BEHAVIOR PATTERN INDEXING

ABSTRACT

Judgment Space Methodology
in Behavior Pattern Indexing

Judgment space methods are applied to the problem of identifying, distinguishing, and automatically processing descriptions of behavior patterns which are of interest to criminal justice agencies. This methodology provides continuous, quantitative indexing in contrast to the traditional discrete, qualitative indexing. It offers the following advantages for research and evaluation.

(a) A quick screening for improving the quality of the data base
(b) A sensitive and distinctive dependent variable for studying criminal behavior as a function of significant influences or merely change over time
(c) Empirical derivation of indexing categories
(d) A benchmark for evaluating the effectiveness of behavioral indexing and retrieval systems.

The specific products of the project include the following.

(a) Parametric analyses of criminal episodes
(b) Two behavioral indexing systems
(c) A functional computerized Modus Operandi File, using the Colorado Bureau of Investigation data base
(d) Empirical tests of the system for purposes (a), (b), and (d), above.

Schedule of Program Activities (see also Section VI)

	Task	Week Begun	Week Ended
1.	Scenario Analysis	1	4
2.	First Psychometric Indexing System (Classification Space I)	2	19
3.	Second Psychometric Indexing System (Classification Space II)	19	38
4.	Programming functional Classification Space information system	28	32
5.	Integrating C-Space information system with existing data base	33	38
6.	Optimize information system functioning and conduct empirical tests	38	48
7.	Final report and system documentation	49	52

Total Time: 52 weeks

Organizational Qualifications and Resumes of Key Personnel

The Linguistic Research Institute is organized around a group of Senior Fellows who have strong research backgrounds and are connected to university communities across the country. LRI specializes both in basic methodological and theoretical scientific work and in creating innovative solutions to real world problems.

Members of the project group have a history of involvement with criminal justice agencies and problems and have conducted prior research within the justice system. They are also involved in information system problems and in the computer simulation of human judgment.

Both the basic conceptual framework and the general human judgment methodology which are exemplified by judgment space information systems were originated within LRI and are described in the LRI series of scholarly publications. Both the original empirical research and later applications of this methodology were conducted by LRI Fellows or supervised by them. Thus, LRI has a preeminent, and in many ways exclusive, expertise in regard to the methodology and applications of judgment space information systems.

Resumes of key professional personnel are found in Appendix B.

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I. Introduction

One of the most widely recognized needs in justice system research is the need for an effective way of characterizing criminal behavior and crime episodes. Among the problems encountered by present approaches are the following.

A. There is a problem in identifying relevant aspects of criminal behavior in some way other than by reference to the statutory definitions of elements defining the crime.

B. Whatever aspects are selected as relevant, there is a premium on preserving the information provided by specifying these aspects. But these aspects are generally discrete and qualitative, hence they present difficulties when one tries to quantify them and when one tries to combine them into an overall characterization. Yet most research and evaluation procedures and designs require quantitative characterizations and overall characterizations. Moreover, it is highly desirable that this data be computer analyzable, yet the potential for doing so with basically qualitative data has been extremely limited.

The present project, "Behavior Pattern Indexing" (BPI), is responsive to these and other research and evaluation needs. It involves the use of psychometrically based judgment space methods to identify, distinguish, and process automatically certain behavior patterns which are of interest to law enforcement and correctional agencies. The specific experimental context proposed for a demonstration project is the computer implemented Modus Operandi File maintained

by the Colorado Bureau of Investigation. The project involves the adaptation of a novel information storage and retrieval methodology which was developed for intelligence analysis (Ossorio, 1964, 1965, 1966, 1967, 1968, 1971) and subsequently adapted to a variety of other purposes (Jeffrey, 1979).

