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LABORATORY DESCRIPTION

REBIRTH OF THE SHRIVER AUTOMATED TEACHING LABORATORY

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This article describes an updated version of an automated teaching laboratory (ATL) that first became operational over 30 years ago. The original laboratory was developed by Larry Stoddard in the late 1960s. Studies in the ATL (e.g., McIlvane, Withstandley, & Stoddard, 1984; Stoddard & Gerovac, 1981; Stoddard & McIlvane, 1989) laid the groundwork for extensive stimulus control research in many other laboratories (e.g., Wilkinson & Green, 1998). The functional characteristics of the original Stoddard ATL have changed, although major technological improvements have been made. Like its predecessor, the current version of the ATL has been designed to teach low-functioning individuals (e.g., those with little or no language) certain basic skills, such as simultaneous and successive discrimination and matching to sample. In addition, the ATL can be used to investigate several topics of interest to behavior analysts, such as stimulus equivalence, behavioral momentum, and behavioral economics. This article will: 1) offer a brief history and description of the ATL; 2) describe some experiments conducted with the original version; 3) provide a detailed description of the updated version of the ATL; and 4) outline some of the experiments that have become possible given the laboratory upgrade.

THE ORIGINAL LABORATORY

The ATL was developed as part of an ambitious behavioral research endeavor. The intent was to design a teaching environment capable of improving the lives of children with severe behavior disorders and other problems in social functioning. The premise was that an initially nonsocial environment might have advantages for teaching. By providing a highly simplified, nonsocial environment, there might be unique opportunity to build a new repertoire of constructive behavior that might then be transferred to social settings.

The long-term goals of the ATL were to create a model for a living environment that encompassed a significant portion of daily life and to teach basic skills necessary to cope with the demands of that environment. To that end, the ATL had an adjacent self-care area in addition to a main teaching room (for details see Stoddard, 1982). The major ATL apparatus was located in the latter area. This apparatus consisted of a wall-mounted display of nine response keys on which stimuli could be presented (see Figure 1). Touch responses were recorded automatically. On an adjacent wall, there were three compartments (two mounted side by side and one mounted directly beneath the aforementioned two) in which edible stimuli could be presented. In addition, token slots were mounted on either side of the compartments.

EXPERIMENTS IN THE ORIGINAL ATL

Although the ATL never achieved its goal of developing an experimental living environment, the main teaching room proved to be valuable for teaching low-functioning individuals certain basic skills and for decreasing the frequency of undesirable behaviors. Training typically began with establishing simple behavior chains, maintained in part via conditioned reinforcers. These chains were the foundation for developing more complex behavioral repertoires. By using the method of successive approximations and various prompting and fading techniques, individuals were first trained to respond to the food compartments (e.g., to open the doors and remove food reinforcers), then to respond to red poker chip tokens (e.g., to insert a token in the token slot to access food in the compartment), and finally to

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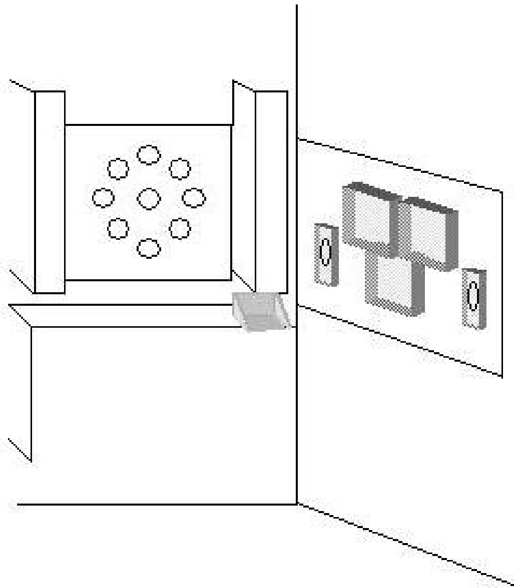

Figure 1

respond to the display keys (e.g., press the stimulus display-response keys to receive a token). Once these behaviors were reliably established, individuals could be trained to discriminate similar-looking stimuli (e.g., circle vs. ellipse; Sidman & Stoddard, 1966) and even to do various forms of matching to sample (see Stoddard, 1982 for more details).

The success of this program of research was remarkable for two reasons. First, prior to ATL training, many of these low-functioning individuals were considered unteachable and "unreachable" due to a lack of language and attending skills, to ritualistic and sometimes destructive behaviors, and to lack of control by environmental stimuli (including teachers). Second, the training took place without a teacher being physically present. That is, all operations were controlled by a teacher who monitored the participant via closed-circuit television.

