An Examination of Reinforcer Identification and Stimulus Discrimination in Elderly Individuals with Alzheimer's Disease

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AN EXAMINATION OF REINFORCER IDENTIFICATION AND STIMULUS DISCRIMINATION IN ELDERLY INDIVIDUALS WITH ALZHEIMER'S DISEASE

BY

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Abstract

Two experiments were conducted: The purpose of the first experiment was to identify reinforcers for each participant, and the purpose of the second was to examine discriminative learning when demonstrated reinforcers were used. Three elderly people with Alzheimer's disease and one elderly control without any signs of dementia participated. In Experiment 1 a button press was established and assorted stimuli (edible, social, and recreational) were successively tested as "reinforcers." Several stimuli were tested each day in a multi-element baseline design. The results clearly showed differential responding for different stimuli relative to response rates during extinction, and, in some cases, relative to each other. The rates varied considerably across participants. There was a marked contrast across participants in the training required to establish button pressing. In Experiment 2 a simultaneous discrimination task was trained using Blissymbols (pictographs) as the discriminative stimuli and individually identified reinforcers. Two of the participants with Alzheimer's disease initially learned to discriminate several Blissymbol pairs. Performance deteriorated after this point and the introduction of several procedures for enhancing discriminative responding (time-out, correction procedure, differential reinforcement) failed to increase learning. One participant was unable to discriminate known picture cards at this time. Discriminative stimuli for the third participant with Alzheimer's disease were simplified when he failed to learn a Blissymbol discrimination.

Two coloured cards were introduced in replacement. Once this discrimination was learned, the Blissymbols were faded in. Fading proceeded at a slow, steady pace but performance deteriorated at the final step, that is, when the Blissymbols were re-introduced. The elderly control showed a high, steady, and sustained discriminative learning rate of Blissymbols. The discrimination training results illustrate the great difficulty in establishing a simple discriminative response in individuals with Alzheimer's disease even though identified reinforcers and established procedures are used. Future research with individuals with Alzheimer's disease could further examine discrimination training, specifically looking at procedural variations (successive versus simultaneous discrimination and the role of an attending response) and exploring the potential of a discrimination task as a technique for assessing deterioration. Additionally, it is recommended that this research be replicated with individuals with early onset of Alzheimer's disease.

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An Overview of Dementia of the Alzheimer Type

It is estimated that approximately 15% of the population 65 years and older exhibit dementia (Kosik & Growdon, 1982). Two-thirds of these individuals exhibit mild to moderate disturbances in their cognitive functions and the remaining one-third display severe impairment (Schneck, Reisberg & Ferris, 1982). The etiology of dementia may be attributable to any of several factors (see Appendix A for discussion on dementia). It appears, however, that Alzheimer's disease may account for 50-80% of all cases of dementia in patients over 65 years of age (Blessed, Tomlinson, & Roth, 1968; Tomlinson, Blessed, & Roth, 1970). In Canada this represents 100,000 to 300,000 people (Alzheimer Society of Canada, 1984).

Alzheimer's disease is a progressive, idiopathic deterioration of brain cells resulting in severe impairment in intellectual and cognitive behaviors and a significant reduction in life expectancy. The disease was identified by Alois Alzheimer in 1906. He presented the case of a 51 year old woman who initially showed loss of memory and disorientation, followed by depression, hallucinations, profound dementia, and death, all in less than 5 years. Autopsy showed atrophy of the brain and a curious clumping and distortion of nerve cells in the cerebral cortex which he called neurofibrillary tangles.

The presenile dementia identified by Alzheimer came to be referred to as Alzheimer's disease. While a similar type of dementia occurs in the senium, the diagnosis of Alzheimer's disease was reserved at one time for presenile dementias. It is now recognized that the presenile and senile forms of this dementia are neuropathologically indistinguishable (Schneck et al., 1982) and show similar patterns of genetic transmission (Hesten, Mastri, Anderson, & White, 1981). The distinction between presenile and senile dementia has been said to be arbitrary and not founded on any features except age (Kushnir, 1982). Consequently, Alzheimer's disease is now used to refer to both presenile and senile dementia of the Alzheimer type.

Alzheimer's disease is characterized by the presence of certain abnormal morphological characteristics: senile plaques, neurofibrillary tangles, and granulovascular degeneration (DeBoni & Crapper-McLachlan, 1980). While these neuronal changes are also present in the normal aged, they appear in greater number and in different anatomical sites in individuals with Alzheimer's disease (Wells, 1978). With the Alzheimer population, they are most numerous in temporal regions (Hoyer, 1982). There is substantial evidence demonstrating that increases in these morphological changes are correlated with higher dementia ratings (e.g., Blessed et al., 1968). Thus, a greater number of plaques and tangles, a combination unique to the human organism (Selkoe, Ihara, & Salazar, 1982), will generally result in a more severe dementia.

In addition to these changes, Alzheimer's disease is frequently accompanied by cortical atrophy and dilated ventricles (DeBoni & Crapper-McLachlan, 1980). Further, biochemical research on neurotransmitter systems has identified a cholinergic deficiency in both the cortex and hippocampus of affected individuals (Coyle, Price, & DeLong, 1983). As medical research continues, it is expected that Alzheimer's disease will become more precisely defined.

Clinically, Alzheimer's disease presents a course of steadily declining cortical functioning which can be roughly divided into three stages. The first stage is primarily characterized by memory loss of recent events (Schneck et al., 1982). Initially, the individual may be able to compensate for this apparent "forgetfulness"; however, as time goes on additional losses in logic and judgement (Charles, Truesdell, & Wood, 1982) and learning abilities (Alzheimer Society of Canada, 1984) make this impossible. The first stage then represents subtle changes in cognitive functioning; hence the description of insidious onset.

In the second stage memory functions continue to decline while other disturbances appear; these include focal neurological signs, spatial and temporal disorientations, and language dysfunctions (ASC, 1984; DeBoni & Crapper-McLachlan, 1980). There is some disagreement as to how early in the disease language disturbances appear. There are some reports of inability to say or to understand words very early in onset of the disease (e.g., Charles et al., 1982), while others do not note aphasic signs until the "middle" stages (e.g., Sourander & Sjögren, 1970). Regardless of the time of onset, language problems do appear, the nature of which appear to be specific to the disease (Cummings' research cited in Lechky, 1984).

As deterioration continues into the final stage, there is a profound loss of all higher mental functions (DeBoni & Crapper-McLachlan, 1980). At this point the individual has lost communication and mobility; frequently, seizures occur (Alzheimer Society of Canada, 1984). It has also been noted that in the latter stage "self-stimulatory" behaviors occur; for example, the individual may engage in continued hand rubbing, scratching, or picking at him/herself or clothing (Hussian, 1981; Hussian & Hill, 1980). The protracted course of the disease is 2 to 19 years with an average of 8 years before the individual dies (DeBoni & Crapper-McLachlan, 1980).

Behavioral Interventions with Alzheimer Individuals

The application of behavioral principles to modify behavior of the elderly is a relatively new area in the field of behavior analysis. Although it is as yet an understudied area when viewed within the context of all behavioral research, it is showing modest growth as evidenced by increasing publications (Wisocki & Mosher, 1982), the formation of a behavioral gerontology special interest group within the Association for Behavior Analysis, and the appearance of a text dealing exclusively with behavioral geriatrics (Hussian, 1981). Behavioral interventions with the elderly have demonstrated increases in self-care behaviors, social interactions, and participatory behaviors, and reductions in maladaptive behaviors (for an extensive review see Patterson & Jackson, 1980).

To date there appears to be only one published study attempting a behavioral intervention with elderly people with Alzheimer's disease: Hussian (1982) manipulated entry behavior in three people with Alzheimer's disease and reduced stereotyped, self-stimulatory behavior in another three patients. Other researchers have undoubtedly, perhaps unknowingly, included individuals with Alzheimer's disease in their research. To illustrate: Research participants described as "moderately demented" (Haley, 1983) or as having "senile dementia with severe spatial disorientation" (Hanley, 1981) may in fact be individuals with Alzheimer's disease. M. L. MacDonald (personal communication, September 5, 1984) verified that some of her treatment groups, referred to as "long term psychiatric patients," having included individuals with Alzheimer's disease, for example, "low activity level" residents described in MacDonald, Davidowitz, Gimbel, and Foley (1982).

One may argue that all studies which had demented subjects could provide data which would be applicable to Alzheimer subjects. However, one problem with the subject classification "dementia" is that it includes at least two distinctively different groups: (a) individuals who presumably had "normal" behavioral repertoires until becoming demented (e.g., Hanley, 1981) and (b) long-term psychiatric patients who have aged (e.g., Libb & Clements, 1969). Wisocki (1984) notes that the psychiatric patients who have grown old during their hospital stay exhibit behaviors which are probably a function primarily of long-term institutionalization. Thus, although the behavioral repertoires of these two groups may be topographically similar, they represent vastly different behavioral histories. Consequently, research which has studied elderly psychiatric patients may not be applicable to modifying behavior of individuals with Alzheimer's disease.

When the studies with confused or withdrawn nonpsychiatric subjects are isolated another problem arises. Specifically, this does not appear to be a homogeneous population. Hence generalization of findings to the Alzheimer population must be done cautiously. To illustrate: Baltes and Lascombe (1975) modified socialization in an 80 year old woman described as confused and paranoid who had a history of alcoholism and who hadn't left her room for one and one-half years since a fracture. This appears to be a case of Korsakoff's syndrome. Korsakoff's is a partially reversible organic brain condition which recently has been associated with learning impairments of a different nature than those associated with Alzheimer's disease (Kopelman, 1985).

It is reasonable then to question whether an intervention demonstrated effective with elderly demented will be applicable to individuals with Alzheimer's disease. MacDonald et al. (1982) provide data which suggests that identical procedures may have differential effects with different subgroups among geriatric samples. She demonstrated that several behavioral interventions, for example social reinforcement of meaningful activities, had differential effects on patients grouped according to activity levels. She found, with respect to meaningful activity, that restructuring the physical environment and social reinforcement had little or short term effect on the rate of meaningful activity in elderly people who were at a relatively low activity level; whereas patients who were previously determined to be at a relatively high activity level showed great increases in activity as a function of these interventions. Thus, elderly geriatric patients, grouped on level of activity only, showed differential effects of the same treatment. As previously stated, individuals with Alzheimer's disease were probably in the group of low activity individuals. Given the progressive, deteriorating course of Alzheimer's disease and associated disruption of cognitive behaviors, the Alzheimer population presents a subset of demented elderly and as such deserves individual examination.

Both of the studies in Hussian's (1982) paper manipulated problematic behaviors in individuals with Alzheimer's disease through enhancing stimulus control. In the first study large vividly coloured cues which he called "supernormal" visual stimuli were established as discriminative stimuli. Attention to orange rectangles or arrows was consequated with a favoured food and attention to a blue circle was followed by a noxious noise. The behavior of entering hazardous places was dramatically reduced in two of the three patients when these stimuli were located in their respective places. Introduction of reinforcement for not engaging in the behavior had only a minimal effect. In the second study attention to another supernormal stimulus (red circle) was consequated with candy or fruit. A differential reinforcement procedure wherein designated responses incompatible with the targeted stereotyped response (e.g., manipulation of clothing) were reinforced was effective in reducing the targeted behavior only when the supernormal stimulus was present. The differential reinforcement procedure alone was insufficient to effect behavior change. In both of these studies modification of a previously established behavior was achieved when discriminative stimuli, with a history provided by Hussian, were introduced. The effects of manipulation by consequent control only were minimal.

Further data on the modification of individuals with Alzheimer's disease can be gleaned from a pilot study conducted by the author. In the pilot study three elderly people with Alzheimer's disease were trained to name Blissymbols. (The reader is referred to Appendix B for a detailed description of this study.) Blissymbols are pictographs which were displayed as black graphics on a white background with overall dimensions of 12.5 cm by 20.5 cm. The training procedures that were employed have been demonstrated to be very effective in teaching retarded children to name pictures (Olenick & Pear, 1980; Stephens, Pear, Wray, & Jackson, 1975; Welch & Pear, 1980). While the purpose was to train novel names and document retention, the study was limited by the fact that only one of the three participants learned to name Blissymbols. The participant who did show learning (four Blissymbols were learned to the criterion defined in the study) appeared in many respects to be less impaired than the other two participants. For example, she could recount events that she had participated in the previous day and she was oriented to her current environment. It is possible then that as the disease progresses, impairment is so severe as to prevent learning even when established procedures are implemented. At the conclusion of the pilot study, however, it was not known whether the lack of learning was due to Alzheimer's disease or other variables. It may have been not that learning per se was impossible but that the task was too complex or too abstract. Hussian (1982) mentioned that signs traditionally associated with danger or direction were not effectively established as discriminative stimuli, thus he opted for the supernormal stimuli. Blissymbols do approximate directional signs. Another possibility, and the simplest explanation, is that the stimuli which were consequent on naming behavior were not in fact reinforcers. A positive reinforcer is defined as a stimulus which strengthens the response it follows (Skinner, 1974). The issue of the reinforcing value of the consequences employed must be reviewed before other explanations of the results can be considered.

Statement of the Problem

There appears to be only one published study modifying the behavior of individuals with Alzheimer's disease. Hussian (1982) demonstrated a reduction in inappropriate behaviors and pinpointed the critical role of stimulus control in effecting this change. With respect to the establishment of new responses, pilot work by the author has illustrated the difficulty and low success rate in teaching new responses. This pilot work clearly directs future study to initially defining reinforcers in the Alzheimer population. The following studies first identified reinforcers in elderly people with Alzheimer's disease and then investigated the establishment of discriminative responding using these reinforcers.

EXPERIMENT 1

Identification of Reinforcers in Elderly Individuals With and Without Alzheimer's Disease

The selection of reinforcers for the elderly in general has been identified as idiopathic. In Hussian's view "age-related changes as well as cohort characteristics often make it necessary to depart from the usual schedules and sources of reinforcement" (Hussian, 1981, p. 48). Reinforcers which have been most frequently selected by investigators for use in research with the elderly are foods (e.g., Baltes & Lascomb, 1975), social interactions (e.g., Geiger & Johnson, 1974), and money (e.g., Ankus & Quarrington, 1972). When geriatric patients themselves have been directly solicited for stimulus preferences using a Reinforcement Survey Schedule (Cautela, 1972; Cautela & Kastenbaum, 1967), considerable preference was for edibles of sweet, soft, and easy to eat characteristics and recreational activities which were relatively sedentary and solitary such as music and theatre (Wisocki, 1982). This apparent discrepancy between stimuli which have been demonstrated as reinforcers with the elderly and stimuli which have been labelled as reinforcers by the elderly may reflect the idiosyncratic nature of reinforcers with this population. Alternatively, it may simply illustrate that stimuli we state a preference for and reinforcing stimuli are not necessarily the same. That preferred (defined by an approach response) and reinforcing stimuli may match, but do not necessarily need to match, has been recently demonstrated with the mentally retarded (Pace, Ivancic, Edwards, Iwata, & Page, 1985).

When we focus on the reinforcers used with the population of individuals with Alzheimer's disease they fall into the categories of edible, social, and recreational. Hussian (1982) used foods (candy, fruit, and "favoured foods," e.g., apple sauce, cola drink, and M & M's), social interaction (30 seconds), or exposure to an exterior view (30 seconds). While these can be taken as suggestions for the selection of potential reinforcers for the Alzheimer population, it must be noted that Hussian did not consistently show behavior change when these stimuli consequated the target behavior. Pilot work by the author demonstrated that praise and music were reinforcers for one elderly woman with Alzheimer's disease. However, various consequences (praise and edibles) did not appear to establish learning in two other participants with Alzheimer's disease, although care had been taken to select items they stated that they liked.

Martin and Pear (1983) have stated that the simplest way to determine whether or not a stimulus is a reinforcer is to conduct an experimental test. Some time ago Ankus and Quarrington (1972) attempted to assess the reinforcing value of various stimuli with elderly psychiatric patients by examining lever pulling response rates on an intermittent schedule of reinforcement. A schedule of reinforcement may be continuous wherein every response is reinforced, or intermittent wherein responses are only occasionally reinforced following some rule. Each schedule generates a characteristic response rate and pattern. The intermittent schedule Ankus and Quarrington employed was a fixed-ratio schedule; that is, a stimulus was delivered after a fixed number of level pulls was emitted. They did not find characteristic response rates when pennies were delivered but did find characteristic behavior when liquids were delivered if deprivation levels were manipulated. That is, only when a deprivation state was established deliberately did liquids function as reinforcers and generate fixed ratio behavior. The utility of their procedure is limited by the deprivation levels which appear necessary to be established. Additionally, generating characteristic schedule behavior in human participants in general has been identified as difficult (Lowe, 1979). Thus, an experimental model of establishing fixed-ratio behavior to test potential reinforcers does not appear to be feasible.

Recently two studies with profoundly retarded children and adolescents have presented relatively easy ways of determining reinforcers. Wacker, Berg, Wiggins, Muldoon, and Cavanaugh (1985) used a microswitch which could be activated by a designated motoric response (raising arm or head) to evaluate potential reinforcers (battery activated devices). After several sessions of baseline, two potential reinforcers were presented contingent on the motoric response in alternating sessions. (With some of the students two more potential reinforcers were evaluated after several sessions). Reinforcers were determined on the basis of duration of responding during a session and differential responding was observed.

Pace et al. (1985) selected an imitative response or instruction-following behavior, different for each participant, to assess previously determined "preferred" stimuli. After a baseline of several sessions the participants were presented with either a preferred or nonpreferred stimulus following correct responses. Preferred and nonpreferred conditions were reversed several times. Reinforcer value was determined by percentage of correct responding and a reinforcer was clearly identified for each student. More than one reinforcer was identified for two students by sequentially introducing additional stimuli.

Both of these studies are excellent demonstrations of simple responses and dependent variables which are suitable for expedient testing of the reinforcing value of stimuli. As pilot work with individuals with Alzheimer's disease has indicated, a simple response is essential as establishment of complex responses may obscure the demonstration of reinforcement.

These studies offered two designs for testing stimuli - alternating treatments or reversal designs. The alternating treatments design (Barlow & Hayes, 1979) is a version of the multi-element design (Sidman, 1960), also known as the multiple schedule design (Hersen & Barlow, 1976), and simultaneous treatment design (Kazdin, 1982). In the multi-element design two (or more) baselines of the same behavior maintained by different contingencies are established at the same time. Each baseline is associated with a distinctive stimulus. The multi-element design is particularly suited for research with Alzheimer's disease as it allows comparisons to be made between experimental conditions even though the baseline might be changing. As one may expect gradual deteriorations over time with individuals with Alzheimer's disease, reversals may be impossible to obtain. With a multi-element design, disease deterioration will affect each baseline equally. Multi-element design has been recommended for research with the aged in general (Rebok & Hoyer, 1977). Additionally, a multi-element design allows for the comparison of several conditions within one session or day.

The purpose of the present experiment was to identify reinforcers for elderly people with Alzheimer's disease. A button-press response was selected as an easily established, non-strenuous response which did not involve fine motor coordination. A modified multi-element design was employed wherein several stimuli were tested each day with the stimulus itself representing the distinctive stimulus; during baseline conditions no stimulus was present. Reinforcers were identified by the associated response rates. Although intermittent schedules were introduced, the purpose was not to establish characteristic schedule behavior but rather to preclude potential satiation effects.

Method

Subjects

Four elderly people, three with Alzheimer's disease and one healthy older man who had resided in a personal care home for many years participated in Experiment 1.

Diagnosis of Alzheimer's Disease. The individuals with Alzheimer's disease had clinical histories compatible with Alzheimer's disease and were diagnosed as having Alzheimer's Dementia by a geriatrician. The geriatrician's diagnosis was based on an interview with each participant and a review of his/her medical records. This procedure yielded a clinical diagnosis of dementia and excluded other specific causes of dementia, for example, hypothyroidism, and multi-infarct dementia.

Assessment and Screening Measures. Three evaluations were completed for each participant. The first was a brief Mental Status Questionnaire (MSQ), developed for assessment of cognitive impairment in the Canadian elderly, consisting of 10 questions relating to orientation and memory (Robertson, Rockwood, & Stolee, 1982). The participant was asked to give his/her full name and address, the year, month, and day of the week, his/her age, the name of the Prime Minister, and the year the first World War started. He/she was then given three names of objects to remember, asked to count backwards from 20, and asked to recall the names of the three objects. An individual scoring 7 or greater, based on one point for each correct answer, would be considered "normal" or not showing dementia; whereas an individual scoring 0 to 2 would be considered to characterize dementia of a severe degree.

The second evaluation was the Aphasia Screening Test (from Russell, Neuringer, and Goldstein's (1970) version of the Halstead Rietan battery) which consists of 32 tasks. The participant was asked to name common objects (e.g., baby) and geometric figures (e.g., triangle); to copy geometric figures (e.g., cross) and a common object (key); to write a word when presented in printed form and when presented pictorally; to spell the names of geometric figures (e.g., square); to read letters, words, numbers, and passages of varying lengths; to repeat words and sentences; to compute; to explain the meaning of a sentence; to follow written instructions; and to demonstrate the use of a common object (key).

The third evaluation was the Geriatric Evaluation by Relative's Rating Instrument (GERRI) which is a rating scale for evaluating primarily cognitive and social functioning in elderly outpatients as observed and rated by a significant other (Schwartz, 1983). The GERRI consists of 49 items describing cognitive functioning, for example, remembers where clothes are placed; social functioning, for example, shaves or puts on makeup, combs hair without help; and mood, for example, reports feeling optimistic about the future. These items are rated on a 5 point scale with 1 representing "almost all the time" and 5 representing "almost never." (A sixth category, "does not apply," refers to cases where there is no opportunity to perform the behavior.) A low score represents a high level of functioning whereas a high score reflects severe deterioration. The GERRI was selected for two reasons: (a) the items all describe discrete behavioral units thereby giving the GERRI preference over rating scales involving inference about the individual's behavior (Schwartz & Lowe, 1983a; 1983b); and (b) the GERRI is designed to assess an elderly population living in the community which more closely approximated the participants of this study. A staff nurse who was in frequent contact with the participant completed the GERRI. There were two items in the cognitive cluster (Items 41 and 47) and five items in the social cluster (Items 3, 7, 12, 15, and 42) which did not apply to some of the participants; therefore they were omitted from all the participants' scores.

Tim. Tim was the participant without Alzheimer's disease included for comparison purposes. He was 61 years old and had resided in the personal care home for 15 years. He was cerebral palsied at birth and consequently paraplegic. Although Tim had not received any formal education he had learned some elementary reading. According to his performance on the Wechsler Adult Intelligence Scale-Revised (WAIS-R) and the Wechsler Memory Scale (WMS), Tim would be classified as borderline mentally retarded without any memory impairment. He was oriented to person, time, and place, and he responded correctly to all 10 questions on the MSQ. His performance on the Aphasia Screening Test showed only reading, spelling, and computational difficulties, all which can be attributed to lack of training rather than impairment. Tim's scores on the GERRI, total and individual cluster scores, are presented in Table 1. Ratings of his functioning were superior to that expected of an individual with the least deterioration.

Christina. Christina was 90 years old and had an approximate 3 year history of dementia. Although born and educated in Europe, she had lived in Canada for over 50 years and was fluent in

Table 1

Mean GERRI Scores* for Each Participant

Participant	Cognitive Functioning	Social Functioning	Mood	Total Score
Tim	1.3	1.3	1.6	1.4
Christina	3.5	3.0	2.4	3.1
Lena	3.7	2.5	3.1	3.2
Adam	4.0	2.6	2.8	3.3

*All items were rated in a 5 point scale where 1 = almost all the time and 5 = almost never.

English. At the start of the research she lived in hospital and was awaiting permanent placement in a personal care home; she had been hospitalized for 1 year. Christina was oriented to person and place but not time. On the MSQ she was able to give her full name and counted backward from 20 to 16. She was not able to give an adequate response to the other items. On the Aphasia Screening Test Christina was able to name familiar objects but could not name geometric figures. She showed moderate difficulty in copying geometric figures and a familiar object. She had some difficulty in following the instruction to place her left hand to her right ear. She showed great difficulty in spelling, both oral and written, and calculating. She could readily read words and brief passages; however, she had some difficulty in repeating lengthy words (the latter partially attributable to hearing difficulties). She did not appear to have any difficulty understanding what she read. Christina's GERRI scores are presented in Table 1. Overall, ratings of her functioning correspond to that expected of an individual with a high degree of deterioration. Ratings of her cognitive functioning were at the lower level of high deterioration.

