assessment. The participants also did not have access to the fourth item 24 to 48 hr prior to the assessment. The investigators presented each stimulus under deprivation conditions only once. During the satiation condition, the participants had 10 min of free access to one of the four items immediately prior to the follow-up assessment. The participants also did not have access to the other three items for 24 to 48 hr prior to the assessment. Likewise, the investigators presented each stimulus under satiation conditions only once. For each participant, the investigators conducted four follow-up assessments under deprivation conditions, four assessments under satiation conditions, and three assessments under control conditions. Deprivation evoked responding for at least one item in all participants and at least three items in two participants. Compared to the control condition, satiation abated responding for three items in all participants. However, an experimental confound potentially limited these results. Given that the experimenters allowed the participants 10-min access to the stimuli in both the satiation and control conditions, the percentages of selecting such stimuli

during the follow-up assessments should be comparable in both conditions. Otherwise, within a discrete trial (i.e., paired) presentation, a decrease in selecting a stimulus under satiation conditions could simply be the result of an increase in selecting the alternative paired-stimulus (i.e., the stimulus not presented under satiation conditions). As described, during the satiation condition, the participants did not have access to all alternative stimuli for 24 to 48 hr prior to the assessment. When allotted 10-min free access to a stimulus most participants chose the stimulus less frequently in satiation conditions than in control conditions. Therefore, choosing a stimulus less frequently in satiation conditions might be a function of reduced access to (deprivation of) the alternative paired-stimulus.

Although Gottschalk et al. (2000) and McAdam et al. (2005) evaluated the effects of deprivation on rank within preference assessments there is one significant procedural limitation these studies did not address. These studies did not systematically evaluate the effects of deprivation on choice responding within a single-subject research design. Such a design would allow for the assessment of functional relations between variables. Both Gottschalk et al. and McAdam et al. manipulated deprivation conditions only twice (i.e., once under satiation and once under deprivation) per stimulus and for only six paired-stimulus trials within each condition. A functional relation cannot be derived from only one data point per condition. In contrast, Klatt et al. (2000) demonstrated a functional relation between responding and different values of deprivation within a single-subject multi-element design. However, Klatt et al. presented only one response alternative (i.e., single-stimulus presentation) to their participants. Actually, all operant behavior is choice behavior, because every situation involves more than one alternative. For example, in the

study by Klatt et al., although participants engaged in the high-preferred activity for the shortest time when they last had access to the activity 15 min prior to the session, how did they allocate free-operant behavior within the session?

The current investigation attempted to extend Klatt et al. (2000) by using a combination multi-element / multiple-baseline-across-participants design to evaluate systematically the effects of different values of deprivation on choice by presenting concurrent response alternatives. The experimenter sought to extend the effects of deprivation by observing two phenomena. First, relative to lower values of deprivation, absolute response rates across sessions should be higher the longer participants are deprived access to a stimulus. This hypothesis should be supported even when stimuli are presented as concurrent response options. Second, if responding varies positively with the value of deprivation then the proportion (i.e., percentage) of responses allocated to the deprived stimulus relative to total responses for all stimuli should diminish with lower values of deprivation. Choice proportions should change systematically with the value of deprivation as long as responding to the other alternative is weaker across all values of deprivation.

Method

Participants and Setting

Three adult men with mild intellectual disabilities, as measured on the Wechsler Adult Intelligence Scale – Revised (WAIS-R) (Wechsler, 1981), participated. Mr. R was 34-years-old and diagnosed with Prader-Willi syndrome. Mr. C was 33-years-old with a forensic history of sexual assault. Mr. J was 49-years-old with a forensic history of pedophilia. None of the participants had any psychiatric diagnoses or took psychotropic medication. All participants were verbal, followed multi-step directives, and had experience working with computers. The analysis took place in an approximately 18.58 m^2, L-shaped room within the participants' residential unit. The room contained three tables, four chairs, two file cabinets, a bookshelf, and a mini-refrigerator. Other individuals and staff had access to the room during the experiment. Therefore, the presence of such individuals could have occurred at any time. Nevertheless, the experimenter indicated to these individuals, via gestures, not to bother the participants during sessions.

Materials

The experimenter presented two sets of stimuli to each participant. The first set included thirteen still pictures of fictional characters (see Appendix A, p. 71, for the images of all stimuli designated as the audio-visual (A-V) set of stimuli). Each picture measured 640 x 480 pixels. The experimenter included these images of characters in the investigation if participants did not possess videos portraying them and if television listings did not schedule the broadcast of the characters' respective shows or movies. The

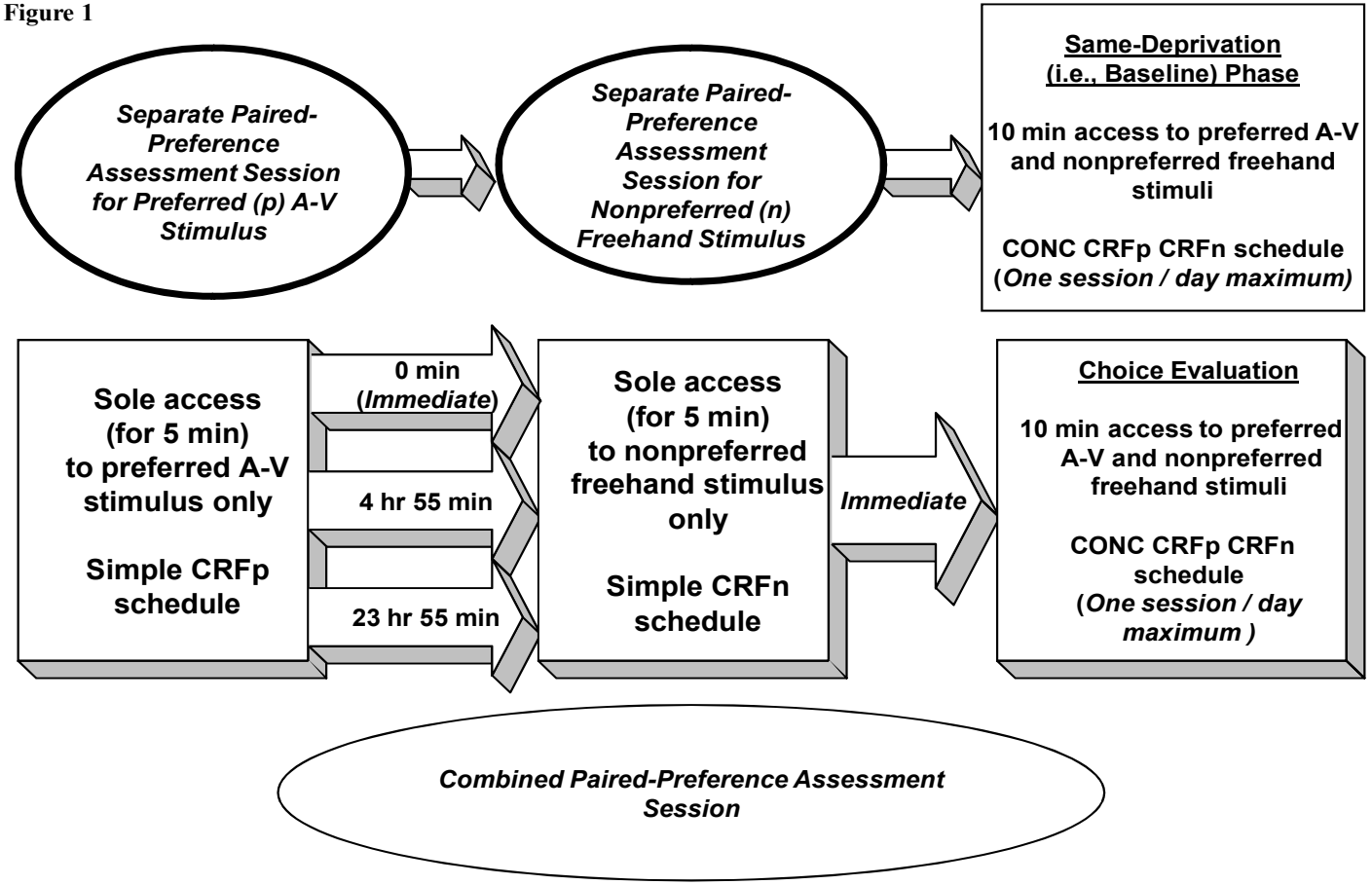
second set included eight freehand drawings (see Appendix B, p. 74, for the images of all stimuli designated as the freehand set of stimuli) The experimenter created each freehand drawing in approximately 30-s using Microsoft Paint (Microsoft Corporation, Redmond, WA) by unsystematically moving the mouse pointer across the screen. Each drawing measured 640 x 480 pixels.

The experimenter presented all stimuli to the participants and recorded all participant responses on a Hewlett-Packard Pavilion dv6000 laptop computer. The laptop featured Windows XP, an Intel Core 2 Duo 1.50 GHz processor, 2 GB RAM, and a 39.1-cm wide-screen display. Participants responded on a wireless, two-button scroll mouse (Microsoft optical mouse 3000). The laptop screen background depicted a faded image of four dialogue boxes, associated with the main computer program, which remained visible throughout the study (see Appendix C, p. 76, for an image of the laptop screen with the faded dialogue boxes). All participants wore headphones (Sennheiser© model# HD-202) that were connected to the laptop and played pink noise throughout all sessions to attenuate any potential distractions (the actual dB level was not measured). Pink noise contains equal sound pressure level in each octave band (i.e., energy decreases as frequency increases), whereas the more commonly used *white noise* contains an equal amount of energy in all frequency bands (MediaCollege.com, n.d.). The experimenter selected pink noise, because it sounded subjectively less shrill than white noise. The experimenter ascertained the intensity level prior to the start of each session by manipulating the volume control on the laptop. The experimenter subjectively judged a level that was deemed comfortable for the participants to listen and effectively attenuate any environmental noise present at that time.

Procedure

Figure 1 illustrates the specific procedures and order of conditions. The experimenter conducted only one session per day for each participant. Generally, sessions occurred between the hours of 2 and 4 pm. During experimental conditions, one press on the left-mouse button defined a response.

Figure 1


Separate Paired-Preference Assessment Session for Preferred (p) A-V Stimulus
Separate Paired-Preference Assessment Session for Nonpreferred (n) Freehand Stimulus
Same-Deprivation (i.e., Baseline) Phase
10 min access to preferred A-V and nonpreferred freehand stimuli
CONC CRFp CRFn schedule (One session / day maximum)
Sole access (for 5 min) to preferred A-V stimulus only
Simple CRFp schedule
0 min (Immediate)
4 hr 55 min
23 hr 55 min
Sole access (for 5 min) to nonpreferred freehand stimulus only
Simple CRFn schedule
Immediate
Choice Evaluation
10 min access to preferred A-V and nonpreferred freehand stimuli
CONC CRFp CRFn schedule (One session / day maximum)
Combined Paired-Preference Assessment Session

Separate Preference Assessments

For each participant, the experimenter conducted two, separate paired-stimulus preference assessment procedures (Fisher, Piazza, Bowman et al., 1992) (see Figure 1, top panels). For both assessments, the participants sat at a table and in front of the laptop, with no access to the mouse. The experimenter sat to the left of the participants. The experimenter instructed the participants: "Please place the headphones on your head."

The session began with the presentation of the first preference assessment. The first assessment identified a preferred A-V stimulus. Selecting a picture resulted in the simultaneous offset of pink noise and the presentation of a 1-s audio phrase, beginning at stimulus onset, delivered through the headphones and associated with that character. For example, selecting the *Terminator*® (The Halcyon Company, Los Angeles, CA) resulted in a picture of the character as well as the audio phrase, "I'll be back!" (see Appendix A, p. 71, for all audio transcriptions associated with each preferred stimulus). Selecting an A-V (preferred) stimulus always resulted in the presentation of a 1-s, combined audio-visual consequence. The resumption of pink noise immediately followed stimulus offset.

Initially, the experimenter named and showed the participants each picture, and played the corresponding audio phrase. After the experimenter showed the participants each picture and played the audio phrase once, the first assessment began. The experimenter paired each picture with every other picture twice and counterbalanced their left-right positions. Hence, the experimenter presented each picture 24 times within a session. Prior to the beginning of the assessment, a random number generator from *www.randomizer.org* determined the selection of each pair of pictures and their left-right positions.

During each trial, the experimenter loaded the first picture (i.e., the picture predetermined for placement on the left side of the screen) from the database in the laptop. As soon as the first picture appeared, the experimenter loaded the second picture (i.e., the picture predetermined for placement on the right side of the screen). When the experimenter loaded both pictures they appeared randomly positioned on the screen. Therefore, the experimenter had to manually place both pictures in their predetermined left-right positions, using the mouse, toward the center of the screen and equidistant from either edge of the screen. While using the mouse to point to each picture, the experimenter asked the participant, "Would you like (the name of the first character) or would you like (the name of the second character)?" The experimenter then waited for a response. If the participant pointed or verbally indicated his selection within 10 s then the experimenter closed the non-selected picture, while leaving the selected picture visible on the screen, and played the 1-s audio phrase, once, for the selected picture. The experimenter repeated the question if the participant neither pointed nor verbalized his selection within 10 s (this happened once per participant). When the 1-s audio phrase ended, the experimenter closed the selected picture and a new trial began after approximately 10 s. The experimenter conducted the first assessment in one session, which lasted approximately 50 min, for a total of 156 trials per participant.

The second preference assessment occurred on a separate day and approximately 24 hr after the completion of the first preference assessment. The second assessment identified a nonpreferred freehand drawing. The experimenter conducted separate assessments, because the experimenter assumed that pairing an audio-visual stimulus with a freehand drawing would most likely result in consistent preference and,

consequently, responding for the former throughout the duration of the study. The selection of any of these drawings resulted in the presentation of the drawing, but without any sound. The same procedure used for the first preference assessment occurred for the second assessment, except the experimenter left the selected picture on the screen for approximately 1 s. The experimenter conducted the preference assessment for the freehand stimuli in one session, which lasted approximately 20 min, for a total of 56 trials per participant. The experimenter paired each picture with every other picture twice and counterbalanced their left-right positions on the laptop screen. Hence, the experimenter presented each picture 14 times within a session.

The dependent variable for all preference assessments was the frequency of selecting each stimulus. For each participant, the experimenter selected the preferred A-V stimulus with the highest percentage of choices and the nonpreferred freehand stimulus with the lowest percentage of choices for inclusion in the subsequent phases of the study.