The functional judgment space indexing system described below is a completely automatic or interactive system in which indexing of an Entry is accomplished by (automatically) assigning the Entry a set of coordinates within an N-dimensional subject-matter representation (e.g., in the present project one subject matter is the domain of legally defined crimes). This type of indexing is quantitative and contrasts with the traditional all-or-nothing classification under some, and only some, of the "headings" in the retrieval system. (Matching of key word descriptors is a special case of using subject matter "headings.") The quantitative indexing permits a variety of quantitative treatments of indexing and search procedures. The judgmental basis of the indexing goes substantially beyond simple word matching or phrase matching and ensures that the quantitative indexing preserves the descriptive richness of qualitative characterization.

As a functional information retrieval system, the Behavior Pattern Index makes the following methodological contributions.

1. Many MO files have an uncomfortably large proportion of data which has questionable validity or which can, with intensive investigation, be shown to be erroneous. The BPI can quickly detect behavioral entries which are substantially deviant from other entries under the same name.

Consequently, it can serve as a screening device for identifying data which has a relatively high likelihood of being invalid and which, if invalid, substantially reduces the effectiveness of the MO file. Thus, it makes a contribution to improving the validity of the data in the existing file.

2. The BPI provides a representation of behavior patterns that is both informationally rich and mathematically tractable, and so it holds the prospect of handling behavioral patterns on the model of fingerprint identification—a criminal's BPI coordinates would be his behavioral "fingerprint." From this, other things follow:

(a) It provides a sensitive and distinctive dependent variable for studying the effects of significant influences on criminal behavior. Among such possible influences are incarceration, rehabilitation programs, demographic characteristics, and personality variables.

(b) Descriptively, it provides a framework for mapping trends or changes over time in the prevalent patterns of criminal behavior.

(c) As with analytic fingerprint descriptions, the BPI provides a notation for retrieving information from other BPI type MO files which are not directly computer-linked. (In this connection, it should be noted that once the BPI indexing system is set up, it can be set up independently in any number of locations with independent data bases without any further psychometric data gathering. In this sense, the developmental work on the BPI is likely to be exceptionally cost-effective.) For example, a study of recidivism in one jurisdiction could request information from other agencies or jurisdictions having

their own BPI type MO files in terms of BPI profiles or coordinates ("Do you have anyone with a profile like this one and these characteristics and MO entries between this date and that date?")

3. The BPI permits an effective empirical derivation of classification dimensions (parameters) in contrast to traditional analytic indexing schemas. The method of empirical derivation (factor analysis) tends to emphasize strongly those dimensions which discriminate among cases; thus, improved discrimination among cases is likely.

4. The BPI provides a methodology for studying the effectiveness of a given MO file information system:

(a) As an operating MO file information system, it would provide a benchmark for assessing the effectiveness of any existing MO system.

(b) As a quantitative coordinate-indexing system, it would provide objective measures (essentially, density measures) for assessing the difficulty of the MO identification problem for a given MO system. This capability reflects the fact that MO identification is objectively more difficult if there are a great many individuals with similar and overlapping MO's in the file than if the set of MO's in the file are relatively distinctive and non-duplicative. These differences can be assessed quantitatively in the BPI. Such an assessment would be crucial for an evaluation of a given MO system in terms of accuracy and precision.

II. Background

One of the general resources for law enforcement agencies is a modus operandi (MO) file. The rationale for this is that a given person will tend to commit similar crimes on different occasions so that a description of a crime can be used to identify known persons who are likely to have committed it, because they are known or believed to have committed similar crimes in the past.

A functional MO file depends on the selection of relevant features of the crime and the combination or integration of the various items of information about a given crime. From the standpoint of information retrieval systems, the present MO files function as Key Word indexing systems. Descriptive elements of the crime, e.g., Mode of Entry: forcible, serve as Key Words for indexing purposes. Criminals are identified with a set of such Key Words summarizing their crime histories, and retrieval takes place by matching the Key Words for individuals against the Key Words for the crime in question.