Lena. Lena was 90 years old and had shown signs of dementia for about 5 years. She was born and educated in Winnipeg. At the time of this study she resided in a personal care home and had lived there for almost 3 years. Lena was oriented to person but not to place or completely to time. On the MSQ she was able to give her full name and the current month. She correctly completed the counting backwards task when repeatedly prompted "more, more." The other questions were not adequately answered. On the Aphasia Screening Test Lena was able to name familiar objects and one of the geometric figures, square. She was able to draw the simple geometric figures but had serious difficulty in drawing a cross and a key. She was unable to write or to spell. She was able to read words and brief passages but was unable to do a reading task that involved shifting sets from numbers to numbers in written form (7 SIX 2). She showed some left-right confusion. She was able to complete one simple computation. She had some difficulty in repeating words (partially due to a mild hearing impairment) yet no difficulty understanding what she repeated. Lena's scores on the GERRI are presented in Table 1 and overall her ratings correspond to those expected of an individual with a high degree of deterioration. Her ratings reflected minimal impairment in social functioning for an individual with a high level of deterioration but very high impairment in mood.

Adam. Adam was 87 years old and had at least a 5 year history of dementia. Adam and Lena were siblings. He resided in a personal care home and had been admitted 5 months prior to the start of the study. He received .5 mg Haloperidol in the evening (this was administered on a p.r.n. basis for agitation). He was the only participant to receive any psychotropic medication. Adam was oriented to person but not to time or place. On the MSQ he was able to give his first name but needed prompting to give his surname. He did not adequately answer any of the other questions.

On the Aphasia Screening Test Adam was able to name some familiar objects but not able to name any geometric figures. He had serious difficulty in copying geometric figures. He had mild difficulty in reading yet little difficulty in repeating and could explain the meaning of a brief statement that was read. He was unable to write and showed great difficulty in spelling and computing. He had complete left-right confusion. Neither Adam nor any of the other participants displayed evidence of visual field deficits as measured, for example, by missing the left half of a reading passage or one arm of a cross being copied. Adam's scores on the GERRI are presented in Table 1. Ratings of his functioning reflect those of an individual with a high degree of deterioration. Ratings of cognitive functioning show a much higher level of deterioration in this area relative to social functioning and mood.

Informed consent was obtained from the closest living relative of the individuals with Alzheimer's disease. Additionally, the participants themselves agreed to repeated visits by the experimenter. In the case of Tim, informed consent was obtained from the participant himself.

Setting, Apparatus, and Materials

Sessions were conducted in a private room at the residence of each participant. Sessions with Christina and Lena took place in a nurse's office and meeting room, respectively. In these cases the participant and the experimenter sat adjacent to each other at the desk or board table which was available in the room. Sessions with Adam and Tim were conducted in their bedrooms where the participant and the experimenter sat facing each other across a small portable table. Sessions were conducted at the same time every day.

A console measuring 7.3 cm by 13 cm by 5.2 cm with a button and red light on the top was placed directly in front of the participant. A counter which automatically recorded button presses and the light control switch were held in the experimenter's lap out of sight from the participant. A stop watch and data sheet with 1 second intervals in 3 minute blocks were placed on the table to the experimenter's right. The stimulus which was being tested was displayed in clear view either to the right or left of the participant. (This position remained constant but varied across participants.) The stimuli which were tested as reinforcers included assorted food and drink items for all participants, pennies for Lena and Adam, a hurdy gurdy and gardening book for Christina, and magazine pictures depicting family scenes for Lena.

Procedure

Sessions were conducted weekdays individually with each participant. On a given day several stimuli were successively tested. The testing block for each stimulus proceeded as follows: The stimulus was placed on the table beside the console. The console light was illuminated, and the participant was instructed "press the button as much as you'd like, sometimes you'll get something for pressing it." When the participant pressed the button and met the ratio requirement set for him or her (described below) a portion of the stimulus was presented to him or her. The duration of the testing block, excluding time to deliver the stimulus and set up the next portion, was 3 minutes. At the end of the test block the console light was turned off and the stimulus was removed from the table. There was a brief interval between the testing of successive stimuli and a break was given after four to six stimuli had been tested. From 4 to 13 stimuli were tested in this fashion each day. A particular stimulus was tested over several days with attempts made to test it both at the beginning and near the end of the session. Praise was tested for all participants and during this stimulus test a coloured picture (7.5 cm by 6 cm) of a teddy bear was placed on the table. At least once during a session a 3 minute extinction block was interspersed. During extinction all procedures were identical except a stimulus was not present on the table and no consequence was delivered after the ratio was met. In all cases when the participant asked questions about the button press, the experimenter said "you can press the button if you'd like."

The stimuli tested for each participant are listed in Table 2. Individualized procedures and schedules of reinforcement for each participant are described below.

Tim. Five stimuli were tested over two days with Tim. The stimuli were: orange (1/4 of a section), 7-up (5 ml), grape (one-half), orange crush (5 ml), and praise (consisting of "good" or "that's great" or "you're really doing good"). Four stimuli

Table 2

Stimuli Tested as Reinforcers for Each Participant

Tim	Christina	Lena	Adam
orange (1)[a]	coffee (5)	chocolate (7)	salami (11)
7-up (1)	cookies (4)	fruit drink (10)	beer (2)
grapes (2)	praise (5)	ice cream (8)	peanuts (12)
orange crush (1)	music (4)	pudding (8)	cheese (10)
praise (1)	gardening book (4)	chips (4)	cookies (10)
		pretzels (3)	fruit drink (2)
		cheese (1)	M & M (7)
		lemon lime drink (3)	ice cream (2)
		pennies (3)	pennies (2)
		social interaction (6)	praise (10)
		praise (2)	

[a]numbers in parenthesis indicate the number of times that particular stimulus was tested with that participant.

and two extinction blocks were tested each day. On both days the schedule of reinforcement for button pressing was fixed ratio 5 (FR5), that is, only every fifth button press was consequated with presentation of the stimulus being tested.

Christina. Five stimuli were tested over five days with Christina. The stimuli were: coffee (5 ml), digestive cookie (bite-sized piece), praise (consisting of "good" or "that's fine," smiling, and stroking her arm or hair), music (15 seconds played on the hurdy gurdy), and viewing one page of a gardening catalogue. From four to seven stimuli and one or two extinction blocks were tested each day. On Days 1 and 2 a fixed ratio 3 (FR3) schedule of reinforcement was in effect; on this schedule only every third button press was consequated by delivery of the stimulus being tested. On Days 3 to 5 inclusive the ratio requirement was increased to a FR5.

Lena. Eleven stimuli were tested over eight days with Lena. The stimuli were: chocolate (one-half of a maple bud), fruit drink (5 ml), ice cream (spoonful of chocolate swirl vanilla), pudding (spoonful of butterscotch flavoured), potato chip (bite-sized piece of salt and vinegar flavoured), pretzel (2 cm piece), cheese (1 cm cube), lemon-lime drink (5 ml), one penny, social interaction (in the form of showing her magazine pictures and prompting conversation about her family), and praise (consisting of "good" or "you're doing well" and stroking her hair or back). From 4 to 13 stimuli and one or two extinction blocks were tested each day.

On Day 1 a schedule of continuous reinforcement (CRF) was in effect wherein every button press was followed by presentation of the stimulus being tested. After the seventh item a FR3 schedule was introduced and remained in effect until the end of the session. On Day 2 the first button press in the test block for a particular stimulus was followed by delivery of the stimulus and thereafter only every third button press was reinforced (FR3). This schedule was continued on Day 3. On Days 4 to 8 inclusive the schedule of reinforcement for button pressing remained at CRF; however, the stimulus conditions preceding button pressing varied. On Day 4 before each stimulus was tested Lena was told the contingency: "Every time you press the button you'll get (name of stimulus); if you'd like some (name of stimulus), press the button." On the extinction blocks she was told "you can press the button if you'd like, but nothing will happen." On Day 5 the contingency was again explained for each stimulus; additionally, for the last stimulus tested the actual portion to be delivered was held up above the console light directly behind the button and her finger was removed from the button after each response, the latter procedure was introduced to promote discrete button presses. On Day 6 the procedures introduced on the preceding days were again implemented, that is, the contingency was stated, the stimulus was held in place by the button (when praise was being tested the teddy bear card was held up behind the button), and Lena's finger was removed from the button after each button press while the stimulus was being delivered to her; furthermore, the testing block time was reduced from 3 minutes to 90 seconds. Periodically, Lena would say "thank you, that's enough" and on these occasions she would be told that she didn't have to button press if she didn't want to but that the item would remain on the table and be offered to her if she reponded. These procedures remained in effect for the duration of the stimulus testing, Days 7 and 8.

Adam. Ten stimuli were tested over 10 days with Adam. The stimuli were: salami (1 cm cube), beer (5 ml), peanut (one-half), cheese (1 cm cube), cookie (bite-sized piece of chocolate chip), fruit drink (5 ml), M & M, ice cream (spoonful of vanilla), one penny, and praise (consisting of "good" or "that's good" or "that's great" and rubbing his chest). From 4 to 13 stimuli, and one or two extinction blocks were tested each day; typically the number tested was seven.

On Day 1 a FR3 schedule for button pressing was in effect for the first seven stimuli tested after which the schedule was reduced to CRF for the remaining six stimuli tested. This schedule remained in effect for Days 2 and 3. Midway through the session on Day 3 the food items were placed directly in Adam's mouth and this practice was continued for the duration of Experiment 1. This procedure appeared to circumvent the problem of Adam not recognizing that the items were consumables. On Day 4 the first button press in the stimulus test block was followed by delivery of the stimulus and following this every second button press was reinforced (FR2). On Day 5 the schedule of reinforcement for button pressing was reduced to a CRF schedule and this remained in effect for the duration of the stimulus testing. Days 9 and 10 of stimulus testing were conducted 3 weeks following Day 8 and actually were conducted during Experiment 2. The schedule of reinforcement for button pressing was again a CRF schedule; however, at this time the contingency was explained to Adam and the stimulus was held up by the button. The explanation was the same as that given to Lena. Introduction of these additional procedures was directed at maximizing the conditions for generating high rates of button pressing with Adam.

Experimental Design

A multi-element design was used. Several baselines of button pressing were established each session with a different stimulus being tested during each baseline. The distinctive stimulus associated with each baseline was the presence of the stimulus itself (e.g., cookie) or a representation of a theme (e.g., the teddy bear picture during the testing of praise). Extinction was not associated with any stimulus and as such represented a modification in the multi-element design.

Dependent Variables

The dependent variables were the response rate for each stimulus during the testing interval and the pattern of responding for each stimulus during the test interval. Cumulative records were constructed from the daily session data sheets. During sessions the experimenter had recorded the time when each stimulus was delivered or, with respect to extinction, the time when the ratio requirement was met. Stimulus deliveries were then plotted as the cumulative number of responses emitted to meet the ratio requirement as a function of time.

Reinforcer Selection

Three reinforcers were identified for each participant using the following guidelines. Each day the stimulus which had generated the highest rate of button pressing was noted. In cases where many stimuli were tested the highest two or even three stimuli were noted. A comparison was then made across days, and stimuli which repeatedly appeared to generate the highest rates were indicated. Any stimuli on which the participant appeared to satiate quickly within the testing block interval, which produced highly variable response rates from day to day, or which were readily available in the participant's meals or everyday activities were eliminated.

Results

The results are presented individually as each participant was exposed to different contingencies of reinforcement.

Tim

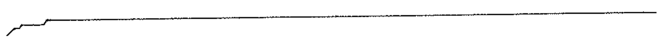
The cumulative records for the 2 days of stimulus testing with Tim are presented in Figure 1. The cumulative records show moderately high and steady response rates when all of the stimuli were tested. Overall, Day 2 response rates were lower than Day 1. During extinction, although button presses continued to occur, the response rates were lower than those observed during the testing of any of the stimuli that day.

Figure 1. Cumulative number of button presses for each stimulus tested on Days 1 and 2 with Tim. The response rate increments are in blocks of five responses.

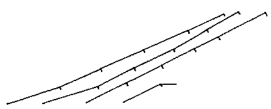
Tim

Day I FR5

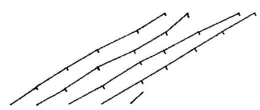
extinction



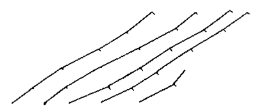
orange



7-up



grapes

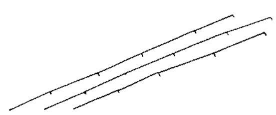


extinction

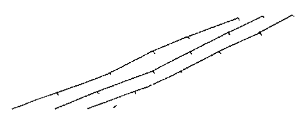
Day 2 FR5

extinction

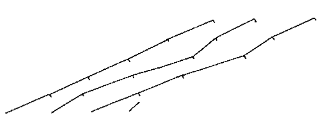
orange crush



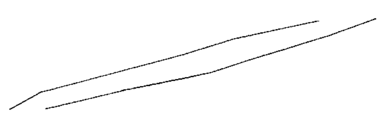
praise

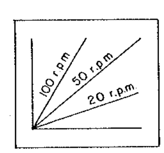


grapes



extinction





On Day 1 the first test block was extinction and only four button presses were made, all within the first 15 seconds of testing. When orange was tested, button presses immediately increased to a rate of approximately 27 responses per minute (r.p.m.). Button pressing increased to rates of approximately 35 r.p.m. and 36 r.p.m. when 7-up and grapes were tested. When extinction was reintroduced at the end of Day 1 button pressing decreased from the levels of the previous two test intervals but continued to occur at approximately 28 r.p.m.

On Day 2 the first test block was again extinction with a resultant response rate of approximately 18 r.p.m. During the next test interval orange crush was tested and button pressing increased to approximately 23 r.p.m. When praise was tested button pressing occurred at approximately 25 r.p.m., and when grapes were tested a second time the response rate was 26 r.p.m. In the final test block of extinction button pressing decreased to approximately 17 r.p.m.

Based on these 2 days of button pressing, grapes, 7-up, and praise were selected as reinforcers for Tim.

Christina

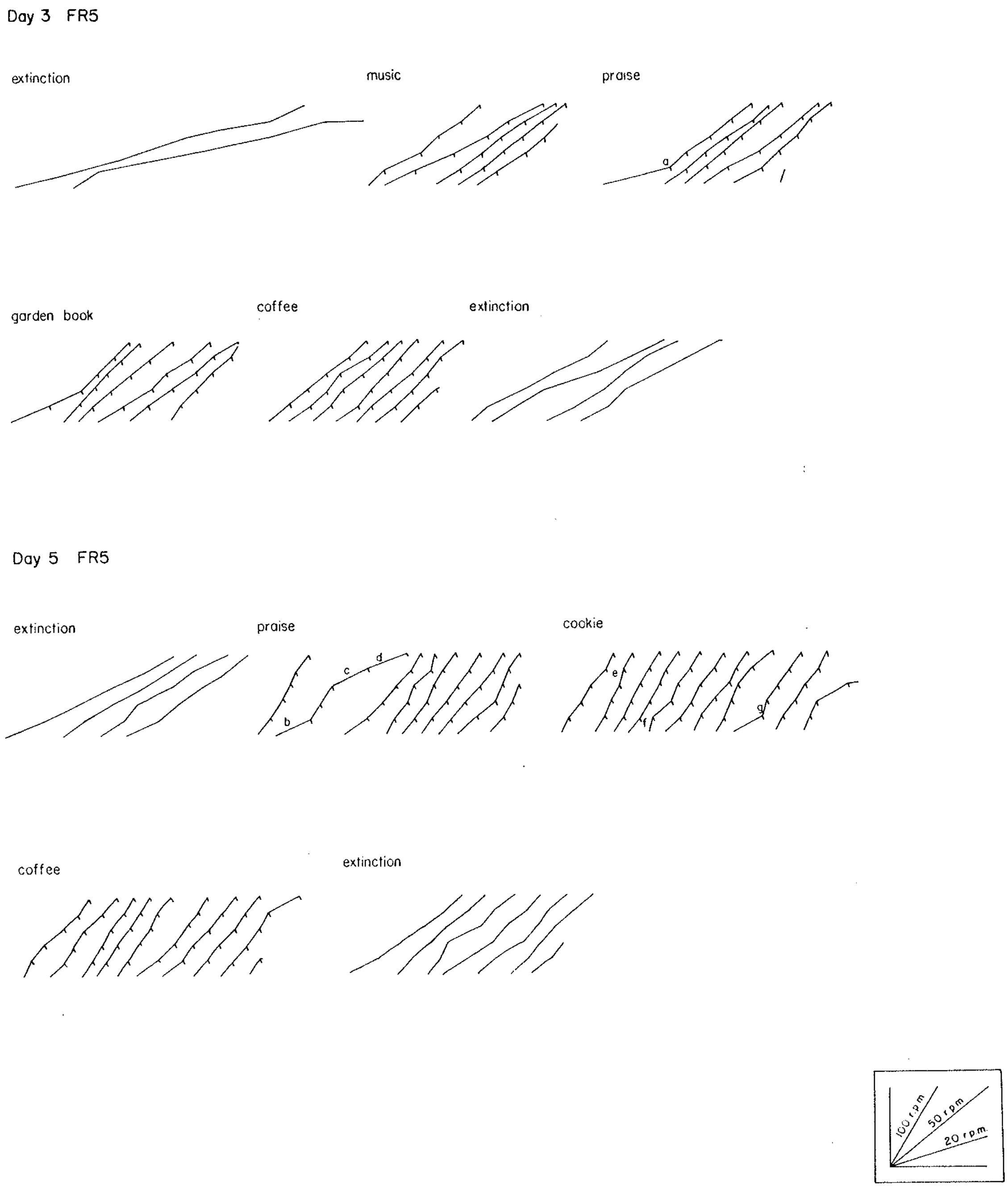
Button pressing was readily established with Christina. Overall, the rate of button pressing increased with each successive day of testing. Response rates during the testing of all stimuli were high relative to the rate during the extinction block that session.

On Days 1 and 2 button pressing was consequated on a FR3 schedule of reinforcement. On Day 1 when the button pressing task was introduced response rates were low, for example, three r.p.m. when coffee was first tested, but increased to higher rates as more stimuli were tested, for example, 14 r.p.m. when coffee was tested at the end of the session. On Day 2 response rates were substantially higher than on Day 1 for all stimuli tested, with differential rates for the different stimuli, for example, 23 r.p.m. with music compared to 33 r.p.m. when a garden book was presented versus approximately 15 r.p.m. during a final extinction block.

On Days 3 to 5 inclusive the schedule of reinforcement was FR5. The cumulative records for Days 3 and 5 are presented in Figure 2. On Day 3 high rates of button pressing were observed when coffee was tested, approximately 54 r.p.m., and when the garden book was presented, approximately 49 r.p.m. Response rates for the other stimuli tested were also high relative to the extinction blocks. For the first 20 seconds of the test block with praise the bear stimulus was inadvertently not present on the table; its absence was associated with a low rate of button pressing for praise (see a in Figure 2). Responding during the first and final extinction blocks were 15 r.p.m. and 33 r.p.m. respectively. On Day 4 response rates were high for all stimuli tested. Praise and cookies generated the highest rates which were approximately 63 and 64 r.p.m. An extinction block was introduced at the start of the session and resulted in approximately 17 r.p.m. On Day 5 the overall rate of button pressing continued to accelerate. Very high response rates were observed when cookie

Figure 2. Cumulative number of button presses for each stimulus tested on Days 3 and 5 with Christina. The response rate increments are in blocks of five responses.

Christina


Day 3 FR5
extinction
music
praise
a
garden book
coffee
extinction
Day 5 FR5
extinction
praise
b
c
d
cookie
e
f
g
coffee
extinction
100 r.p.m.
50 r.p.m.
20 r.p.m.

was tested, approximately 89 r.p.m., followed by that observed when coffee was tested, approximately 77 r.p.m. During extinction the response rates were approximately 34 r.p.m. at the start of the session and 53 r.p.m. at the end. While these rates were higher than those previously observed during extinction, they were still below the rates generated that day when any of the stimuli were presented. Whereas Days 3 and 4 showed fairly steady patterns of responding, there were several occasions on Day 5 where Christina briefly paused, for example, during the testing of praise (see b, c, and d in Figure 2), or momentarily accelerated at button pressing, for example, during the testing of cookie (see e, f, and g in Figure 2).

Based on the results of the last 3 days of button pressing with Christina, coffee, praise, and cookie were selected as reinforcers.

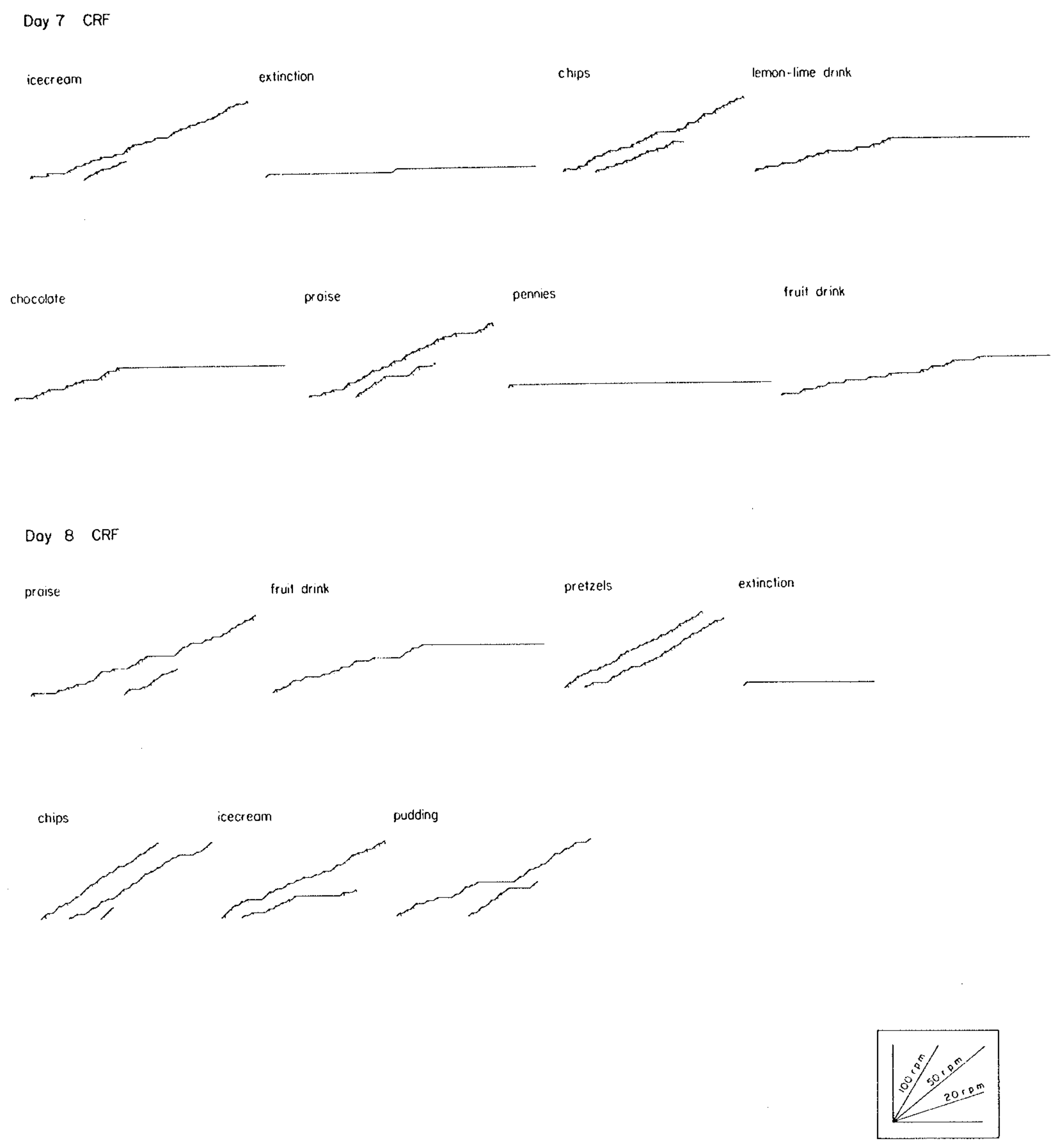
Lena

Button pressing was finally established with Lena on Day 6. Prior to this button pressing was quite erratic. On Day 1 for the first several stimuli tested Lena button pressed at very low rates, for example, three r.p.m. when ice cream was presented. When other stimuli were subsequently tested Lena held the button down for long intervals. This problem persisted when the schedule was increased to FR3 that day and for the next 2 days when the first button press was reinforced followed by a FR3 schedule. When the rule for button pressing was introduced on Day 4 and the schedule was decreased to CRF, Lena emitted discrete button presses more frequently; however, she still would hold the button down occasionally. She also appeared to satiate quickly on consumables; for example, all button presses emitted when fruit drink was tested occurred in the first minute of the interval with no responses occurring in the next 2 minutes. On Day 5 only two or three responses in total were emitted for each of the first five stimuli tested. All of these responses occurred at the beginning of the interval. However, when the sixth stimulus being tested, pretzel, was held up by the button a response rate of 13 r.p.m. of discrete button presses was observed.

