

# AN ANALYSIS OF UNOBTRUSIVE OBSERVATIONS OF PEDESTRIAN MOVEMENT AND STATIONARY BEHAVIOR IN A SHOPPING MALL

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## Abstract

The present study was concerned with the comparative analysis of stated design objectives vs. the effects of the realized design solution on behavior patterns of shoppers in the Mall of the new town of Columbia, Maryland. The major steps in the analysis process include 1. "Intuitive" evaluation of the shopping mall by the investigator team to become familiar with the setting 2. Interviews with the planners, organizers and managers of the mall to identify design objectives. 3. Unobtrusive observation of user behavior in selected areas of the mall using time sampled videotape recordings. 4. Structured interviews with a representative sample of shopping mall users regarding positive and negative features of the shopping mall. 5. Evaluation of interviews and quantitative analysis of observations.

## Introduction

Environmental effects on user behavior in a complex setting like a shopping mall can only be inferred indirectly and the setting has to be used as its own control to study varying conditions occurring in it. The general design of the study was based on the fact that environments with unique characteristics will only allow for limited generalizations to be drawn from analyses conducted under naturalistic rather than experimental conditions. In the shopping mall such natural conditions could be assumed to exist for the two aspects of user behavior under study. The variations accounted for were temporal and environmental because at certain predictable time periods the three or fourfold increase in the number of shoppers and visitors to the mall would alter the environmental conditions drastically and would prevent certain behaviors from occurring which are normal under uncrowded conditions. Therefore, the aim of this study was to compare velocity and stationary behavior under extreme conditions of crowdedness and uncrowdedness.

## The Ethological and Ecological Approach

Systematic observation as a research technique is evolving among researchers of human spatial behavior. The methodology proposed

by Esser (1965, 1967) in studying the spatial behavior of mental patients and of free ranging gibbons is most advanced.

A basic argument still exists between researchers favoring the ethological approach to the study of behavior and those representing the ecological direction like Barker (1968) and Wright (1967). The behavioral units of analysis for the ecologists may be long sequences of behavior episodes with goals and intentions of the actors being inferred by the observer, while the ethologist does not diagnose the causes and circumstances of behavior. Rather, he intends to give an objective description of behavior pattern which can be observed systematically. To quote Hutt and Hutt (1970:22):

It is our contention that facial expressions, gestures, postures and visual fixations are the essential raw material of behavior (and further) their distribution in time provides basic information about the effects of the environment upon behavior and of underlying functional mechanisms.

### Procedure

The ethological approach was chosen for this study. The author and a team of student assistants made videotape recordings of four areas in the two-level enclosed shopping mall of the new town of Columbia, Maryland. The locations filmed were representative of the following environmental conditions in the shopping mall:

1. Circulation area at the upper level (carpeted).
2. Circulation area at the lower level (brick floor).
3. Seating area in the northern middle court.
4. Seating area in the southern middle court.

The data on pedestrian movement behavior in circulation areas were recorded velocity measurements over identical distances under crowded and uncrowded conditions. The seating areas were identical in layout except for their differing location in the south and north wing of the mall respectively. Each contained three 4' by 4' low wooden benches and one 20 ft. living tree and were placed in the circulation areas of the lower mall level. The data on stationary behavior, too, were recorded under crowded and uncrowded conditions. The recordings were time-sampled to the extent that both extreme crowded and uncrowded conditions were represented equally in the sample size of observations of subjects. Recording times were standardized 1/2 hour periods.

The environmental conditions in the mall were considered independent variables which includes the conditions of crowdedness. The index for uncrowdedness was arbitrarily set at 0-400 pedestrians per check point and 10-minute period, whereas the range between 600 and 1000 pedestrians in the same time interval was considered crowded. The dependent variables were the observed behavioral changes.

### Subjects

The subjects for this study were users of the Columbia, Maryland shopping mall. Four types of users could be differentiated:

1. Shoppers from the surrounding town of Columbia and other nearby communities.
2. Young and older persons from nearby communities using the mall for leisure time activities.
3. Tourists from near and far away visiting the mall as a tourist attraction, usually for the first time.
4. Employees of stores in the Columbia mall.

For the purpose of the study subjects were identified by sex, age group, the size of group they belonged to and by so-called "handicaps", i.e. strollers or packages which might have an effect on the speed of pedestrians. Within a given time period of 30 minutes of recorded tape all subjects present in the area of investigation were analyzed for their velocity, and stationary behavior patterns respectively.