Same-Deprivation (Baseline) Phase

The same-deprivation (i.e., baseline) phase followed the completion of both preference assessments (see Figure 1, top panels). The purpose of baseline was to provide a comparison of responding and choice proportions between this phase and subsequent deprivation conditions. Prior to the same-deprivation phase, the experimenter showed the participants how to use the control panel with two pictures that were not included in the preference assessment. The control panel was a small window, approximately 286 x 137 pixels, which appeared on the laptop screen. The control panel contained two buttons that measured approximately 92 x 32 pixels each. The buttons were aligned side-by-side and displayed the numbers one and two, respectively (see Appendix D, p. 77, for an image of

the control panel). The random number generator from *www.randomizer.org* determined the assignment of the numbers one and two to the two A-V and freehand stimuli identified from the preference assessments. The assignment of numbers remained constant throughout the session. The experimenter placed the control panel toward the bottom-left portion of the laptop screen to eliminate the likelihood of it being hidden from view by the opening of a stimulus. The control panel remained on the laptop screen during each session of this condition. The experimenter remained in the room during the session, but sat behind the participants. The experimenter conducted no more than one session per day for each participant. Therefore, the experimenter deprived the participants access to both stimuli for at least 24 hr from the end of one session to the beginning of the next session. Participants did not have access to either stimulus between sessions.

During the same-deprivation phase, the experimenter demonstrated to the participants each stimulus that corresponded with the appropriate button on the control panel. The numbers on the buttons corresponded to the numbers one and two that were embedded in the top-right corners of the preferred and nonpreferred stimuli (see Appendix E, p. 78, for an image of the laptop screen with the faded dialogue boxes, control panel, and a picture of a nonpreferred stimulus embedded with the number one). The embedded numbers measured approximately 56 x 75 pixels each. There were two versions of the same stimulus numbered "one" and "two." The experimenter clicked the button with the number one and said, "The first button shows (*the name of the A-V stimulus)"* or *"*this picture" *(of the freehand stimulus)*. The experimenter then clicked the button with the number two and added, "And the second button shows (*the stimulus not associated with the first button*)." The experimenter then instructed the participants:

"Click the buttons on the screen to show which picture you would like to look at. I will let you know when you are done. Please place the headphones on your head. Ready?" Sessions began when the participants either verbalized or gestured they were ready. During sessions, participants could access either the preferred (p) A-V or nonpreferred (n) freehand stimulus on a concurrent continuous reinforcement (CONC CRF_p CRF_n) schedule. Pressing either button on the control panel resulted in 1-s access to the corresponding stimulus. When 1 s had elapsed, the stimulus disappeared from the screen. Neither the experimenter nor the computer prompted the participants to make a choice regardless of how much time elapsed since the last response. Starting with stimulus offset, a 1.5-s delay occurred if the participant made a choice while any of the stimuli were displayed on the screen during the 1-s access time. Sessions lasted for 10 min. The dependent variable during the same-deprivation condition and all subsequent conditions was responses per minute.

Deprivation phase

The deprivation phase consisted of four components per session: Sole access to the preferred A-V stimulus, deprivation period, sole access to the nonpreferred freehand stimulus, and choice evaluation (see Figure 1, lower panels).

Sole Access to Preferred A-V Stimulus. The purpose of this component was to have the participants respond for repeated access to the preferred A-V stimulus only. Repeated presentation of a reinforcing stimulus should establish a level of satiation and set up the conditions for manipulating deprivation periods. During this component, the control panel displayed either the number one or two, on only one of the respective buttons. The other button did not display a number. For each session, the random number

generator from www.randomizer.org determined which number and, consequently, which button (i.e., side) on the control panel should control responding for the preferred A-V stimulus. Both the number as well as its position on the control panel stayed constant during the session. The control panel remained on the laptop screen during the entire component. The experimenter then instructed the participants: "Click the button on the screen to show (*the name of the preferred A-V stimulus*). I will let you know when you are done. Please place the headphones on your head. Ready?" Sessions began when the participants either verbalized or gestured they were ready. The experimenter calibrated the computer program so that for 5 min, each participant was exposed to a simple CRF_p schedule for 1-s access to the preferred A-V stimulus. When 1 s had elapsed, the stimulus disappeared from the screen. Neither the experimenter nor the computer prompted the participants to respond regardless of how much time elapsed since the last response. A 1.5-s delay occurred, starting with stimulus offset, if the participant responded while the stimulus was displayed on the screen during the 1-s access time.

Deprivation Period. After 5-min of sole access to the preferred A-V stimulus, the participants then did not have any further access to the preferred A-V stimulus for 5 min, 5 hr or 24 hr prior to a choice evaluation (i.e., the final component of the deprivation phase and described below). During the 5-hr and 24-hr deprivation periods, participants went about their typical day outside of the experimental context (e.g., attending their respective day programs and residing on their residential units) for 4 hr 55 min and 23 hr 55 min, respectively. During the 5-min deprivation period, participants remained in the experimental context and were given sole access to the nonpreferred freehand stimulus (described in the next section). The experimenter presented each level of deprivation only

once per session, within a block of three sessions. The experimenter counterbalanced the sequence of sessions within each block over six blocks.

Sole Access to Nonpreferred Freehand Stimulus. The purpose of this component was to have the participants respond for repeated access to the nonpreferred freehand stimulus only. This condition also functioned to ensure that the effects of deprivation were limited to only the preferred A-V stimulus. For 5 min immediately prior to the start of the choice evaluation, the experimenter exposed each participant to a simple CRF_n schedule for 1-s access to the nonpreferred freehand stimulus. This 5-min period also functioned as a 5-min deprivation period for the preferred A-V stimulus. The same procedure used for responding during sole access to the preferred A-V stimulus also held for sole access to the nonpreferred freehand stimulus, except that the control panel displayed the other number on the button not associated with responding during sole access to the preferred A-V stimulus. Both the number as well as its position on the control panel remained constant during the session.

Choice Evaluation. The choice evaluation occurred immediately after 5 min of sole access to the nonpreferred freehand stimulus had elapsed. The numbers and buttons on the control panel associated with responding to the preferred A-V and nonpreferred freehand stimuli during the respective sole access periods remained the same during the choice evaluation. The procedure during the choice evaluation resembled that of the same-deprivation condition; however, the experimenter did not show the participants which buttons resulted in responding for the preferred A-V and nonpreferred freehand stimuli to avoid exposing them to the stimuli prior to the choice evaluation. Sessions lasted for 10 min.

Combined Preference Assessment

The combined preference assessment occurred on a separate day following the completion of the deprivation phase and included all audio-visual and freehand stimuli (see Figure 1, lower panel). Only Mr. C and Mr. J participated in the combined preference assessment. The combined preference assessment directly compared preference between both sets of stimuli and identified any potential shifts in preference within each set. The same procedure used for the separate preference assessments occurred for the combined assessment. For each participant, the experimenter conducted the combined assessment in one session and paired each picture with every other picture twice and counterbalanced their left-right positions on the laptop screen for a total of 420 trials. Hence, the experimenter presented each stimulus 40 times within a session. The dependent variable for the combined assessment was the number of times each stimulus was selected.

Independent Variable and Experimental Design

The independent variable was deprivation of a preferred A-V stimulus, operationally defined as the time since the previous opportunity to access the stimulus (cf. Klatt et al., 2000). Deprivation times were 5 min, 5 hr and 24 hr (note that these times do not agree with the middle panels in Figure 1 and included the five minutes that participants responded for sole access to the nonpreferred freehand stimulus).

A combination multi-element / multiple-baseline-across-participants design evaluated the systematic effects of deprivation on responding for the preferred A-V stimulus. The experimenter controlled the presence/absence of deprivation in the multiple-baseline design (same-deprivation vs. deprivation phases), and the degree of deprivation in the

multi-element design during the deprivation phase. The experimenter determined the introduction of deprivation conditions to each participant by visual inspection of the trends and levels of mean responses per minute for the preferred A-V stimulus.

Inter-observer Agreement (IOA) and Procedural Fidelity

The experimenter did not collect IOA for responding by the participants, because the computer program tabulated and recorded all responses.

The experimenter and another observer who worked on the residential unit assessed the implementation of procedures for the following information: Appropriate left-right pairings of stimuli during the preference assessment; the presentation of all 5-min sole access periods (nonpreferred freehand and preferred A-V stimuli) at their appropriate times; the randomization of left-right presentations for each session during each condition; and, the presentation of the appropriate deprivation condition indicated for the current block. The observer's records indicated that these procedures were implemented with 100% fidelity during integrity checks for 12.5% of all preference assessment sessions, 92.9% of all sessions in the same-deprivation phase, and 94.4% of all components in the deprivation phase.

Data Analysis

For the separate and combined preference assessments, the experimenter calculated the percentages of choices for each stimulus by dividing the frequency of choices for that stimulus by the total number of presentations for that stimulus and multiplying by 100%.

The experimenter calculated responses per minute during the sole access components, by summing the frequency of responses in each session block and dividing by 5 min.

Responses per minute and choice proportions for across-session comparisons during the same-deprivation phase and choice evaluation component of the deprivation phase were calculated. In addition, responses per session and choice proportions for within-session comparisons during the same-deprivation phase and choice evaluation component of the deprivation phase were calculated. For across-session comparisons, responses per minute for both the nonpreferred freehand stimulus and the preferred A-V stimulus were calculated by summing the frequency of responses in each session block and dividing by 10-min. Choice proportions were calculated by summing the frequency of responses for the A-V stimulus in each session block and dividing by the frequency of all responses in each session block.

For within-session comparisons during the same-deprivation and deprivation phases, responses per session for both the nonpreferred freehand stimulus and the preferred A-V stimulus were calculated by summing the frequency of responses in each minute across all session blocks and dividing by the total number of session blocks. Last, choice proportions per session were calculated by summing the frequency of responses for the A-V stimulus at each minute across all session blocks and dividing by the frequency of all responses in each minute across all session blocks.

Results and Discussion

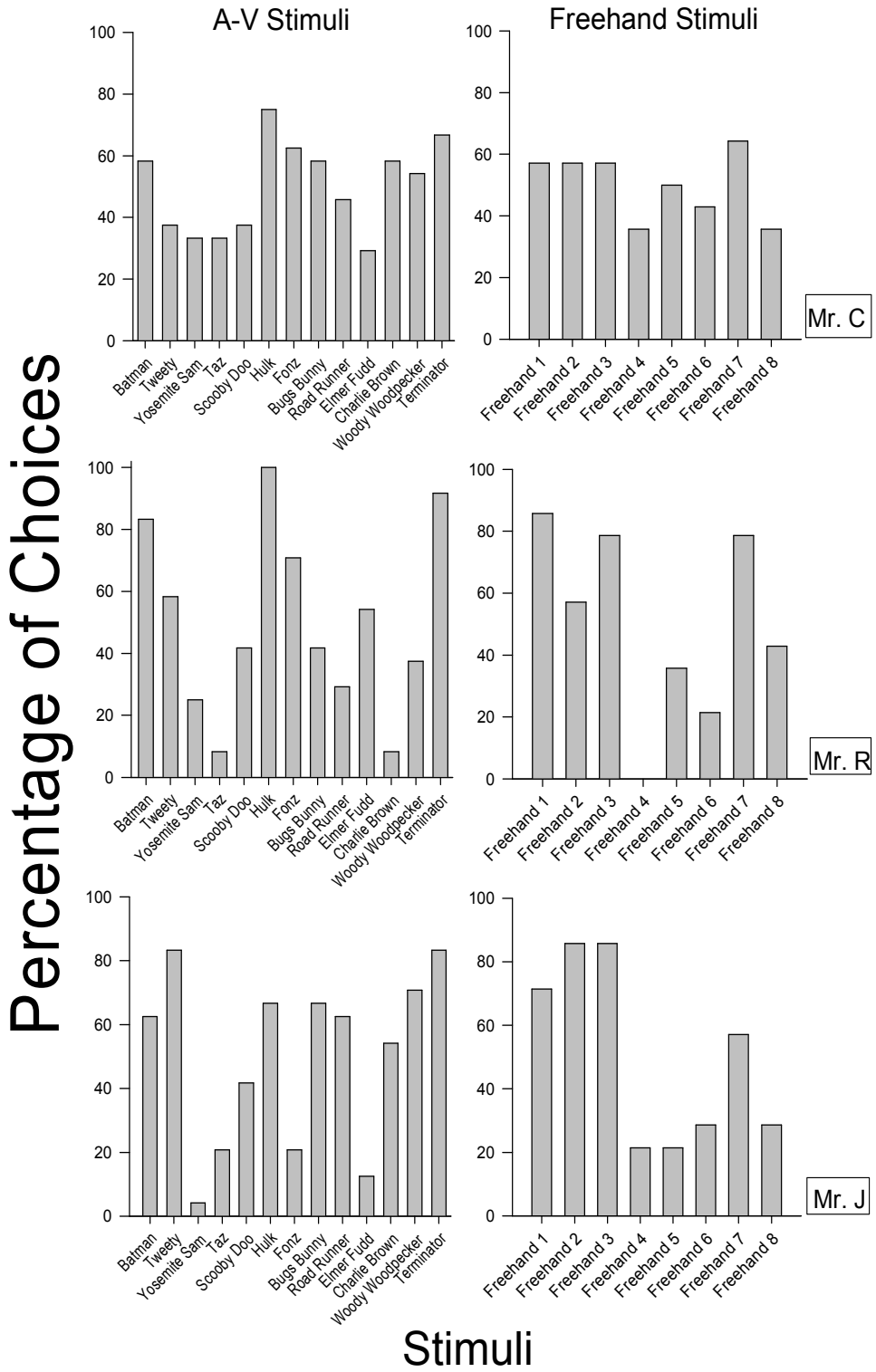
Separate Preference Assessments

The results from the separate, paired-stimulus preference assessments for each participant are shown in Figure 2. For each participant, the A-V stimulus selected with the highest percentage of choices and the freehand stimulus selected with the lowest percentage of choices were included in the subsequent phases of the study.

Among all A-V stimuli presented, Mr. C selected the *Incredible Hulk*® (Marvel Comics Group, New York, NY) on 75% of choice trials. Mr. R selected the Incredible Hulk on 100% of choice trials. Mr. J selected the Terminator and *Tweety Bird*® (Warner Brothers, Burbank, CA) on 83.3% of choice trials. Therefore, for both Mr. C and Mr. R, the Incredible Hulk was the preferred A-V stimulus selected for inclusion in the investigation. A coin flip determined that the Terminator would be the preferred A-V stimulus for Mr. J.

Among all freehand stimuli presented, Mr. C selected both stimulus #4 and stimulus #8 on 35.7% of choice trials. A coin flip determined that stimulus #4 would be the nonpreferred freehand stimulus for Mr. C. Mr. R never selected stimulus #4 on any choice trial. Therefore, for Mr. R, stimulus #4 was the nonpreferred freehand stimulus selected for inclusion in the investigation. Mr. J selected both stimulus #4 and stimulus #5 on 21.4% of choice trials. A coin flip determined that stimulus #4 would be the nonpreferred freehand stimulus for Mr. J.