On Days 6 to 8 when all of the strategies introduced up to this point (stating the contingency, holding up the stimulus item, and removing Lena's finger from the button after button presses) were implemented and the test interval was reduced to 90 seconds, differential rates of button pressing were observed. On Day 6 fairly high stable response rates were observed for fruit drink, pudding, and pretzels, 20, 20, and 18 r.p.m. respectively. The last two stimuli tested were associated with very low response rates and Lena stated repeatedly during these tests "thank you, that's enough." There was only one button press during the extinction block. The cumulative records for Days 7 and 8 are presented in Figure 3. On Day 7, chips, praise, and ice cream generated the highest response rates: 24, 24, and approximately 21 r.p.m., respectively. For three stimuli tested, chocolate, and lemon-lime and fruit drinks, responding ceased after 35 to 60 seconds. Again Lena stated "that'll be enough" or "I've had

Figure 3. Cumulative number of button presses for each stimulus tested on Days 7 and 8 with Lena.

Lena



Day 7 CRF
icecream
extinction
chips
lemon-lime drink
chocolate
praise
pennies
fruit drink
Day 8 CRF
praise
fruit drink
pretzels
extinction
chips
icecream
pudding
100 rpm
50 rpm
20 rpm

enough" and stopped button pressing. There was only one button press when pennies were delivered. During the extinction block there were two responses. On Day 8 the rate of button pressing overall was relatively high for Lena. The highest rate, 36 r.p.m., was generated when chips were tested, followed by approximately 33 r.p.m. when pretzels were tested. Pudding, praise and ice cream generated similar rates of approximately 23 to 24 r.p.m. Responding when fruit drink was tested ceased after 50 seconds. There was one response emitted midway during the extinction block.

Several stimuli, then, were observed to maintain button pressing with Lena. A variety of conditions allowed for the selection of only three stimuli. One stimulus, pudding, was excluded as it was frequently available with meals. Fruit drink was eliminated because Lena tended to satiate on this item. Although praise generated comparable rates of button pressing, it appeared to prompt verbalizations and often was associated with emotional behavior. Because those behaviors may have interfered with training, praise was not selected. The three stimuli selected as reinforcers for Lena were chips, pretzels, and ice cream.

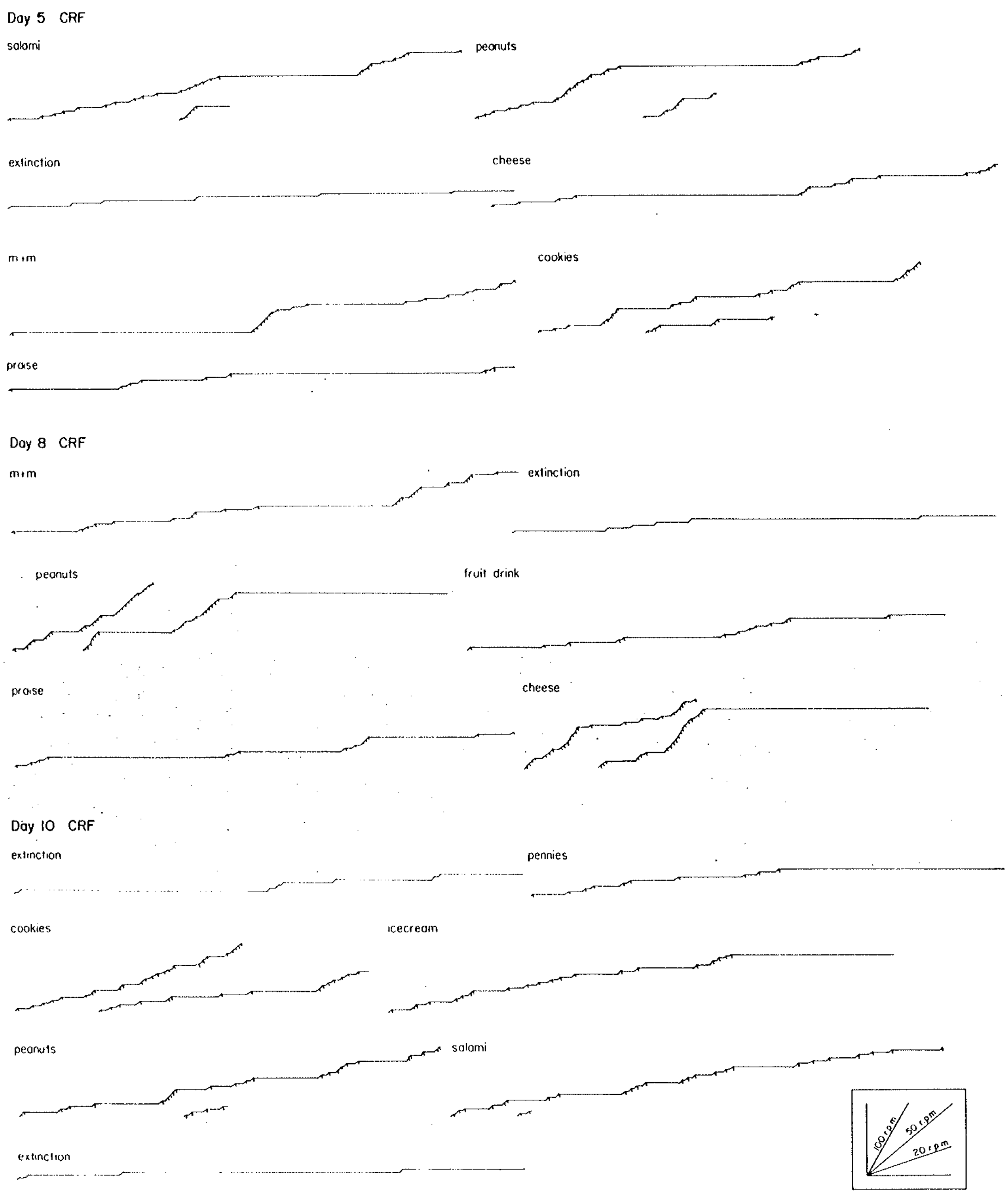
Adam

Button pressing was established with Adam, although at quite low rates, by Day 5 of training. On Day 1 less than two r.p.m. occurred for the six stimuli tested. Low response rates persisted when the schedule was decreased to CRF from the initial schedule of FR3, and when a variety of stimuli were tested over 3 days. A noticeable increase in response rate for stimuli tested in the latter half of Day 3 occurred when the consumable was placed in Adam's mouth. The response rate during the extinction block following this increase was equally high. The next day when the schedule was increased response rate decreased after the first stimulus tested.

Days 5 to 8 represent button pressing on a CRF schedule. At this time the consumables continued to be placed in Adam's mouth. The cumulative records for Days 5 and 8 are presented in Figure 4. On Day 5 peanuts, cookies, and salami generated the highest button press rates which were approximately 11, 10, and 10 r.p.m., respectively. The lowest response rate, two r.p.m., occurred during the extinction block. On Day 6 the same three stimuli generated the highest rates with cookies the highest at 11 r.p.m. and peanuts and salami at slightly lower response rates of approximately seven r.p.m. During the extinction block approximately three r.p.m. occurred. On Day 7 response rates were low for all stimuli tested. There was an acceleration in button pressing near the end of the interval when salami was tested; however, the overall response rate was only four r.p.m. This was approximately the overall rate generated when M & M's were tested, although responding for M & M's was spaced. On Day 8 button pressing occurred at the highest levels for Adam. Cheese and peanuts generated equal rates of approximately 15 to 16 r.p.m. The cumulative records show high response rates (over 20 r.p.m.) during the first half of the test interval followed by zero responding which appears due to satiation. M & M's generated

Figure 4. Cumulative number of button presses for each stimulus tested on Days 5, 8, and 10 with Adam.

Adam


Day 5 CRF
salami
peanuts
extinction
cheese
m+m
cookies
praise
Day 8 CRF
m+m
extinction
peanuts
fruit drink
praise
cheese
Day 10 CRF
extinction
pennies
cookies
icecream
peanuts
salami
extinction
100 rpm
50 rpm
20 rpm

button press rates of approximately eight r.p.m. Less than three r.p.m. occurred during the extinction block.

Days 9 and 10 represent button pressing when, in addition to the preceding procedures, the contingency was explained to Adam and the stimulus was held up by the button. On Day 9 the highest rate of button pressing occurred when peanuts were tested, the rate was approximately nine r.p.m. Cookies and salami generated the next highest rates of eight r.p.m. and approximately five r.p.m., respectively. Extinction blocks resulted in zero r.p.m. at the beginning of the session and approximately two r.p.m. at the end. The cumulative records for Day 10 are presented in Figure 4. Responding was generally higher on Day 10. The highest response rate was approximately 13 r.p.m. which occurred when cookies were tested. The next highest rates were approximately 10 r.p.m. when both peanuts and salami were tested. Extinction resulted in less than three r.p.m. when introduced twice. Responding during Days 9 and 10 was generally more spaced than responding on the preceding test days.

Reinforcer selection was made after Day 8 of button pressing. The stimuli selected were cookies, peanuts, and salami. While cheese and M & M's had periodically generated high rates of button pressing with Adam, the three stimuli chosen were consistently associated with the highest rates when tested on a given day.

Discussion

Reinforcers were identified for all of the participants. The strength of the reinforcers was quite variable across participants as evidenced by the different response rates of participants reinforced for button pressing on the same schedule of reinforcement. While Christina responded at a rate of 70 to 80 r.p.m. or greater on an FR5 schedule, Tim, the control participant, showed a terminal response rate of only 25 to 35 r.p.m. Lena's highest response rate was 33 r.p.m. on a CRF schedule while Adam generally responded at only 10 to 15 r.p.m. on the same schedule. Variability of response rates when participants are reinforced on the same schedules of reinforcement has been observed in other research. For example, Libb and Clements (1969) found mean response rates from 23 to 76 r.p.m. when elderly psychiatric participants were reinforced on the same varible ratio schedule for bicycle pedal responses. The differences across response rates reinforced on FR5 versus CRF schedules of reinforcement are to be expected with the larger ratio requirement generally generating higher rates of responding (Ferster & Skinner, 1957).

The variability in the strength of reinforcers may reflect the idiosyncratic nature of reinforcers in the elderly. Ankus and Quarrington (1972) eventually established deprivation states to increase the reinforcing value of the other stimulus tested which was liquids. Given those conditions liquids did generate FR behavior. While no attempt was made to directly manipulate deprivation states, consumables were chosen which were known not to be readily available to the participants. And, in one case, Adam, sessions were conducted 30 to 45 minutes before his regularly scheduled supper. However, it appears that selecting items of limited availability and strategic timing may not be sufficient to maximize the reinforcing power of the consumables in the elderly with Alzheimer's disease.

Lindsley (1964) has speculated that with the elderly, consequences will need to be delivered on a CRF schedule or the behavior will not be maintained. His speculation is based on his extensive work with intermittent schedules with psychotic patients (Lindsley, 1960). Baltes and Barton (1977) have also speculated that delayed and intermittent reinforcement schedules may be less effective in the elderly. With Lena and Adam whenever the ratio for button pressing was increased the behavior was disrupted. The disruption of behavior when an intermittent schedule was introduced seems to support Lindsley's view: That the reinforcing consequence needs to be delivered on a CRF schedule. However, it may be simpler to view the problem from a reinforcer perspective. Perhaps the inability to maintain responding when reinforcers are delivered on an intermittent schedule is a function of weak reinforcers not that the elderly individual is incapable of responding on an intermittent schedule.

It is interesting to note that money, at least in the low denomination used, was not observed to be a reinforcer with either of the two participants tested. This replicates Ankus and Quarrington's (1972) findings that money as a consequence for lever pulling would not generate FR behavior. The response rates generated in this study when money was presented paralleled those observed during extinction. This finding is even more suprising than Ankus and Quarrington's findings because the two participants for who money was tested in this study did not represent long term care elderly. Their verbal behavior with regards to money was incongruous with their button press behavior; for example, both of these participants would express concern about not having money and ask who was paying for their meals, yet gave back the pennies delivered to them.

While the expressed purpose of this study was to identify reinforcers for individuals with Alzheimer's disease, the design was such that a successive discrimination was required. A multi-element design essentially involves stimulus discriminations (Hersen & Barlow, 1976). Each stimulus testing baseline represented the presentation of a discriminative stimulus during which time button pressing would be reinforced or not, depending on the reinforcing value of the stimulus to that participant. The extinction baseline represented the absence of any stimulus and during this time responding was never reinforced. It appears that all of the participants, with varying degrees of training, were able to perform a successive discrimination. Differential response rates were observed between occasions when stimuli were being tested and extinction. This was observed for all participants. The discrimination was established more readily with some participants than with others. With Christina and the control participant, Tim, discriminative responding was established in the first session. With both Tim and Christina responding continued to occur during extinction with differential extinction rates observed at the beginning of the session versus the end. This reflects that discriminative behavior was not under complete control of the discriminative stimuli and perhaps had a distinctive stimulus been present during extinction responding would have been lower. However, the relatively higher response rates during extinction for Tim and Christina may be due to the schedule of reinforcement. Extinction rates following an intermittent schedule are higher than those observed following a CRF schedule (Reynolds, 1975). Both Lena and Adam required substantial training trials and modification of procedures to establish discriminative responding; however, their cumulative records do demonstrate differential responding during the presentation of different stimuli as well.

The stimuli which had been used as reinforcers in the pilot study were all tested in this study and observed to be reinforcers for the participant in question. Given that reinforcers were identified for each participant, the next variable was investigated - the establishment of a simple response. A discrimination task appeared most appropriate as it was just demonstrated that successive discriminations could be made by these participants and further, because Hussian (1982) had established stimulus discriminations in elderly people with Alzheimer's disease.

EXPERIMENT 2

Two Choice Simultaneous Discrimination Training of Blissymbols With Elderly Individuals With and Without Alzheimer's Disease.

Discrimination training involves differential reinforcement of responding in the presence of different stimuli. When responding is reinforced in the presence of one stimulus (S^+) and not reinforced in the presence of another (S^-), response rates will increase in the former case and decrease in the latter case (Reynolds, 1975). Discriminations involving assorted stimuli, for example, colours (Williams, Koegel, & Egel, 1981) and lexigrams (Meador, 1984) have been established with several populations. Children (e.g., Moore & Goldiamond, 1964) and the mentally retarded (e.g., Delprato, Pappalardo, & Holmes, 1984) have been most frequently studied. Discriminative responding continues to be routinely investigated with infrahuman subjects (e.g., Journal of the Experimental Analysis of Behavior).

In human research simultaneous discriminations are most frequently trained. In a simultaneous discrimination both the S^+ and the S^- are present and only responding to the S^+, typically a pointing response, is reinforced. There may be more than one S^- present, for example, Sidman and Stoddard (1967) used an eight key manipulandum in which one of the keys was the S^+, the remaining keys representing S^-'s. There are many procedural variations in the discrimination training research which appear to enhance discrimination.

Fading is one of the most commonly used procedures to establish discriminative responding. Originally demonstrated by Terrace (1963a), fading or "errorless learning" involves first establishing responding in the presence of the S^+, then briefly and slowly introducing the S^- in a manner such that responding does not occur in its presence, even when the S^- is presented in equal duration and intensity as the S^+. Terrace extended his first demonstration of fading with colours to fading with lines (1963b). While Terrace's studies were conducted with pigeons and used a successive discrimination, this procedure has been extended to simultaneous discrimination training with humans. For example, Sidman and Stoddard (1967) demonstrated higher learning rates of a circle-ellipse discrimination when fading was used than when traditional discrimination training was conducted.

The treatment of errors varies across discrimination training programs. In basic research errors have typically been followed by a brief time out or period of darkness. Touchette and Howard (1984) used a time out of 10 seconds for incorrect responses in teaching severely retarded children and adolescents letter discriminations. While time out was used throughout all phases of the study, hence its absolute contribution cannot be determined, it appeared that throughout all phases the participants learned a great many discriminations. Another treatment of errors which appears to facilitate discriminative responding is a correction procedure. The actual correction technique appears to vary across studies. Newsom and Simon (1977) simply repeated the trial after an error had occurred whereas Sidman and Stoddard (1967) maintained illumination of the keys, that is, did not terminate the trial, until the child corrected his error.

Recently a procedure which has been demonstrated to be very powerful in teaching autistic children discriminations has been extended to the mentally retarded. With autistic children it has been found that a discriminative response will be learned more readily if the response is functional in procuring a reinforcer than when a discriminative response is arbitrary with respect to the reinforcer (e.g., Williams et al., 1981). Delprato et al. (1984) showed a response-reinforcer relationship, specifically, a spatial contiguity between the response and the tangible and found that it was associated with more efficient discriminative performance than when there was no relationship. This was demonstrated with severly retarded adults on a picture/object discrimination task.

Another technique which recently has appeared to increase discrimination performance is differential reinforcement of prompted versus nonprompted discriminative responses. Touchette and Howard (1984) found that letter discriminations were learned in the fewest number of trials when correct discriminative responses were reinforced on a CRF schedule and prompted discriminative responses on an intermittent (FR3) schedule as compared to a nondifferential schedule of reinforcement and when the schedules were reversed. This is exactly what Olenick and Pear (1980) found when a differential schedule was introduced in picture name training with retarded children. Differential reinforcement, specifically, a richer schedule of reinforcement for nonprompted than prompted responses results in increases in learning. It is important to note that in both of these studies the participants were already learning at a slow moderate rate prior to the introduction of differential reinforcement.

The goal of the present experiment was to train a number of simultaneous discriminations to individuals with Alzheimer's disease. Initially a traditional training procedure was used with additional procedures selected on an individual basis to enhance discriminative responding. Given the population under investigation, elderly people with Alzheimer's disease, an important feature of this study was that previously identified reinforcers were used. Additionally, the reinforcing power was demonstrated on a regular basis. An elderly man without Alzheimer's disease was included for comparison purposes.

Method

Subjects

Three elderly people with Alzheimer's disease, Christina, Lena, and Adam and one healthy elderly person, Tim, who had previously participated in Experiment 1 participated in this experiment. The residence of Christina changed midway through Experiment 2 when she was moved to a personal care home. Periodically in her new residence she would receive chloral hydrate after midnight to induce sleeping.

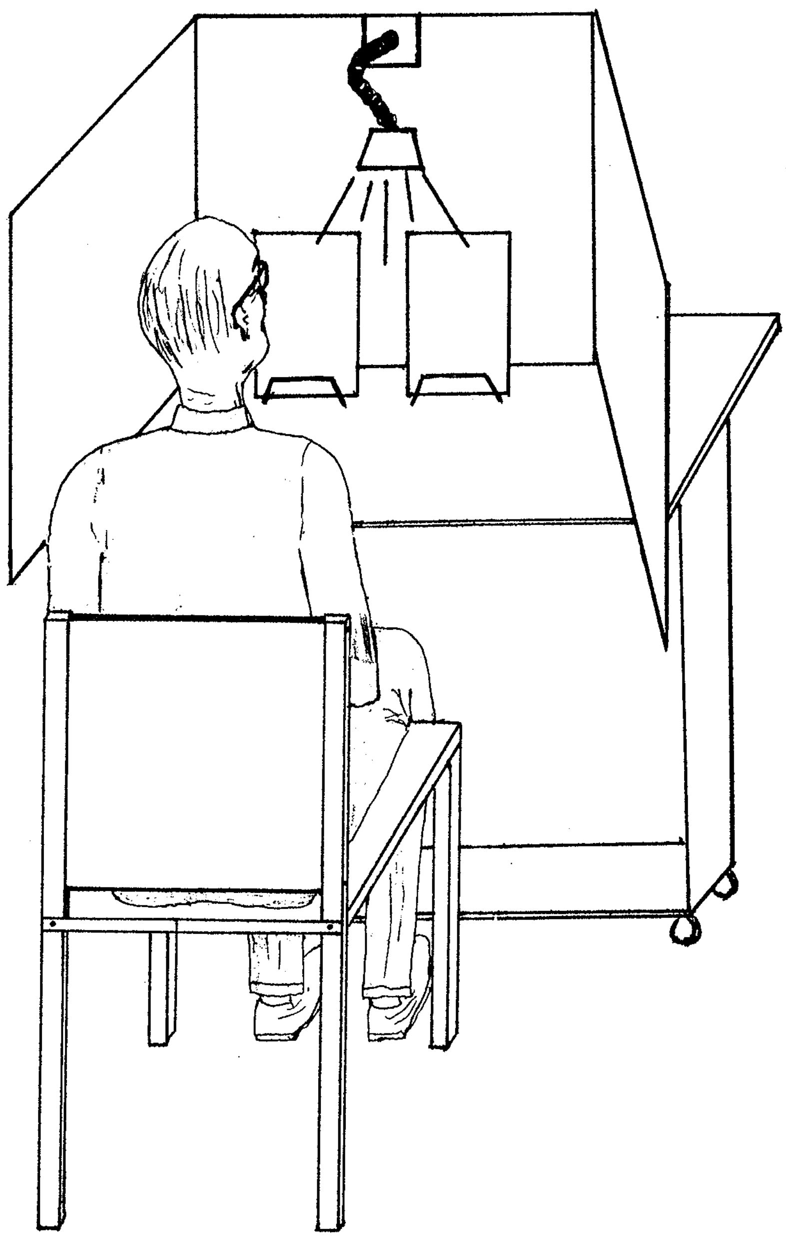
Setting, Apparatus and Materials

The settings for Tim, Lena and Adam were identical to that already described in Experiment 1. The setting for Christina was as described in Experiment 1 until Session 35 when she moved. In the new setting sessions with Christina were conducted in her bedroom with the participant and the experimenter seated facing each other across a small table.

In the early phases of this experiment the stimulus testing console described in Experiment 1 was used during pre-tests only. A white mat 30 cm by 35 cm with a blaze orange dot (19 mm in diameter) affixed to the centre, 8 cm from the participant was placed on the table directly in front of the participant. Reinforcers were placed on the table in front of or to the left of the participant and assorted data sheets and stop watches were placed to the right of the experimenter. The Blissymbols used with all participants were portrayed as black graphics on a white background on 12.5 cm by 20.5 cm cards. In some phases with Adam a Blissymbol covered with varying numbers of layers of purple transparencies and a white and a purple card 12.5 cm by 20.5 cm were used as discriminative stimuli. Additional phases of discrimination training with Christina used colour picture cards 17 cm by 22 cm from a Peabody articulation kit. Pictures of nouns were selected.

The apparatus depicted in Figure 5 was used in the modified training procedure. The partition was 45.7 cm high and the three sides extended around the participant. A lamp with a 15-watt bulb was positioned centre-top of the middle partition. Plastic covered metal plate stands were affixed to the table such that discriminative stimuli were placed 4 cm apart. Reinforcers were

Figure 5. Apparatus used in the modified discrimination training procedure in Experiment 2.



placed in coloured paper baking cups 4.5 cm in diameter; the cup was placed behind the discriminative stimulus. A divider 27.5 cm high by 42 cm across could be placed on the table to block the training stimuli from the participant's view. The experimenter stood behind the partition.

The reinforcers used in this experiment were: grapes, 7-up, and praise for Tim; coffee, digestive cookies, and praise for Christina; chocolate swirl vanilla ice cream, pretzels, and salt and vinegar potato chips for Lena; salami, peanuts, and chocolate chip cookies for Adam. The portions of edibles and form of praise were as described in Experiment 1.

Reinforcer pre-test

Prior to the first discrimination training session each day a reinforcer pretest was conducted with each participant to determine the reinforcers to be used for that day. The reinforcer pretest represented a brief version of the stimulus test sessions conducted in Experiment 1. The three reinforcers that had been identified in Experiment 1 were each tested for a 1-minute interval (30 seconds for Lena) along with one extinction block of the same duration. The order of testing was randomly determined each day. The instructions given to each participant and the schedule of reinforcement were a continuation of the procedures which had been established in the last few days of button pressing in Experiment 1. To summarize: Christina and Adam were given the instruction "you can press the button as much as you'd like, sometimes you'll get something for pressing it," the reinforcer was placed on the table and the schedule of reinforcement was FR5 and CRF, respectively. (Note: The final two days of Experiment 1 for Adam were conducted after Experiment 2 had commenced; consequently, these were not the procedures used in this pretest.) Lena was instructed "every time you press the button you'll get (name of reinforcer)," the reinforcer was held up behind the button, her finger was removed from the button after each button press, and reinforcers were tested on a CRF schedule. The two reinforcers which generated the highest rate of button pressing each day were used as reinforcers in discrimination training that day. On days when two or more of the reinforcers generated equal rates, a random choice was made.