### Data Recording

Observational data were recorded unobtrusively with Sony 3400, and 3600 videocorders respectively. Two cameras recorded simultaneously the same category of behavior in two similar environmental conditions of the mall. This procedure was to insure that comparable situations were taped which then could be analyzed for their effects upon user behavior. Cameras were always stationed on the upper level of the mall to reduce obtrusiveness and to gain a good field of vision for the recordings. Wide angle lenses were used in the recording of velocity data across the mall for both the upper and lower level. In order to standardize the distances of measurement of pedestrian speed, modular columns (at 24' intervals) were chosen as reference points in the recorded pictures.

Camera positions for the recording of pedestrian velocity and stationary behavior were maintained strictly for all recordings throughout the period of the project. On a regular recording day, a schedule would be worked out in advance which allowed for

alternate filming of the two topics. Time periods of 1/2 hour tape length alternated with 15 minute breaks in which cameras could be moved to new positions. While recordings were underway counts were made of traffic moving in various directions in the major circulation areas. These counts served as indices of traffic density at different observation times.

### Time Sampling

Because of necessary lighting conditions, videotape recordings were limited to daylight hours. Further, the collection of data was restricted to Fridays and Saturdays, because of travel and manpower limitations, as well as the considerable distance from the place of investigation. However, by time sampling on Fridays and Saturdays the most important points of this study could be demonstrated, i.e. the effect of low and high conditions of crowding on the behavior of shopping mall users.

### The Setting

The mall in the new town of Columbia, Maryland, the setting for this study of relationships between environmental features of a shopping mall and their effect upon various aspects of shopping mall behavior was chosen for the following reasons:

1. It is unique with its street-like character. The developers of the mall, the Rouse Company, planned this aesthetically attractive mall as a "downtown" to provide for a variety of functions other than just shopping.
2. Opened in August, 1971, this mall represents the latest type of development in the design of enclosed shopping malls, of which about 20 are currently in the planning stage. It was felt appropriate to evaluate this type of shopping mall from the user point of view and to feed the obtained results back to the developers.
3. From an architectural point of view the shopping mall is spatially differentiated into functional zones which lend themselves very well to the analysis of the behavior categories outlined above. For example, the floor materials differ between the lower level (tile) and the upper level (carpet). With approximately the same variety of stores bordering the traffic circulation areas, the question arises whether the floor material has any effect on the shopper's velocity as he wanders through the mall.
4. From the analysis point of view the Columbia Mall was particularly suited to the study of user behavior since the two

level arrangement of floors allowed for unobtrusive data collection from the elevated vantage points of the upper level of the mall.

### Environmental Features

In this setting two types of environments were analyzed.

**Circulation areas:** In order to measure pedestrian velocity camera positions VU and VD at the north end of the mall were chosen to record data for both the upper and lower levels. At the upper level stores were recessed. The floor was carpeted and although the pedestrian circulation area was limited in width compared with the lower level mall, there was a feeling of spaciousness and an interesting view of the downstairs activities from the upper level. The lower level was paved with tile. It was 30 feet wide, divided into two circulation zones of 10 feet each and a middle zone designed for seating facilities, exhibits, special sales, etc. A street-like feeling was prevalent at the lower level, particularly in the evening when the dim "streetlights" went on. There were natural full grown trees to reinforce this impression.

**Seating area:** In order to record observational data on stationary activity two camera positions were selected to cover the northern middle court (MC<sub>1</sub>) as well as the southern middle court (MC<sub>4</sub>). The environmental conditions for both courts were identical, except for the position of the tree in relationship to three low wooden benches (4' by 4'). On each bench twelve possible seating positions were recorded for the users. The benches were open for access from all sides and surrounded by pedestrian traffic. A maximum of four persons could sit on the benches.

The recording of behavioral episodes included pedestrian velocity and stationary behavior. A behavioral episode for individual subjects was recorded as they entered the demarcated zone for speed measurement, until they left the zone of 24 ft. standard distance between columns in the shopping mall. Each episode could contain behavioral events, such as stopping, interrupting, or changing the behavior the subject was engaged in. Group episodes were defined as tightly spaced clusters of subjects 0-24 in. apart moving through the demarcated space.

