AN ELECTRO-MECHANICAL STRAIGHT ALLEY FOR RECORDING MOVEMENT, POSITION, AND RUNNING TIME

JOE W. DARNALL

Texas Technological College

The straight alley is an accepted piece of apparatus in animal research. Latency from the start area and running time to the goal are typical measures of performance and are easy to obtain with a stop watch or some automatic timing device. If the investigator is primarily interested in recording the location of the animal in the runway over a period of time his problems are multiplied. The ultimate recording device would be a radar tracking unit, but this is usually outside the range of most experimenters' budgets. One method that has been used is visual observation and recording. Other methods incorporate photo-electric cells or electronic capacitance discharge devices which are placed at regular intervals in the alley and are used to activate independent pens on a multiple event recorder. Brown attached one end of a line to his animals and through a series of pulleys converted the animal's activity to pen movement, thereby continually recording the location of his subjects.[1] In a later study Brown and Hoopes pivoted a runway in the center so that it was displaced in teeter-board fashion when the animal moved from end to end; a strain-gauge transducer connected to a variable recording pen plotted the continuous location of the animal.[2]

Sight observation leaves much to be desired, primarily because it requires the investigator to be in close proximity to the runway, thereby introducing uncontrolled variables. Photo-electric cells and capacitance discharge devices are expensive because they require an amplifier for each unit in the system. Reducing cost by using fewer detectors results in lost precision of measurement. Any atachment to the animal, such as a harness or line, hinders movement and introduces new variables. The pivot system does provide a continuous measure of location, but the animal must be weighed before each running session, a time-consuming process. The pivot system also must depend upon a linear operating strain-gauge, or some adjustment must be made for non-linearity.

In order to eliminate the prohibitive expense of amplifiers for

[1]J. S. Brown, Gradients of Approach and Avoidance Responses and Their Relation to Level of Motivation, *Journal of Experimental Psychology*, 41, 1948, 450-465.

[2]J. S. Brown and J. J. Hoopes, A Device for Recording a Rat's Position in a Straight Alley, *American Journal of Psychology*, 78, 1965, 130-133.

the photo-electric system and in order to avoid the time-consuming task of weighing each animal and making adjustments for each in the pivot system, an alternate apparatus is proposed which the author has constructed and found efficient, cheap, and reliable.

This system incorporates movable floor sections within the alley, which are slightly depressed by the weight of the animal, and a multiple-channel event recorder. When the floor section is depressed, contact points beneath that section are closed. Each contact switch is wired to a separate pen of the recorder. The pens are sequenced so that they correspond to the sequence of spaces within the alley. When the animal moves to an adjacent floor section the next pen is activated. Because paper speed of the recorder is known, measures of latency, running time to the goal, amount of time spent in any one section, general activity, and reversals are easily taken from the record.

Construction. The alley itself is of wood construction. The walls are made of ½-in. plywood attached to a 2-in. x 6¼-in. wooden base (the base was a 2-in. x 8-in. board ripped to 6¼ in.). The walls of the runway are 7 in. high measured from the top of the floor sections, and the overall end-to-end length is 9½ ft. The movable floor consists of sixteen 6-in. x 6-in. squares totalling 8 ft. of actual runway to the goal box. The goal box is 6 in. x 6 in.; the floor of the goal box is a grid constructed of brass welding rods spaced ½ in. apart. The goal box food container is the bowl portion of a ¼-teaspoon glued to a plexiglass end wall. The plexiglass was sanded so that it was translucent. The remaining one ft. of runway behind the plexiglass houses the cue stimulus light which designates the goal area. When the runway is in use the light's intensity is regulated by a rheostat, such as a Variac.

Three sections of ⅛-in. clear plexiglass 7 in. wide are hinged to the top edge of one wall, providing a cover for the runway. Clear plexiglass is a marked improvement over hardware cloth for use as a cover because it provides no holes to poke noses through, no shadows to distract, and it helps eliminate extraneous oders and sounds. Details of the runway are seen in Fig. 1.