Reinforcer pre-testing was continued until Session 47 with Christina, Session 41 with Lena, and Session 43 with Adam. Commencing with these sessions, two of the three reinforcers were randomly chosen each day. An exception to this was three days when Lena did not have her dentures which precluded using pretzels; on these days the other two reinforcers were used. Pretesting was not conducted with Tim, rather, two reinforcers were randomly chosen each day.

Preliminary Procedures

Christina, Lena, and Adam had been previously exposed to Blissymbols in pilot work. At that time a pool of 79 Blissymbols which could not be readily recognized had been developed through testing with healthy elderly people. Because of their symbolic nature, some Blissymbols may readily be recognized without any previous history and it was important to eliminate these Blissymbols from training. In addition to the Blissymbol screening by healthy elderly people, each of the participants was asked to identify each Blissymbol from the pool in a process to eliminate any Blissymbols that he/she may easily identify. Blissymbol name training was conducted for 3, 9, and 13 days with Christina, Lena, and Adam. Tim had not participated in this pilot experiment, however, the Blissymbol name baseline was conducted with him. Each of the 79 Blissymbols was presented with the question "What does this look like?" He was prompted to guess if he didn't know. The consequence for all responses was verbal approval. Any Blissymbols which Tim named or approximated were eliminated from the pool.

An attending response was trained during the Blissymbol name baseline with all participants. Each participant was trained to touch the orange dot if he/she wanted to initiate a trial. A trial could be initiated when the experimenter had the Blissymbol card placed face down on the table and looked at the dot. Touching the dot was the attending response and a trial was not presented until the participant attended.

Discrimination Pairs

A list of discriminative pairs was developed for each participant. For Christina, Lena, and Adam, all Blissymbols which had not been trained in the pilot study were randomly paired and one of the pair was assigned S^+ status. With Tim, the Blissymbols not named in baseline were randomly paired and S^+, S^- status was assigned.

Discrimination Training Procedures

Initial Training. Two sessions of 30 trials each were conducted each day with each participant. Sessions were separated by a 10-minute interval. A trial was initiated when the participant emitted the attending response. The experimenter simultaneously held up the S^+ and the S^- approximately 10 cm apart and 30 cm in front of the participant and said "Point to the surprise card." On the first few days of discrimination training the experimenter gave additional instructions on the first trial: "One of these cards is a surprise card, if you find it you'll get a surprise." If the participant pointed to the S^+ the experimenter said "good" or "that's right," placed the Blissymbols face down, and delivered one of the reinforcers which had been selected for that day, alternating between the two. If the participant pointed to the S^- the experimenter gestured and said "No, that's not it" and placed the Blissymbols face down. An intertrial interval of approximately 5 seconds followed delivery of the reinforcer on trials when a correct discrimination was made or followed removal of the Blissymbols on trials where an error had been made. If the participant did not respond the instruction was repeated and/or rephrased, for example, "which one is the surprise card?" until a response was given. Only the first response was counted, for example, if the participant pointed to the S^- and then quickly touched the S^+, it was counted as an error. The S^+ position on each trial, described as either to the experimenter's left or right, was randomly determined before sessions each day by a coin toss, with the stipulation that one position could not occur on more than seven consecutive trials.

A discrimination was said to have been learned when the participant correctly pointed to the S^+ on 10 consecutive trials. Once a discrimination was learned that pair of Blissymbols was retired and a new S^+, S^- pair was presented.

Time out for S^- responses. A 30 second time out following each error was introduced for Christina (Sessions 27 to 38) and for Lena (Sessions 19 to 32). The discrimination training was conducted as described in the initial training procedures except that when the participant pointed to the S^- the experimenter gestured and said "No, that's not it," placed the Blissymbols face down, and put her head down for 30 seconds while covering the attending stimulus with her hand. After the time out interval had elapsed the intertrial interval started, the experimenter recorded the response, and set up for the next trial.

Retraining. Retraining of pairs of Blissymbols which had previously reached discrimination learning criterion was conducted with Christina and Lena. This procedure was introduced because both participants had ceased learning new discriminations. The conditions under which the discriminations had been initially learned were reintroduced. The initial training procedure was followed until the pair reached criterion again or until the number of training trials equalled the number of trials to reach criterion previously, whichever occurred first. An exception to this was the last discriminative pair retrained with Lena. This pair was not trained for the initial number of trials due to time constraints. A second retraining run was completed with Christina and started with Lena. At this time retraining was implemented with a modified training procedure (described below). Similarly, retraining continued until criterion was met or until the number of trials previously required to reach criterion was met.

Modified Training. The modified training condition included restructuring the physical environment in order to minimize distractions and the introduction of a response-reinforcer relationship and brief time out for errors to highlight conditions for learning. The setting was remodelled as depicted in Figure 5 such that the participant sat facing a three-walled partition with the experimenter partially or completely out of view and all other room furnishings obscured. The room lighting was dimmed by drawing the drapes and extinguishing the overhead light. The Blissymbol cards were placed in stands on the table and could be illuminated by one light. The reinforcer was placed in a paper cup behind the S^+.

The following instructions were given to the participants at the beginning of the modified training procedure: "When I turn the light on you are to pick a card. If you're right and pick the surprise card you'll find a surprise. If you're wrong the light will go out and you'll have a little while in darkness. Try and pick the surprise card every time. I'll help you in the beginning." As training progressed no instructions were given for Christina; Adam was told "the light's on, pick up the surprise card."

A training trial was initiated by the experimenter turning the light on and removing the divider to reveal the cards. Instructions were given as necessary. If the participant picked up the S^+ the reinforcer became visible and the experimenter pointed to it and said "look." If necessary, the participant was prompted to take the item. The experimenter said "good" when the S^+ was picked up and the light remained on until the participant had placed the reinforcer in his/her mouth. After this time the divider was replaced and the light turned out. If the participant picked up the S^- the light was immediately turned out and the experimenter remained out of sight for 15 seconds. At the end of the time out interval the divider was replaced. If the participant reached for the S^+ the time out was terminated and the divider was put in place. The termination of a trial was marked by replacement of the divider. During the 20-second intertrial interval the experimenter set up for the next trial. If the participant reached for both the S^+ and the S^- his/her hands were withdrawn and placed on the table midway between the two cards. The discrimination learning criterion was 10 consecutive correct responses. This was the same as in the initial training.

During the modified training procedure only two of the three reinforcers were used for each participant. Praise was no longer used with Christina and ice cream was dropped for Lena. In these cases the particular reinforcer was dropped because of the difficulty of incorporating it into the response reinforcer relationship. With Adam one reinforcer, salami, had to be discontinued because of its perishable nature.

Colour fading with Adam. After 14 sessions of discrimination training with one pair of Blissymbols with Adam a purple-white discrimination was trained. This was followed by a fading procedure with the S^- Blissymbol. The purple-white discrimination was trained using the initial training procedures. The white card was the S^+ and the purple card the S^-. Once this discrimination was learned the previous pair of Blissymbols was reintroduced with the S^+ as it was originally and the S^- covered with 5 layers of purple transparencies. Once this discrimination was learned one layer of purple was removed from the S^-. This practise was continued such that every time a criterion was reached another layer of purple was removed. The discrimination learning criterion remained at 10 consecutive correct discriminative responses until Session 70 after which an addition was made to the criterion to include "or 80% correct discriminative responses in a session." The initial training procedures were followed until Session 55 at which time the modified training procedures were introduced and remained in effect until training terminated. In the final phase with Adam the last fading step (one layer of purple covering the S^-) was retrained.

Known picture discrimination training and additional procedural changes with Christina. In the last phase of discrimination training with Christina Blissymbols were discontinued and picture cards she could readily identify were introduced. First a picture name baseline was conducted during which 60 colour picture cards were individually presented to

Christina along with the question "What's this?" Correct naming responses were followed by "good, that's right," and incorrect responses by "okay." The attending response was used during the baseline and 15 minute sessions were conducted until each card was tested twice. From the baseline 40 picture cards were selected which Christina had clearly and easily identified on both occasions. These were randomly paired and one of the pair was assigned S^+ status.

On Session 73 discrimination training with one pair of known pictures was initiated following the modified training procedure. On Session 81 a correction procedure replaced the time out when responses to the S^- were made. In this phase when Christina attempted to pick up the S^- her hand was pushed away, as many times as necessary until she picked up the S^+. Every time she picked up the S^+ she obtained the reinforcer placed behind it and the experimenter said "good." On Session 89 a differential reinforcement schedule was introduced. If Christina picked up the S^+ without any correction by the experimenter she was allowed to take the reinforcer and the experimenter said "good." If she picked up the S^+ after the correction procedure had been implemented she was told "good" but prevented from obtaining the reinforcer by the experimenter replacing the S^+ in its stand. This schedule remained in effect until training terminated at Session 100.

Experimental design

Each participant except Tim was exposed to a number of experimental manipulations; typically one manipulation followed another. Most of the procedures were replicated across participants. The order and session numbers (indicated in parentheses) in each condition were as follows:

Tim: Initial training (1-16)

Christina: Initial training (1-26), Time-out (27-38), Initial training (39-46), Retraining (47-58), Modified-retraining (59-72), Modified-known pictures (73-80), with correction procedure (81-88), and with differential reinforcement (89-100).

Lena: Initial training (1-18), Time-out (19-32), Initial training (33-44), Retraining (45-58), Modified-retraining (59-64).

Adam: Initial training-Blissymbols (1-14), Initial training - purple:white (15-28), Initial training - Blissymbols with colour fading (29-54), Modified training - Blissymbols with colour fading (55-85), Modified training - Blissymbols (86-94), Modified training - retraining (95-104).

Dependent variables

The dependent variables that were studied were: (a) number of discriminations learned in each phase, (b) number of correct (noncorrected) discriminative responses per session of a given phase, (c) highest number of consecutive correct (noncorrected) responses per session of a given phase, (d) highest number of consecutive errors per session of a given phase, (e) discriminative behavior as defined when responding to the S^+ was greater than 50% (Terrace, 1966) in a session of a given phase, (f) total number of trials to criterion for a discrimination pair, and (g) accuracy for a discrimination pair under each training procedure as defined by the number of correct discriminative responses divided by total number of training trials for that pair.

Results

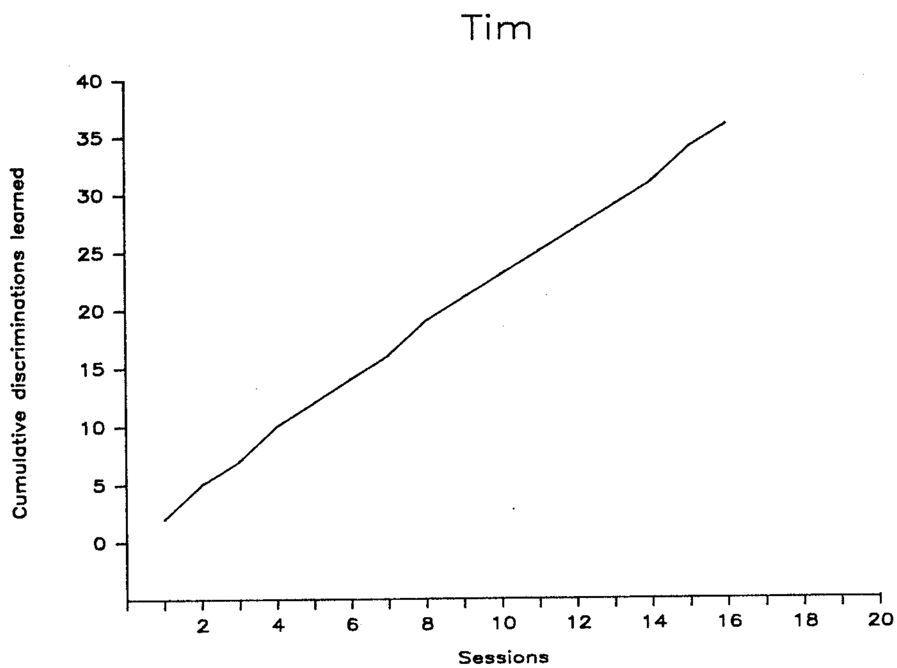
The results for Experiment 2 are presented individually for each participant followed by a summary.

Tim

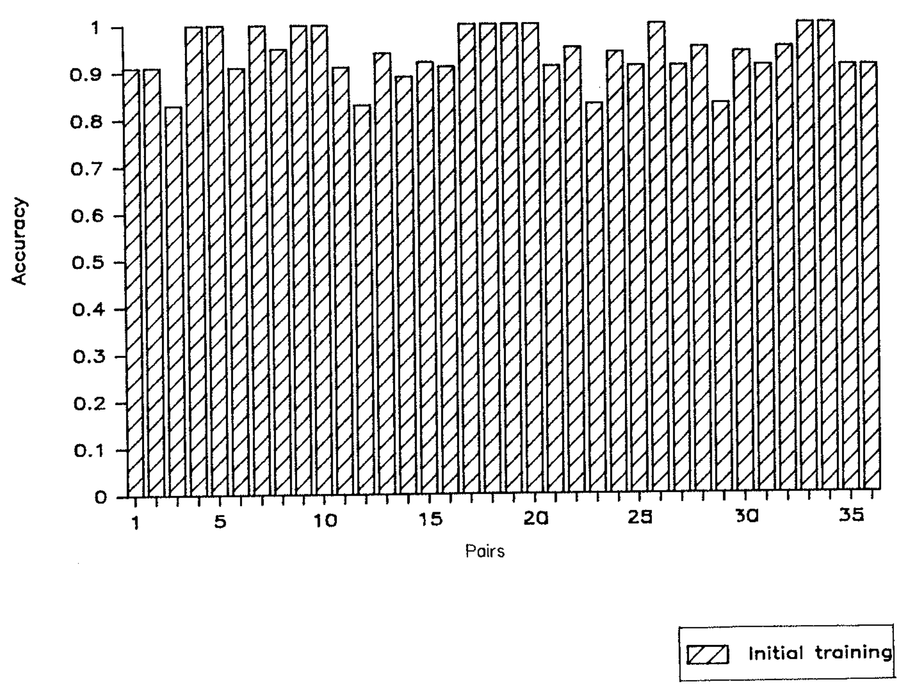
The cumulative number of discriminations Tim learned and the accuracy for each pair are presented in Figure 6. In the 16 sessions of discrimination training Tim learned to discriminate 36 pairs of Blissymbols. Learning proceeded at a steady pace. The number of trials to criterion for each discrimination are presented in Table 3. Most pairs required only 10 to 12 trials for the discrimination to be learned. High accuracy levels (greater than 80%) can be seen for all pairs learned.

Responding within each session generally reflects Tim's high learning rate. The number of discriminative responses per session is presented in Figure 7. Correct discriminative responses were maintained at high levels of 25 to 30 correct for all sessions. The number of consecutive correct responses and number of consecutive errors are also presented in Figure 7. While the number of consecutive correct responses appears variable the number never dropped below 10 and overall was very high. When the number of consecutive errors are examined it is seen that Tim seldom made successive errors.

Figure 6. Cumulative discriminations learned by Tim and accuracy for each discrimination pair.



Tim
Cumulative discriminations learned
40
35
30
25
20
15
10
5
0
2
4
6
8
10
12
14
16
18
20
Sessions



Accuracy
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1
5
10
15
20
25
30
35
Pairs
Initial training

Table 3

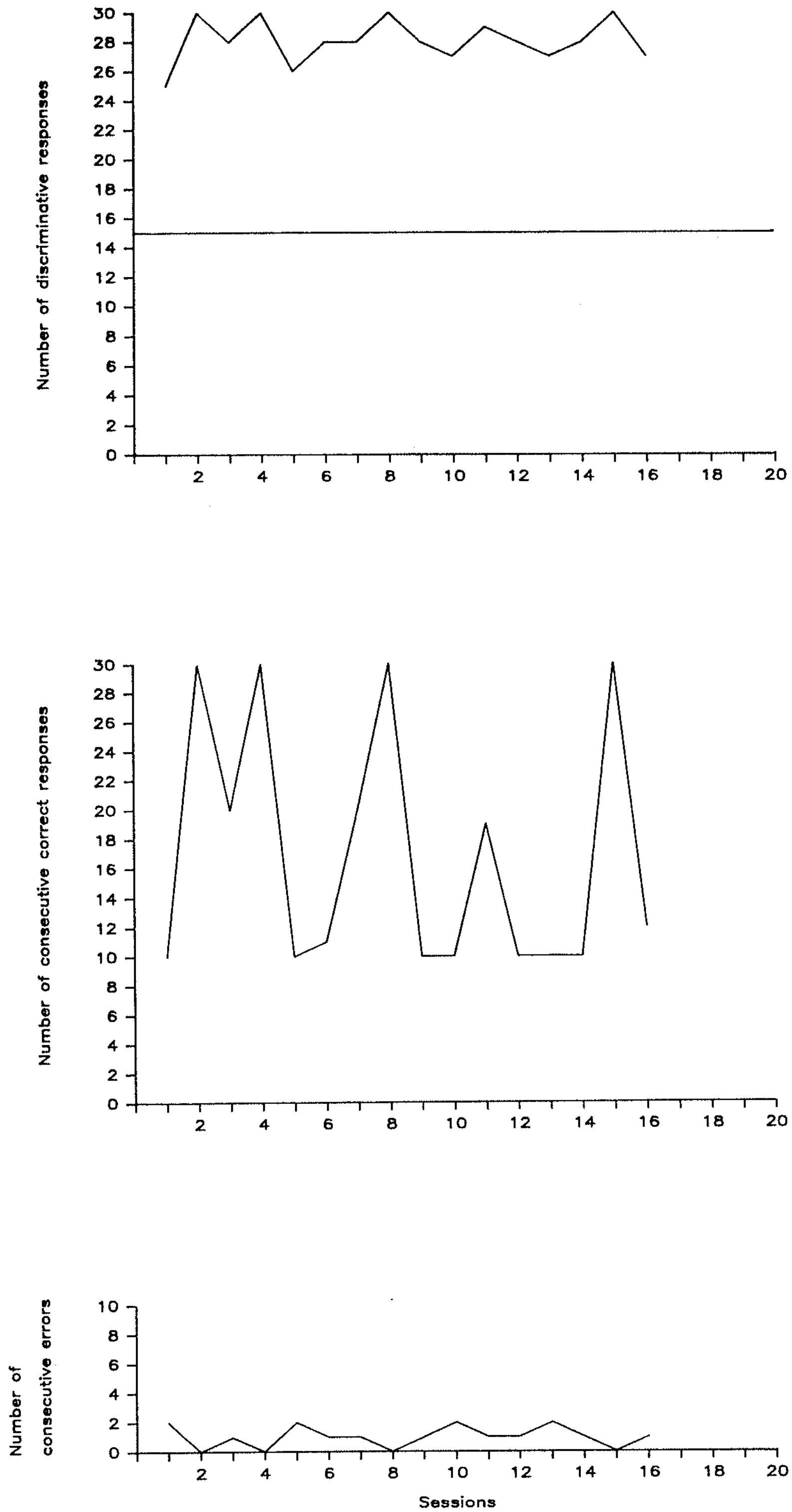
Total Number of Trials to Reach Discrimination Learning Criterion.

Participant	Discriminative Pair	Trials to Criterion	
Tim	(1) +badge -work	11	
	(2) +woman -bread	11	
	(3) +ball -vegetable	18	
	(4) +wind -blackboard	10	
	(5) +sky -boy	10	
	(6) +bottle -tree	11	
	(7) +shirt -bath	10	
	(8) +bird -seed	19	
	(9) +tool -boat	10	
	(10) +bridge -stove	10	
	(11) +teeth -body	11	
	(12) +baby -soup	12	
	(13) +snow -bone	17	
	(14) +airplane -scissors	19	
	(15) +scale -book	12	
	(16) +cloth -snail	11	
	(17) +sword -cloud	18	
	(18) +day -parent	10	
	(19) +comb -park	10	
	(20) +rain -cheese	10	
	(21) +child -radio	11	
	(22) +plastic -electricity	19	
	(23) +flower -paper	12	
	(24) +mountain -fish	17	
	(25) +fire -money	11	
	(26) +nose -furniture	19	
	(27) +needle -food	11	
	(28) +gas -number	19	
	(29) +nurse -gathering	12	
	(30) +girl -name	18	
	(31) +gym -music	11	
	(32) +metal -grass	19	
	(33) +man -head	10	
	(34) +hand -machine	10	
	(35) +lake -glass	11	
	(36) +hobby -leaf	11	
Christina	(1) +bridge -glass	28	
	(2) +boat -tool	29	
	(3) +body -vegetable	17	
	(4) +wind -airplane	13	
	(5) +animal -woman	43	
	(6) +baby -work	10	
	(7) +seed -child	125	
	(8) +bone -shirt	51	
Lena	(1) +hobby -park	118	
	(2) +parent -garbage	87	
	(3) +airplane -tree	29	22*
	(4) +vegetable -animal	333	
Adam	(1) +white -purple	406	
	(2) +man -head[5]	384	
	(3) +man -head[4]	699	
	(4) +man -head[3]	402	
	(5) +man -head[2]	14	
	(6) +man -head[1]	217	286*

*asterisk denotes the total number of trials to criterion at retraining

Figure 7. Number of discriminative responses, consecutive correct responses, and consecutive errors for each session with Tim.

Tim


Number of discriminative responses
Number of consecutive correct responses
Number of consecutive errors
Sessions

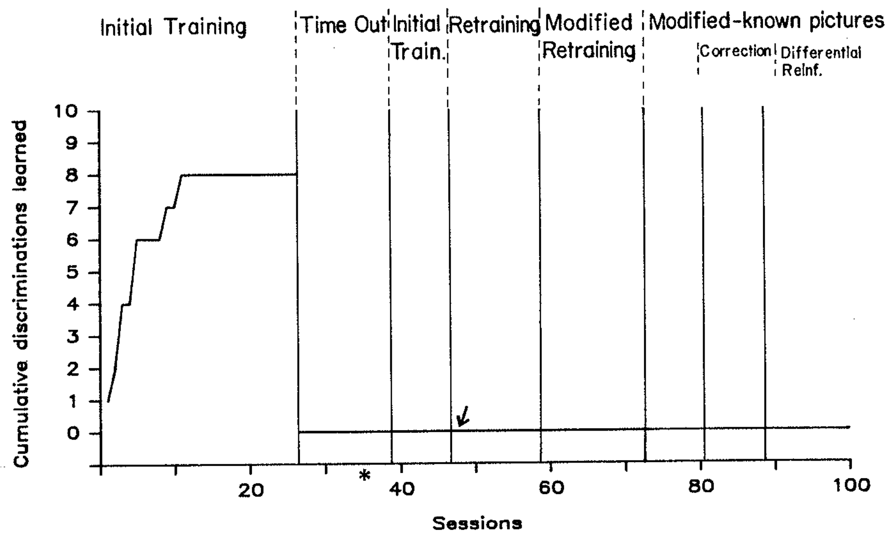
Christina

The cumulative number of discrimations that Christina learned and the accuracy for each pair are presented in Figure 8. Christina learned to discriminate 8 pairs of Blissymbols within the first 11 sessions of initial training; she did not learn any discriminations after that time in any of the training conditions nor did she relearn discriminations when retrained. The number of trials required to reach criterion for the discriminations learned are presented in Table 3. The number of trials for Christina to reach criterion varied from the minimum of 10 trials for the sixth discrimination learned to 125 trials for the seventh discrimination learned. Accuracy levels (see Figure 8) when the discriminations were initially learned were always greater than 60% and usually in the range of 70 to 85%. The accuracy scores when these discrimination pairs were retrained both under the initial training conditions and modified procedures are with one exception approximately 50% or less. The exception was Pair 5 which showed accuracy scores of 65% and 60% when retrained and when the modified training procedures were implemented.