In this topic area discrete events were recorded at one minute intervals, and behavior boundaries for individuals could be clearly established for the time of observation. Groups were defined as subjects related in some discernible way, such as arriving together, and occupying adjacent spaces without necessarily interacting in the process. Spatially, middle courts were

surrounded by traffic zones for pedestrians, i.e. they were essentially unbounded and open at all sides to inflowing traffic.

#### Reduction of Recorded Data: Measurements

It was pointed out earlier that the physical environment features of the mall were considered independent variables, as were the conditions of crowding. The behavioral effects of the environmental features on the mall users were considered dependent variables. For the reduction of videotapes standardized procedures were devised. In a typical data reduction session one person would be needed to operate the replay equipment and another to record measurements on IBM data sheets with preestablished categories. The replay equipment consisted of a Sony 3600 videocorder and a Setchell-Carson Monitor.

Discrete variables in observed behavior were recorded at one minute intervals, with a record of the elapsed time since the behavior was initiated. Thus, duration measures of behavior were obtained, as in the case of stationary events. Continuous data were taken on the velocity of pedestrians in the mall, in which case an individual would be tracked continuously for the standard distance of measurement, i.e. 24 feet. In the case of velocity measurements, stopwatches were used to time the subjects. With hand counters, counts of traffic density in the mall were made regularly at the time of recording tapes to establish indices of crowding conditions.

#### Data Categories

Data categories in the velocity measurements included the sex, age group, the "handicap" and speed of the subject, whether he was alone or in a group, whether he had physical contact with other subjects and his approximate distance from the storefront.

Data categories for stationary behavior included the sex and age groups of subjects, their locations and distances maintained among each other, their orientations and interactions with each other, their postures and activities and duration of stay in the respective seating area.

#### Results and Analysis

The "Statistical Analysis System" developed by Barr and Goodnight<sup>1</sup> containing standard analysis programs for frequency counts, means, standard deviations, and correlations was used to describe and analyze the reduced observational data. In addition, a program for the analysis of variance developed at Virginia Polytechnic Institute and State University<sup>2</sup> was used for the test of

significance of differences in the data of the basic four conditions for velocity measurements. Finally, combined totals for all collected data were compiled. In the following the data are presented:

Pedestrian Velocity

Table 1 contains a percentage breakdown of the mall user population according to sex, age, and observed group sizes as observed at the two floor levels, under crowded and uncrowded conditions.

It will be noted that more women were shopping in the Columbia Mall at all times than did men, but at busy times on weekends this tendency was even stronger, i.e., on Friday nights and Saturday afternoons.

Interestingly enough, at the upper level comparatively more men tended to be found under crowded conditions, while the reverse was true for women whose relative percentage tended to be higher under uncrowded conditions, generally amounting to about 60 percent of the mall user population.

TABLE 1. Percentage of Mall Users According to Sex, Age and Group Size: At Two Floor Levels, Under Crowded and Uncrowded Conditions

		Location and Degree of Crowding				
		Upstairs		Downstairs		Combined Total in %
		Crowded	Un-crowded	Crowded	Un-crowded	
Sex	Male	45.5	37.2	43.9	39.5	41.6
	Female	54.5	62.8	56.1	60.5	58.4
Age	Child	14.1	9.4	22.9	6.9	12.0
	Adult	85.9	91.6	77.6	93.1	88.0
No. of Persons in Group	1	36.3	43.7	14.9	17.1	27.9
	2	42.4	40.1	56.8	42.6	44.6
	3	15.5	10.0	15.3	21.8	16.3
	4	4.6	3.1	8.8	10.0	6.7
	5 or more	--	--	2.5	4.3	1.7

Table 1 shows that group sizes in the mall including individual users vary considerably between the upper and lower level, overall however, they do not vary under crowded or uncrowded conditions. Upstairs, between 30 and 43 percent of the observed subjects

are alone, both under crowded and uncrowded conditions, whereas there is great variation downstairs under crowded conditions (15%) vs. uncrowded conditions (36%) regarding the group size of observed subjects. Again, in groups of two, there appears to be little difference upstairs while downstairs the trend is reversed, i.e., 57 percent under crowded and 42 percent under uncrowded conditions.