The 6-in. x 6-in. floor sections of the alley are constructed of ¼-in. plywood. Legs for each floor section were made by drilling a hole 1/6-in. deep in each corner of the square, ½ in. from the nearer edges. A short length of 3/16-in. dowel was inserted in each hole, and then sanded so that each leg was ¼ in. in length. In order to provide a point at which the floor touches the contact switch, a 1½-in. length of 5/16-in. dowel was glued to the middle of each square, with the length of the dowel perpendicular to the alley. The flooring

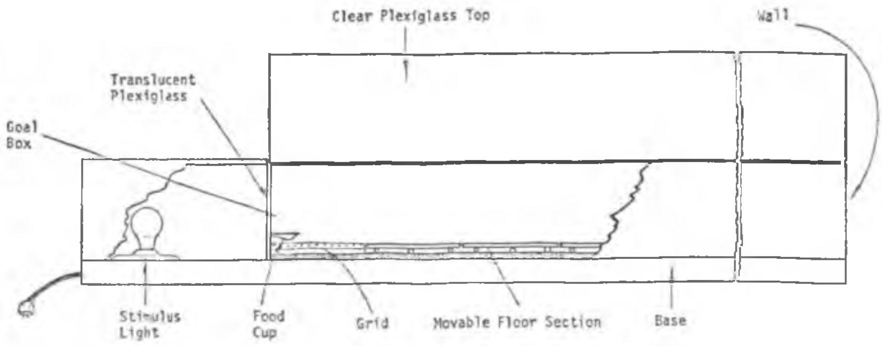

FIG. 1. DETAILS OF CONSTRUCTION

squares rest on a ½-in. cushion of foam latex. Latex foam rubber provides a soft spring action that would be difficult to accomplish through the use of a mechanical suspension, such as a spring. A band saw was used to slice ½-in. strips from a 12-in. x 12-in. x 1-in. block of foam latex, yielding 1-in. x ½-in. x 12-in. lengths. These strips were then placed along each edge of the base next to the wall, so that the legs of each floor section rested on the foam latex. Trial and error procedures indicated that ½ in. was the optimum thickness; depths of more than ½ in. allowed too much depression of the floor square, and depths of less than ½ in. were not compressible.

The switches beneath the flooring squares were constructed from contact points and spacers salvaged from old relays. These switches were glued to the base of the alley so that the points centered under each square where the 5/16-in. dowel forced them together when the floor was depressed. Details of floor sections are seen in Fig. 2.

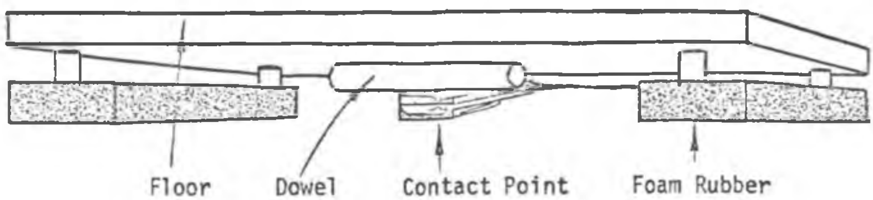

FIG. 2. DETAILS OF MOVABLE FLOOR SECTION

Adjustment between the floor and the contact point is easily accomplished by bending the points or sanding the 3/16-in. dowels. If the floor depresses too easily, usually due to irregularities in the thickness of the foam rubber, a square of masking tape attached to the rubber under a leg of floor will firm it up.

This runway has been used in several studies, and the author has found it to be reliable and trustworthy. Its simplified construction means that on-the-spot adjustments can be carried out mechanically rather than having to call on an electronics technician for assistance. The author has not observed that the slight movement of the floor presented a distraction for animals. The runway furnishes a continuous measure of straight alley performance with resolving power of six inches, which for most studies is sufficient.