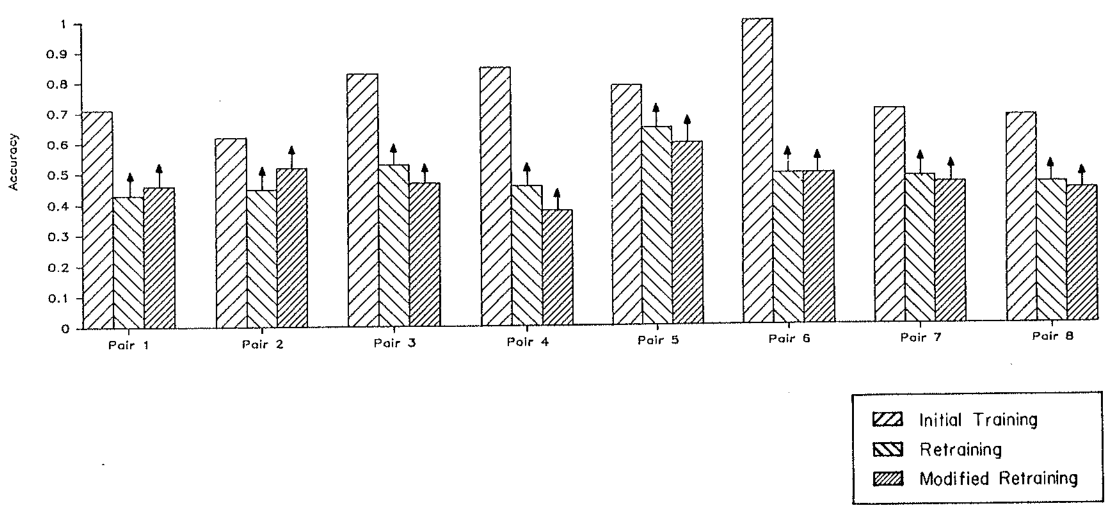
The number of correct discriminative responses Christina emitted each session are presented in Figure 9. Discriminative responding was high when training first commenced; however, it steadily declined within the initial training phase to chance (i.e., 50% correct responses) or to below chance levels before stabilizing at 17 to 18 correct discriminative responses per session. The introduction of time out did not seem to appreciably

Figure 8. Cumulative discriminations learned by Christina and accuracy for each discrimination pair. The upward arrows indicate that learning criterion was not reached. The arrow at Session 47 indicates when the reinforcer pretest was discontinued. (The asterick in the upper figure denotes when Christina moved.)

Christina



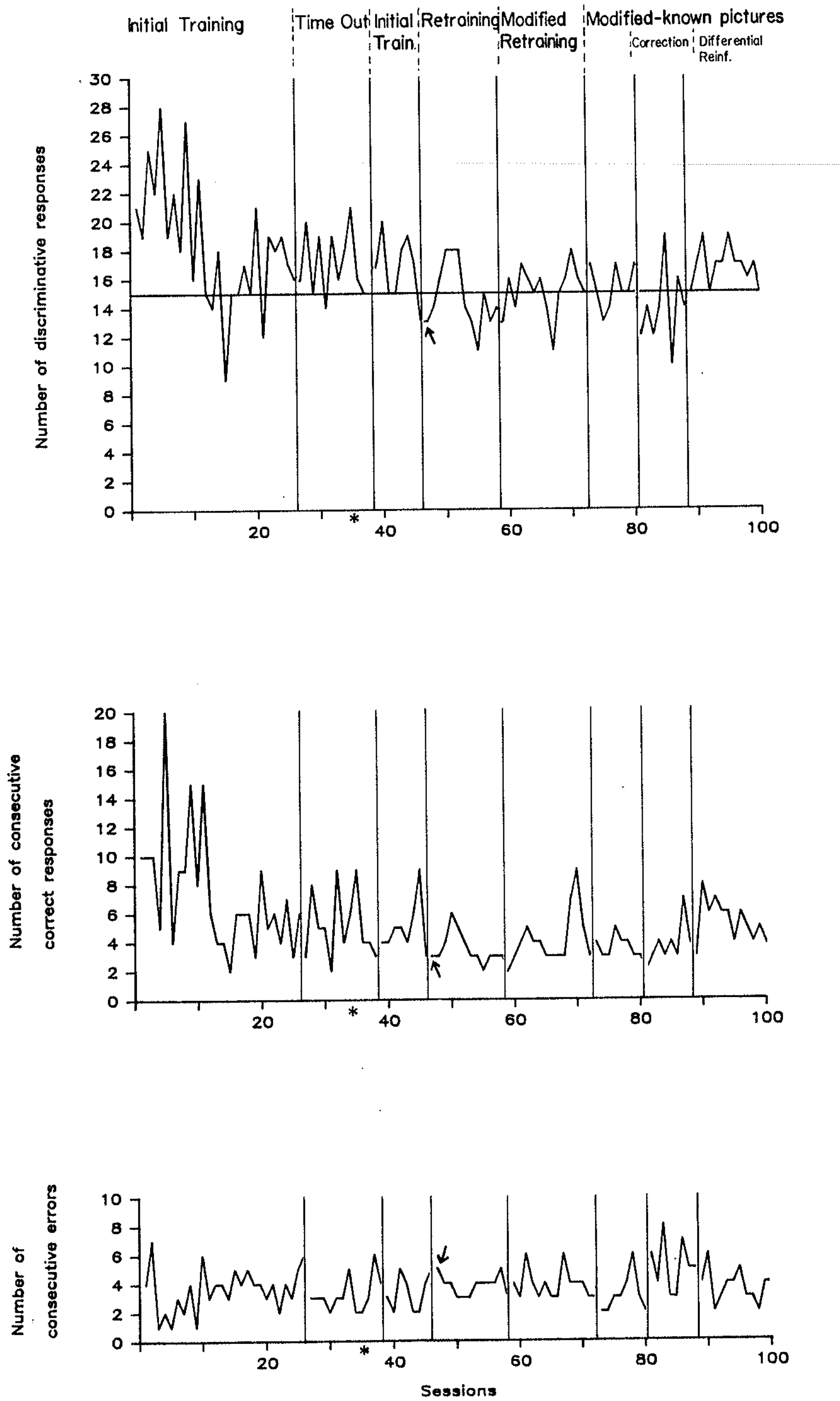
Initial Training
Time Out
Initial Train.
Retraining
Modified Retraining
Modified-known pictures
Correction
Differential Reinf.
Cumulative discriminations learned
0
1
2
3
4
5
6
7
8
9
10
*
20
40
60
80
100
Sessions



Accuracy
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Pair 1
Pair 2
Pair 3
Pair 4
Pair 5
Pair 6
Pair 7
Pair 8
Initial Training
Retraining
Modified Retraining

Figure 9. Number of discriminative responses, consecutive correct responses, and consecutive errors for each session with Christina. The arrows at Session 47 indicate when the reinforcer pretest was discontinued. (The asterick denotes when Christina moved.)

Christina



Initial Training
Time Out
Initial Train.
Retraining
Modified Retraining
Modified-known pictures
Correction
Differential Reinf.
Number of discriminative responses
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
20
*
40
60
80
100
Number of consecutive correct responses
Number of consecutive errors
Sessions

affect discriminative responding. When time out was terminated discriminative responding remained at the same level. During retraining discriminative responding deteriorated and was below chance for the last half of retraining. When these same Blissymbol pairs were again retrained using the modified training procedures correct responding gradually increased but overall the level was barely above chance.

Known picture cards replaced Blissymbols at Session 73 and discrimination training continued with the modified procedures. As with the previous phase, discriminative responding was at chance or near chance levels. When the correction procedure was introduced correct responding immediately decreased and remained below chance on all but two occasions. In the last phase, when differential reinforcement was added to the correction procedure discriminative responding increased and remained at levels comparable to those in the last few days of initial training with Blissymbols.

The number of consecutive correct responses and consecutive errors per session are also presented in Figure 9. The number of consecutive correct responses initially was variable with high peaks but by the end of initial training had become less variable and appeared to be declining. Consecutive errors remained fairly stable after the first 10 sessions. Neither of these variables were significantly affected when time out was introduced or removed. Generally, consecutive correct responses reflected discriminative responding in a given session, for example, during retraining consecutive correct responses was stable at its lowest levels. Consecutive correct responses increased during the last phase to a level higher than that seen in the last days of initial training but did decrease to a comparable level at the end. Consecutive errors appeared to be the reciprocal of discriminative responding, for example, consecutive errors were highest with known picture cards when the modified training included the correction procedure.

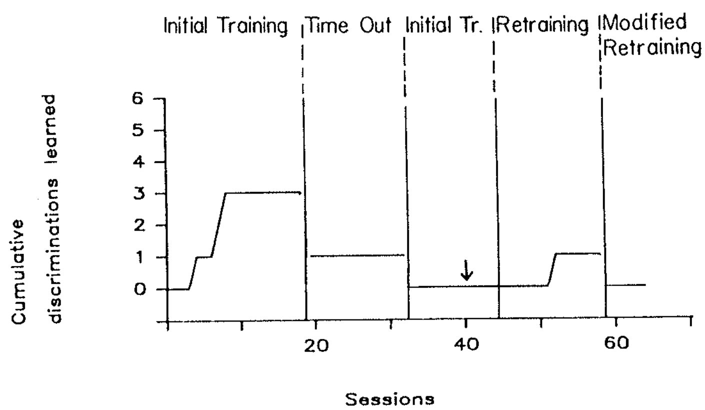
The reinforcer pretest, which was conducted daily with Christina until retraining began, showed consistently high rates of button pressing every day for all reinforcers selected. The rates ranged from 59 r.p.m. (cookies, Session 1) to 152 r.p.m. (coffee, Session 29), with an average of over 100 r.p.m. The pretest most often showed highest rates for coffee and cookies, although praise did generate comparable rates. There was no apparent correlation between rates of button pressing at pre-test and discriminative responding.

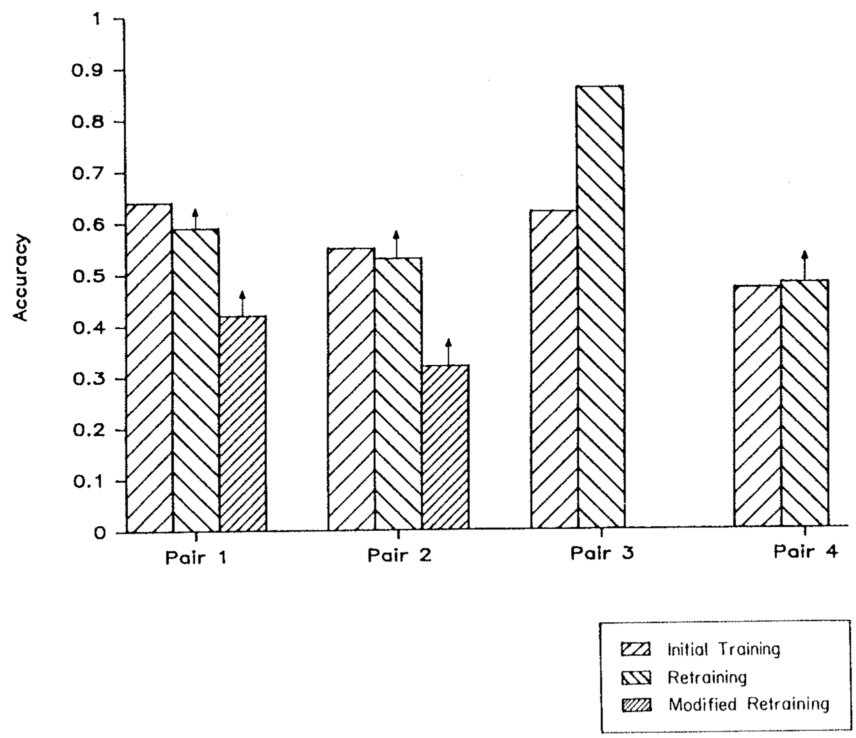
Lena

The cumulative number of discriminations Lena learned and accuracy for discrimination pairs trained are presented in Figure 10. Lena learned to discriminate three pairs of Blissymbols during initial training, all within the first eight sessions. When time out was introduced one discrimination was learned in the first session but none thereafter. At retraining one of the four previously learned discriminations reached learning criterion. The number of trials required to learn each of these

Figure 10. Cumulative discriminations learned by Lena and accuracy for each discrimination pair. The upward arrows indicate that learning criterion was not reached. The arrow at Session 41 indicates when the reinforcer pretest was discontinued.

Lena


Initial Training
Time Out
Initial Tr.
Retraining
Modified Retraining
Cumulative discriminations learned
6
5
4
3
2
1
0
20
40
60
Sessions

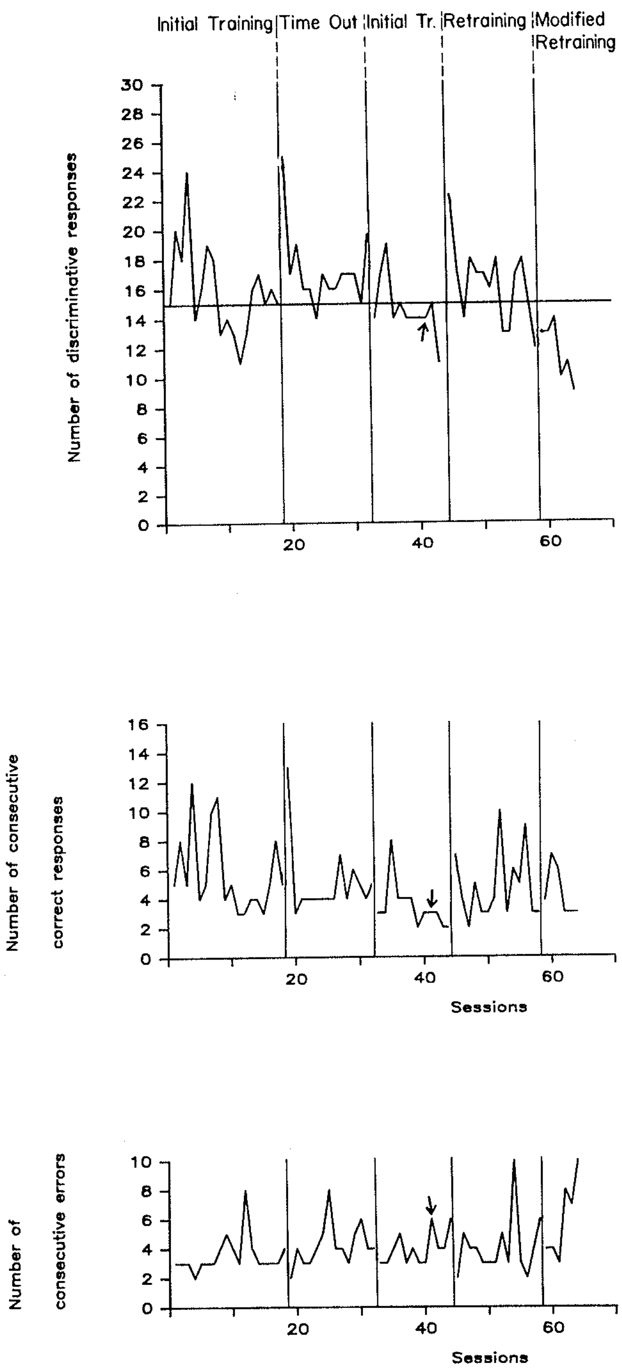

Accuracy
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Pair 1
Pair 2
Pair 3
Pair 4
Initial Training
Retraining
Modified Retraining

discriminations are presented in Table 3. There was a tremendous variability in the number of training trials that Lena required, from only 29 trials to learn the third discrimination to 333 trials to learn the fourth discrimination. The Blissymbol pair which reached criterion at retraining was relearned in fewer trials than originally required and was the pair which required the fewest number of trials initially. Accuracy for the four discriminations when initially learned versus retraining is also presented in Figure 10. The accuracy for each of the pairs when initially learned ranged from just under 50% (Pair 4) to just over 60% (Pair 1). When Pair 3 was relearned the accuracy was much higher than when initially learned. Accuracy scores at retraining for the discriminations which were not relearned were comparable to the initial accuracy scores. When the modified procedures were introduced and retraining started again the accuracy scores were substantially lower.

The number of discriminative responses for each session are presented in Figure 11. The number of discriminative responses appeared to be increasing initially but then started to decline and continued such that Lena was responding at below chance levels. Correct responses had increased to just above chance when time out was introduced, which resulted in a sharp, though momentary, increase in discriminative responding. At the end of time out discriminative responding had stabilized at approximately 17 correct responses. When time out was terminated and the initial training procedures reinstated discriminative behavior

Figure 11. Number of discriminative responses, consecutive correct responses, and consecutive errors for each session with Lena. The arrows at Session 41 indicate when the reinforcer prestest was discontinued.

Lena



Initial Training
Time Out
Initial Tr.
Retraining
Modified Retraining
Number of discriminative responses
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
20
40
60
Number of consecutive correct responses
16
14
12
10
8
6
4
2
0
20
40
60
Sessions
Number of consecutive errors
10
8
6
4
2
0
20
40
60
Sessions

deteriorated. Retraining resulted in higher levels of discriminative responding overall; however, there were some occasions when correct responding was very low, especially at the end of retraining. Responding during the final phase, modified retraining, was very low and deteriorating. Examination of the nurses' records showed documentation of Lena complaining of stomach pains and nausea and vomiting on several days during the final phase and the previous one; it may be that this was responsible for the deterioration in responding. At Session 64 training was terminated due to Lena being restricted to bed and subsequently hospitalized.

The number of consecutive correct responses and consecutive errors per session for Lena are also presented in Figure 11. Consecutive correct responses were variable and slowly decreased during initial training except for the last three sessions. Consecutive errors did not increase during this phase, although there were a few sessions where consecutive errors were higher. After time out was introduced, aside from the initial surge on the first session, consecutive correct responses were not much higher, whereas consecutive errors appeared to be slightly higher. Consecutive correct responses decreased when initial training was reintroduced, and increased both in absolute number and variability when retraining occurred. Consecutive errors were virtually unchanged when time out was terminated. There was a noticeable increase in variability in consecutive errors during retraining and a definite steady increase when the modified procedures were introduced.

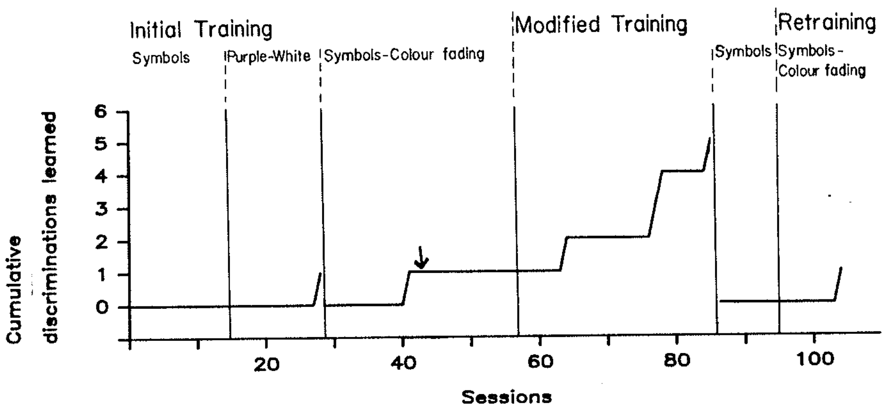
The reinforcer pretest resulted in almost equal rates of button pressing for each of the three stimuli each day. Across days the response rate ranged from 32 r.p.m. (pretzels, Session 13 and ice cream Session 31) to 66 r.p.m. (pretzels, Session 25). There was no apparent relationship between the rate of button pressing and discriminative responding.

Adam

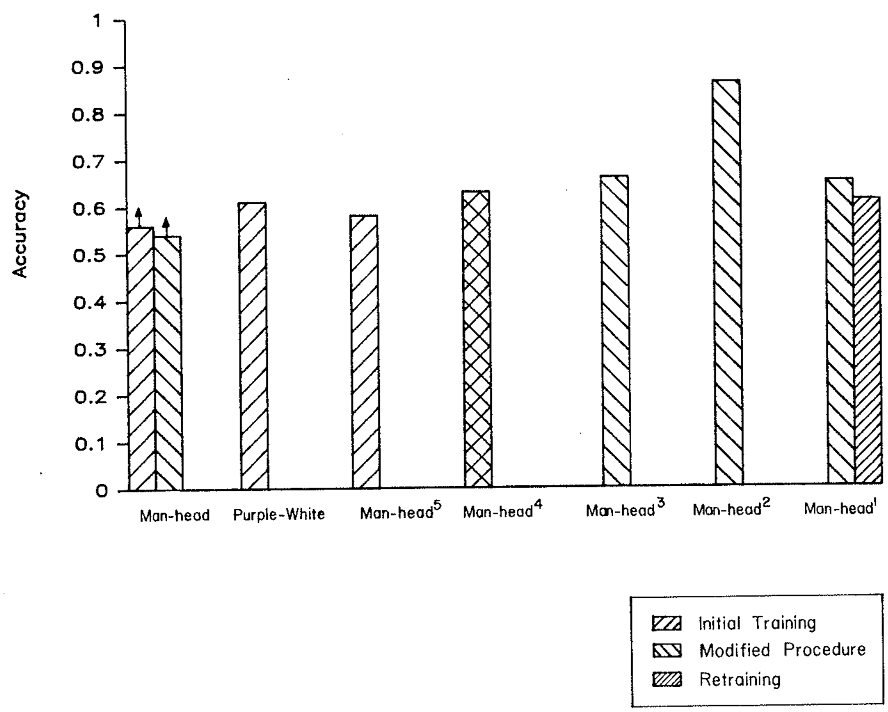
The cumulative number of discriminations that Adam learned and accuracy for the discriminative pairs are presented in Figure 12. Adam did not learn to discriminate any Blissymbol pairs when the initial training procedures were introduced; however, he did learn to discriminate the purple-white stimuli when they replaced the Blissymbols. Subsequently he reached criterion on the first colour fading step with Blissymbols and, when the modified training procedures were introduced, the remaining four steps. There was no learning when the symbols were reintroduced, but, Adam did discriminate the pair at the last fading step when it was retrained. The number of trials to reach criterion for each of the discriminations learned are presented in Table 3. With the exception of Pair 5 (fading step 4) the number of trials was always greater than 200 with the third pair (fading step 2) requiring almost 700 trials to reach criterion. The last fading step required more trials to reach criterion at retraining than when it was first learned. Accuracy for each of the discriminative pairs learned and the Blissymbol pair that was not learned are also presented in Figure 12. Accuracy for the

Figure 12. Cumulative discriminations Adam learned and accuracy for each discrimination pair. The upward arrows indicate that learning criterion was not reached. The arrow at Session 43 indicates when the reinforcer pretest was discontinued.

Adam



Initial Training
Symbols
Purple-White
Symbols-Colour fading
Modified Training
Symbols
Retraining
Symbols-Colour fading
Cumulative discriminations learned
0
1
2
3
4
5
6
20
40
60
80
100
Sessions



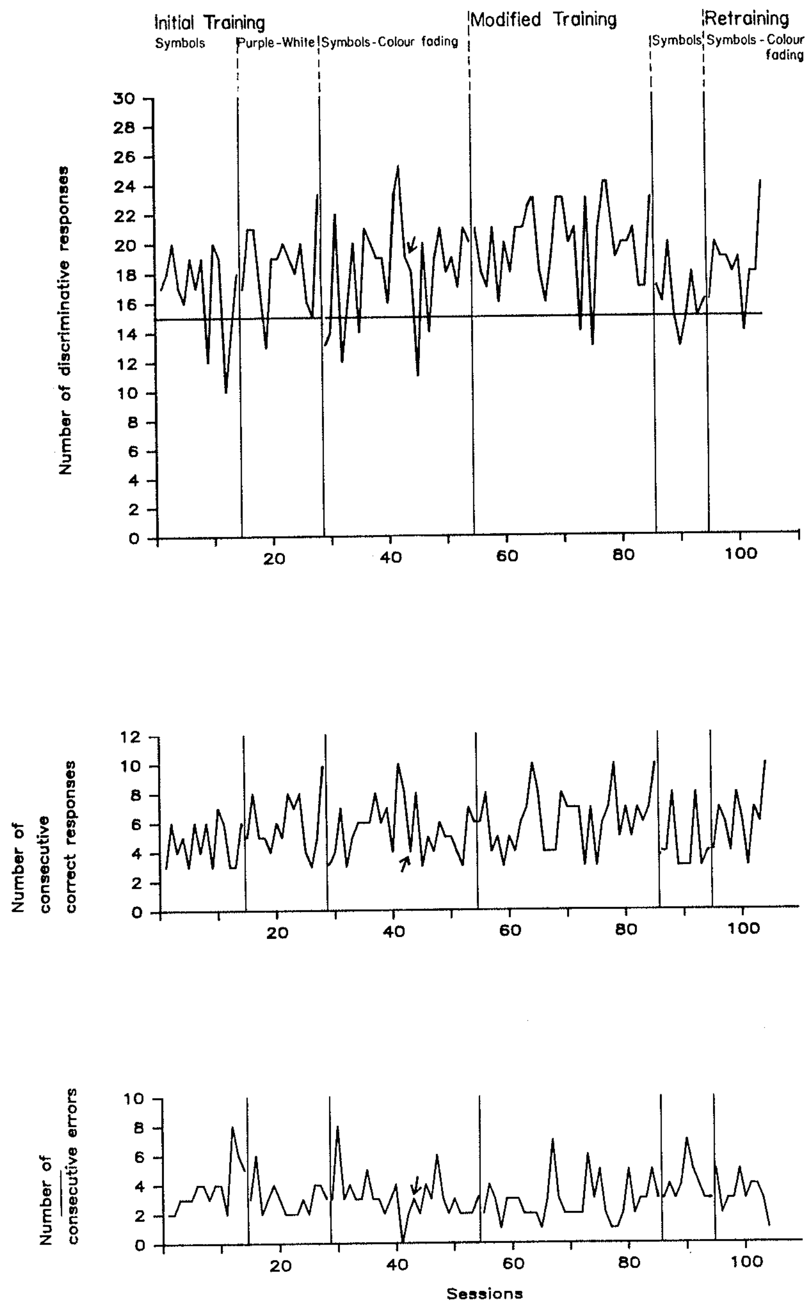
Accuracy
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Man-head
Purple-White
Man-head5
Man-head4
Man-head3
Man-head2
Man-head1
Initial Training
Modified Procedure
Retraining

purple-white discrimination and at each of the colour fading steps, except Step 4, were within the range of 58% to 66%. Accuracy for the Blissymbol pair during initial training and the modified training procedures were not significantly lower, 56% and 54% respectively, although the learning criterion was not reached. Step 4 which reached criterion in the fewest number of trials, had an accuracy score of almost 90%.