Figure 2


A-V Stimuli
Freehand Stimuli
Percentage of Choices
Stimuli
Mr. C
Mr. R
Mr. J
0
20
40
60
80
100
Batman
Tweely
Yosemite Sam
Taz
Scooby Doo
Hulk
Fonz
Bugs Bunny
Road Runner
Elmer Fudd
Charlie Brown
Woody Woodpecker
Terminator
Freehand 1
Freehand 2
Freehand 3
Freehand 4
Freehand 5
Freehand 6
Freehand 7
Freehand 8

Combination Multi-Element / Multiple-Baseline Design

Recall the hypothesis that relative to lower values of deprivation, absolute response rates across sessions should be higher the longer the participants are deprived access to a stimulus. This hypothesis should be supported even when stimuli are presented as concurrent response alternatives. In particular, participants should emit more responses to the preferred A-V stimulus when they last had access to it 5 hr and 24 hr prior to the choice evaluation than 5 min prior to the choice evaluation.

Figure 3 presents a combination multi-element / multiple-baseline-across-participants figure. Figure 3 consists of three panels, one for each participant, and shows responses per minute for the preferred A-V stimulus. In each panel, the data are plotted against the temporal order of days when sessions were conducted. Within the deprivation phase, multi-element data are presented and represent responding for the preferred A-V stimulus following each of the three levels of deprivation.

The data for Mr. C are shown in the top panel of Figure 3. Within each session block, during the deprivation phase, responding for the preferred A-V stimulus that followed the 5-min deprivation period was always less than responding for the preferred A-V stimulus that followed the 5-hr and 24-hr deprivation periods. There were no systematic differences for responding for the preferred A-V stimulus during the same-deprivation phase and following the 5-hr and 24-hr deprivation periods during the deprivation phase. Further, responding for the preferred A-V stimulus that followed each 5-min deprivation period never exceeded the number of responses on any day of the same-deprivation phase. No systematic effects were observed for responding for the preferred A-V stimulus during the deprivation phase between the 5-hr and 24-hr

deprivation periods.

The data for Mr. R are shown in the middle panel of Figure 3. During the deprivation phase, responding for the preferred A-V stimulus following the 5-min deprivation period was less than responding for the preferred A-V stimulus that followed the 5-hr and 24-hr deprivation periods for five out of seven session blocks. Responding for the preferred A-V stimulus on all days (except the first) within the same-deprivation phase, exceeded responding for the preferred A-V stimulus following the 5-min deprivation period, during the deprivation phase, for five out of seven session blocks. No systematic effects were observed for responding for the preferred A-V stimulus during the deprivation phase between the 5-hr and 24-hr deprivation periods.

The data for Mr. J are shown in the bottom panel of Figure 3. The number of responses Mr. J emitted for the preferred A-V stimulus during the same-deprivation phase increased from Day 3 to the Day 9 and then decreased in Day 13. Beginning with Day 18, little variability in responding for the preferred A-V stimulus occurred for all remaining days during the same-deprivation and deprivation phases.

Figure 3

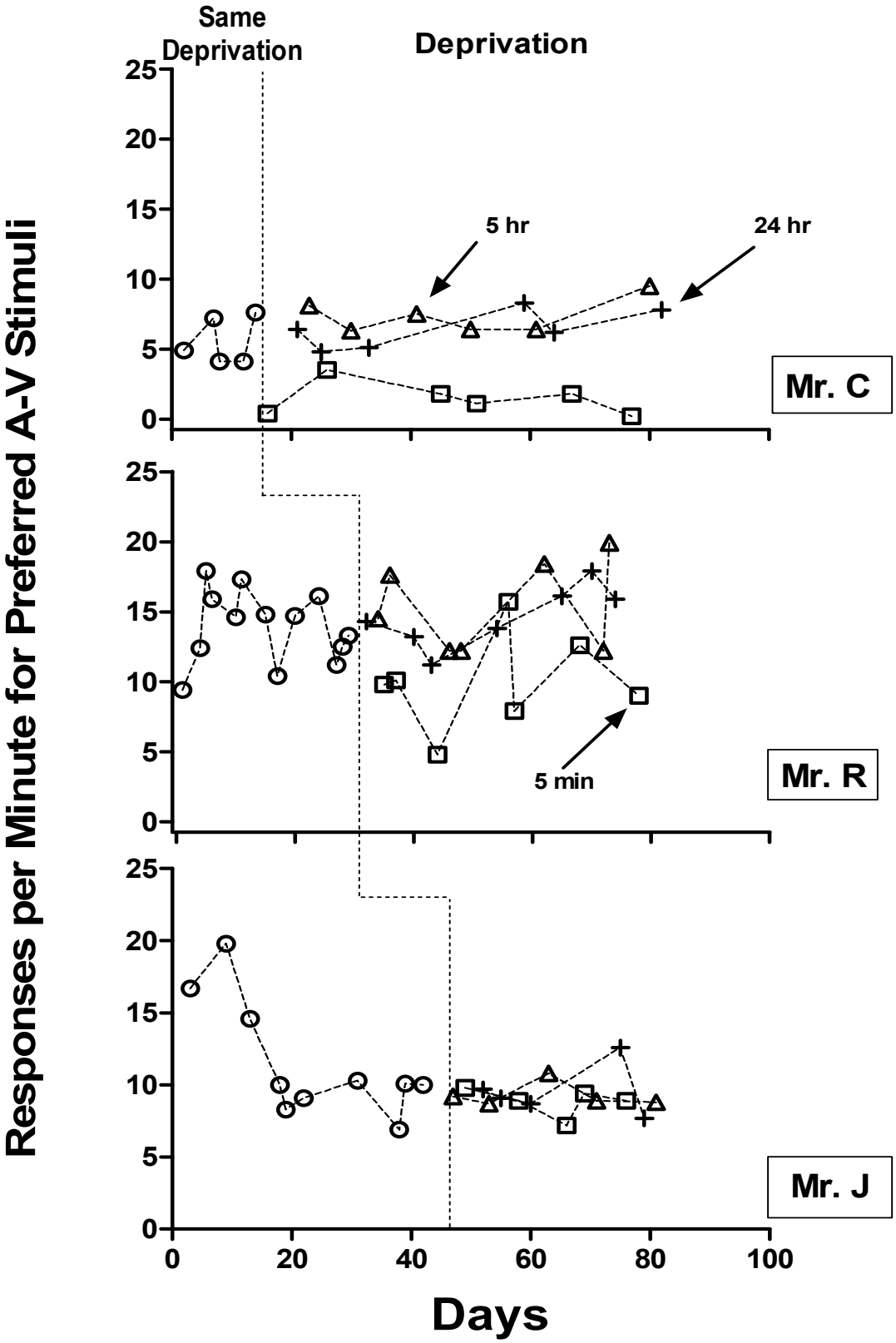

Same Deprivation
Deprivation
5 hr
24 hr
5 min
Mr. C
Mr. R
Mr. J
Responses per Minute for Preferred A-V Stimuli
Days
0
5
10
15
20
25
0
20
40
60
80
100

Table 1 shows mean responses per session (and standard deviations) for the preferred A-V and nonpreferred freehand stimuli for each participant during the same-deprivation phase and for all three levels of deprivation during the deprivation phase. For both Mr. C and Mr. R, Table 1 shows that systematically less responding for the preferred A-V stimulus occurred following 5-min deprivation than responding for the preferred A-V stimulus within the same-deprivation phase as well as following 5-hr and 24-hr deprivation. For Mr. J, Table 1 shows that the variability of the data, as evidenced by the values of the standard deviations, suggests that different values of deprivation had no systematic effects on responding for the preferred A-V stimulus.

Table 1

Mean Responses per Session (and Standard Deviations) for the Preferred A-V and Nonpreferred Freehand Stimuli for Each Participant During the Same-Deprivation Phase and for All Three Levels of Deprivation During the Deprivation Phase. Each Participant's First Row of Data Show Responding for the Preferred A-V Stimulus. Each Participant's Second Row of Data Show Responding for the Nonpreferred Freehand Stimulus.

Ppt.	Stimulus	Same Deprivation[a]		5-min Deprivation		5-hr Deprivation		24-hr Deprivation	
		Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)
Mr. C	A-V	55.80	(16.99)	14.67	(12.03)	73.67	(12.74)	64.33	(14.04)
	Freehand	84.20	(16.95)	18.33	(13.22)	103.17	(22.50)	95.00	(31.57)
Mr. R	A-V	135.60	(19.00)	99.86	(34.58)	152.86	(33.05)	146.29	(22.01)
	Freehand	26.60	(12.70)	21.86	(11.49)	26.14	(17.99)	20.86	(14.05)
Mr. J	A-V	92.80	(14.10)	88.40	(9.91)	92.80	(8.70)	95.60	(18.49)
	Freehand	90.40	(17.60)	89.60	(9.07)	94.20	(9.01)	95.80	(17.80)

[a]Last five sessions.

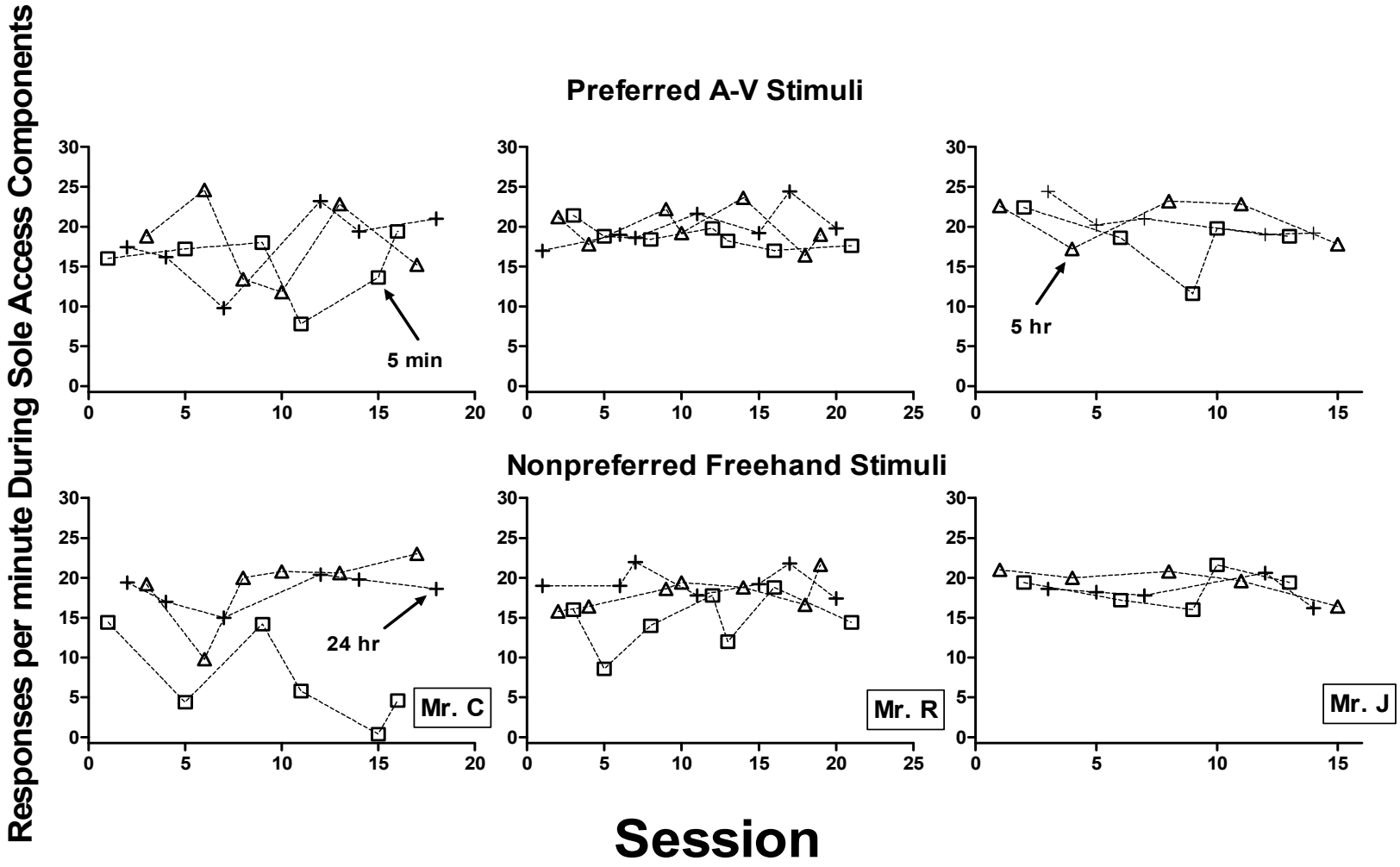
Sole Access to Preferred (A-V) and Non-Preferred (Freehand) Stimuli

Recall from the procedure section that the repeated presentation of a reinforcing (A-V) stimulus should establish satiation and set up the conditions for manipulating deprivation periods. Also, the repeated presentation of the nonpreferred freehand stimulus should ensure that the effects of deprivation were limited only to the preferred A-V stimulus. As such, deprivation periods should not have any systematic effects on responding within both sole access components.

Figure 4 shows the data for all participants during the sole access components of the deprivation phase for the preferred A-V and nonpreferred freehand stimuli. All graphs are presented as multi-element figures. The data in the three graphs in the top row show responses per minute, plotted against sessions, for sole access to the preferred A-V stimuli immediately prior to the commencement of each deprivation period. The data in the three graphs in the bottom row show responses per minute, plotted against sessions, for sole access to the nonpreferred freehand stimuli immediately prior to the commencement of the choice evaluation that followed each deprivation period.

As the data in the top panels of Figure 4 show, there were no systematic differences for responding for sole access to the preferred A-V stimulus for any of the participants. However, the data in the bottom panels of Figure 4 show that compared to responding prior to the 5-hr and 24-hr deprivation periods, Mr. C responded less for sole access to the nonpreferred freehand stimulus prior to the choice evaluation of the 5-min deprivation period.