Despite its many successes, the ATL was forced to discontinue operations in the early 1990s. In part due to its location (the Fernald State School), the ATL program was dependant on grants from the National Institutes of Health and other sources to support its operations; such support was particularly hard to come by at the time. Moreover, there had been an increasing shift in the location of service delivery for Fernald residents; many had relocated to community placements. Deprived of adequate grant support and a steady stream of participants, the ATL research became logistically unsustainable at the Fernald site.

Happily, new opportunities have made it possible to reopen and update the ATL. A substantial grant was received from the National Institute of Child Health and Human Development, and the necessary space was made available at The New England Center for Children in Southboro, MA. Work to renovate the laboratory has been completed, and a new program of research has begun. For the remainder of the article, we will describe new features and capabilities of the ATL and outline the types of projects that will be conducted in the near future.

UPDATED ATL DESCRIPTION

Figure 2 shows an overhead view of the new ATL. It is housed in a room sectioned into two separate areas: the ATL apparatus and a teacher's programming area. The participant's view of the ATL apparatus and a small wall containing a standard-size door create the two sections. The programming area contains two desks, a

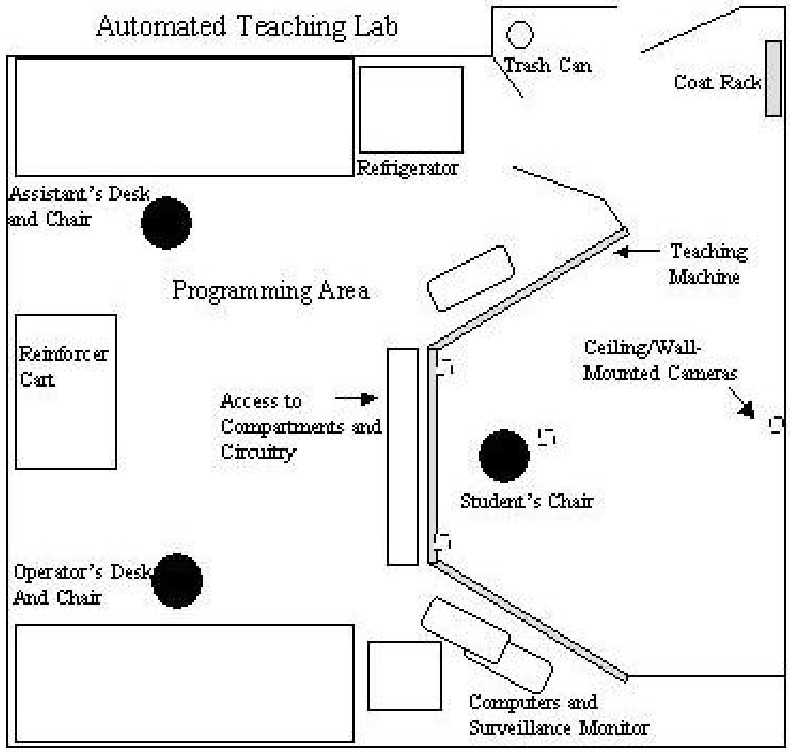

Figure 2

reinforcer cart, a mini refrigerator, and all the computer and electrical equipment required to power the ATL apparatus. During a session, the teachers remain in the programming area and do not have direct contact with the student. When a participant enters the room (accompanied by a teacher), s/he is led to a chair which is fixed to the floor in front of the apparatus. The teacher then proceeds to the programming area and shuts the door separating the two areas. The participant is monitored at all times via four overheard surveillance cameras (ProVideo, Model # CVC-770PH). Both the main door and the door dividing the two sections remain unlocked throughout the sessions.

Figure 3 shows a diagram of the front panels of the teaching apparatus from the participant's perspective. It consists of three walls bolted directly to the ceiling and floor, one directly in front of the participant, and two at 120-degree angles from the front panel. The panels are constructed of laminate covered with medium-density fiberboard. The front panel (A) measures 36 in wide whereas each side panel (B) measures 32 in wide; all panels are 8.5 ft tall. A counter (C), approximately 5 in wide, bisects each panel 30 in from the floor. Accumulated tokens can be stored on the counter or the wells in which they are delivered. The bottom portion of each panel contains amplifying bass speakers (D) for emitting low frequency sound (Cambridge SoundWorks, Model # PCWorks Amplified Multimedia). The two side panels each contain 19 in LCD flat panel touch screens, ELO Touch Model # ET 1725L-8SWA-1, (E) connected to networked Macintosh G4 computers (located on the programmer's side of the apparatus) and flanked on either side by 3 in speakers for emitting high-frequency, directional (i.e., left vs. right) sound, Cambridge SoundWorks, Model # Surround IV (F).