The number of discriminative responses per session for Adam are presented in Figure 13. Discriminative behavior during initial training with Blissymbols was fairly stable at levels of 17 to 20 correct responses per session except for two occasions when responding dramatically dropped below chance. When the purple-white stimuli were introduced discriminative responding overall increased and on only one occasion did it dip below chance. Initially when the Blissymbols with colour fading were introduced discriminative responding became quite variable and overall increased until criterion was reached. This pattern was repeated with the next fading step; however, criterion was not met before training procedures changed. When the modified training procedures were introduced discriminative behavior overall remained fairly high, between 16 and 24 correct responses per session, with two occasions when responding was just below chance. Reintroduction of the Blissymbols resulted in an immediate deterioration of discriminative responding. When the last fading

Figure 13. Number of discriminative responses, consecutive correct responses, and consecutive errors for each session with Adam. The arrows at Session 43 indicate when the reinforcer pretest was discontinued.

Adam



Initial Training
Symbols
Purple-White
Symbols-Colour fading
Modified Training
Symbols
Retraining
Symbols - Colour fading
Number of discriminative responses
Number of consecutive correct responses
Number of consecutive errors
Sessions

step was retrained responding increased with only one session below chance.

The number of consecutive correct responses and consecutive errors are also presented in Figure 13. When initial training took place with Blissymbols consecutive correct responses oscillated between three and approximately six correct responses in sequence, but, consecutive errors increased. When the simple purple-white discrimination was introduced consecutive correct responses increased and consecutive errors decreased. Consecutive correct responses generally varied during the colour fading steps with a slightly higher level at the end; the level decreased when Blissymbols were reintroduced. Consecutive errors increased when colour fading was introduced for approximately 10 sessions after which it decreased and fluctuated. At the end of colour fading consecutive errors appeared higher and this increase continued through the reintroduction of Blissymbols and the last fading step.

The reinforcer pretest results for Adam were quite variable. Button pressing ranged between 2 r.p.m. (cookies and salami, Session 19) and 29 r.p.m. (cookies, Session 9). Generally, the response rates were between 11 r.p.m. and 20 r.p.m. There were five occasions when button pressing was below 10 r.p.m.; on one of these occasions discriminative behavior was uncharacteristically low (Session 19). Each of the three reinforcers was chosen almost an equal number of times from the pre-test rates.

Summary

Each of the participants showed quite different results. Tim learned 36 Blissymbol discriminations at a very high and steady rate. Christina initially learned eight Blissymbol discriminations; her pace was slower than Tim's and she abruptly stopped learning at Session 11. Lena learned to discriminate three Blissymbol pairs during initial training and one more when time out was introduced; at retraining she relearned one discrimination. Adam did not learn to discriminate any Blissymbol pairs but did learn a purple-white discrimination and five discriminations involving the colour fading on Blissymbols.

The number of training trials required for a pair of stimuli to reach discriminative criterion varied tremendously across participants and, except for Tim, varied across discriminations learned for each participant. Tim required only a minimal number of trials, Christina varied from 10 trials to 125 trials, Lena from 29 trials to 333 trials, and Adam from 14 trials to 699 trials.

Accuracy for the discriminations learned varied considerably across participants. Tim had accuracy scores of above 80% for all of the discriminations learned; Christina's accuracy scores most often ranged from 70 to 85%. Both Lena and Adam showed lower accuracy scores for the discriminations they learned, generally 50% to 60%. One exception each of higher accuracy occurred with Lena and Adam.

When discriminative responding across sessions was examined, Tim showed consistently high numbers of correct responses.

Christina initially showed a high level of discriminative responding but responding slowly deteriorated to below chance levels. Discriminative responding later increased, but the levels reached were at just above chance levels. Neither retraining nor changes in training procedures or discriminative stimuli served to increase discriminative responding. When the correction procedure was introduced discriminative responding decreased; however, when differential reinforcement was added, responding increased to levels not seen for approximately 80 sessions. Lena similarly showed a decrease in discriminative responding after moderately high levels of correct responding. A slight increase in responding did occur, however, when time out was introduced and at retraining. The very low discriminative behavior at the end of training with Lena could most likely be attributed to a stomach illness which required bed care. Adam's discriminative responding was moderately high overall. He showed definite decreases when Blissymbols were being trained, and increases with the colour fading. The relationship between consecutive correct responses, consecutive errors, and discriminative responding appeared to be slight and different for each participant.

The reinforcer pretest results with Christina and Lena showed high or moderate rates of button pressing for all three of the reinforcers every day. Adam's button pressing rates were low on some occasions; however, only one of these occasions was associated with an uncharacteristically low number of discriminative responses.

Discussion

This experiment demonstrated that individuals with Alzheimer's disease can learn to discriminate novel stimuli; however, learning rates were not high nor were they sustained. This deficit in learning is even more apparent when a comparison is made with the elderly participant who did not have Alzheimer's disease yet was borderline mentally retarded. It must be emphasized that the simplest procedures for establishing discriminations were sufficient to sustain learning in the participant without Alzheimer's disease, whereas procedures which have been found to be effective with other populations, implemented individually or in combination, over many trials had minimal effect with the participants with Alzheimer's disease. It appears that Alzheimer's disease at the stage encountered with these individuals precludes sustained or high rates of learning.

The response-reinforcer relationship which Delprato et al. (1984) and others have shown to be very powerful in enhancing discriminations did not dramatically increase discriminative responding when introduced. It is problematic to evaluate this procedure as it was introduced with two other experimental changes; however, all of the changes were designed to enhance discriminative responding and little enhancement was observed. A small effect was observed with Adam, namely, he did finally reach discriminative criterion on a pair that had been in training for quite some time and his discriminative learning rate did increase after the modified procedures were introduced. However, because fading was ongoing when the modified procedures were introduced, it is not possible to isolate the factor responsible for the increase in learning rates.

Fading was introduced with Adam only because he had not learned a discrimination after 14 sessions (420 trials). The introduction of a fading procedure resulted in discriminative learning of each fading step but was not completed to the terminal stimuli, that is, the Blissymbols. The fading procedure employed in the present study was not a "pure" fading procedure in that errors occurred in the presence of the S^- and, therefore, the procedure does not fit the procedural definition of errorless learning (Terrace, 1966a). It is possible that had an errorless procedure been implemented the terminal stimuli may have been discriminated. However, it should be noted that while fading was not successfully accomplished, enhancement of discriminative responding as a function of modifying the training stimuli was observed.

The differential schedule of reinforcement appeared to have the greatest impact on enhancing discriminative behavior with Christina. Although the observed effect was small, it must be considered within the context of an individual who had probably significantly deteriorated at the time it was introduced. With Christina it is plausible that the decline in discriminative responding reflected deterioration due to Alzheimer's disease. This is partially supported by anecdotal data. First, when she was baselined on the picture cards for the last phases she could not identify one-third of them whereas when the research began she did not appear to have any difficulty in naming. Additionally, at the end of Experiment 2 she did not even appear to have 24 hour retention. This was illustrated when she was "taught" the name of her new residence on one day, and could not emit that name on the following day, whereas in the pilot study she showed retention for new Blissymbol names for up to 1 week. If we accept that Christina had significantly deteriorated by the last phase, the fact that differential reinforcement not only maintained discriminative behavior but increased it, indicates an experimental effect.

All of the preceding procedures, while demonstrated by others to be effective in training discriminations, had not been used previously with individuals with Alzheimer's disease. Hussian's (1982) study, while focussing on response-reduction techniques appropriate for the elderly, involved discrimination training. A comparison then between the present study and Hussian's study seems most relevant. There are several major differences. First, the stimuli Hussian used were large (5 in. to 18 in.), colourful, and contrasting, whereas the stimuli in the present study were black and white and all were graphics. The low rates of learning may be due to the discriminative stimuli used. It may be that the Blissymbols are too abstract or complex for an individual with Alzheimer's disease to discriminate. But two of the participants with Alzheimer's disease learned discriminations early in training indicating that the stimuli were not too complex to discriminate, at least for participants at this functioning level. At face value these stimuli can be evaluated as more complex, consequently, this discrimination task appears, at least, to be more difficult than Hussian's. However, when the discriminative stimuli were modified in the present study, specifically, in ways which increased the contrast between the S^+ and the S^-, discriminative responding did not dramatically increase. Adam did learn the purple-white discrimination which is analogous to Hussian's red circle (S^+) white circle (S^-), but required 406 trials (the number of trials to criterion was not stated in Hussian's study). Further, the failure of Christina to simultaneously discriminate picture cards which had readily been identified suggests that it was not solely the nature of the discriminative stimuli which had deleterious effects on learning.

A second difference between the two studies was that Hussian (Study 1) introduced an aversive stimulus. When the participant attended to the S^- a noxious noise was delivered. Although there was no discriminative learning criterion, he did note avoidance behavior on the part of all of the participants when S^- was presented on subsequent trials. The demonstration of stimulus control was the documentation of inappropriate entries which showed reductions in entries to areas where S^- was affixed. While there is no question that a discrimination was formed the involvement of a conditioned aversive stimulus (S^-) and a behavioral process of avoidance greatly differs from the procedures used in the present study.

The last major difference between the present study and Hussian's was the type of discrimination task employed, simultaneous versus successive. It appears that Hussian trained discriminations successively, that is, he presented S^+ and reinforced attention to it and alternately presented S^- and consequated attention with a noxious noise (Study 1) or extinction (Study 2). In the present study a simultaneous task was presented to the participants, that is, S^+ and S^- were presented concurrently and responses to S^+ were reinforced. At this point the reinforcer pretest provides some valuable information. First, the pretest clearly demonstrated that the stimuli used as reinforcers were in fact reinforcers and, specifically for Christina and Lena, the reinforcing power of these consequences was repeatedly demonstrated while discriminative responding was declining. The reinforcer pretest, a shortened brief version of Experiment 1, in addition to Hussian's study, demonstrates responding on a successive discriminative task. Differential response rates in the presence of reinforcers versus extinction was again observed in the participants (although the effect was somewhat weaker with Adam) during reinforcer testing. Thus, the participants were successfully performing a successive discrimination task while deteriorating on a simultaneous task. It must be acknowledged that the nature of the tasks were somewhat disparate. Regardless, a successive discrimination task has been demonstrated both in this research and Hussian's to be successfully performed by individuals with Alzheimer's disease.

In the present study discriminative responding deteriorated in two of the participants without any changes in training. Hussian similarly found that a procedure effective at one time was not effective at a later time with elderly people with Alzheimer's disease. In Study 1, once inappropriate entry was reduced the super-normal stimuli were faded; however, at a later time when booster sessions were required, and fading was again attempted, it was unsuccessful. Hussian attributed the lack of successful fading at the later time to the advancing deterioration of the participants. While it is difficult to determine whether disease deterioration is responsible for these effects, the fact that performance decrements over time have been observed in more than one study with the population of Alzheimer's individuals strengthens the argument.

GENERAL DISCUSSION

Experiments 1 and 2 demonstrated that reinforcers can be identified, with varying degrees of ease, for elderly individuals with Alzheimer's disease and that discriminations can be learned. However, the simultaneous discrimination learning rates were low and not sustained. The issue of simultaneous versus successive discrimination task is raised in light of the fact that the only other discrimination study with elderly people with Alzheimer's disease involved a successive discrimination task. In the present study performance on a successive discrimination task, the reinforcer test, was superior to performance on the simultaneous discrimination task. In the latter, learning was minimal and discrimination behavior, in general, was only moderately above chance levels of responding. Observations from the present research suggest that successive discriminations are more readily acquired than simultaneous discriminations. However, differences in the discriminative stimuli across the two tasks prevents any definitive statements.

In the last phase, Christina was able to name more than 60% of the picture cards individually presented to her; that is, she showed approximately 66% accuracy on a successive discrimination. In contrast, her performance on a simultaneous discrimination task with the same stimuli, a simpler response (pointing), and programmed reinforcers resulted in 40% to 60% accuracy. This illustration does have problems, specifically that the successive discrimination may have involved premorbid learning (Schacter, 1983); however, it does show that a very simple simultaneous task could not be performed at very high levels of accuracy.

Schlotterer, Moscovitch, and Crapper-McLachlan (1983) examined visual processing deficits in patients with senile dementia of the Alzheimer type and found that spatial organization was not as grossly affected as temporal organization. If we put this finding into the context of discrimination tasks, their results would predict simultaneous discrimination (spatial organization) to be acquired more readily than successive discrimination (temporal organization). This is not in agreement with the preceding discussion and certainly merits further attention. A study examining discriminative responding which is not dependent on previous history, and is under the control of the same or highly similar discriminative stimuli which are presented successively versus simultaneously is needed.

The role of attention has been and continues to be an issue in stimulus control. According to Dinsmoor (1985), the extent of stimulus control depends on how much contact the organism has with the stimuli. In the initial training condition of Experiment 2 an attending response, touching a dot on the table in front of the participant, was required prior to presentation of the discriminative stimuli. This was based on Lindsley's (1964) recommendation that an attending response should be used with geriatric patients who appear to have intermittent attention to ensure that stimuli are not missed. While the required attending response increased the probability that the participants were "on task" it did not necessarily guarantee that they were attending to the salient features of the training stimuli. In other discriminative studies the attending responses have included looking at cards (Newsom & Simon, 1977) or the discriminative response itself, for example, touching a key illuminated with the S^+ (Sidman & Stoddard, 1967). These attending responses appear more likely to ensure that the participant will observe the stimulus and hence should result in a greater degree of stimulus control (Dinsmour, 1985). In fact, Hussian (1982) demonstrated strong stimulus control when the discriminative response was "attending," namely, looking or touching the discriminative stimuli. Later in the present study, the introduction of the response-reinforcer relationship necessitated that the participant pick up and hold the discriminative stimuli. Certainly this procedure increased the contact the participant had with the discriminative stimuli, however, it did not serve to narrow stimulus control. The nature of attending then does not appear to be simply a matter of "contact" with elderly people with Alzheimer's disease. A study investigating the nature of attending responses facilitative in discriminative responding in elderly individuals with Alzheimer's disease would be worthwhile.

In Hussian's study it was found that reinforcement alone was not particularly effective with elderly people with Alzheimer's disease. In the first study entry behavior was successfully reduced by the introduction of discriminative stimuli thus the subsequent introduction of reinforcement had little effect. In

Study 2, however, when reinforcement procedures were introduced to reduce stereotyped behaviors by reinforcing an alternative behavior there was no change in the stereotyped behavior. This procedure was only effective when the discriminative stimulus, specifically, the S^+, was introduced. It appears that MacDonald et al. (1982) have supporting data. When patients were reinforced for meaningful activity, the patients previously determined to be at a high activity level showed large increases in activity whereas the low activity patient group, reportedly including Alzheimer patients, showed little effect from the reinforcement contingencies. However, when an intervention primarily involving antecedent control, namely activity prompts, was introduced, there appeared to be a substantial impact on the activity level of the low activity patients.

A possible factor in the relatively poor consequent control of behavior in individuals with Alzheimer's disease may be that reinforcers in general are weak. It was demonstrated in Experiment 1 that a simple button press response was difficult to establish and impossible to maintain on an intermittent schedule in two of the Alzheimer participants. An explanation was that the strength of the reinforcers may have been low. A problem with this analysis is that the participants in this study not only had Alzheimer's disease but also were elderly, over 85 years of age. It has already been noted that the selection reinforcers for the elderly is problematic. Thus the issue of weak reinforcers in these participants with Alzheimer's disease is compounded. A study examining strength of reinforcers, analogous to the reinforcer test, in individuals with early onset of Alzheimer's disease is required.

The level of deterioration of individuals with Alzheimer's disease appears to be an important factor yet has not been systematically addressed. The overall low rates of learning in the present study may be due to the level of deterioration of the participants. According to the GERRI scores they all fell within the range of severely demented. The generality of the present findings may be limited to individuals with this level of deterioration. However, behavioral interventions with individuals at earlier stages of the disease may be gleaned from Christina's data. If Christina is representative, we could say that early in the course of the disease acquisition of new behaviors is possible (as evidenced by learning of names of Blissymbols in pilot study) whereas later in the course of the disease learning is far more tedious, if not impossible. While this is highly speculative it does offer some encouragement for behavioral interventions. A study then which examines the effects of training at various stages in the course of Alzheimer's disease, especially early in the course of the disease, is of interest. It has been the author's experience that people at this level of Alzheimer's disease will not agree to participate in a research program focused on learning. Hussian (1981) labels this "denial"; these individuals respond in ways to reduce the negative affect of the disease. One such way is by not putting themselves in situations which may illustrate an inability on their part to answer a simple question or complete a simple task. Conducting research with people early in the course of Alzheimer's disease presents a major ethical concern (MacDonald, 1976). If an informed consent process results in nonparticipation of individuals early in the course of Alzheimer's disease the options open to studying this subgroup of individuals are: (a) to not inform or alternatively, misinform, the individual as to the nature of the research or (b) bypass the individual with the disease and seek informed consent from a "guardian." Neither option is appealing.

While learning in the present series of experiments was minimal, there were differences in performance across participants with Alzheimer's disease. And while the participants all fell within one level of dementia, an examination of their aphasia screening test results and cluster GERRI scores could place the participants on a continuum from "moderately-severely deteriorated" (Christina), to "severely deteriorated" (Lena), to "severely-severely deteriorated" (Adam) (These classifications are the author's categories). Their respective performances on the Blissymbol discrimination task could be placed along a similar continuum. The differences in performance across participants may be an indication of differential responding due to different levels of deterioration. Erickson and Scott (1977) emphasize the need for an assessment tool which can accurately evaluate a patient's learning capabilities. It appears that a task such as the discrimination task may have utility as such an assessment tool. It is important to note that the participants appeared to "enjoy" the Blissymbol discrimination task. They readily attended sessions and were very cooperative throughout the sessions. An assessment technique such as this task which does not produce unpleasant emotional behaviors is preferred (Robertson et al., 1982). A study exploring the potential of a discrimiantion task as an assessment tool to identify or track deterioration would be a valuable contribution.

References

Alzheimer Society of Canada (1984). Alzheimer's disease: A family information handbook. Department of National Health and Welfare.

American Psychiatric Association (1980). Diagnostic and statistical manual of mental disorders (3rd ed.). Washington, DC: Author.

Ankus, M., & Quarrington, B. (1972). Operant behavior in the memory disordered. Journal of Gerontology, 27, 500-510.

Appell, J., Kertesz, A., & Fisman, M. (1982). A study of language functioning in Alzheimer patients. Brain and Language, 17, 73-91.

Baer, D. M., Wolf, M. M., & Risley, T. R. (1968). Some current dimensions of applied behavior analysis. Journal of Applied Behavior Analysis, 1, 91-97.

Baltes, M., & Barton, E. (1977). New approaches toward aging: A case for the operant model. Educational Gerontology: An International Quarterly, 2, 383-405.

Baltes, M. M., & Lascomb, S. L. (1975). Creating a health institutional environment for the elderly via behavior management: The nurse as a change agent. International Journal of Nursing Studies, 12, 5-12.

Barlow, D. H., & Hayes, S. C. (1979). Alternating treatments design: One strategy for comparing the effects of two treatments in a single subject. Journal of Applied Behavior Analysis, 12, 199-210.

Blessed, G., Tomlinson, B. E., & Roth, M. (1968). The association between quantitative measures of dementia and of senile change in the cerebral grey matter of elderly subjects. British Journal of Psychiatry, 114, 797-811.

Bliss, C. K. (1965). Semantography - Blissymbolics (2nd ed.). Sydney, Australia: Semantography Publications.

Blissymbolics Communication Foundation. Provisional dictionary (revised ed.). Toronto, Ontario, 1976.

Catania, A. C. (1984). Learning. New Jersey: Prentice-Hall.

Cautela, J. R. (1972). The Psychiatric Reinforcement Survey Schedule. Unpublished questionnaire. Boston College, Chestnut Hill, Mass.

Cautela, J. R., & Kastenbaum, R. A. (1967). Reinforcement Survey Schedule for use in therapy, training, and research. Psychological Reports, 20, 1115-1130.

Charles, R., Truesdell, M. L., & Wood, E. L. (1982). Alzheimer's disease: Pathology, progression, and nursing process. Journal of Gerontological Nursing, 8, 69-73.

Coyle, J. T., Price, D. L., & DeLong, M. R. (1983). Alzheimer's Disease: A disorder of cortical cholinergic innervation. Science, 219, 1184-1190.

DeBoni, U., & Crapper-McLachlan, D. R. (1980). Senile dementia and Alzheimer's disease: A current view. Life Sciences, 27, 1-14.

Delprato, D. J., Pappalardo, P. A., & Holmes, P. A. (1984). The role of response-reinforcer relationship in discrimination learning of mentally retarded persons. American Journal of Mental Deficiency, 89(3), 267-274.

Dinsmoor, J. A. (1985). The role of observing and attention in establishing stimulus control. Journal of the Experimental Analysis of Behavior, 43, 365-381.

Emery, O. B., & Emery, P. E. (1983). Language in senile dementia of the Alzheimer type. Psychiatric Journal of the University of Ottawa, 8, 169-178.

Erickson, R. C., & Scott, M. L. (1977). Clinical memory testing: A review. Psychological Bulletin, 84, 1130-1149.

Ferster, C. B., & Skinner, B. F. (1957). Schedules of reinforcement. New York: Appleton Century Crofts.

Gallagher, D., & Thompson, L. W. (1983). Depression. In P. M. Lewinsohn and L. Teri (Eds.), Clinical geropsychology: New directions in assessment and treatment (pp. 7-37). New York: Pergamon Press.

Geiger, G., & Johnson, L. (1974). Positive education for elderly persons: Correct eating through reinforcement. Gerontologist, 14, 432-436.

Haley, W. E. (1983). A family-behavioral approach to the treatment of the cognitively impaired elderly. Gerontologist, 23, 18-20.

Hanley, I. G. (1981). The use of signposts and active training to modify ward disorientation in elderly patients. Journal of Behavior Therapy and Experimental Psychiatry, 12, 241-247.

Helfman, E. S. (1981). Blissymbolics - speaking without speech. New York: Elsevier Nelson Books.

Hersen, M., & Barlow, D. H. (1976). Single-case experimental designs: Strategies for studying behavior change. New York: Pergamon Press.

Heston, L. L., Mastri, A. R., Anderson, V. E., & White, J. (1981). Dementia of the Alzheimer type: Clinical genetics, natural history, and associated conditions. Archives of General Psychiatry, 38, 1085-1090.

Heston, L. L., & White, J. A. (1983). Dementia: A practical guide to Alzheimer's Disease and related illnesses. New York: W. H. Freeman & Company.

Hoyer, S. (1982). The abnormally aged brain. Its blood flow and oxidative metabolism. A review - Part II. Archives of Gerontology and Geriatrics, 1, 195-207.

Hussian, R. A. (1981). Geriatric psychology: A behavioral perspective. New York: Van Nostrand Reinhold.

Hussian, R. A. (1982). Stimulus control in the modification of problematic behavior in elderly institutionalized patients. International Journal of Behavioral Geriatrics, 1, 33-42.

Hussian, R. A., & Hill, S. O. (1980). Stereotyped behavior in elderly patients with chronic organic mental disorder. Journal of Gerontology, 35, 689-691.

Kazdin, A. E. (1982). Single-case research designs. New York: Oxford University Press.

Kopelman, M. D. (1985). Rates of forgetting in Alzheimer-type dementia and Korsakoff's syndrome. Neuropsychologia, 23, 623-638.

Kosik, K. H., & Growdon, J. H. (1982). Aging, memory loss,and dementia. Psychosomatics, 23, 745-747, 751.

Kushnir, S. L. (1982). Reflections on Alzheimer's disease. Canadian Journal of Psychiatry, 27, 18-22.

Lechky, O. (1984, October 17). Overlooking aphasia as a prime Alzheimer's signal. Medical Tribune, p. 46.