Figure 4

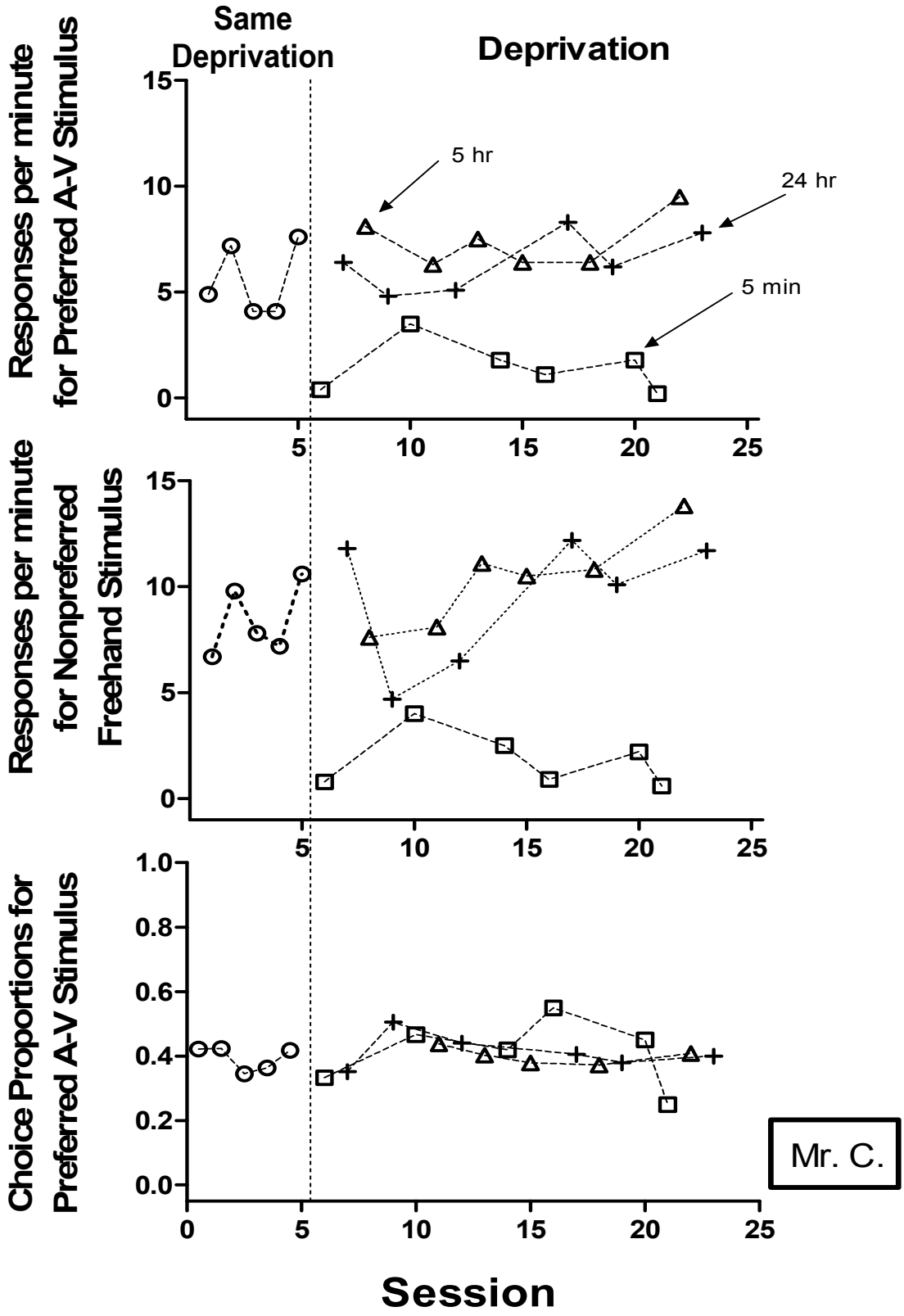

Preferred A-V Stimuli
Nonpreferred Freehand Stimuli
Responses per minute During Sole Access Components
Session
5 min
5 hr
24 hr
Mr. C
Mr. R
Mr. J

Same-Deprivation and Deprivation Phases (Across-Session Measures)

Figures 5, 6, and 7 illustrate responses per minute for each session, for Mr. C, Mr. R, and Mr. J, respectively, during the same-deprivation and deprivation phases when both the preferred A-V and nonpreferred freehand stimuli were available as concurrent response alternatives. The figures also illustrate the corresponding choice proportions per session that resulted from responding for both stimuli. The top graphs in each figure are the same as those depicted in Figure 3. They are presented here to show how participants allocated their responses to both stimuli within each individual session. Within the deprivation phase, multi-element data are presented and represent responding following each of the three levels of deprivation.

For Mr. C, the data in the top and middle panels of Figure 5 show that compared to the same-deprivation phase and the 5-hr and 24-hr deprivation periods, Mr. C responded less for both the preferred A-V and nonpreferred freehand stimuli at each session block during the deprivation phase following the 5-min deprivation period. Further, Mr. C emitted more responses for the nonpreferred freehand stimulus than for the preferred A-V stimulus within both the same-deprivation and deprivation phases for all but three session blocks. The data in the bottom panel of Figure 5 show no systematic differences in choice proportions across all deprivation periods. However, there appears to be slightly more variability in the proportion of responses allocated to the preferred A-V stimulus relative to total responses during the deprivation phase following the 5-min deprivation period.

Figure 5


Same Deprivation
Deprivation
Responses per minute for Preferred A-V Stimulus
5 hr
24 hr
5 min
Responses per minute for Nonpreferred Freehand Stimulus
Choice Proportions for Preferred A-V Stimulus
Mr. C.
Session

For Mr. C, the question that is raised by the data observed in the bottom panel of Figure 4, and the top and middle panels of Figures 5 is whether responding for the nonpreferred freehand stimulus during the sole access component somehow abated responding for both the preferred A-V and nonpreferred freehand stimuli during the deprivation phase following the 5-min deprivation period. Hence, it was possible that five minutes of repetitive responding for sole access to the nonpreferred freehand stimulus affected subsequent responding during the choice evaluation. If so, then substantially less responding for the preferred A-V and nonpreferred freehand stimuli, combined, should have occurred during the choice evaluation following all deprivation periods.

Table 2 shows mean responses per session (and standard deviations) for each participant during the sole access components of the deprivation phase. Mean responses are shown for the preferred A-V stimuli immediately prior to the commencement of each deprivation period and for the nonpreferred freehand stimuli immediately prior to the commencement of the choice evaluation that followed each deprivation period. Table 2 also shows mean overall responses per session (and standard deviations) for both the preferred A-V and nonpreferred freehand stimuli during the first and last five minutes of the same-deprivation phase and choice evaluations during the deprivation phase.

The third row of Table 2 for Mr. C shows that when compared to the 5-min deprivation period, there was an increase in overall responding during the initial five minutes of the choice evaluation period following the 5-hr and 24-hr deprivation periods subsequent to responding for sole access to the freehand stimulus. Therefore, decreased responding for the preferred A-V stimulus during the choice evaluation following the 5-

min deprivation period was likely not influenced by prior responding for the nonpreferred freehand stimulus within the sole access component.

Table 2

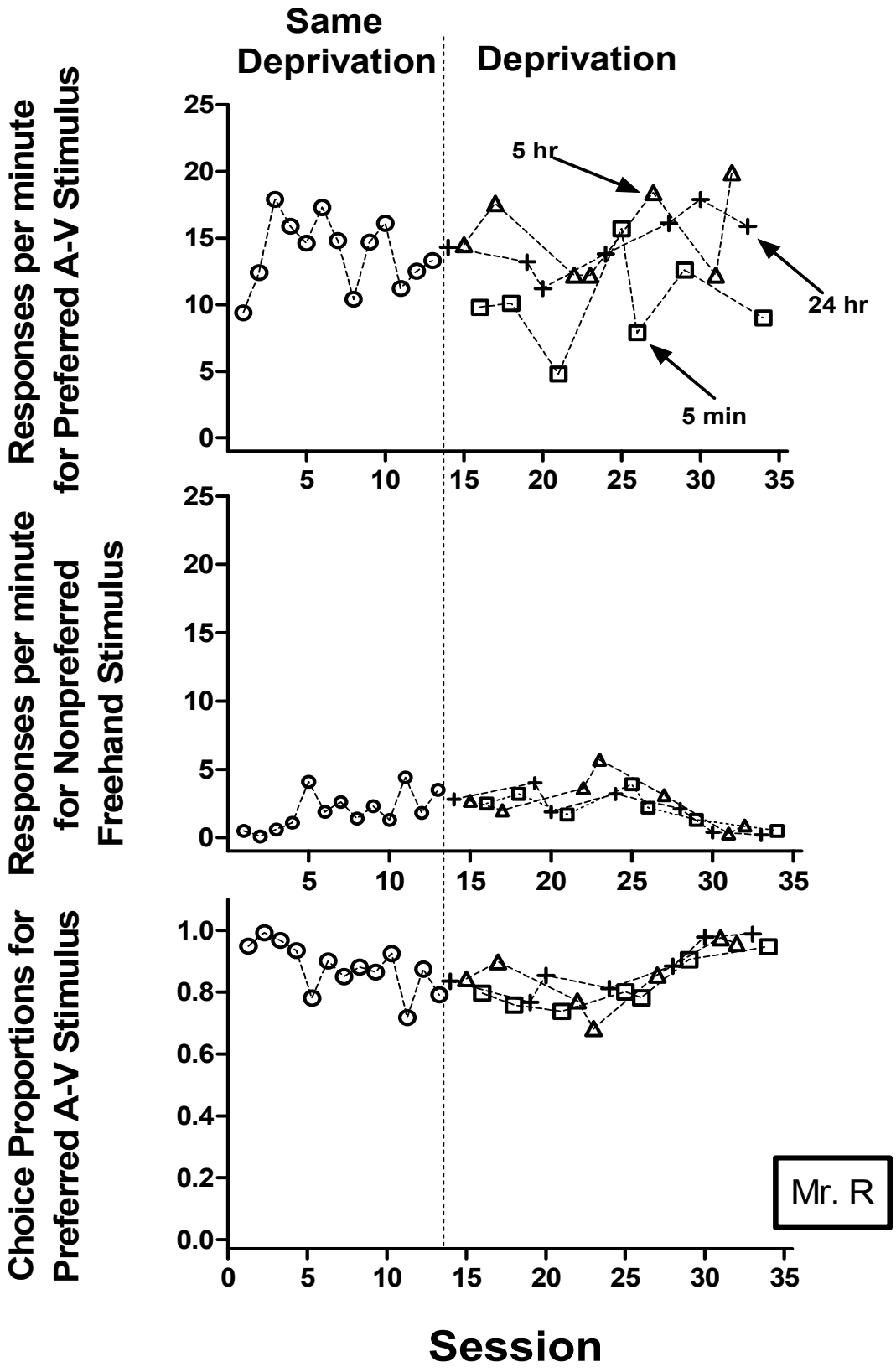
Mean Responses per Session (and Standard Deviations) for Each Participant During the Sole Access Components of the Deprivation Phase. Mean Responses are Shown for the Preferred A-V Stimuli Immediately Prior to the Commencement of Each Deprivation Period and for the Nonpreferred Freehand Stimuli Immediately Prior to the Commencement of the Choice Evaluation that Followed Each Deprivation Period. Each Participant's First Row of Data Show Responding for the Preferred A-V Stimulus. Each Participant's Second Row of Data Show Responding for the Nonpreferred Freehand Stimulus. The Table also Shows Mean Overall Responses per Session (and Standard Deviations) for Both the Preferred A-V and Nonpreferred Freehand Stimuli During the First and Last Five Minutes of the Same-Deprivation Phase and Choice Evaluations During the Deprivation Phase. Each participant's Third Row of Data Show Overall Responding for Both Stimuli During the First Five Minutes. Each Participant's Fourth Row of Data Show Mean Overall Responding for Both Stimuli During the Final Five Minutes.

Ppt.	Component	Stimulus / Stimuli	Same Deprivation[a]	5-min Dep.	5-hr Dep.	24-hr Dep.
			Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Mr. C	Sole Access	A-V		76.67 (20.90)	88.83 (25.92)	89.17 (23.32)
		Freehand		36.50 (28.60)	94.50 (23.18)	91.83 (10.13)
	Choice Evaluation	Minutes 1-5 Overall	78.00 (11.00)	21.00 (11.59)	89.17 (19.79)	85.83 (20.32)
		Mins. 6-10 Overall	62.00 (23.74)	12.00 (15.03)	87.67 (14.57)	73.50 (25.11)
Mr. R	Sole Access	A-V		93.71 (7.34)	99.57 (12.69)	99.71 (12.00)
		Freehand		72.57 (17.43)	90.86 (10.22)	97.29 (8.99)
	Choice Evaluation	Minutes 1-5 Overall	87.40 (7.16)	64.29 (26.59)	89.00 (18.93)	95.57 (8.89)
		Mins. 6-10 Overall	74.80 (11.52)	57.43 (35.14)	90.00 (12.71)	71.57 (24.90)
Mr. J	Sole Access	A-V		91.20 (20.04)	103.60 (14.77)	103.80 (10.94)
		Freehand		93.60 (10.88)	97.80 (9.28)	91.40 (7.92)
	Choice Evaluation	Minutes 1-5 Overall	93.40 (14.83)	87.00 (10.44)	92.80 (7.22)	99.40 (18.00)
		Mins. 6-10 Overall	89.80 (16.98)	91.00 (8.92)	94.20 (11.10)	92.00 (18.91)

[a]Last five sessions.

For Mr. R, the data in the top panel of Figure 6 show that responding for the preferred A-V stimulus during the deprivation phase following the 5-min deprivation period was less than responding following the 5-hr and 24-hr deprivation periods for five out of seven session blocks. When comparing the data in the top and middle panels of Figure 6, Mr. R responded for the preferred A-V stimulus more than the nonpreferred freehand stimulus within each session block of the same-deprivation and deprivation phases. Also, compared to responding during the same-deprivation phase and the 5-hr and 24-hr deprivation periods (top panel), less responding for the preferred A-V stimulus following the 5-min deprivation periods did not reliably result in an increase in responding for the nonpreferred freehand stimulus during the 5-min deprivation condition (middle panel). This observation suggests that less responding for the preferred A-V stimulus was a function of decreased deprivation and not due to an increase in responding for the nonpreferred freehand stimulus (i.e., the response alternative). The data in the middle panel of Figure 6 also show that the effects of deprivation appeared to have no systematic effect on responding for access to the nonpreferred freehand stimulus across all session blocks within the deprivation phase. However, at around Session 28, compared to responding within previous session blocks during the deprivation phase, responding for access to the nonpreferred freehand stimulus began to decrease across all deprivation periods. The data in the bottom panel of Figure 6 appears to show that there were no systematic differences for choice proportions across deprivation periods within the deprivation phase.

Figure 6


Same Deprivation
Deprivation
Responses per minute for Preferred A-V Stimulus
Responses per minute for Nonpreferred Freehand Stimulus
Choice Proportions for Preferred A-V Stimulus
5 hr
24 hr
5 min
Mr. R
Session

For Mr. J, the data in the top panel of Figure 7 show that the number of responses emitted for the preferred A-V stimulus during the same-deprivation phase increased from the first session to the second session and then decreased in the third session. Beginning with the fourth session, little variability in responding for the preferred A-V stimulus occurred for all remaining session blocks within both the same-deprivation and deprivation phases. The data in the middle panel of Figure 7 show that Mr. J never responded for the nonpreferred freehand stimulus during the first two sessions of the same-deprivation phase. Responding for the nonpreferred freehand stimulus increased during the third session and then little variability in responding for the nonpreferred freehand stimulus occurred for the remaining sessions in that phase as well as during the deprivation phase. The data in the bottom panel of Figure 7 show that different values of deprivation had no systematic effects on the proportion of responses allocated to the preferred A-V stimulus relative to total responses across all deprivation periods.