Present MO files appear to exhibit the same limitations as Key Word indexing generally. Three general limitations are the following:

(a) Key Word indexing generally requires a strongly formatted input, in contrast to the discursive textual form in which the information is normally found and used. Accuracy may be sacrificed because of the necessity for judgment and decision making (in generating the appropriate Key Word descriptors) in what would otherwise be a clerical task. Conversely, personnel who could make such decisions with confidence are likely not to be available because of time or cost limitations.

(b) Storage and retrieval is limited by the specific verbal form of the Key Words. Since Key Words are mutually exclusive, this puts a heavy premium on correct classification, since matching is an all or none process depending on the specific words. For example, "violent" would be a complete mismatch with respect to "forcible." Similarities, as against identities, cannot be dealt with effectively in Key Word indexing, even though in most cases, including an MO file, the rationale for the system as a whole is similarity or inclusion rather than identity.

(c) Key Word indexing is subject to conflicting constraints. Greater discrimination requires more refined distinctions, and more Key Words; however, the more distinctions, and particularly the more refined the distinctions, the greater is the cost and decision-making burden for data entry and the more serious is the dependence on identical matching rather than similarity comparisons.

Because of these limitations, Key Word indexing systems have not performed impressively in terms of the standard criteria of Accuracy (does the system retrieve the desired information) and Precision (how much non-desired information does the system retrieve). MO files appear to be particularly strongly affected by these limitations. Thus, an approach to MO file organization which does not have the same in principle limitations as Key Word indexing would offer a significant prospect for improved law enforcement.

III. General Approach to Problem

Judgment space classification, and particularly Classification Space Storage and Retrieval (Ossorio, 1964, 1965; Jeffrey, 1979), is a psychometrically based methodology which provides indexing on formatted or unformatted text and retrieval which is sequential (i.e., in order of relevance) and based on similarity without the usual limitations of word shape or mutually exclusive indexing categories. After an initial round of system construction and programming, such a system is essentially fully automatic, requiring only occasional updating if the domain in question is subject to change. (For example, 25 years ago computer crimes would not have appeared in a standard set of crime categories or modus operandi.)

The general procedures for constructing a functional Classification Space are as follows:

1. Select a set of variables which jointly are a good sample from a domain of interest (e.g., crimes).

2. Select a sample vocabulary (e.g., by a random process) from the literature of the domain in question (e.g., from crime reports).

3. Obtain formatted judgments from knowledgeable people relating each vocabulary item to each domain variable.

4. Factor analyze the correlations among the variables. (The result is an N-dimensional factor space.)

5. Assign coordinates to each vocabulary item, thus locating it (indexing it) in the factor space.

6. Process documents (e.g., formatted or unformatted crime reports) by identifying the vocabulary items in the document and using a Classification Formula to index the document as a function of the locations of the vocabulary items in the document.

7. Index information requests as in 6, above.

8. Retrieve items in accordance with the principle that items indexed closest to the information request in the factor space will be the most relevant to it.

The present proposal describes procedures designed to improve MO file effectiveness by augmenting the existing system with judgment space capabilities. The judgment-based indexing and retrieval system offers the methodological advances noted above, and empirical demonstrations of the use of this methodology in research or evaluation are conducted. The project involves the following elements:

(a) A systematic scenario analysis of various crimes and their behavioral (vs legal) elements. This analysis provides resources for the Judgment Space procedures but can also be used directly for identifying criminal behavior patterns. For example, it can be used to refine the present MO file input format.

(b) A Classification Space indexing system based on the domain of statutory crime categories and behavioral elements.

(c) A Similarity Space indexing system based on discursive crime descriptions and behavioral elements.

(d) Functional indexing and retrieval systems based on optimizing and empirical evaluation of (a) the judgment space capabilities as an alternative to the Key Word capability, and (b) the combined judgment space and Key Word capabilities of the information system.

(e) Empirical demonstrations of Behavior Pattern Indexing as a research and evaluation tool.

(f) Documentation of the foregoing.

IV. Work Plan

The project is designed to be accomplished in the following stages.