Lezak, M. (1983). Neuropsychological Assessment (2nd ed.). New York: Oxford University Press.

Libb, J. W., & Clements, C. B. (1969). Token reinforcement in an exercise program for hospitalized geriatric patients. Perceptual and Motor Skills, 28, 957-958.

Lindsley, O. R. (1960). Characteristics of the behavior of chronic psychotics as revealed by free-operant conditioning methods. Diseases of the Nervous System, 21, 66-78.

Lindsley, O. R. (1964). Geriatric behavioral prosthetics. In R. Kastenbaum (Ed.), New thoughts on old age (pp. 41-60). New York: Springer.

Lowe, C. F. (1980). Determinants of human operant behavior. In P. Harzem and M. D. Zeiler (Eds.), Advances in the analysis of behavior. Volume 1 (pp. 59-192). New York: Wiley.

MacDonald, M. L., Davidowitz, J. J., Gimbel, B., & Foley, L. M. (1982). Physical and social environmental reprogramming as treatment for psychogeriatric patients. International Journal of Behavioral Geriatrics, 1, 15-32.

Mackie, R., & Mackay, C. K. (1982). Attention *vs.* retention in discrimination learning of low-MA retarded adults and MA-matched nonretarded children. *American Journal of Mental Deficiency*, *86*, 543-547.

Martin, G., & Pear, J. (1983). *Behavior Modification: What it is and how to do it* (2nd ed.). New Jersey: Prentice-Hall, Inc.

McDonald, E. T. (1980). *Teaching and using blissymbols*. Toronto: Blissymbolics Communications Institute.

Meador, D. M. (1984). Effects of color on visual discrimination of geometric symbols by severely and profoundly mentally retarded individuals. *American Journal of Mental Deficiency*, *89*, 275-286.

Miller, E., & Hague, F. (1975). Some characteristics of verbal behavior in presenile dementia. *Psychological Medicine*, *5*, 255-259.

Moore, R., & Goldiamond, I. (1964). Errorless establishment of visual discrimination using fading procedures. *Journal of the Experimental Analysis of Behavior*, *7*, 269-272.

Newsom, C. D., & Simon, K. M. (1977). A simultaneous discrimination procedure for the measurement of vision in nonverbal children. *Journal of Applied Behavior Analysis*, *10*, 633-644.

Olenick, D. L., & Pear, J. J. (1980). Differential reinforcement of correct responses to probes and prompts in picture-name training with severely retarded children. *Journal of Applied Behavior Analysis*, *13*, 77-89.

Pace, G. M., Ivancic, M. T., Edwards, G. L., Iwata, B. A., & Page, T. J. (1985). Assessment of stimulus preference and reinforcer value with profoundly retarded individuals. Journal of Applied Behavior Analysis, 18, 249-255.

Patterson, R. L., & Jackson, G. M. (1980). Behavior modification with the elderly. In M. Hersen, R. M. Eisler, and P. M. Miller (Eds.), Progress in Behavior Modification (pp. 205-239). New York: Academic Press.

Rebok, G., & Hoyer, W. (1977). The functional context of elderly behavior. Gerontologist, 17, 27-32.

Reisin, I. (1980). Effects of interspersal versus concurrent training of picture-names on acquisition, maintenance, and generalization. Unpublished master's thesis, University of Manitoba, Winnipeg, Canada.

Reynolds, G. S. (1975). A primer of operant conditioning (rev. ed.). Illinois: Scott, Foresman and Co.

Robertson, D., Rockwood, K., & Stolee, P. (1982). A short mental status questionnaire. Canadian Journal on Aging, 1, 16-20.

Russell, E. W., Neuringer, C., & Goldstein, G. (1970). Assessment of brain damage. New York: Wiley-Interscience.

Sattler, J. M. (1974). Assessment of children's intelligence (rev.). Philadelphia: W. B. Saunders Co.

Schacter, D. L. (1983). Amnesia observed: Remembering and forgetting in a natural environment. Journal of Abnormal Psychology, 92, 236-242.

Schlotterer, G., Moscovitch, M., & Crapper-McLauchlan, D. (1983). Visual processing deficits as assessed by spatial frequency contrast sensitivity and backward masking in normal aging and Alzheimer's disease. Brain, 107, 309-325.

Schneck, M. K., Reisberg, B., & Ferris, S. H. (1982). An overview of current concepts of Alzheimer's disease. American Journal of Psychiatry, 139, 165-173.

Schwartz, G. E. (1983). Development and validation of the geriatric evaluation by relative's rating instrument (GERRI). Psychological Reports, 53, 479-488.

Schwartz, G.E., & Loew, D. M. (1983a). A new rating scale for geriatric psychopharmacology. Psychopharmacology Bulletin, 19, 50-51.

Schwartz, G. E., & Loew, D. M. (1983b). Assessment of psychopathology by significant others. In T. Cook, S. Ferris, and R. Bartus (Eds.), Assessment in geriatric psychopharmacology (pp. 111-119). New Canaan, Conn.: Mark Powley Assoc.

Selkoe, D. J., Ihara, Y., & Salazar, F. J. (1982). Alzheimer's disease: Insolubility of partially purified paired helical filaments in sodium dodecyl sulfate and urea. Science, 215, 1243-1245.

Sidman, M. (1960). Tactics of scientific research. New York: Basic Books.

Sidman, M., & Stoddard, L. T. (1967). The effectiveness of fading in programming a simultaneous form discrmination for retarded children. _Journal of the Experimental Anaylsis of Behavior_, _10_, 3-5.

Silverman, H., McNaughton, S., & Kates, B. (1978). _Handbook of Blissymbolics_. Toronto: Blissymbolics Communication Institute.

Skelton-Robinson, M., & Jones, S. (1984). Nominal dysphasia and the severity of senile dementia. _British Journal of Psychiatry_, _145_, 168-171.

Skinner, B. F. (1957). _Verbal behavior_. New Jersey: Prentice-Hall.

Skinner, B. F. (1974). _About behaviorism_. New York: Knopf.

Sourander, P., & Sjögren, H. (1970). The concept of Alzheimer's disease and its clinical implications. In G. E. W. Wolstenholme and M. O'Connor (Eds.), _Alzheimer's disease and related conditions_ (pp. 11-36). London: Churchill Press.

Stephens, C. E., Pear, J. J. Wray, L. D., & Jackson, G. C. (1975). Some effects of reinforcement schedules in teaching picture names to retarded children. _Journal of Applied Behavior Analysis_, _8_, 435-477.

Terrace, H. S. (1963a). Discrimination learning with and without "errors". _Journal of Experimental Analysis of Behavior_, _6_, 1-27.

Terrace, H. S. (1963b). Errorless transfer of a discrimination across two continua. _Journal of the Experimental Analysis of Behavior_, _6_, 223-232.

Terrace, H. S. (1966). Stimulus control. In W. K. Honig (Ed.), Operant behavior: Areas of research and application (pp. 271-344). New York: Appleton Century Crofts.

Tomlinson, B. E., Blessed, G., & Roth, M. (1970). Observations on the brains of demented old people. Journal of the Neurological Sciences, 11, 205-242.

Touchette, P. E., & Howard, J. S. (1984). Errorless learning: Reinforcement contingencies and stimulus control transfer in delayed prompting. Journal of Applied Behavior Analysis, 17, 175-188.

Wacker, D. P., Berg, W. K., Wiggins, B., Muldoon, M., & Cavanaugh, J. (1985). Evaluation of reinforcer preferences for profoundly handicapped students. Journal of Applied Behavior Analysis, 18, 173-178.

Welch, S. J., & Pear, J. J. (1980). Generalization of naming responses to objects in the natural environment as a function of training stimulus modality with retarded children. Journal of Applied Behavior Analysis, 13, 629-643.

Wells, C. E. (1978). Chronic brain disease: An overview. American Journal of Psychiatry, 133, 1-12.

Williams, J. A., Koegel, R. L., & Egel, A. J. (1981). Response-reinforcer relationships and improved learning in autistic children. Journal of Applied Behavior Analysis, 14, 53-60.

Wisocki, P. A. (1984). Aging women. In E. Blechman (Ed.), Behavior modification with women (pp. 450-476). New York: Guilford.

Wisocki, P. A., & Mosher, P. A. (1982). The elderly: An under-studied population in behavioral research. *International Journal of Behavioral Geriatrics*, *1*, 5-14.

Zarit, S. H., & Zarit, J. M. (1983). Cognitive impairment. In P. M. Lewinsohn and L. Teri (Eds.), *Clinical geropsychology: New directions in assessment and treatment* (pp. 38-80). New York: Pergamon.

Appendix A

Forms of Dementia

Dementia is a broad term and is used ambiguously in the literature. The DSM III (1980) classification of dementia specifies (a) loss of intellectual abilities which interferes with social or occupational functioning, (b) memory impairment, and (c) (one of) either impairment in abstract thinking, impaired judgement, other disturbances of higher cortical functioning, aphasia, or personality changes. The criteria must be met without clouding of the person's state of consciousness.

Based on etiology, Hesten and White (1983) have differentiated dementias as primary versus secondary with the former indicating the brain as the major area of disease. The primary dementias include diseases which primarily affect the brain and produce dementia by directly affecting brain tissue. Primary dementias may or may not have distinguishable or observable characteristics which give them features which differentiate them from other dementias and are referred to as differentiated or undifferentiated, respectively.

The primary undifferentiated dementias are dementia of Alzheimer types (DAT), Pick's disease, normal pressure hydrocephalus, and unclassified dementias. DAT has been elaborated on in the text and will not be further discussed here except to note that it accounts for most of the cases of dementia. Pick's disease is clinically indistinguishable from Alzheimer's disease, however it generally occurs at early ages and, on the average, survival is shorter. The affected brain cells have Pick's bodies which are a miscellaneous collection of parts of a normal cell but in disarray. Normal pressure hydrocephalus refers to impaired circulation of spinal fluid and accounts for only 5% of the mid-life dementias. With this type of dementia station and gait are disturbed and urinary incontinence occurs early in the illness. The unclassified dementias behaviorally appear similar to Alzheimer's and Pick's diseases with the most frequent age of onset in mid-life. Unclassified dementia, like Pick's disease occur very infrequently in individuals over 70 years of age.

The primary differentiated dementias include Huntington's disease, Creutzfeldt-Jacob disease, and Wilson's disease. These dementias are easily recognized by their distinguishing features which are usually abnormal movements.

In secondary dementia the disease does not affect the brain directly, rather, brain functioning is indirectly, although still significantly, affected. Depression, quite common in the elderly, features many behaviors typically classified as dementia, e.g., psychomotor retardation, withdrawal from activities, and memory loss (Zarit & Zarit, 1983). The term pseudodementia has been used to refer to cases where depression is so pronounced as to result in severe impairment of cognitive functioning (Gallagher & Thompson, 1983). In these cases, the symptoms of impairment will subside if the depression is treated.

Another cause of secondary dementia is vascular disease. While previously regarded as the cause of most dementias, the frequency of dementia due to vascular disease is decreasing (Heston & White, 1983). Multi-infarct dementia refers to one type of vascular disease, multiple small strokes, and has been held responsible for 10 to 20 percent of all types of dementias (Zarit & Zarit, 1983). Vascular disease is characterized by a sudden onset, focal signs, and a step-wise progression, that is, abrupt worsening followed by partial recovery.

There are a large number of other conditions which may result in secondary dementia. For example, any internal disturbances caused by toxic effects of medications, drug interactions, infections, electrolyte imbalances, or malnutrition can affect cognitive functioning (Zarit & Zarit, 1983). Secondary dementias are potentially reversible.

Appendix B

A Comparison of Reinforcers in Blissymbol Name Training and Retention with Elderly Individuals with Alzheimer's Disease

Individuals with Alzheimer's disease show language deficits in addition to deterioration in other areas. Several researchers have quantified this dysfunction (e.g., Emery & Emery, 1983; Miller & Hague, 1975). Appell, Kertesz, and Fisman (1984) administered a battery of aphasia tests and found that individuals with Alzheimer's disease can all be classified as aphasic to some degree, ranging from mild to severe impairment. Naming was the most impaired function, fluency the least impaired. That is, while individuals with Alzheimer's disease will continue to respond, the naming of objects is most often incorrect. It appears that as the degree of dementia worsens, naming difficulties increase (Skelton-Robinson & Jones, 1984).

In a functional analysis of verbal behavior a unit of verbal behavior is operationally defined and the contingencies which establish and maintain the response are studied (Skinner, 1957). A naming response can be defined as a response which has the increased probability of being emitted in the presence of a particular stimulus (e.g., object or picture). Naming repertoires have been readily established in language deficient populations by the introduction of special contingencies of reinforcement. As individuals with Alzheimer's disease show deficits in naming responses, and as these responses can be learned by establishing new contingencies of reinforcement, naming appears to be an ideal response against which to study experimental conditions. Additionally, once names have been trained the retention of those names can be examined. Generality is of particular importance for applied research in general (Baer, Wolf, & Risley, 1968) and specifically to the population under investigation, that is, individuals with Alzheimer's disease.

It has been shown that while an individual with Alzheimer's disease shows impairment in many areas, responses learned prior to Alzheimer's disease may still be intact early in the course of the disease (Schacter, 1983). The potential confound of some names which may have been retained in the individual's repertoire was avoided by choosing a novel naming task. Blissymbols are pictographs and were selected because it was unlikely that Alzheimer individuals would have had a previous history with them. Blissymbols have been demonstrated to be readily learned by populations with deficient verbal repertoires and recently these demonstrations have included stroke victims who were elderly (Helfman, 1981; McDonald, 1980). Thus Blissymbols should be suitable for elderly Alzheimer individuals. (See Appendix C for a discussion and some illustrations of Blissymbols.)

The purpose of this experiment then was to establish novel naming responses in individuals with Alzheimer's disease. As there hasn't been any research specifically conducted to examine reinforcing new responses, a comparison of reinforcers for each individual was made. Retention of names learned was also documented.

Method

Subjects

Three elderly people with Alzheimer's disease, Christina, Lena, and Adam participated in this study prior to Experiment 1. Descriptions of each of these participants are given in Experiment 1. For comparison purposes two elderly women aged 70 years and 81 years and one elderly man aged 69 years who were healthy, with no indications of dementia, and living independently in the community also participated in some of the preliminary procedures of this experiment.

Setting, Apparatus, and Materials

Sessions were conducted individually in the settings described in Experiment 1. A coloured and/or patterned matting 30 cm by 35 cm associated with the ongoing experimental condition was placed on the table directly in front of the participant. A blaze orange dot 19 mm in diameter was affixed to the centre of the mat 8 cm from the edge nearest the participant. Reinforcers were displayed on the table to the experimenter's left; data sheet and stop watches were placed to the experimenter's right. A tape recorder was placed on the floor with a clip-on microphone attached to the participant's clothing (collar or pocket) during experimental sessions. The Blissymbols were displayed as black graphics on a white background on 12.5 cm by 20.5 cm cards. Only symbols depicting nouns were used.

The reinforcing stimuli varied across participants. A list of preferred stimuli was developed by interviewing staff, a member of the participant's family, and the participant him or herself. Items were chosen from this list which were of limited availability to the participants outside of research sessions. These stimuli were: a hurdy gurdy for Christina, fruit drink, chocolate buds, and chocolate swirl vanilla ice cream for Lena, and cookies, M & M's, and fruit drink for Adam.

Preliminary procedures were conducted privately with the healthy elderly in their respective community homes. Sessions were conducted with the individual and the experimenter seated adjacently at a table or while seated side-by-side on a sofa.

Preliminary Procedures

NonAlzheimer Elderly. Because of their symbolic nature, some Blissymbols may readily be recognized without any previous history with them, for example, the Blissymbol for flag appears as a flag at full mast. In an attempt to eliminate these symbols, a baseline was conducted with healthy elderly people. One hundred and five Blissymbols were presented individually to each of the three healthy elderly individuals along with the instructions "These are symbols for actual objects or things. Tell me what you think it looks like. I can't tell if you're right or wrong until we're finished." All answers were followed by verbal praise. If an individual did not give an answer that symbol was re-presented at the end of the list. Each Blissymbol was tested in this fashion. Blissymbols were eliminated if any of the individuals (a) identified the Blissymbol, for example, the response "elevator" for the symbol "elevator," (b) identified the components, for example, the response "doors" to the symbol "cupboard," or (c) described the symbol for example, the response "peak on the house" for the symbol "roof." The resultant list contained 79 Blissymbols which were used in the following procedures with the Alzheimer research participants.

Alzheimer Elderly. Each participant was trained to touch the orange dot when the experimenter displayed the "ready" position to indicate that he or she wanted to initiate a training trial. The "ready" position consisted of the experimenter sitting still with the training stimulus held face down in front of the participant and looking at the dot. Touching the dot then became the attending response; a training trial was not presented until the participant attended. If the participant did not attend the experimenter prompted the attending response by pointing to the dot or in the case of Adam, by saying, "its your turn." Pretraining of the attending response took place during the Blissymbol naming baseline with white matting.

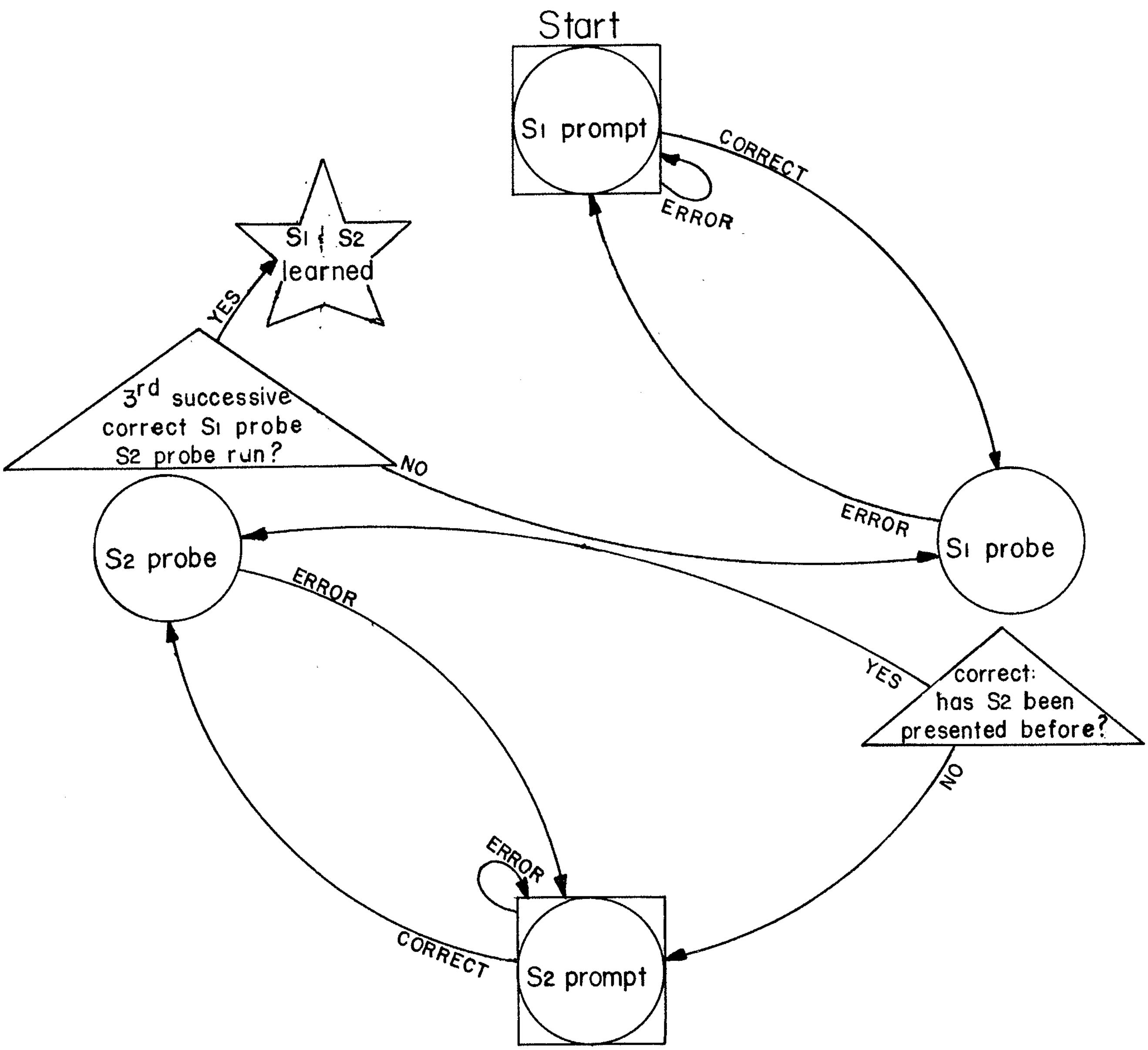
A Blissymbol naming baseline was conducted to ensure that the participants could not name the symbols, yet could imitate the names correctly. Seventy-nine Blissymbols were individually presented to the participants along with the question "What's this?" or "What do you think this is?" or "What does it look like?" If the participant responded "I don't know" he/she was prompted to guess. The consequence for any response was verbal approval, for example, "good answer" or "fine." Following this, without presenting any Blissymbol stimuli, participants were asked to imitate the names of the symbols. During the imitative baseline correct responses were followed by "good." The baselines were conducted in 15-minute sessions. Blissymbols which the participant did not correctly name yet which he or she could reliably imitate were chosen as training stimuli for each participant. These were randomly divided into several pools for each of the experimental conditions.

Blissymbol Training Procedure

Two 15-minute Blissymbol name training sessions were conducted each week day individually with each participant. A short break separated the sessions. Sessions were held at the same time every day for each participant. The procedure for training the names of the Blissymbols was a variation of a standardized picture name training procedure successfully employed with mentally retarded children (Olenick & Pear, 1980; Welch & Pear, 1980). In this procedure a series of prompt and probe trials for alternating pictures are systematically presented. On prompt trials the experimenter presents the picture, and says "What's this?" and provides the name for the participant to imitate. On probe trials the experimenter does not provide the name. Pictures the participant can already name are typically interspersed with the unknown picture which is being trained. As the participants in this research did not have an established repertoire of Blissymbol names, the variation developed by Reisin (1980) wherein two unknown pictures are concurrently trained was used.

The concurrent Blissymbol naming procedure is presented in Figure B-1. On prompt trials the experimenter presented the Blissymbol and said to the participant "What's this? This is/this means (name of Blissymbol), say (name of Blissymbol)." An incorrect response or no response within 20 seconds resulted in a repeat of the prompt trial. A correct response on a prompt trial, that is, correct imitation of the name, advanced to a probe trial for that Blissymbol. On probe trials the experimenter presented the Blissymbol and said to the participant "What's this?" or "What did I say this was?" An incorrect response or omission on a probe trial resulted in repeating a prompt trial for that Blissymbol. If the participant responded "I don't know" on a probe trial the experimenter asked the question again or waited an additional 5 seconds before terminating the trial. In the case of Lena, if she gave the German word for the Blissymbol she was asked to repeat her answer in English. A correct response on a probe trial advanced to a probe trial with the other Blissymbol unless this was the initial presentation of the other Blissymbol in which case a prompt trial for that Blissymbol was presented. The two Blissymbols were systematically alternated in this fashion. The Blissymbols were said to have reached criterion or to have been learned when three successive runs of Blissymbol 1 probe, Blissymbol 2 probe were completed. There was an approximate 5 second intertrial interval following the termination of every trial, that is, after a correct response, an incorrect response, or 20 seconds of no response. In all cases the Blissymbol card

Figure B-1. Schematic of the Blissymbol name training procedure.


Start
S1 prompt
CORRECT
ERROR
S1 & S2 learned
YES
3rd successive correct S1 probe S2 probe run?
NO
S2 probe
ERROR
S1 probe
ERROR
YES
correct: has S2 been presented before?
NO
ERROR
CORRECT
S2 prompt

was placed face down and the intertrial interval commenced. The consequence for correct responses was determined by the experimental condition as described below.

If a pair of Blissymbols did not reach criterion within a given session, training was resumed at the next session at the point where it had finished the session before. If a pair of Blissymbols did not reach criterion within 4 sessions, they were discarded and 2 new Blissymbols were selected from the pool.

Experimental Conditions

Three experimental conditions were examined. In the praise condition every correct response was followed by the experimenter saying "good" or "that's right" or "great" or some variation and gently touching the participant, for example, stroking his/her arm. The second experimental condition for Adam and Lena was the delivery of consumable stimuli following each correct response. A small portion (bite-size piece or 5 ml in the case of liquids) of one of the three individually selected items was given to the participant in addition to the experimenter saying "good." The second experimental condition for Christina was music. After each correct response the experimenter played the hurdy gurdy for 15 seconds in addition to saying "good."