Figure 7

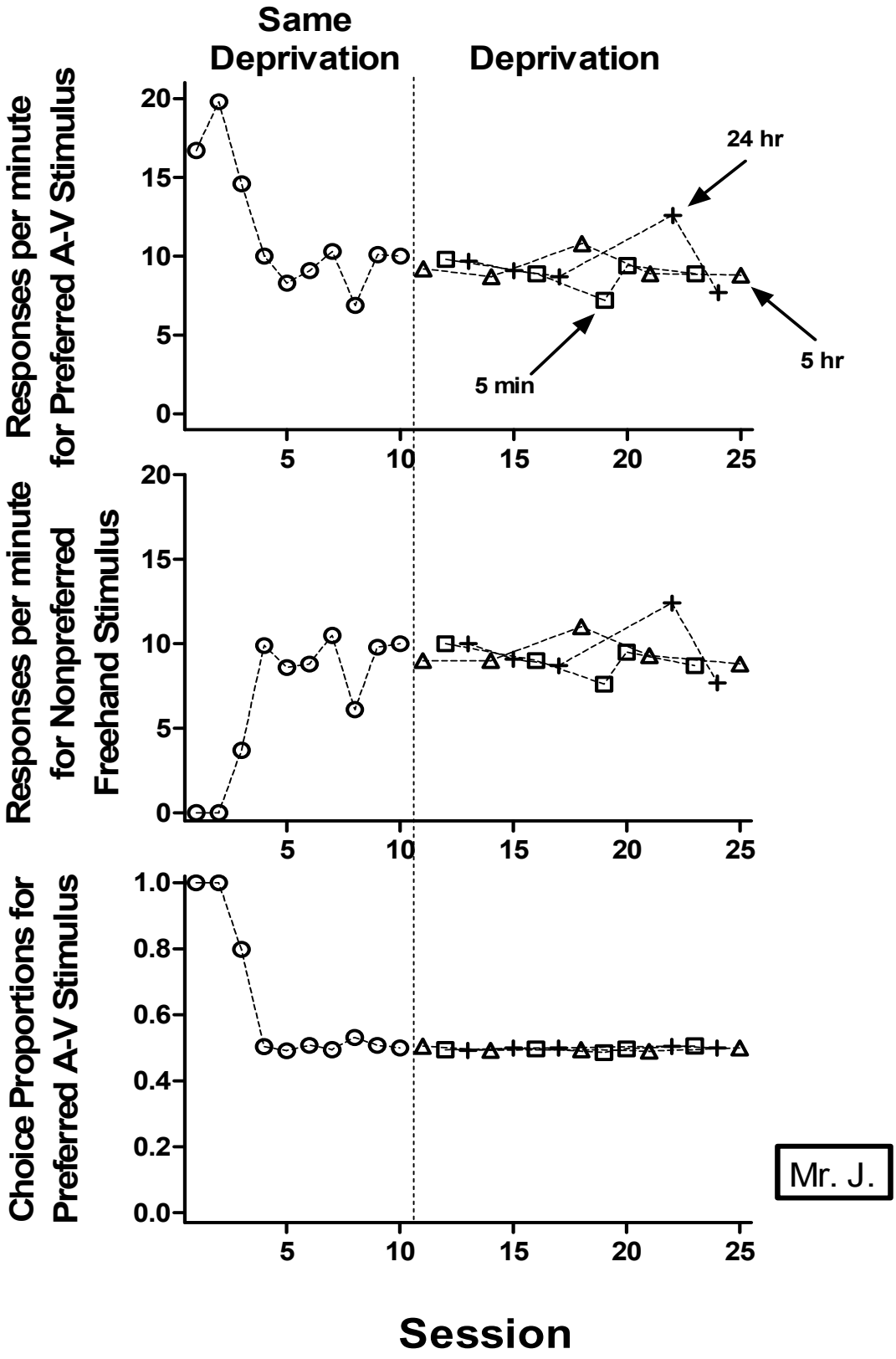

Same
Deprivation
Deprivation
Responses per minute for Preferred A-V Stimulus
Responses per minute for Nonpreferred Freehand Stimulus
Choice Proportions for Preferred A-V Stimulus
24 hr
5 hr
5 min
Mr. J.
Session

Table 3 shows mean choice proportions (and standard deviations) per session, for the preferred A-V stimulus relative to total responses for each participant during the same-deprivation phase and for all three levels of deprivation during the deprivation phase. Although data from the middle row of Table 3, for Mr. R, show that the mean proportion of responses across all sessions allocated to the preferred A-V stimulus increased slightly with longer deprivation times, however, the variability of the data, as evidenced by the values of the standard deviations, suggests that different values of deprivation had no systematic effects on choice proportions. As such, Table 3 validates the data presented in the bottom panels of Figures 5, 6, and 7 showing no systematic differences in choice proportions for any participant as a function of deprivation level.

Table 3

Mean Choice Proportions (and Standard Deviations) per Session, for the Preferred A-V Stimulus Relative to Total Responses During the Same-Deprivation Phase and for All Three Levels of Deprivation During the Deprivation Phase. Data are Shown for Each Participant.

Participant	Same Deprivation[a]		5-min Deprivation		5-hr Deprivation		24-hr Deprivation	
	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)
Mr. C	0.39	(0.04)	0.41	(0.10)	0.42	(0.05)	0.41	(0.05)
Mr. R	0.83	(0.08)	0.82	(0.08)	0.85	(0.10)	0.87	(0.08)
Mr. J	0.51	(0.01)	0.50	(0.01)	0.50	(0.01)	0.50	(0.00)

[a]Last five sessions.

Recall the hypothesis posited earlier that if responding on one alternative varies positively with the value of deprivation then the proportion of responses allocated to the deprived stimulus relative to responses allocated to the other (i.e., alternative) stimulus should diminish with lower values of deprivation. The results from the current investigation do not appear to support this hypothesis for any of the participants. However, when compared to lower values of deprivation, the hypothesis that given concurrent response alternatives, absolute response rates across sessions should be higher the longer the participants are deprived access to one of the stimuli appears to be supported for one of the participants (Mr. C) and, possibly, for a second participant (Mr. R). In particular, when two stimuli were available for participants to access in a concurrent schedule, the value of deprivation appears to have systematically affected responding for the preferred A-V stimulus. Mr. C and to a lesser extent, Mr. R, emitted more responses to the preferred A-V stimulus when they last had access to it 5-hr and 24-hr prior to the choice evaluation than 5-min prior to the evaluation. Although each participant's respective first row of data in Table 1 show that mean responses for the preferred A-V stimulus increased from 5-min deprivation to both 5-hr and 24-hr deprivation, these effects were more pronounced for Mr. C and Mr. R. The results are strengthened further by the experimental design employed in the current study. Because data are plotted for each participant on separate days (see Figure 3), the passage of time was shown not to be a controlling variable for the observed effects. For all participants, there were no systematic differences in responding for the preferred A-V stimulus during the deprivation phase between the 5-hr and 24-hr deprivation periods.

These findings are in line with Klatt et al. (2000). Not only were the effects of deprivation on responding apparent with the lowest deprivation value, but there were no systematic differences between the two higher deprivation values. A plausible reason as to why there were no systematic differences between the 5-hr and 24-hr deprivation periods is that 5-hr deprivation might have been too long for systematic differences to occur at higher values. That is, it was possible that the function asymptotes at a shorter deprivation value. Because the passage of time effectively increased the effects of deprivation on responding for the preferred A-V stimulus, decreasing the deprivation value from 5 hr could result in systematic differences in responding between the 5-min and 24-hr deprivation values. The experimenter chose the values of deprivation from Klatt et al. and the availability of the participants, and did not systematically assess the values along a continuum that would have resulted in differences in responding at deprivation values above 5 min. Further, the generalizability of the results from the study by Klatt et al. to the current study is strengthened by two additional differences. First, Klatt et al. measured responding using duration of engagement. In the current study rate of responding was measured. Second, whereas Klatt et al. presented toys to their participants, the experimenter in the current study presented computer-based stimuli.

The results from the current study also showed that participants continued to respond for the nonpreferred freehand stimulus during the choice evaluation, even though they had responded for it during the sole access component, just prior to the commencement of the choice evaluation. As such, one would expect little, if any, responding to the nonpreferred freehand stimulus during the choice evaluation; however,

three reasons could explain this persistent responding. First, adults with intellectual disabilities bring to the experimental context a long learning history of complying with tasks from staff, caregivers, etc. Even though the experimenter took care not to influence responding, it was possible that responding persisted given that the context as a whole, including the presence of the experimenter, functioned as a discriminative stimulus for responding to both stimuli. It is also possible that the participants' residential setting was quite sterile and that looking at random drawings in the experimental context beat the standard routine.

Second, the nonpreferred freehand stimulus may have had some preferred value relative to the preferred A-V stimulus. Because the experimenter did not administer a combined preference assessment prior to the start of the investigation, relative preferences between both stimuli were unknown. In fact, *The Mere Exposure Effect* (Zajonc, 1968) posited that the repeated exposure to a stimulus increases its preferred or hedonic value for that stimulus. Hence, it was possible that the separate preference assessments increased the preferred value for freehand stimuli by virtue of their repeated presentations. It was also possible that the preferred A-V stimuli were insufficiently reinforcing. That is, even though the most preferred A-V stimulus was selected for inclusion from an array of other A-V stimuli, the class of A-V stimuli might not have been preferred relative to other classes of stimuli, such as soft drinks.

Third, 5-min sole access may not have been enough time to attenuate responding during the choice evaluation. Five minutes sole access to the nonpreferred freehand stimulus attempted to ensure that the effects of deprivation were limited to only the

preferred A-V stimulus and functioned to minimize the effects of stimulus sampling (Ayllon & Azrin, 1968). Analogous to the Mere Exposure Effect (Zajonc, 1968), stimulus sampling increases the likelihood (i.e., preference) that a particular stimulus would be selected from among an array of stimuli when participants are exposed to that stimulus briefly. Brief exposure to a stimulus could result in an increase in behavior to access that stimulus as a reinforcer. At some point along the continuum of repeatedly presenting a stimulus, sampling may become satiation (Vollmer & Iwata, 1991).

Interestingly, all participants did not switch their responses to the nonpreferred freehand stimulus following the 5-min deprivation period. In fact, responding for the nonpreferred freehand stimulus by both Mr. R and Mr. J were nearly comparable during their respective same-deprivation and deprivation phases; however, as illustrated in the middle panel of Figure 6, Mr. R began to show a negative trend across sessions in responding for the nonpreferred freehand stimulus. Thus, a decrease in responding for the preferred A-V stimulus during the choice evaluation did not reliably result in an increase in responding for the nonpreferred freehand stimulus as one might expect within a paired-stimulus presentation. Given that the participants responded less for access to the preferred A-V stimulus following 5-min deprivation and did not increase responding for access to the nonpreferred freehand stimulus, the rest of the time might have been spent engaging in other operant behavior, such as looking around the context and stretching.

Systematic effects on responding for the preferred A-V stimulus, were likely not due to the differential presentation of contextual stimuli, such as the presence of the experimenter. That is, the effects of deprivation resulted in not having access to the preferred A-V stimulus as well as access to other stimuli embedded within the

experimental context. Because the participants were present in the experimental context for at least 5 min prior to the choice evaluation (i.e., during sole access to the nonpreferred stimulus), if deprivation to contextual stimuli functioned to maintain responding then responding during the choice evaluations following the 5-hr and 24-hr deprivation periods should have been comparable to responding following the 5-min deprivation period. For Mr. R and Mr. C, less responding did not occur following those periods.

Same-Deprivation and Deprivation Phases (Within-Session Measures)

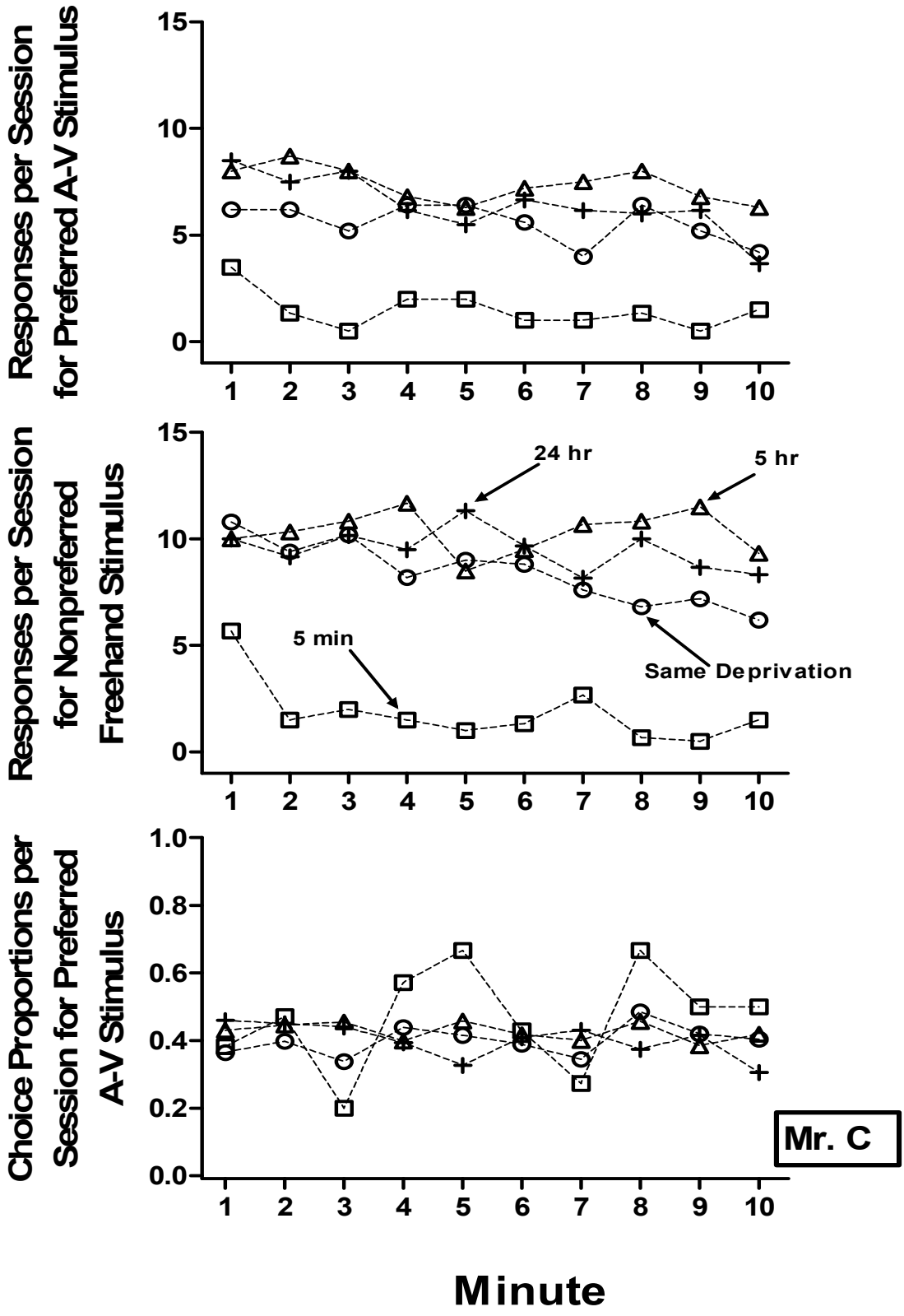
The results presented thus far are representative of responding across sessions. However, is it representative of what is occurring within a session? That is, following the 5-min deprivation period, did the observed diminution in responding for Mr. C and Mr. R occur throughout the entire session or only at certain points (i.e., minutes) within a session? Compared to higher values of deprivation, lower values of deprivation for the preferred A-V stimulus should result in overall diminished responding and choice proportions for the preferred A-V stimulus. Therefore, having had recent access to the preferred A-V stimulus should not only affect responding within the session, but further validate the across-session data.