The front panel is a modified, fully automated Wisconsin General Test Apparatus. A 17 in television monitor (G) is centered between two 3 in speakers (F) identical to those on the side panels. Next to each speaker are token slots (H) in which the participant deposits tokens in exchange for edible or other reinforcers (e.g., an interesting display on the TV). The token slots, designed and

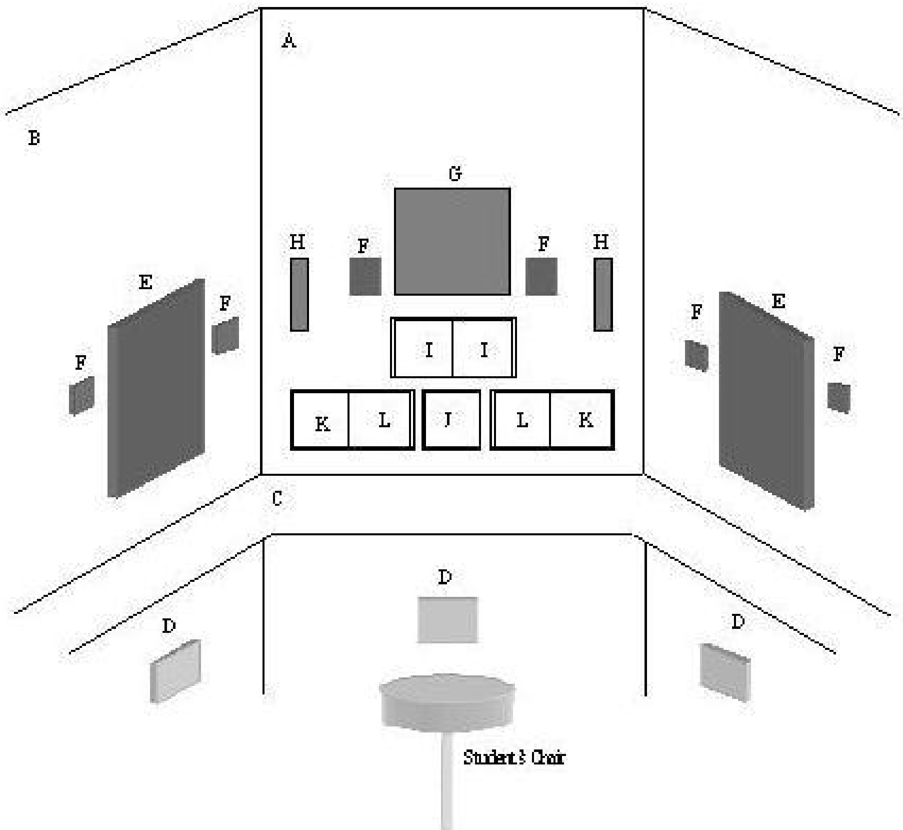

Figure 3

constructed by the Shriver Center prototyping shop, are equipped with both red and white lights that can be faded. The lights may be used to indicate when accumulated tokens may be exchanged for food.

Beneath the television monitor are two compartments (I) with clear sliding doors from which the participant can obtain food and other items. These food compartments are constructed of white plastic and the doors are constructed of clear plastic. Each door can be locked/unlocked and open/closed from the controlling computer located in the programming area; both doors are equipped with sensors to indicate when the participant touches them. Each compartment contains a three-section "lazy Susan" on which foods or other objects can be presented. Both compartments can be illuminated with red and white light and are equipped with fading circuits.

A third compartment (J) is centered directly below the two food compartments. This sample compartment, however, does not have a door (the front wall is constructed of clear plastic) and can only be illuminated with a single intensity white light. Stimuli may be presented here, but the participant cannot gain access to them. Each of these three compartments measures 4 in tall, 9 in wide, and 12 in deep. Two additional compartments are located on either side of the sample compartment, each of which measures 5 in wide, 4.5 in tall, and 6 in deep. The outermost ones (K) are used as token exchange wells (i.e., where tokens are delivered contingent on the participant's behavior). The remaining two compartments serve as food wells (L), where food is delivered in exchange for tokens deposited in the token slots described above. Each of these compartments is constructed of the same plastic material as the food and sample compartments but none of them features a door or front wall.

Figure 4 depicts the back view of the ATL apparatus. This is where the operator performs his/her tasks and where the teachers remain for the entire training session. One teacher controls experimental events by entering commands into a