A. Construct indexing systems

1. Scenario analysis of behavioral elements of crimes.
2. Select system vocabulary from (a) present MO form, (b) scenario analysis, and (c) discursive reports.
3. Prepare Space experimental materials, using crime categories and the system vocabulary.
4. Conduct data gathering procedures.
5. Construct Classification Space (CS-I).
6. Prepare Similarity Space materials using crime report descriptions.
7. Gather data for Similarity Space
8. Construct second Classification Space (CS-II) using dimensions of the Similarity Space in place of crime categories.

B. Integrate new indexing with existing system and data base

C. Conduct empirical tests of indexing capabilities to establish optimum configuration and level of effectiveness (Precision and Accuracy) of the system with and without the judgment space capabilities. Demonstrate empirically the use of the BPI (a) in improving the quality of the data in the data base, and (b) as a dependent variable (BPI coordinates are the basic dependent variable) for representing behavior pattern changes in quantitative form.

These procedures are described in greater detail below.

Task A. Construct Indexing Systems

Task A 1. The first steps in constructing the indexing systems are to select a set of variables covering the field in question and a system vocabulary of descriptors to discriminate within the field in question. For the MO file, emphasis is on descriptors which designate behavioral elements of crimes. In order to identify such elements systematically some kind of behavioral analysis of crimes is required. The scenario approach to this task involves (a) explicit formulation of a paradigm case of the commission of a given general type of crime (this is the scenario) and (b) an analysis of the major and lesser ways in which this scenario can be the same as another version of the same crime or different from it. These latter will provide essential descriptors (and potential Key Words for Key Word approaches) for distinguishing one way of committing a given crime from another way of committing the same crime.

Task A 2. The second step is to select both the variables covering the field and the system vocabulary. Since the variables for the first Classification Space (CS-I) are simply the crime categories used in the Uniform Crime Reports, the problem reduces to the selection of the system vocabulary. The system vocabulary will include the descriptors which appear in the present MO report form. It will also include all the descriptors which emerge from the scenario analysis or a sample of these (depending on number). It will also

include a sample of words and phrases which appear in the present discursive crime reports.

Task A 3. The judgmental data for a Classification Space consists of pairing each item in the system vocabulary with each one of the domain variables (the crime categories). Where the number of either is even moderately large, a convenient format is to construct a booklet in which each page has one of the variables at the top. On the page are some number of the vocabulary items each accompanied by a quantitative scale. The experimental instructions specify the kind of judgment which is to be expressed in quantitative form by checkmarking the scale. The kind of judgment involved determines the kind of space involved. For example, if the instruction is (in effect) "On this nine point scale, what is the degree of relevance of this word or phrase to this crime category" then the space is a Relevance Space. In contrast, if the instruction is "Rate the degree of similarity in meaning between this word (the vocabulary item) and the word or phrase at the top" (the crime category) then the space is a Similarity Space (and a Meaning Space). The Classification Spaces which have been constructed to date have all been Relevance Spaces. In the present project, a Similarity Space is also constructed (see below).

An effective visual layout enables the rater to make valid judgments at a high rate of speed, i.e., 250-400 ratings per hour. Fatigue and task spacing are important factors.

Task A 4. Gather Classification Space Data

This task consists of obtaining the relevance judgments from persons who are knowledgeable with respect to the crime categories. Each Descriptor - Crime Category pair should be rated by at least three persons, but various persons can be used to cover the entire set of comparisons. It appears that for the first Classifications Space (CS-I), approximately 60 crime categories and 500-800 vocabulary items would be involved. Based on prior experience with relevance and similarity ratings, these judgments will be made at the rate of 250-400 per hour. Thus, these ratings will involve some 350 man hours.

Task A 5. Construct Classification Space

Given the empirical data, the construction of a Classification Space involves the following. (a) Correlation of the variables (crime categories) and factor analyses or cluster analysis of the correlation matrix. The result is an N-dimensional factor space in which the factors, or reference axes, are "type of crime" dimensions. (b) Factor measurement procedures are used to assign each vocabulary item a set of coordinates (hence a location) in the Crime Classification Space.