Within-session data during the same-deprivation and deprivation phases are presented in Figures 8, 9, and 10 for Mr. C, Mr. R, and Mr. J, respectively. The data in the top and middle panels of each figure show responses per session for the preferred A-V stimulus and nonpreferred freehand stimulus, respectively. The data in the bottom panels of each figure show the corresponding choice proportions per session for the preferred A-

V stimulus relative to total responses. Multi-element data are presented in each figure and represent responding during the same-deprivation phase as well as following each of the three levels of deprivation during the deprivation phase.

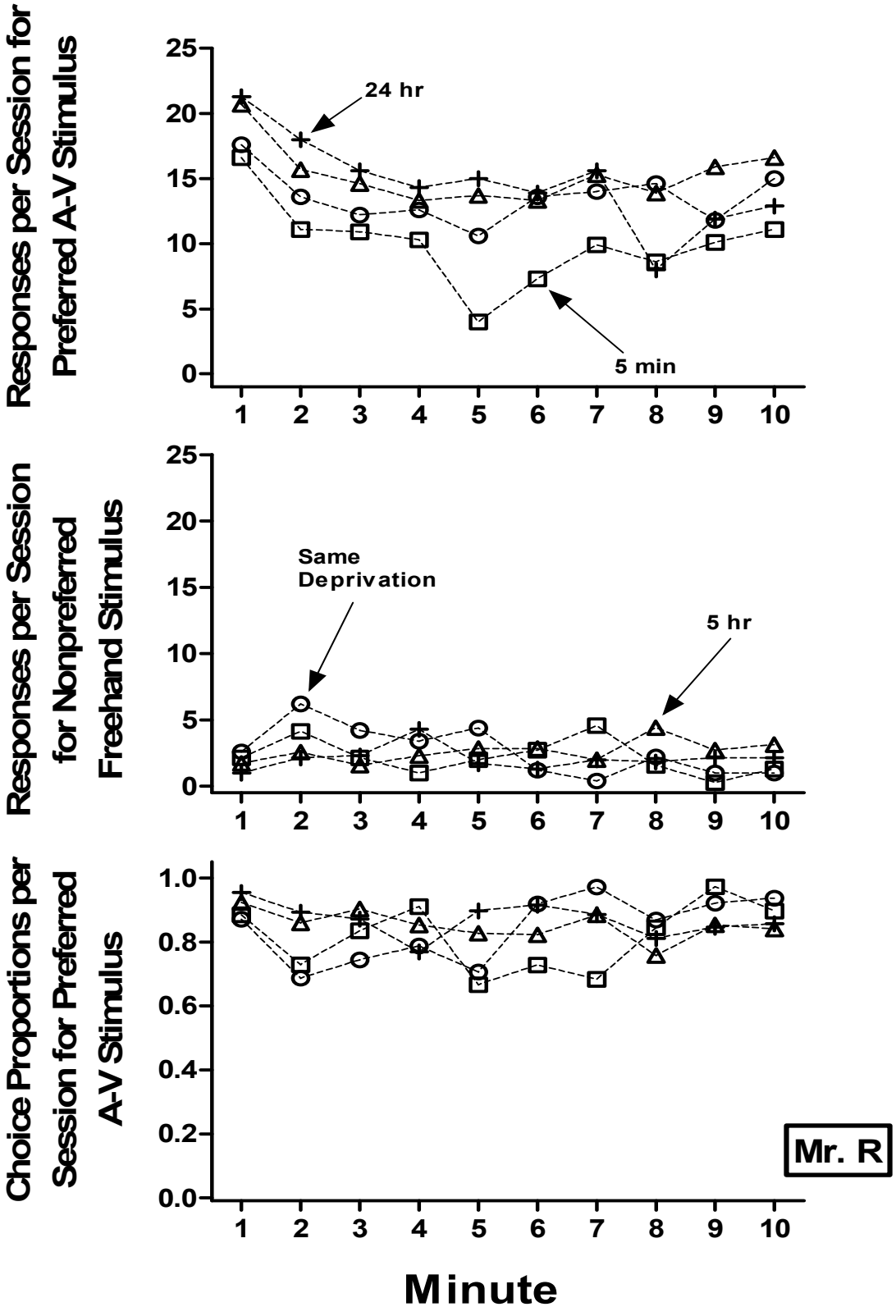
For Mr. C, the data in the top panel of Figure 8 show that responding for the preferred A-V stimulus that followed the 5-min deprivation period was less than responding that followed the 5-hr and 24-hr deprivation periods, and during the same-deprivation phase at each block of minutes. There were no systematic differences in responding for the preferred A-V stimulus that followed the 5-hr and 24-hr deprivation periods, and during the same-deprivation phase. The data in the middle panel of Figure 8 show that following the 5-min deprivation period, compared to responding during the same-deprivation phase and following the 5-hr and 24-hr deprivation periods, Mr. C responded less at each block of minutes for the nonpreferred freehand stimulus. In addition, there were no systematic differences in responding for the nonpreferred freehand stimulus following the 5-hr and 24-hr deprivation periods, and during the same-deprivation phase. The data in the bottom panel of Figure 8 show that there were no systematic differences for within-session choice proportions for the preferred A-V stimulus during the same-deprivation phase and deprivation phases; however, compared to the 5-hr and 24-hr deprivation periods, there was greater variability for within-session choice proportion of responses for the preferred A-V stimulus that followed the 5-min deprivation period.

Figure 8


Responses per Session for Preferred A-V Stimulus
15
10
5
0
1 2 3 4 5 6 7 8 9 10
Responses per Session for Nonpreferred Freehand Stimulus
24 hr
5 hr
5 min
Same Deprivation
Choice Proportions per Session for Preferred A-V Stimulus
1.0
0.8
0.6
0.4
0.2
0.0
Mr. C
Minute

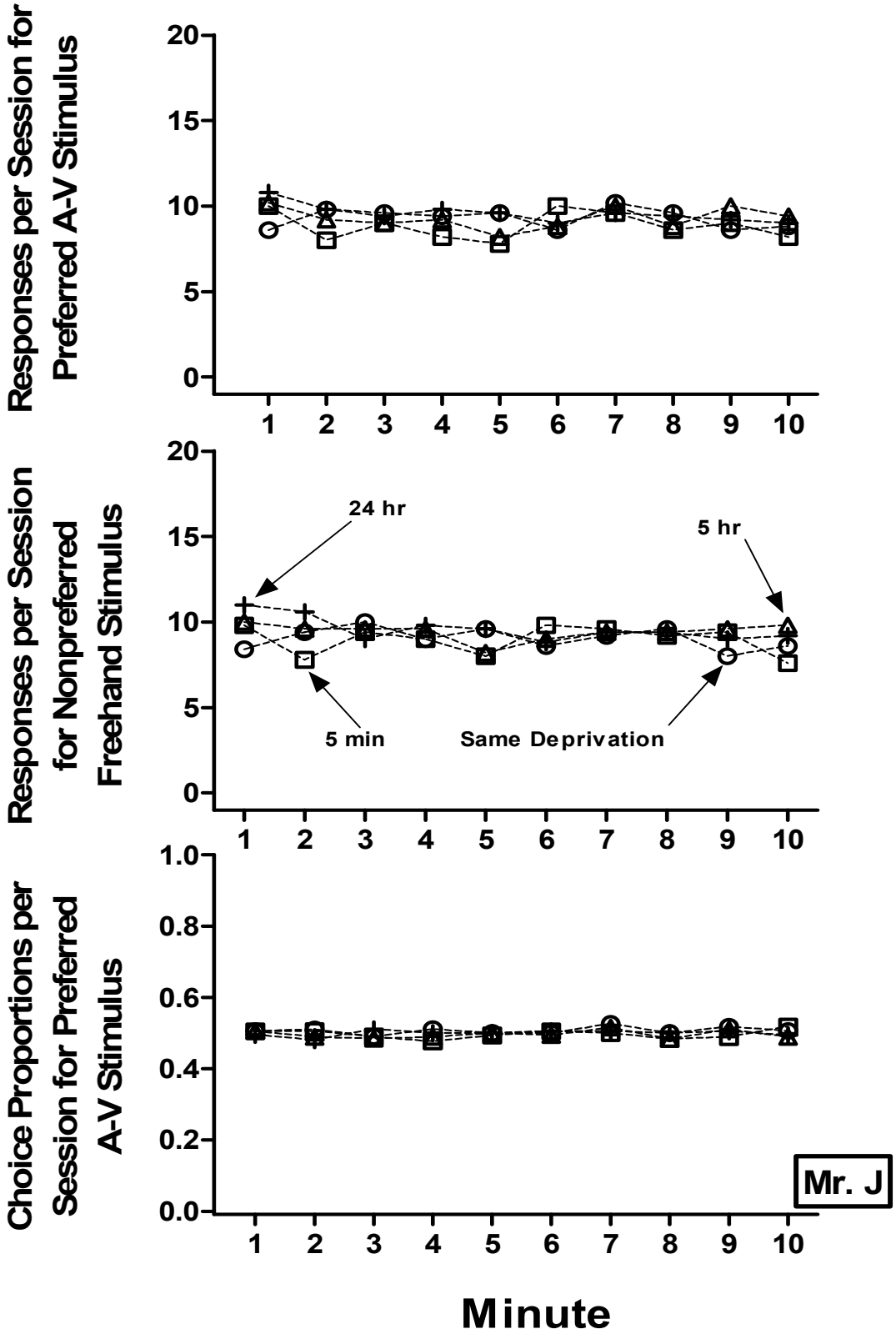
For Mr. R, the data in the top panel of Figure 9 show that responding for the preferred A-V stimulus that followed the 5-min deprivation period was less than responding that followed the 5-hr and 24-hr deprivation periods, and during the same-deprivation phase at each block of minutes except for the 8th minute. There were no systematic differences in responding for the preferred A-V stimulus following the 5-hr and 24-hr deprivation periods, and during the same-deprivation phase. The data in the middle panel of Figure 9 show that there were no systematic differences in responding for the nonpreferred freehand stimulus during the same-deprivation and deprivation phases. The data in the bottom panel of Figure 9 show that there were no systematic differences for within-session choice proportions for the preferred A-V stimulus during the same-deprivation and deprivation phases.

Figure 9


Responses per Session for Preferred A-V Stimulus
24 hr
5 min
Responses per Session for Nonpreferred Freehand Stimulus
Same Deprivation
5 hr
Choice Proportions per Session for Preferred A-V Stimulus
Mr. R
Minute

For Mr. J, the data in the top panel of Figure 10 show that there were no systematic differences in within-session responding for the preferred A-V stimulus during the same-deprivation and deprivation phases. The data in the middle panel of Figure 10 show that there were no systematic differences in within-session responding for the nonpreferred freehand stimulus during the same-deprivation and deprivation phases. The data in the bottom panel of Figure 10 show that there were no systematic differences in within-session choice proportions for the preferred A-V stimulus during the same-deprivation and deprivation phases.

Figure 10


Responses per Session for Preferred A-V Stimulus
20
15
10
5
0
1 2 3 4 5 6 7 8 9 10
Responses per Session for Nonpreferred Freehand Stimulus
24 hr
5 hr
5 min
Same Deprivation
Choice Proportions per Session for Preferred A-V Stimulus
1.0
0.8
0.6
0.4
0.2
0.0
Mr. J
Minute

The within-session results for Mr. C and Mr. R showed that depriving access to the preferred A-V stimulus for only 5-min resulted in lower levels of overall responding relative to the 5-hr and 24-hr deprivation periods. Thus, within a session, compared to increased deprivation, decreased deprivation for the preferred A-V stimulus resulted in overall less responding for the preferred A-V stimulus for two of the participants. In addition, the within-session data validates the across-session data by showing that the observed diminution in responding for both Mr. C and Mr. R occurred throughout the session and not only at certain points (i.e., minutes) within a session. However, as with the results from comparing data across-sessions, the proportion of responses allocated to the deprived stimulus was not systematically affected by deprivation for any participant.

Combined Preference Assessment

An investigation by Hartman and Klatt (2005) showed that both preference and deprivation affected responding in two boys with autism. Hence, in the current study, deprivation might not have been the sole variable that has an effect upon responding.

A combined, paired-stimulus preference assessment, conducted at the end of the investigation, directly compared preference between both sets of stimuli (i.e., freehand and A-V) and identified any potential shifts in preference within each set. That is, all pairs of freehand and A-V stimuli were presented together in the same session. Figure 11 shows the results from the combined preference assessments for Mr. C and Mr. J. Both Mr. C and Mr. J selected every A-V stimulus with a higher percentage of choices than any of the freehand stimuli.

