PROGRAM ABSTRACTS/ALGORITHMS

RECDIS: A BASIC program for computing interindividual distances within a rectangular area

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A variety of investigators have observed freely behaving rats in circular open fields and have used interindividual distances as a quantitative measure of social attraction or "gregariousness" (Barefoot, Aspey, & Olson, 1975; Eckman, Meltzer, & Latané, 1969; Latané, 1969; Latané, Cappell, & Joy, 1970; Latané & Glass, 1968). To facilitate such raw data collection and organization, Aspey (in press-b) developed a computer program (CIRDIS) for determining interindividual distances between any two subjects when observed in a circular open field marked off into 49 sectors. The program RECDIS refers to "rectangular distances," and extends the generality and applicability of determining interindividual distances by specifying locations in terms of numbered sectors to rectangular test areas of variable length and width.

The program is written for a rectangular test area marked off into any number of identified squares of equal size and shape. Length and width are user specified, and the program is applicable to a variety of research situations whenever two animals' locations can be specified in terms of the N squares. In an ethological research example, Aspey (in press-a) computed the theoretical personal space among groups of adult male wolf spiders by determining interindividual distances during agonistic encounters when tested under varying social, spatial, and population densities.

Diagrams of the rectangular area, marked off into a numbered grid (Figure 1), make useful data sheets for recording subjects' locations during testing, or for transcribing tape-recorded protocol. Additionally, a theoretical, chance interindividual distance can be computed by entering all combinations of the numbered squares and obtaining the mean of all possible distances. Furthermore, control distances can be computed by recording each partner's location when tested alone and computing the distances as if the partners had been tested together. This measure provides an indication of the expected interindividual distance between subjects if they were to move through the rectangular field independently of each other.

Description. After operationally defining location (e.g., as that numbered square where a spider's right palp is located during a given trial), the numbers of the squares are recorded where each member of a subject

pair is located. Interindividual distance is calculated from the center of the square where one member of a pair is located to the center of the square where the other member is located. User-specified parameters for each subject pair during one test session (composed of several trials) include: (1) the maximum possible interindividual distance, computed as the distance between diagonally opposed corner squares (e.g., between Squares 1 and 32 or Squares 8 and 25 in Figure 1); (2) the number of data pairs (i.e., locations) per trial; and (3) the number of trials per test session. RECDIS accommodates a rectangular area marked off as a numbered grid into any number of squares of any size; length and width are then specified in terms of the number of squares (see Figure 1). To facilitate comparisons between/among rectangular testing areas or subjects of different sizes, the calculated absolute interindividual distance is also expressed as a percentage of the maximum possible interindividual distance.

Input. Input for each subject pair within a given test session includes: (1) user-supplied identifying labels for subjects, test area size, experimental conditions, and so forth; (2) the maximum possible interindividual distance, determined either empirically or by supplying any two diagonally opposed squares to the program and then using the computer-generated distance; (3) the number of data pairs (i.e., subjects' locations) per trial; (4) the number of trials per testing session; and (5) the appropriate series of data pairs, entered as the numbered squares in any order. The following information is user supplied at indicated points in the program: (1) the number of the square at the end of each row on the rectangular grid area (e.g., Figure 1, Squares 8, 16, 24, 32); and (2) a

1	2	3	4	5	6	7	8
9	10	11	12	13	14	15	16
17	18	19	20	21	22	23	24
25	26	27	28	29	30	31	32

Figure 1. Diagram of a sample rectangular area for use with the program RECDIS in which the area is marked off into a grid of any number of squares of any size. Length and width are specified in terms of the number of squares; in this example, length is eight squares and width is four squares. Interindividual distances are calculated from the center of a numbered square where one member of a subject pair is located to the center of the square where the other member is located.

consecutive series of numbers from "1" to the total number of rows (e.g., 1, 2, 3, 4, since there are four rows in Figure 1).

Output. In addition to user-supplied labels for individual subjects, test area size, experimental conditions, trials, test sessions, and so forth, output from RECDIS consists of the following information for each subject pair: (1) the original numbered squares entered in pairs with the accompanying absolute inter-individual distance for each trial; (2) the absolute inter-individual distance for each paired entry expressed as a percentage of the maximum possible distance; (3) the mean and standard deviation of all distances within each trial; (4) the mean percent of the maximum distance within each trial; (5) the mean and standard deviation of all trials within each test session; and (6) the mean percent of the maximum distance within each test session.

Restrictions. RECDIS is limited to computing inter-individual distances between subject pairs when tested in a rectangular area, and the assumption is made that only two subjects are interacting or being tested together simultaneously. However, the program can be readily modified to accept more than two subjects at a time by adding the necessary number of loops and accumulation variables to accommodate the additional iterations. Modified to accept three or more subjects interacting simultaneously, RECDIS computes inter-individual distances between all possible pair combinations of subjects.

Computer and language. The program RECDIS was written in BASIC (Kemeny & Kurtz, 1968; Sharpe, 1967), developed on an IBM 360/44 computer using the OUIJI system (acronym for "Ohio University

Instructional Job Interface"), and implemented with the BASIC Assembler Interpretive Compiler at the Ohio University Center for Computational Services.

Availability. Copies of this paper, a descriptive source listing of the program RECDIS, and documented output from an illustrative example are available at no charge from Wayne P. Aspey, Division of Comparative Neurobiology and Behavior, Marine Biomedical Institute, University of Texas Medical Branch, 200 University Boulevard, Galveston, Texas 77550.

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