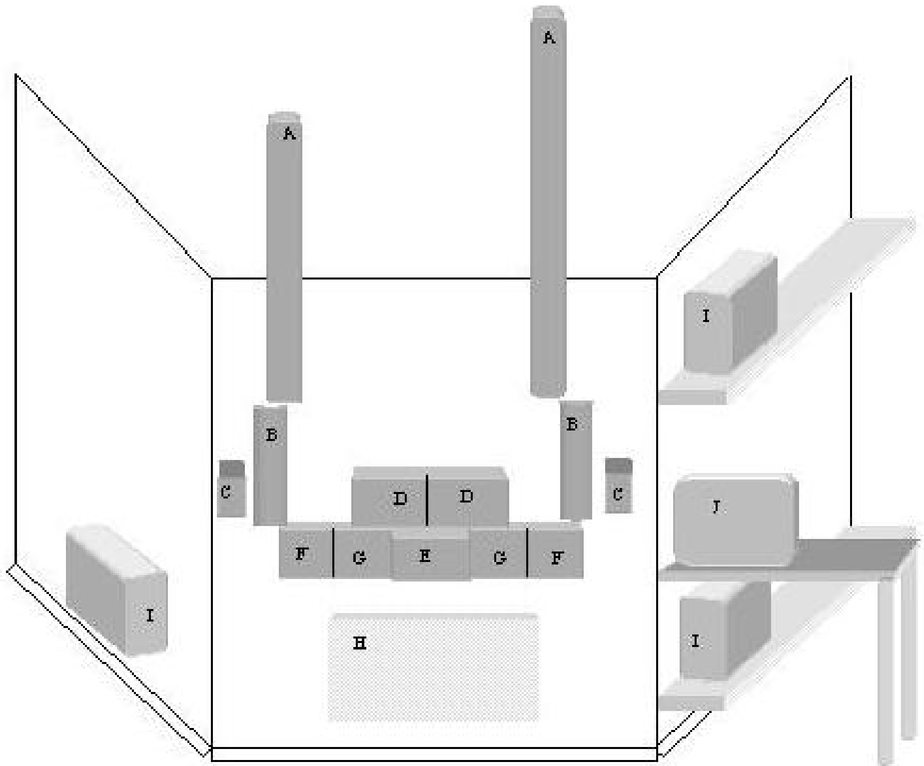

Figure 4

Macintosh G4 computer (I) running LabView 6.0 software. The other teacher assists, loading and unloading the compartment as required. Two additional, identical computers are available to display stimuli on the LCD touch monitors. The participant's behavior can be viewed at all times on a television monitor (J) connected to a multiplexer (Data Bridge, Model # SVR-2001) so that images transmitted from all four cameras can be viewed simultaneously. The back of the center panel contains two universal feeders (A) capable of depositing a variety of edible stimuli to the food wells (G) located on the student's side of the teaching machine. The left feeder, Gerbrands, Model # G5970, is 7 in wide, 6.5 in deep, and 38 in tall. The right feeder, Gerbrands, Model # 120, is the same width and depth, but is 63 in tall. The machine also contains two token dispensers, Gerbrands, Model # TOKEN, that are 17 in tall and 3.5 in wide, and are capable of delivering a single token at a time into the token wells (F) located on the front of the machine. Object stimuli may be placed in the food and sample compartments (D, E) by opening a hinged door. Operation of the lazy Susans, token dispensers, universal feeder, and lights are controlled by the main computer through a collection of circuit boards (H) designed by the Shriver Center prototyping shop.

FUTURE STUDIES

This laboratory is currently focusing on a study of the behavioral prerequisites for stimulus equivalence (Sidman & Tailby, 1982), exclusion (Dixon, 1977), and contingency classes (McIlvane, Dube, Kledaras, Iennaco, & Stoddard, 1990; Sidman, Wynne, Maguire, & Barnes, 1989; Vaughan, 1988) in a nonverbal human population. The initial aim of this project is to teach low-functioning children (students at The New England Center for Children) first to discriminate food items and other stimuli from each other and then to progress to identity matching to sample using the ATL. For example, participants could be presented with a slice of orange in one comparison compartment and a piece of cookie in the other (I in Figure 2). In a simple discrimination procedure, one of the food items is defined as S+. In a variant of the procedure, each compartment presents the same type of food item, and the participant is to select the item lit with red and to reject one lit with white light (e.g., McIlvane et al., 1989). An unusual feature of these procedures is that the discriminative stimuli also serve as the reinforcing stimuli. When the participant makes a correct S+ selection, the door opens and s/he can consume the food; if the food defined as S- is selected, the selected door does not open and the foods are removed from view via rotating the lazy Susan apparatus.

Once simple discrimination is mastered, we will go on to establish identity matching to sample; the positive comparison will be determined by whatever object is present in the sample compartment (J in Figure 2). For instance, if a red M&M is presented in the sample compartment, then choosing the red, rather than the green, M&M will be reinforced and vice versa. Next, the children will be taught to match in a situation in which the sample is a photograph of the food and the comparisons are the actual food items. The ultimate goal is to take children who have failed to learn object discriminations and matching via traditional table-top methods and teach them using the ATL apparatus such that they are ultimately able to perform simple and conditional discriminations with arbitrary stimuli. As these initial training goals are accomplished, we will be in the position to begin training and testing students for stimulus equivalence, one of the long-term goals of this project.

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