Figure 11

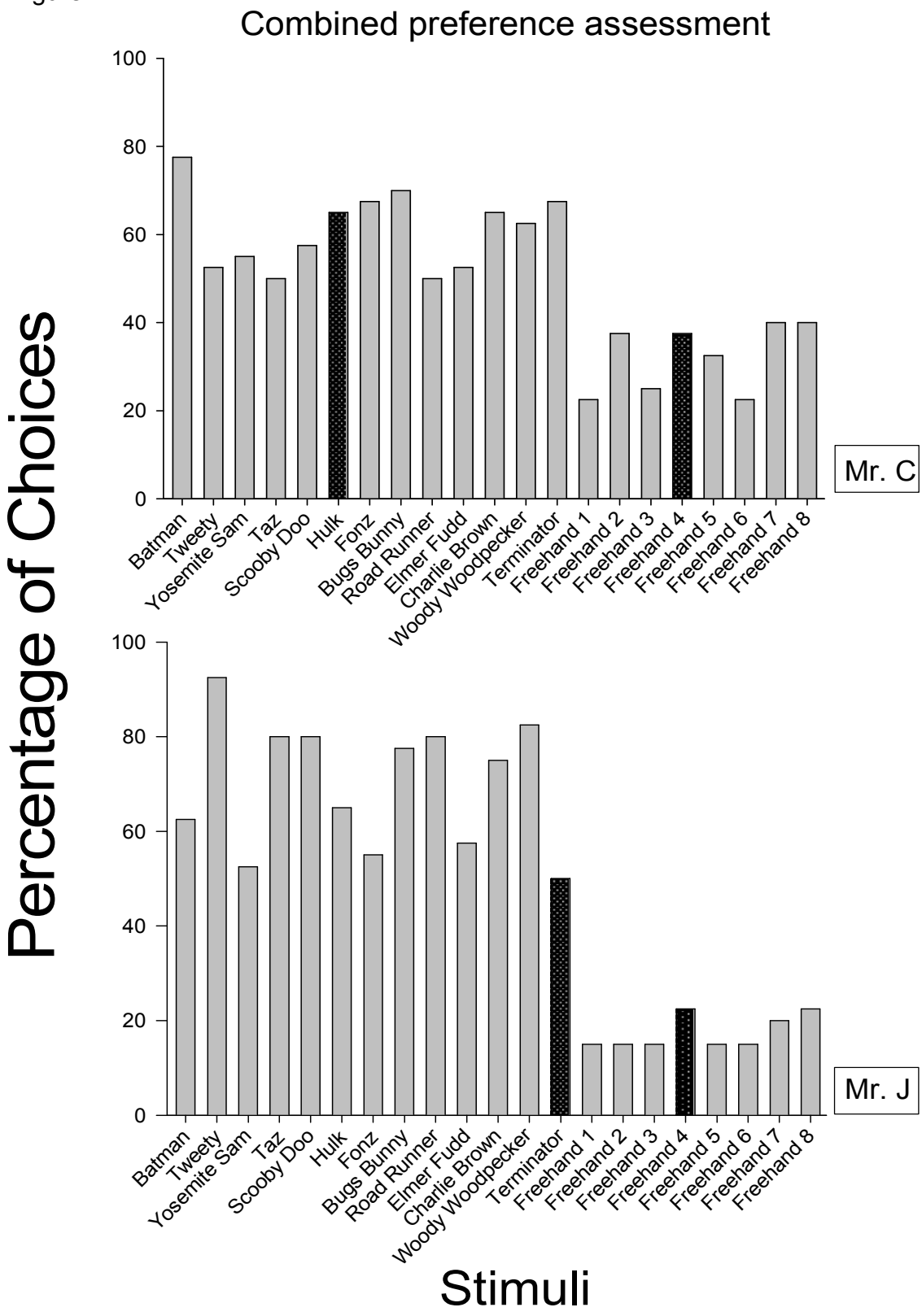
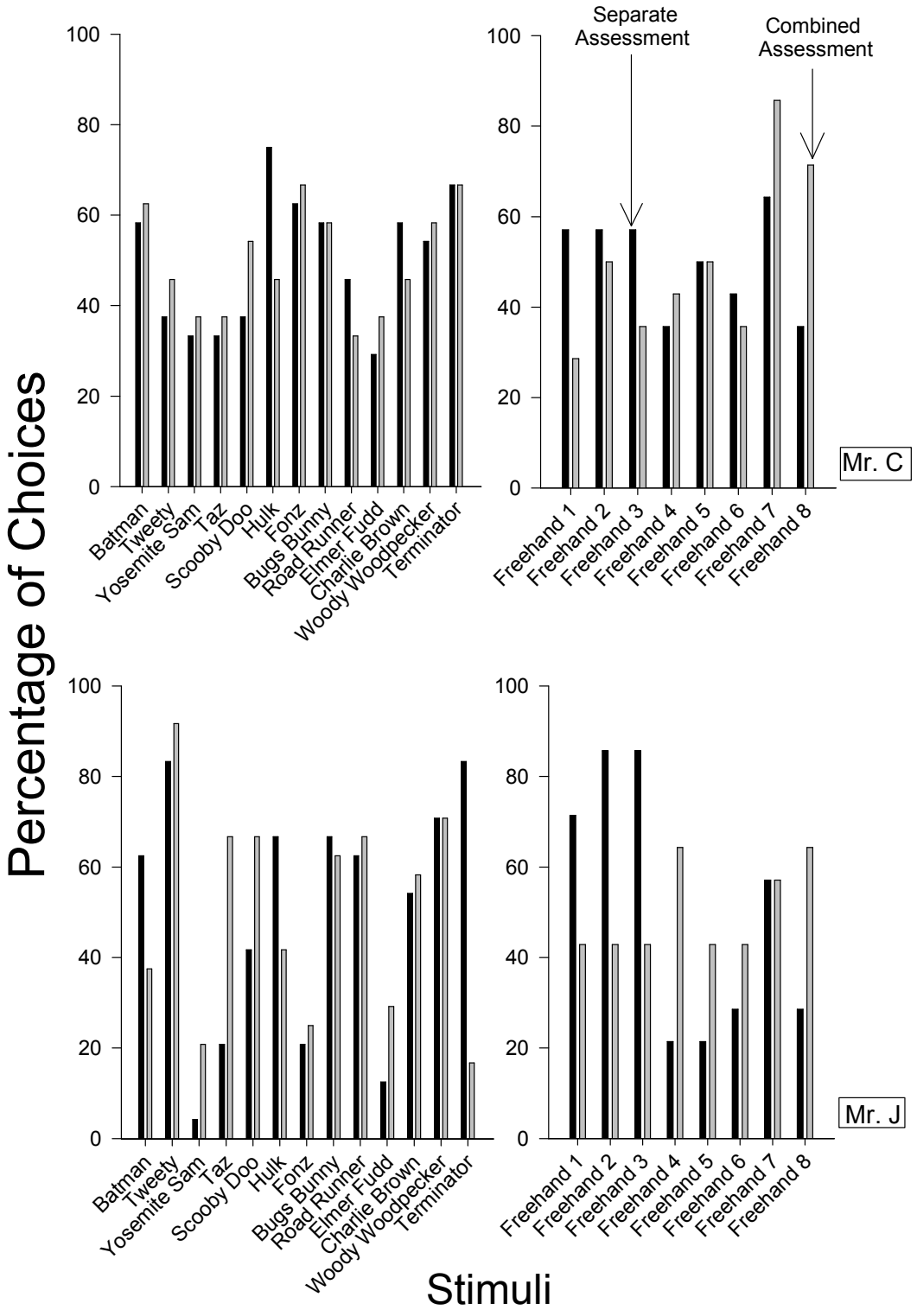

Combined preference assessment
Percentage of Choices
100
80
60
40
20
0
Batman
Tweety
Yosemite Sam
Taz
Scooby Doo
Hulk
Fonz
Bugs Bunny
Road Runner
Elmer Fudd
Charlie Brown
Woody Woodpecker
Terminator
Freehand 1
Freehand 2
Freehand 3
Freehand 4
Freehand 5
Freehand 6
Freehand 7
Freehand 8
Mr. C
Mr. J
Stimuli

Figure 12 shows the results from the separate, paired-stimulus preference assessments, which were administered prior to the start of the investigation, and compared with the results from the combined, paired-stimulus preference assessment for only those trials where the experimenter paired stimuli from within the same set (i.e., A-V / A-V and freehand / freehand). The top row of graphs shows the results for Mr. C and the bottom row of graphs shows the results for Mr. J.

During the separate preference assessment, Mr. C selected the Incredible Hulk as the preferred A-V stimulus on 75% of choice trials. However, during the combined preference assessment, Mr. C selected the Incredible Hulk on 45.8% of within-set choice trials. During the separate preference assessment, Mr. J selected both the Terminator and Tweety Bird on 83.3% of choice trials, with the Terminator selected as the preferred A-V stimulus. During the combined preference assessment, Mr. J selected the Terminator on 16.7% of within-set choice trials. However, Mr. J selected Tweety Bird on 87.5% of within-set choice trials.

Figure 12


Separate Assessment
Combined Assessment
Mr. C
Mr. J
Percentage of Choices
Stimuli
0
20
40
60
80
100
Batman
Tweety
Yosemite Sam
Taz
Scooby Doo
Hulk
Fonz
Bugs Bunny
Road Runner
Elmer Fudd
Charlie Brown
Woody Woodpecker
Terminator
Freehand 1
Freehand 2
Freehand 3
Freehand 4
Freehand 5
Freehand 6
Freehand 7
Freehand 8

For both participants, their respective preferred A-V stimulus showed the biggest decrease in percentage selected from the separate to the combined assessments relative to all other A-V stimuli. Further, as shown in the top and bottom rows of Table 3 for both Mr. C and Mr. J, mean choice proportions across all sessions for the preferred A-V stimulus were either near or below .5. Because choice proportions are a direct measure of preference between two stimuli, it was possible that shifts in preferences from the preferred A-V stimulus to the nonpreferred freehand stimulus occurred during the investigation. Changes in preference might explain why deprivation did not affect the proportion of choice responding for these participants. Although there is no way to know the ranks of these stimuli prior to the study, Hanley, Iwata, and Roscoe (2006) showed that preferences can change over time by providing frequent access to a highly preferred item. For Mr. C and Mr. J, shifts in preference for the preferred A-V stimuli might be a function of having accessed the preferred A-V stimulus repeatedly. In addition, choice percentages increased from the separate to the combined preference assessments for their respective nonpreferred freehand stimulus. As noted earlier, such an increase in hedonic value for the freehand stimuli could be attributed to the Mere Exposure Effect (Zajonc, 1968).

The results from the combined preference assessment at the completion of the study suggested that Mr. C and Mr. J selected every A-V stimulus with a higher percentage of choices than any of the freehand stimuli. As mentioned in the procedure section, the experimenter initially conducted separate preference assessments based on the assumption that pairing a preferred A-V stimulus (i.e., subjectively more interesting) with a nonpreferred freehand drawing (i.e., subjectively less interesting) would most

likely result in higher absolute response rates and increased choice proportions for the preferred A-V stimulus relative to total responses across all values of deprivation. Had the experimenter initially conducted a combined preference assessment, there was the possibility that one of the A-V stimuli could have been selected with the highest percentage of choices (i.e., deemed preferred) and a second A-V stimulus could have been selected with the lowest percentage of choices (i.e., deemed nonpreferred) for inclusion in the current study. If the experimenter were to have presented two A-V stimuli within a concurrent schedule, regardless of their initial preference values, then the experimenter assumed that, at some point, preference would likely shift from one stimulus to the other due to the repetitive nature of the study. Such a shift not only would have likely attenuated any effects from deprivation for the preferred stimulus, but it was assumed that this shift may have been less likely to occur with the pairing of an A-V stimulus and freehand stimulus within a concurrent schedule.

For Mr. J, recall from Figure 7 (top panel) that during the same-deprivation phase, responding for the preferred A-V stimulus increased from the first session to the second session and then decreased in the third session. It is possible that subsequent responding might have been due to either the development of stereotypy or a decrease in initial preference for the preferred A-V stimulus. In the combined preference assessment for Mr. J, the Terminator (the preferred A-V stimulus) and Freehand Stimulus #4 (the nonpreferred stimulus) were only one rank apart. In addition, the results from comparing the separate and combined preference assessments (see Figure 12) also showed that preference shifted downward for the Terminator, but not for Tweety Bird, even though both stimuli were selected equally during the separate preference assessment. Perhaps

offering richer reinforcers or even a variety of reinforcers during the investigation would have altered the effects (or lack thereof) of deprivation on responding with Mr. J. In their study, Klatt et al. (2000) observed that one of the participants responded less with repeated exposure to the same stimulus (i.e., the same puzzle) across all values of deprivation. To address the possibility that doing the same puzzle repeatedly resulted in less responding over time, Klatt et al. presented a choice of various puzzles to the participant. Presenting a choice of puzzles not only attenuated the decrease in responding, but systematic differences in responding became more apparent across all values of deprivation; although, systematic differences could have also been due to intermittent reinforcement that follows the presentation of puzzle variety.

Deprivation had no systematic effects on the proportion of choice responding for the preferred A-V stimulus relative to all responses for any of the participants either across- or within-sessions. It is worth noting that several studies in the animal literature (e.g., Crocetti, 1962; Dinsmoor, 1952) have shown that the effects of deprivation may result in a generalized increase in activity. For example, Dinsmoor (1952) showed that relative rates of responding for food by rats under S^D (i.e., presence of light) and S^Δ (i.e., absence of light) conditions were proportional across various levels of deprivation. That is, rats did not discriminate between stimulus conditions irrespective of the value of deprivation. Nevertheless, in the current study, since responding for the preferred A-V stimulus was somewhat positively related with the length of deprivation for both Mr. C and Mr. R, one could assume that the proportion of choice behavior allocated to responding to the preferred A-V stimulus relative to all (unmeasured) operant behavior increased with longer deprivation. However, proportions did not change with respect to

the measurement of one specific operant (i.e., responding for the nonpreferred freehand stimulus). Hence, it was possible that proportions varied with deprivation values with an operant that the experimenter neither observed nor measured.

Limitations

Five limitations emanated from the current study. First, the same preferred A-V and nonpreferred freehand stimuli were presented repeatedly to each participant. Given the nature of the single-subject design, it was possible that repeated presentations of each stimulus could have influenced responding by attenuating the effects of short-term deprivation as the number of sessions increased, especially for both Mr. R and Mr. C. Second, although the across-session data for Mr. R showed that deprivation might have affected responding for the preferred A-V stimulus following 5-min deprivation, the within-session data appears to support this effect clearly. Perhaps conducting additional sessions with Mr. R could have resulted in more convincing across-session data. Third, there was no combined preference assessment prior to the start of the investigation. Across all values of deprivation, not only were mean choice proportions for Mr. C and Mr. J at or below .5, but there were no systematic differences in responding for access to the preferred A-V stimulus for Mr. J. It is possible that preference values between the preferred A-V stimuli and the nonpreferred freehand stimuli might have been closer than assumed. Fourth, although within-set comparisons from the combined preference assessment showed possible shifts in preferences for the preferred A-V stimulus, it is unclear how much this shift was influenced by pairings with freehand stimuli within the combined assessment. Fifth, even though the stimuli presented in this study were not

explicitly available outside of the sessions, participants could have observed other individuals wearing t-shirts, for example, depicting the fictional character and, therefore, attenuated any effects due to deprivation.