ABSTRACT

Conflict research using animals as subjects has typically been carried out with the straight alley. The experimental animal, usually a rat, is trained to run the alley and approach the goal box for positive reinforcement. After approach is well established, the subject is shocked in the goal box to bring about an avoidance response. These antithetical responses result in conflict, which is represented by the animal's post-shock behavior in the alley. Two of the dependent variables observed are amount of movement and oscillation about a point. This requires continuous tracking of the location of the animal in the alley.

Several methods have been used to accomplish this, but each has certain disadvantages: attaching a line to the animal could interfere with his movement; a pivot system requires careful calibration of equipment and weighing of each animal before he runs. The apparatus described in this article attaches nothing to the animal and requires no calibration, yet will continuously record the movement and position of the subject within the runway to a resolution of ± 3 inches. The equipment consists of a straight alley utilizing "floating" floor sections which activate switches when depressed; the sections are connected to and are isomorphic with the pens on a multiple channel recorder. The alley is simple to build and is reliable, accurate, and yields a permanent record of the conflict behavior.

RESUMEN

Investigaciones sobre conflicto utilizando animales como sujetos han sido llevadas a cabo típicamente con el "corredor recto" (straight alley). El animal experimental, generalmente una rata, es entrenado a correr en el corredor y acercarse a la caja (goal box) para refuerzo positivo. Después que el acercamiento ha quedado bien establecido, el sujeto recibe una descarga (shock) eléctrica en la caja de refuerzo

para lograr una respuesta de evitamiento. Estas respuestas antitéticas resultan en conflicto, que se representa por el comportamiento post-choque del animal en el corredor. Dos de las variables dependientes observadas son: la cantidad de movimiento y la oscilación alrededor de un punto dado. Esto require un registro continuo de la posición del animal en el corredor.

Varios métodos han sido utilizados para este fin, pero cada uno tiene ciertas desventajas: colocar una línea al animal podría interferir con sus movimientos; un sistema con pivote requiere una cuidadosa calibración del equipo y se tiene que pesar cada animal antes de cada ensayo. El aparato descrito en este artículo no requiere la colocación de aparato alguno sobre el animal y no requiere calibración y, sin embargo, permitirá el registro continuo del movimeinto y de la posición del sujeto dentro del corredor a una resolución de ± 3 pulgadas. El equipo consiste de un corredor recto utilizando secciones de piso "flotante" que activan varios contactos al ser oprimidos; estas secciones están conectadas, y son isomórficas, a agujas de un registro de múltiples canales. El corredor es fácil de construir, es preciso y fidedigno y permite un "record" permanente del comportamiento de conflicto.

RESUMO

Pesquisas sôbre conflito usando animais como sujeitos tìpicamente têm sido realizadas com o "corredor reto" (*straight alley*). O animal experimental, geralmente um rato, é treinado no corredor para alcançar a caixa (*goal box*) de reforçamento positivo. Depois de ter o comportamento bem estabelecido, o sujeito recebe um choque elétrico na caixa de reforço, o que então causa uma resposta de evitamendo. Estas respostas antitéticas resultam en conflito, que é representado pelo comportamento pós-choque do animal no "corredor reto." Duas das variáveis dependentes observadas são quantidade de movimento e oscilação ao redor de um dado ponto. Isto requer registro contínuo da posição do animal no corredor.

Vários métodos têm sido usados para êste fim, mas cada um tem suas desvantagens: atar uma linha ao animal poderia interferir com seu movimento; um sistema pivô requer calibração muito cuidadosa dos instrumentos e a pesagem de cada animal antes de cada ensaio. O aparato descrito nêste trabalho não ata nada ao animal e não requer calibração, mas permite o registro continuo do movimento e da posição do sujeito no corredor a uma resolução de ± 3 polegadas. O aparato consiste de um "corredor reto" utilizando secções de "soalho flutuante" que ativam "chaves" (*switches*) quando deprimidas; estas secções são ligadas, e a isomórficas, à agulhas de um registrador de múltiplos canais. O corredor é fácil de construir, é preciso e fidedigno, permitindo um "record" permanente do comportamento de conflito.