A third experimental condition, extinction, was studied with Adam only. During extinction correct responses were followed by the experimenter placing the Blissymbol face down on the table followed by the intertrial interval. The Blissymbol name training procedure was followed as previously described. Incorrect responses and omissions resulted in face down placement of the Blissymbol card followed by the intertrial interval in all experimental conditions.

Experimental Design

A multi-element design (Sidman, 1960) was used to assess the reinforcing value of the different consequences for correct responses described above as the experimental conditions. In a multi-element design two (or more) baselines of the same behavior maintained by different contingencies are established at the same time. Each baseline is associated with a distinctive stimulus.

In this experiment two baselines of Blissymbol naming were established at one time corresponding to the two daily sessions. One baseline was established under the praise condition and a second baseline was established under the consumable stimuli condition for Adam and Lena and the music condition for Christina. Each baseline was associated with a different coloured or patterned matting; the selection of matting was randomized across participants. The ordering of the sessions alternated each day, such that a given experimental condition was the first session one day, the second session the next day, and so on.

The Blissymbols trained in each baseline were selected from separate pools, such that a pair of symbols was trained under one experimental condition only. The exception to this was the extinction baseline for Adam. Extinction was introduced on Day 11 and represented Phase 2 for Adam. In the extinction baselines, the matting and training stimuli associated with the previous experimental conditions, praise or consumables, remained the same. The training stimuli were retained until either the learning criterion or discard criterion was reached after which new Blissymbols were introduced into each extinction baseline.

Retention Tests

Retention tests were conducted on all Blissymbols that reached learning criterion. The retention test resembled the probe trials on the experimental conditions under which the Blissymbol had been learned. The matting associated with that condition was present and if a correct response occurred it was consequated with the same stimulus as had occurred in training. Each Blissymbol was probed three times in random order with the symbol with which it had concurrently reached criterion. Retention tests were conducted for a Blissymbol pair 24 hours after the learning criterion was initially met, then at one week and two week intervals from the 24 hour test.

Dependent Variables

The dependent variables were: (a) the number of Blissymbols learned to criterion in each condition, (b) probe accuracy as defined by the number of correct responses to probes divided by the total number of probe trials for each session of a given condition, (c) prompt accuracy as defined by the number of correct responses on prompt trials divided by the total number of prompt trials for each session of a given condition, (d) total number of training trials completed per session in each condition, and (e) number of correct Blissymbol names given at 24 hour, 1 week, and

2 week retention tests for Blissymbols learned in a given condition.

Inter-Observer Reliability

All experimental sessions were audiotaped and one-sixth of the sessions were randomly selected for inter-observer reliability checks. An observer who was first acquainted with the participants' vocal responses independently scored the participants' responses. Percentage of agreements of correct responses on trials the experimenter judged to be correct were computed as number of agreements divided by number of agreements plus number of disagreements x 100. Percentage of agreements of incorrect responses on trials which the experimenter judged to be incorrect were similarly computed. Omissions were not included in any of the calculations. All retention tests were audiotaped and all were checked for inter-observer reliability.

Procedural reliabilities were carried out on one-sixth of the experimental sessions. The sessions which were randomly chosen for reliabilities in the manner described above were reviewed as to whether the experimenter presented prompt and probe trials of the appropriate Blissymbol in the fashion described under Blissymbol name training procedure.

Percentage agreement of correct and incorrect responses were 100% and 100% respectively for all 3 research participants. There was 100% agreement on all responses given during retention tests. There were no procedural errors detected for sessions conducted with Christina and Lena. There were two procedural errors recorded for sessions with Adam. On one occasion the experimenter repeated a probe trial after he had correctly named the Blissymbol and on the other occasion the experimenter repeated a prompt trial after he had correctly imitated the name.

Results

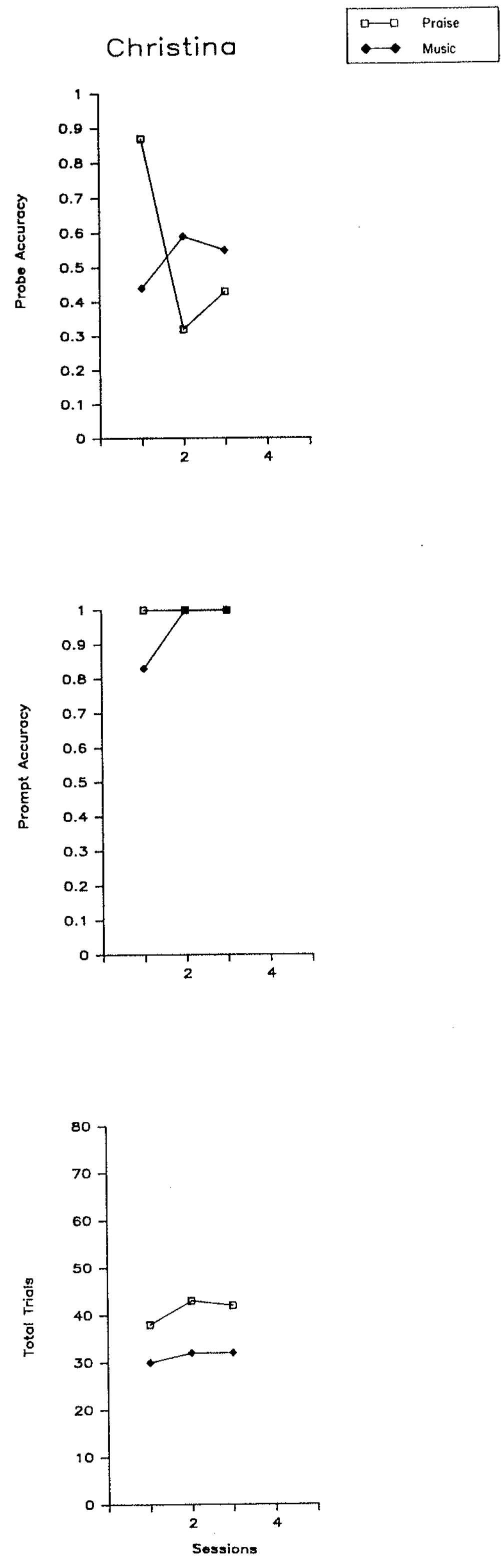
The results are presented individually for each participant with a summary following.

Christina

Christina learned to name two Blissymbols in the first session of the praise condition and two Blissymbols in the second session of the music condition. Probe accuracy, prompt accuracy, and total number of training trials for the 3 days of Blissymbol name training are presented in Figure B-2. Accuracy on probe trials in the praise condition while initially much higher than the music condition (87% compared to 44%) decreased dramatically on Day 2 and remained below the music condition. This is in large part accounted for by one Blissymbol, "needle," being trained in the praise condition, during sessions 2 and 3 which she most often labelled "p" on probe trials. Probe responses for the other Blissymbol were most often correct. With the exception of Session 1 in the music condition Christina correctly imitated the prompts given by the experimenter every time. While total trials increased slightly from Day 1 for both conditions, the number of training trials per session was consistently greater in the praise condition than in the music condition.

The results from the retention tests are presented in Figure B-3. For the two Blissymbols learned in the praise condition

Figure B-2. Accuracy on probe trials and prompt trials and total trials per session for Christina.


Christina
Praise
Music
Probe Accuracy
Prompt Accuracy
Total Trials
Sessions

(upper portion of Figure B-3) only one, "tree," was correctly named at the 24 hour test; it was identified correctly on two of the three presentations. At the 1 week retention test this same Blissymbol was correctly named on all three presentations; no retention was observed for the other Blissymbol. At the 2 week retention test neither of the Blissymbols were identified. For the two Blissymbols learned in the music condition, 24 hour retention was shown for both; "grass" was identified on one of the three presentations and "scissors" on two of the three presentations. At the 1 week and 2 week retention tests no retention was observed for either Blissymbol.

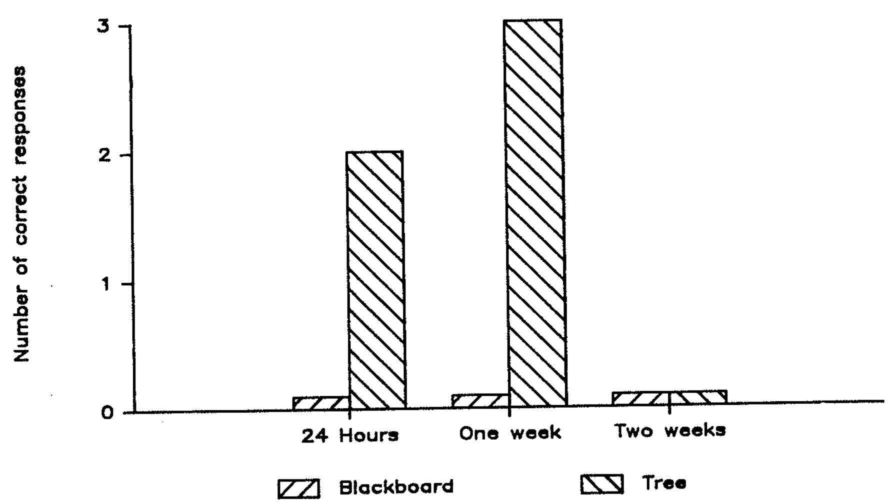
Lena

Lena did not reach learning criterion on any of the Blissymbols which were trained during the nine days that this experiment was conducted with her. Probe accuracy, prompt accuracy, and the total number of training trials are presented in Figure B-4. On Days 1 to 5 probe accuracy was higher in the praise condition than in the consumables condition; however, a slight increase in the consumables condition and a slight decrease in the praise condition resulted in similar rates of probe accuracy for the last four days of training. Probe accuracy at the end of training was approximately 40% to 45%. Lena correctly imitated all prompts except during one session of the praise condition and two sessions of the consumables condition. On these occasions she responded with the name of the other Blissymbol being trained before the experimenter could provide the prompt.

Figure B-3. Number of correct responses for Blissymbols learned when tested at 24 hour, 1 week, and 2 week intervals.

Christina

Praise



Music

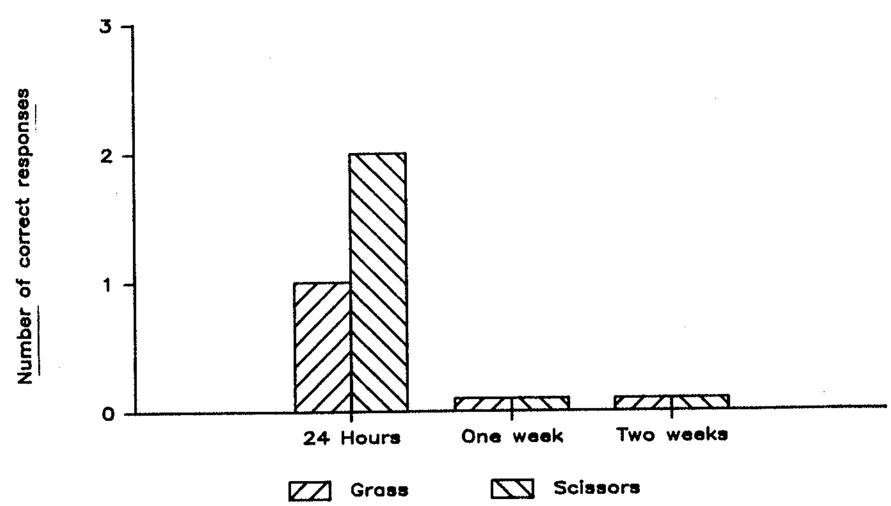
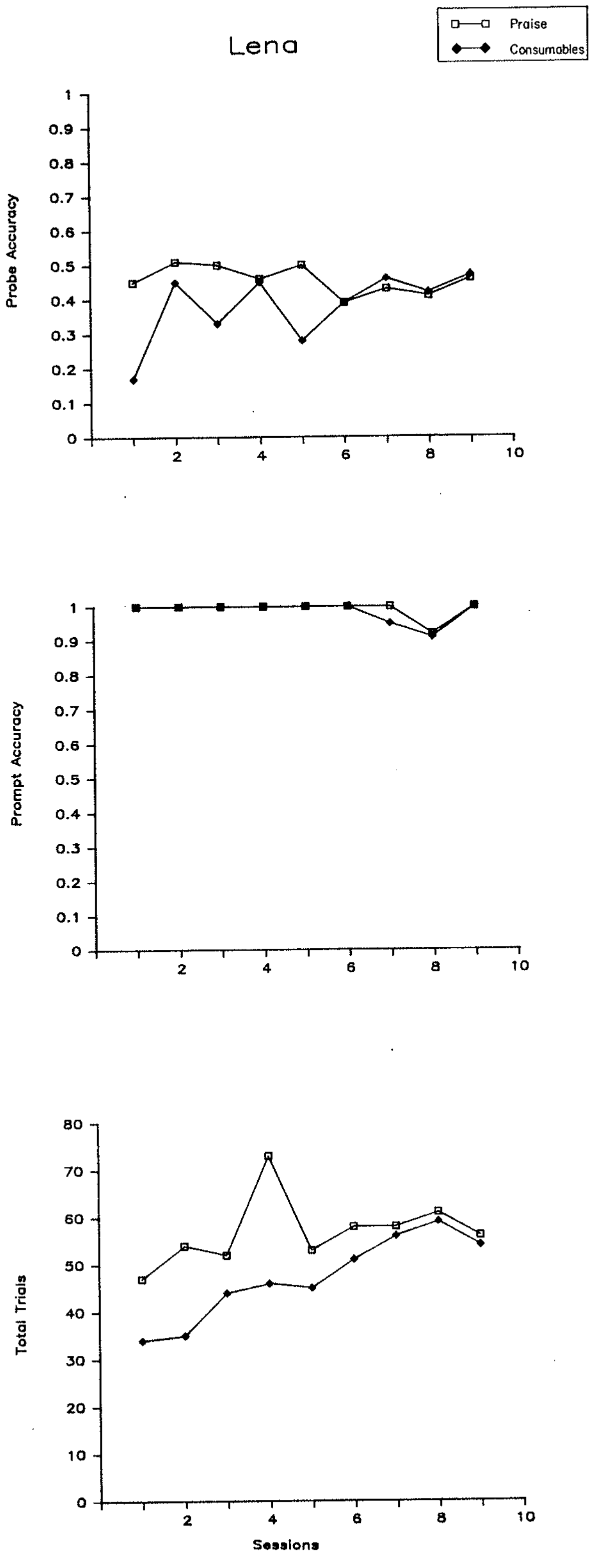


Figure B-4. Accuracy on probe trials and prompt trials and total trials per session for Lena.

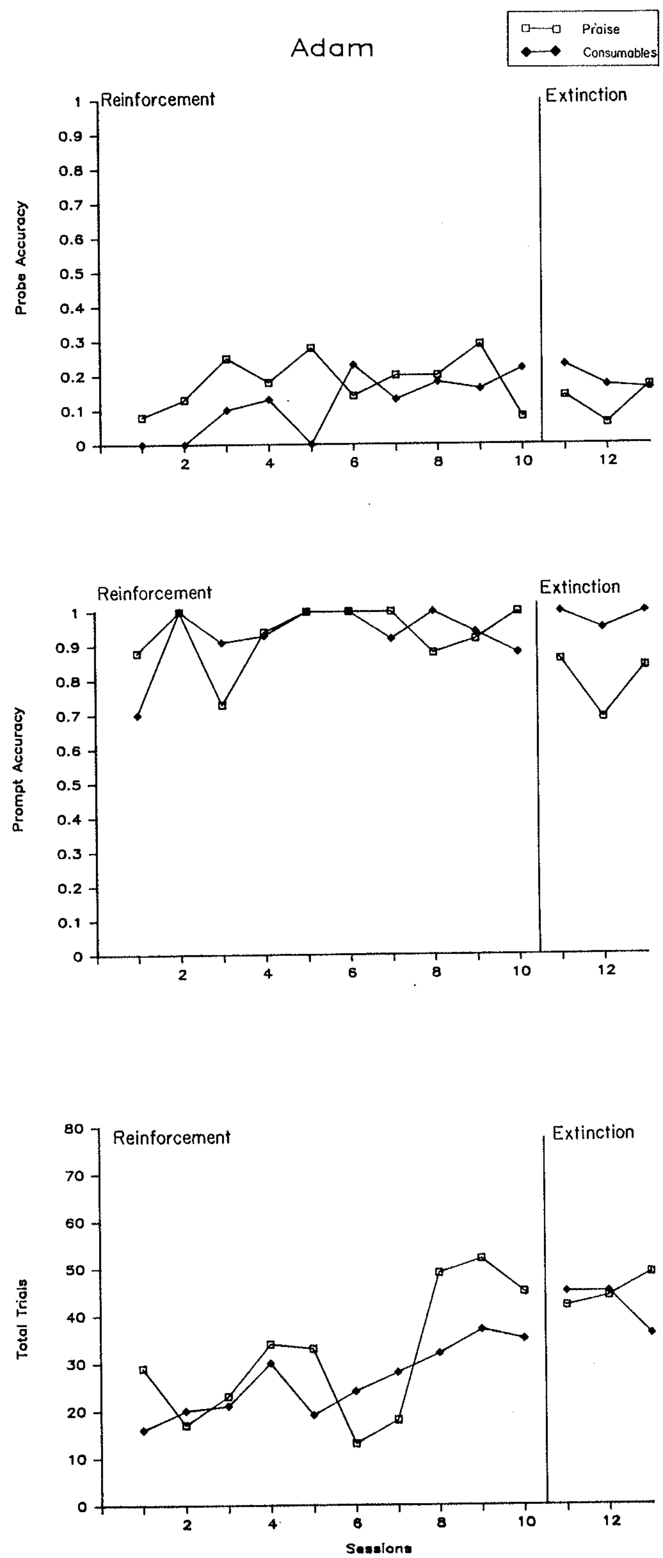

Lena
Praise
Consumables
Probe Accuracy
Prompt Accuracy
Total Trials
Sessions

The total number of trials per session in the consumables condition steadily increased until the end of training; total trials in the praise condition increased only slightly during the same period. While there were always consistently more training trials initiated in the praise condition, the differences between conditions was minimal during the last three days.

Adam

Adam did not learn to name any Blissymbols in the 13 days that training was conducted with him. Probe accuracy, prompt accuracy, and the total number of training trials for the experimental conditions for Adam are presented in Figure B-5. Initially, probe accuracy was higher in the praise condition than in the consumables condition; however, for the last half of training the systematic differences disappeared. Overall, probe accuracy was quite low for Adam; twenty-nine percent was the highest accuracy level recorded. When extinction was introduced on Day 11 probe accuracy was unchanged. Although it appeared to decrease slightly on Day 12 in both conditions overall the level of probe accuracy during extinction was at a level comparable to that during reinforcement conditions. Although there were some fluctuations, prompt accuracy appears to be similar for both conditions and between 88% to 100% for the last part of training. When extinction was introduced prompt accuracy immediately dropped in the condition where praise had been delivered but remained high in the condition where consumables had been used. In the consumables condition the total trials increased from Days 1 to

Figure B-5. Accuracy on probe trials and prompt trials and total trials per session for Adam.



Adam
Praise
Consumables
Reinforcement
Extinction
Probe Accuracy
Prompt Accuracy
Total Trials
Sessions

10; in the praise condition the total trials were quite variable from Days 1 to 7 and then increased sharply. For the last three days of reinforcement, total trials were higher in the praise condition. When extinction was introduced total trials increased in the sessions where consumables had been used and remained approximately the same in sessions where praise only had been delivered.

Summary

Christina learned to name an equal number of Blissymbols in each of the experimental conditions, praise and music. Retention was observed for three of the four Blissymbols learned at a 24 hour interval, but for only one Blissymbol at 1 week interval. Retention was not observed at all at 2 weeks. Lena and Adam did not learn to name any Blissymbols. Probe accuracy was quite low for Adam and moderately low for Lena. Prompt accuracy was quite high for both of these participants, for example, Lena responded almost 100% correctly on prompt trials. In all cases but three with Adam the total number of training trials was greater in the praise conditions; this difference was quite large for Christina. When extinction was introduced with Adam prompt accuracy dropped during the sessions where praise had been delivered and total trials increased during the sessions where consumables had been used; probe accuracy appeared to be unaffected.

Discussion

There was virtually no evidence to show any difference between the reinforcement conditions; that is, praise versus consumables or music. Learning was only demonstrated with Christina and learning rates were equal in both conditions conducted with her, praise and music. A consistent finding across all participants was that were were a higher number of training trials in the praise condition. This difference may simply be an artifact of the different reinforcement conditions. In the praise condition the delivery of pleasantries certainly took less time than the 15 seconds playing of the hurdy gurdy and probably required less time than the delivery of consumables, the latter which also required time to be set up for the next trial. This is supported by the extinction data with Adam; specifically, the increase in training trials in the sessions where consumables previously had been delivered to a level equal to the condition where praise had been delivered.

There is a hint of a difference between praise and consumables when extinction was introduced with Adam. Prompt accuracy which had been consistently high during reinforcement conditions decreased during extinction <u>only</u> in the sessions where praise had been delivered. The maintenance of high prompt accuracy in the sessions where consumables had been delivered but were no longer being administered suggests a greater resistance to extinction for this reinforcement condition (Reynolds, 1975). The lack of any observed differences in the probe accuracy data during extinction may in part be due to the overall low level of probe accuracy throughout the experiment. While this data is not by any means conclusive it does offer some direction for future research.

While there was no learning with Lena and Adam there were high levels of prompt accuracy. When errors occurred, most often they were attributable to hearing impairment. Probe accuracy, however, was quite poor for Lena and Adam. When the errors were examined there was some indication of learning with Lena. Typically, she would say the name of the other Blissymbol being trained and this phenomenon seemed to increase as training progressed. Whereas with Adam probe errors were most often silly words or a "description" of the symbol or a simple "I don't know."

The results from this experiment do however demonstrate that an individual with Alzheimer's disease can learn to name novel stimuli. Additionally it was shown that there was considerable retention of this new learning after a 24 hour interval and a little after a week interval. It should be noted that this individual was probably in the early stages of Alzheimer's disease and was functioning at a higher level than the other two participants. For example, Christina always knew the experimenter's name from day to day whereas the other participants could not correctly name her at the end of the session when told her name at the start of the session.

The results of this study overall are inconclusive. While Christina's data are interesting and encouraging, she represents only one of three participants. The lack of learning with Lena and Adam may be due to one of many factors. At this point it is not known whether the lack of learning with Lena and Adam was attributable to Alzheimer's disease or a function of other variables; for example, complexity of the task or simply lack of powerful reinforcers. While care was taken to select "reinforcers" that significant others and the participant him/herself expressed preference for and the participants were observed during sessions to readily accept these stimuli when offered, one could still argue that lack of learning may be due to lack of sufficient reinforcement. By definition these stimuli were not reinforcers as they did not result in increases in behavior (Skinner, 1974). The issue of reinforcers then must be addressed, or more precisely, reinforcers must be demonstrated before the issue of learning and Alzheimer's disease can be resolved.

Appendix C

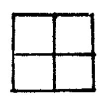
Blissymbols

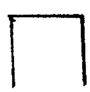
Blissymbolics, or Blissymbols as they are more frequently referred to, were developed in 1949 by C. Bliss as a universal language. Bliss' vision of the use of semantography was widespread and all encompassing: "one writing for one world." He also believed that using it would be preventative, that abstract thinking could lead to wars; therefore, if words were replaced by symbols, thinking could not be perverted (Bliss, 1965). Although Bliss' dream of an international communication system has not been realized, Blissymbols have come to be used extensively with the handicapped populations, in particular cerebral palsied individuals.

The first application of Blissymbols took place in the 1970s with cerebral palsied children at Ontario Crippled Children's Centre in Toronto (Helfman, 1981; McDonald, 1980). These programs have been immensely successful. Since that time, Blissymbol use has been extended to adults with cerebral palsy, elderly retarded people (severely, trainable, and minimally mentally retarded), and stroke victims who have suffered paralysis of the muscles used in speaking.

Blissymbols are made up of (a) pictographs which represent objects, (b) arbitrary symbols which represent modifiers, for example, "/" to express "the," or (c) ideographs which represent actions. There are also compound symbols made up of any combination of the others. Three models have been developed for teaching a Blissymbol repertoire. The models differ as to the degree of sophistication of usage. The least sophisticated model (model 3) presents Blissymbols as a "surface level" communication system and teaches the responses with structured, nondevelopmental procedures and programs reinforcement. In contrast, the most complex model (model 1) uses Blissymbols as a functional argumentive language and assumes that the user has a well-developed receptive repertoire. The evaluation of Blissymbols, conducted primarily within Model 1, has shown increases in a variety of communication concepts and abilities measured over a one year period (Silverman, McNaughton & Kates,1978).

The following are some examples of Blissymbol nouns which were used in this research:

 (animal),  (blouse),  (window),

 (leaf),  (table), and  (cheese).