Conclusions and Future Research

The results from the current study suggest that Mr. C and, possibly, Mr. R emitted fewer responses for the preferred A-V stimulus following 5-min deprivation relative to 5-hr and 24-hr deprivation. For both participants, 5-min deprivation reliably resulted in diminished levels of within-session overall responding for the preferred A-V stimulus relative to 5-hr and 24-hr deprivation. Higher values of deprivation did not increase the proportion of choice responses allocated to the A-V stimulus relative to total responses for any participant. However, compared with the results from the separate preference assessment, the combined preference assessment showed that preference for the A-V stimulus decreased for both participants and might have affected the proportion of choice responses.

Given that responding within a choice format might be a function of both deprivation and preference, additional research should investigate the combined effects of both on choice in a single-subject design. Perhaps taking frequent preference assessments during the course of such an investigation could better attribute results to possible shifts in preference.

Future research should also investigate the co-variation in preference and choice when more than one stimulus has a recent history of deprivation. For example, within the basic animal literature, Weil and Lanson (1976) investigated the effects of depriving rats

of food and water on choice responding. Two rats received free access to food and water throughout the experiment (control rats). The other two rats were exposed to four separate deprivation conditions: (a) water and food deprived for 24 hr, (b) water deprived for 24 hr with free access to food, (c) free access to both food and water, (d) food deprived for 24 hr with free access to water. Each rat was exposed to each condition at three different body weights (80 %, 85 %, and 90 % ad lib). Rats were trained to press a lever for water and pull a chain for food. During choice conditions, however, pulling the chain resulted in a contingency change whereby pressing the lever now resulted in the presentation of food. Rats chose to respond for food the longer they were food deprived. Response rates were inversely related to their ad lib weight. Similarly, rats that were water deprived did not pull the chain frequently to switch contingencies and simply responded by pressing the lever for water. Therefore, this study showed that rats allocated responses to more than one stimulus with a recent history of deprivation.

Last, additional research should also investigate the effects of deprivation that normally occur during the day on engagement with functional activities. For example, the rate of washing dishes may be a function of the last time the individual had access to that activity. Whereas washing dishes may be preferred and reinforcing, and engagement is not contingent upon engagement in any other activity, it may be important to know that an individual may not wash many lunch plates, given how recently he or she washed the breakfast dishes. This is not to say that preference assessments are unreliable. Rather, preferences could change when an activity is presented frequently relative to all other activities.

Appendix A

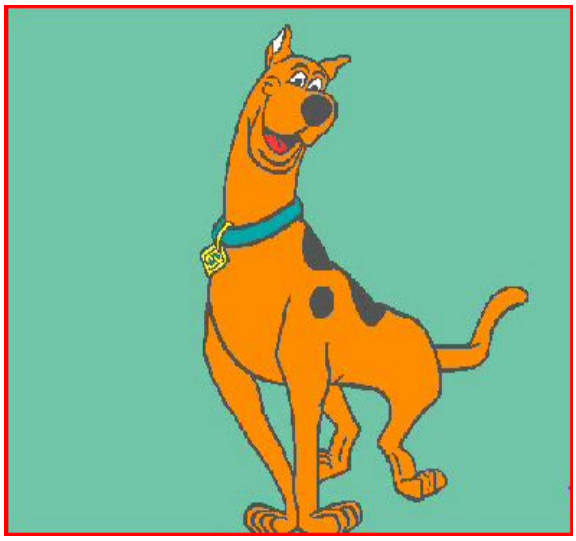
Images and verbal transcriptions of all 13 A-V stimuli.

"To the Batmobile!"

"Hello, puddy tat!"

"Ooooooooo!"

"*(Unintelligible)*"



"Huh?"

"Don't make me angry!"

"Ayyyyyyyyyyy!"

"Ready!"

"Meep-meep, pthwpth!"

"Huhuhuhuhuh"

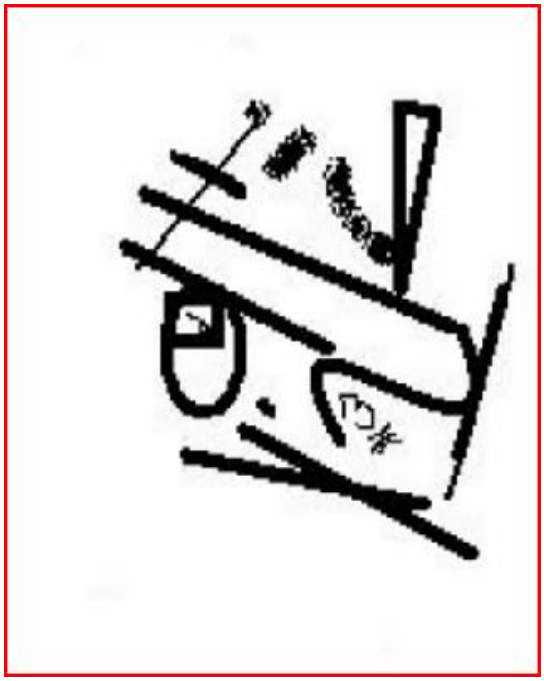
"Oh, Brother!"

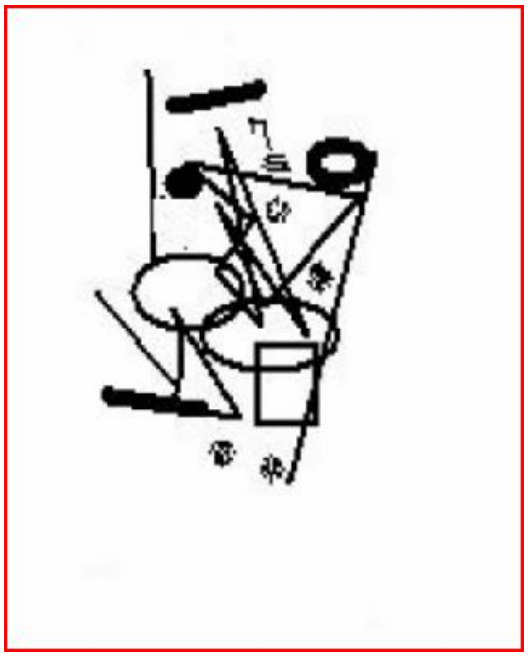
"Huh-huh-huh-hah-ha!"

"I'll be back!"

Appendix B

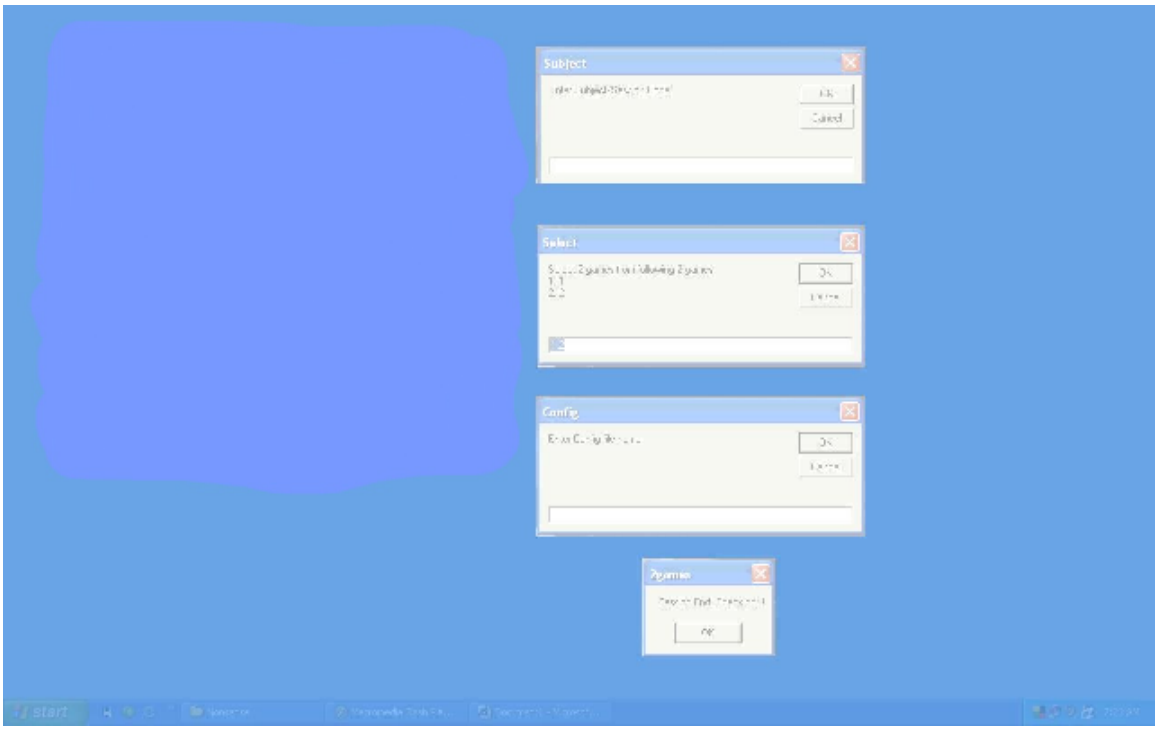
Images of all eight freehand stimuli.





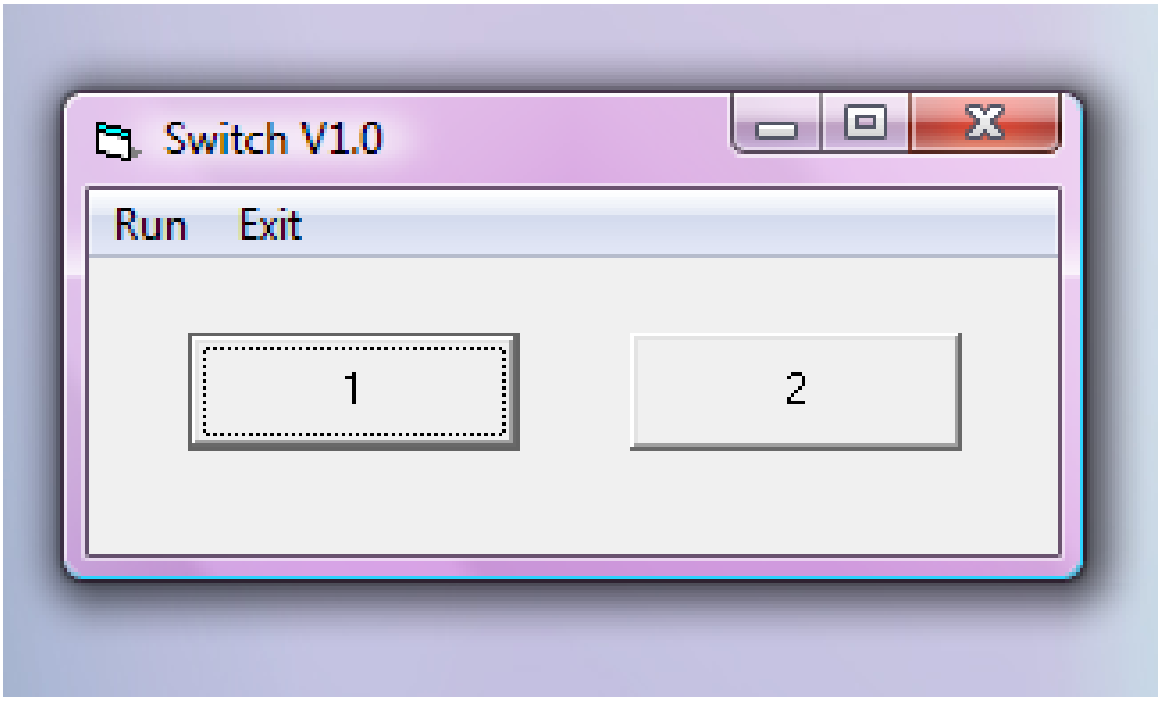
Appendix C

Screenshot image of faded dialogue boxes in laptop screen background. (*Please note that the dialogue boxes were fainter than they actually appear in this image*).



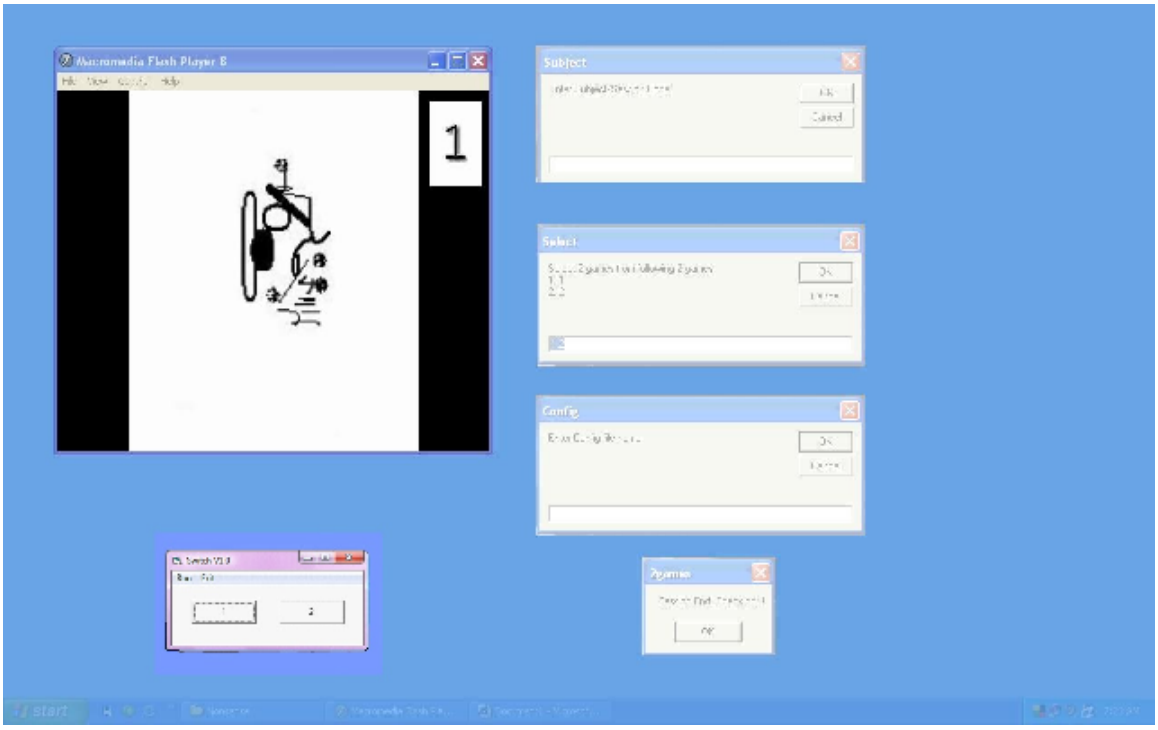
Appendix D

Screenshot image of the control panel.



Appendix E

Screenshot image of faded dialogue boxes in laptop screen background along with the presentation of a freehand stimulus embedded with the number "1," and the control panel. (*Please note that the dialogue boxes were fainter than they actually appear in this image*).



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