The following results were obtained:

1. The average pedestrian speed at the lower floor level (3.04 ft/sec) on tile floor was about 10 percent higher than at the upper floor level which is carpeted (2.78 ft/sec).
2. Under uncrowded conditions the observed average pedestrian speed (3.09 ft/sec) was about 12% higher than under crowded conditions (2.74 ft/sec).
3. The differences in speed depending upon floor level or condition of crowding were independent from each other and significant at the .01 level. There was no interaction or compounding effect of the floor level (floor material) and the conditions of crowding.
4. In comparing the mean velocity between crowded conditions at the upper (2.61 ft/sec.) and the recorded average velocity for the uncrowded condition at the lower level (3.22 ft/sec) a considerable difference of about 23% higher velocity was noted for the lower level.

The tendency in these data suggests generally higher pedestrian speeds at the lower level which is paved with tile, a tactually hard surface while the carpeted floor level shows a tendency for comparatively lower speeds. Table 2 shows the analysis of variance of velocity measurements of shopping mall users, based upon an equal and randomly selected sample of 349 subjects for each of the four basic environmental conditions. A working definition of "crowdedness" for the purpose of this study referred to number of subjects passing in both directions through comparable checkpoints per half hour counting period. The definition of crowdedness was as follows:

- 0 - 400 subjects/half hour is uncrowded
- 600 -1000 subjects/half hour is crowded

Transition periods with about 500 subjects/half hour were not used since the objective was to illustrate the effects of extremely crowded vs. uncrowded or "normal" conditions upon the walking speed of the shopping mall users.



TABLE 2. Analysis of Variance of Velocity

Sources of Variance	Sums of Squares	df	Mean Square	F
Floor Level Crowding	0.799287	1/1396	0.799287	119.761*
Condition Crowding X	0.510305	1/1396	0.510305	76.462*
Floor cover	0.116355	1.1396	0.116355	1.743

\*  $p < .01$

Correlations among the variables of time, sex, age, number of subjects per group, handicaps like strollers, packages, and physical contact as well as the computed speed did not yield significant results, with one exception, i.e. a correlation coefficient of -0.468 for group size and observed speed under crowded conditions downstairs.

#### Stationary Behavior Data

The data on stationary behavior in two identical seating areas located in the north and south middle courts of the central circulation area of the mall were intended to be descriptive only. They were to point to directions for the future study of the many and complex interactions and variables found in public seating areas. The data also revealed some of the deficiencies of the seating areas in the Columbia Shopping Mall. The methodological approach developed for the systematic analysis of stationary behavior in relationship to designed artifacts was found satisfactory regarding the kind behavioral information which could be discerned, although the process of data reduction from videotaped recordings was extremely time consuming. In the following the stationary behavior data are presented for three environmental conditions, i.e. for middle court no. 1 (MC<sub>1</sub>) in the northern wing of the mall data were analyzed for both crowded and uncrowded conditions. Lack of time and resources only permitted to obtain data on the uncrowded condition for middle court no. 4 (MC<sub>4</sub>) in the southern wing of the mall circulation area.

It was found that among the users of the seating areas women (about 80%) generally account for a relatively higher percentage, if compared with the general shopper population, where women amount to about 60%. Under crowded conditions women use the seating areas less (67 percent average) than under uncrowded conditions. As was observed in the velocity data, children account for a relatively higher percentage (36 percent) of the population under crowded conditions vs. 21 percent under uncrowded conditions (the preliminary data only permit very tentative conclusions,

further analysis and larger samples will be necessary).

Data observed in the seating areas show talking and looking as the primary activities, followed by resting and eating. Indications are that these seating areas lend themselves more for social interaction than for solitary activity. No conclusive results were obtained relative to the conditions of crowding.

The orientation of the bench users was recorded, i.e. the major direction they were facing. There appear to be preferred orientations (directions 3,4 and 5, see Fig.1) which face the major counter-clockwise flow of pedestrians coming from the central court in the mall. No conclusions could be drawn regarding the effect of crowding on the orientation of the users of seating areas. An evaluation of the seating positions occupied on the various benches yielded some useful information. The following results were obtained:

1. On bench #1 position G got most use
2. On bench #2 position I got most use
3. On bench #3 position D got most use
4. The tree was related to very often  
by standing persons.

(For seating positions see Schematic plan of middle court  
No. 1 Fig. 1.)

Position G is facing into the seating area, as is I and D. These corner seats are closest in distance from each other and used for verbal interaction.

Only limited data were obtained on the aspect of spatial occupation of the various zones in the seating areas. Bench no. 3 obtained the highest occupancy rate, which might be expected in light of the fact that most pedestrians would reach this bench first in the major traffic flow originating from the center of the mall. Bench no. 3, under uncrowded conditions appears to attract most users (i.e. 47 and 57 percent respectively), for no apparent reason, while bench no. 1 gets comparatively little use in both seating areas.

Finally, correlation coefficients were computed for the variables sex, age, posture and for the primary and secondary activities observed in the seating areas. However, the correlations were very low and not significant.

### Discussion of Results

The results of the velocity measurements of pedestrians walking on different floor materials under different conditions of crowding suggest more leisurely shopping on soft floor materials on

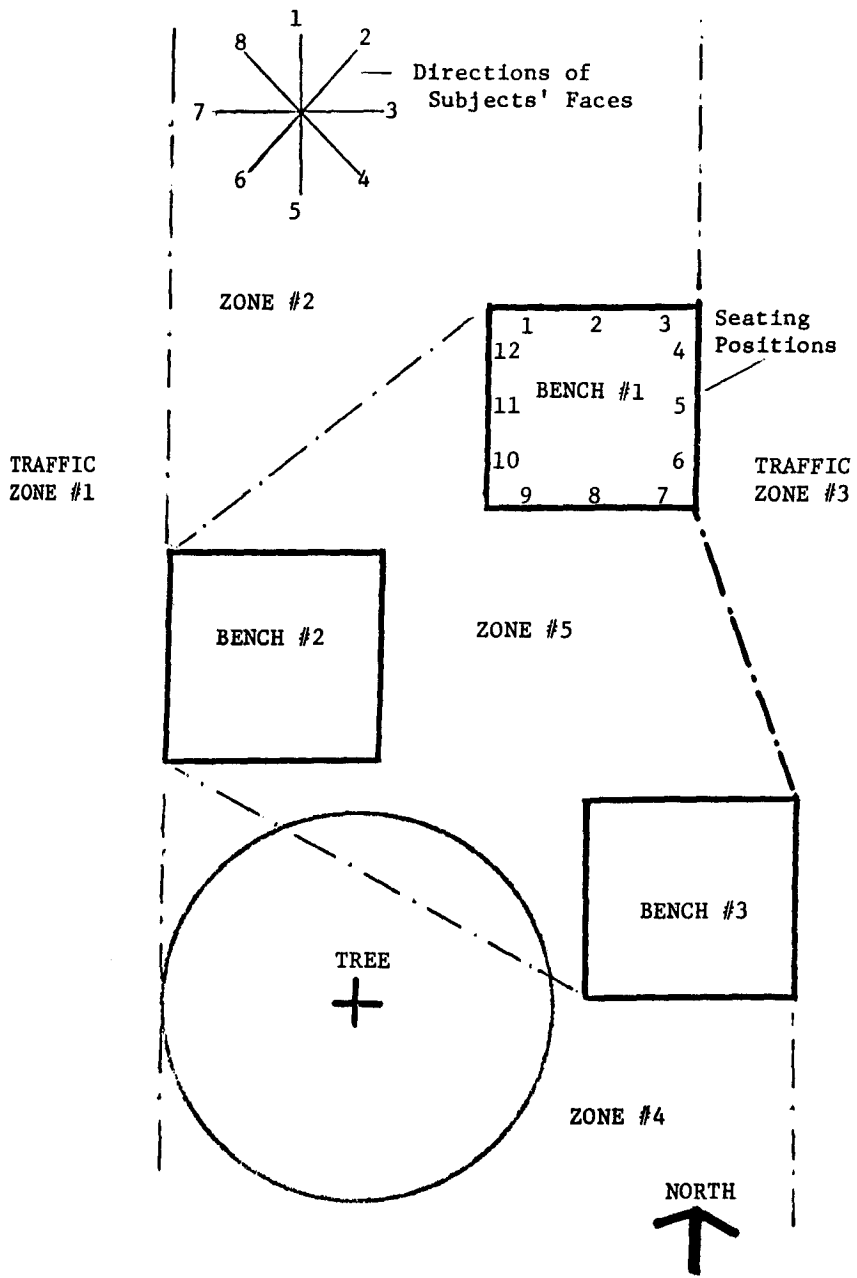


FIGURE 1. SCHEMATIC PLAN OF MIDDLE COURT NO. 1

the one hand and under uncrowded conditions on the other. Sales records at the Columbia Mall may confirm (and so did interviews administered to 144 users of the mall) that larger crowds do not necessarily mean better sales. The effect of storefront displays partly gets lost in large crowds blocking the view and forcing a particular speed upon the individual shopper. Reference to possible theoretical implications of these results will be made later.

There was a problem regarding children in the mall. Generally, for a "young" town like Columbia the low figure of only 12 percent is surprising and can be attributed to the fact that virtually no facilities for children of any age exist in the mall. In fact, the few resting areas provided in the main circulation zone made it difficult to supervise children. Lack of spatial definition of the seating areas, except for the two so-called "endcourts", prohibited any kind of privacy and shelter from the bypassing streams of pedestrian traffic or even traffic crossing through the seating areas. Consequently, it was easy for children to get lost in the crowd. This fact was confirmed in interviews with mall users.

The results of the stationary behavior analysis are so limited that only very tentative conclusions can be drawn at this time. They relate to the phenomena of space occupation and facial directions observed in the seating areas. Whatever the underlying psychological dimensions may be, the majority of bench users preferred to orient themselves toward facing the major stream of traffic.

There was a conflict situation for mothers trying to rest and control their children in the "open" seating areas. Children were much easier contained in the so-called endcourts which had clearly marked spatial boundaries, i.e. pylons and 3 differentiating steps. Another problem was caused by people crossing through the middle courts, particularly under crowded conditions, so that trying to relax there became rather difficult. This might explain why there were comparatively fewer women in the seating areas when they were crowded. Some of them were observed anxiously clinging to their shopping bags. The findings of a previous study (Preiser, 1972) on the spatial behavior-artifact patterns of informal interaction were confirmed to the effect that most stationary events were occurring on or very close to designed physical artifacts like benches and trees. However, the rather barren middle courts of the Columbia Mall did not particularly support informal interaction due to lack of supportive artifacts to which people could relate spatially.

The verbal response data were collected as complementary indicators of fits and misfits in the shopping mall environment. The

main issues resulting from the interviews with shopping mall users and managerial staff have been summarized in the section on design criteria below. It was found that the combination of both observational techniques and verbal response measures yielded valuable information for the evaluation of man-environment interaction. The initial so-called "intuitive" evaluations of the shopping mall qualities by the investigator team served as a basis for the construction of the preliminary interview questions and indeed for most of the final interview questions. In terms of evaluation methodology it is felt that the tools used for this study can be developed further to be applied to any complex setting analysis. Both the interview probes and the videotape recordings could be obtained in relatively few carefully planned site visits.

#### Design Criteria: Implications of the Study

Some of the criticisms for design which have emerged from the evaluation of user responses to the Columbia Mall are listed below.

1. The label "Downtown" of the Columbia Mall which can be found on direction signs in the town of Columbia, is misleading despite the good intentions of its planners. A downtown without food stores, hardware stores, a drug store or a newsstand is incomplete, not to mention community facilities of all types. The generally good variety of offerings at the Columbia Mall should be complemented by the kind of stores and facilities mentioned above.
2. The observed counterclockwise flow of pedestrian movement ought to be reflected in the layout and design of storefronts of shopping malls, e.g. stores could be arranged in a saw-tooth like fashion so that store openings and window displays would be facing the traffic flow more directly to become more effective in attracting shoppers.
3. Floor materials for shopping malls should consist of soft surfaces, e.g. indoor-outdoor carpeting in light of the results of this study.
4. The seating areas need to be spatially differentiated from the major circulation and placed into quieter zones to protect the users from intrusions in their personal space by persons crossing through the area. Small scale, contained seating with backs should be provided. There should be an equal amount of seating available at both levels of the shopping mall.

5. Play facilities for children should be provided near the center of shopping activity and circulation.

### Notes

1. A.J. Barr and J.H. Goodnight developed the "Statistical Analysis System" (SAS) in 1971 at the Department of Statistics, North Carolina State University, Raleigh.
2. This program was developed in 1971 by J.A. Sgro, Department of Psychology, Virginia Polytechnic Institute and State University, personal communication.

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