Task A 6. Construct a Similarity Space

It is not necessarily the case that the judgment space based on crime categories will provide the most effective discrimination among different ways of committing crimes. The Similarity Space based on a sample of descriptions which appear in discursive crime reports provides a way to generate a second set of crime-relevant

variables which can then be used in place of the crime categories in a Classification Space procedure. If 140 such descriptions are used, the minimum number of judgments required is $3 \times 140^2/2$ or about 1/5 the number estimated for the procedure in Task A 4.

Task A 7. Gather data for Similarity Space

This task involves the preparation of experimental materials and collection of human judgment ratings on the 140 x 140 comparisons of the descriptions with each other.

Task A 8. Construct second Classification Space (CS-II)

The similarity judgments are factor analyzed and the factors which define the resulting Similarity Space will be characterized or "interpreted." These characterizations are then used in place of the crime categories to construct CS-II by using the procedures described in Tasks A 2 to A 5 above. The same system vocabulary will be used for both Classification Spaces. Of the dimensions in the Similarity Space, only those suitable for modus operandi discrimination will be used for CS-II. This will reduce the size of the data collection for CS-II and will reduce error variance in the methodological demonstrations and in the operating system.

Task B. Integrate new indexing system with existing system and data base.

Task B 1. Program a functional indexing and retrieval system for the C-Spaces. This involves provisions for read-in, read-out, document (crime report) indexing, request processing, and retrieval procedures. The indexing of documents is done on the basis of

(a) identifying words or phrases in the document which are in the system vocabulary and (b) using one of several existing Classification Formulas to compute a single location for the document as a function of the locations of the system vocabulary words which appear in the document. Indexing of persons will be some function (probably the simple average) or the locations of the crimes ("documents" or "Entries") associated with them. Indexing of requests will be identical to the indexing of a document. (Every crime report filed may be regarded as a request for information in regard to possible perpetrators.) Retrieval is based on the distance between the location of the "Request" and the location of a given person in the C-Space. Output of names is sequential, in the order of the distance between each person and the reported crime in the C-Space. For an ideal system, this distance will be roughly proportional to the likelihood that the person in question committed the crime in question. Regardless of how the output limitations are set (e.g., a critical value for distance or an absolute number of names) the sequencing of output reduces the burden of unwanted information.

Task B 2. Integrate with existing system and data base

Since the C-Space indexing and retrieval is designed to make use of the existing data base and the operate independently or augment the existing system, additional programming is required in order to create the appropriate interfacing with the data base and operating procedures of the system.

Task C. Empirical Tests, Optimization, and Methodological Examples

Task C 1. Empirical testing

This task involves setting up a format for establishing criteria of effectiveness (e.g., Precision and Accuracy) for system handling of requests. A basic procedure here is to take a crime of known authorship, treat the crime report as a new one and see if the author is identified effectively by the system.

Task C 2. Optimization

Given an established format for empirical testing, the parameters of the system are varied so as to provide a decision basis for conditions for optimal functioning.

Relevant comparisons include

(a) Key Word indexing vs CS-I vs CS-II vs CS-I plus CS-II vs all combinations.

(b) different cut-off points for retrieval

(c) different Classification Formulas

(d) different dimensions of the Similarity Space

(e) size of system vocabulary allowed

(f) source and type of terms in system vocabulary

(g) Existing Key Word vs addition of the experimentally added Key Words based on the scenario analysis.

Task C 3. Methodological Examples

Given a system that is demonstrably sound in an operational sense, two methodological demonstrations are conducted. (a) The quantitative indexing is used to detect bimodal or multimodal behavior patterns indexed under the same name. Deviant entries

may be identified and investigated for error at the source.

(b) Since no specific influences are known to have been at work in regard to the data base, a mapping of changes in spatial locations or distributions over time is conducted and the results are compared with information available from other sources in regard to such changes.

Evaluation

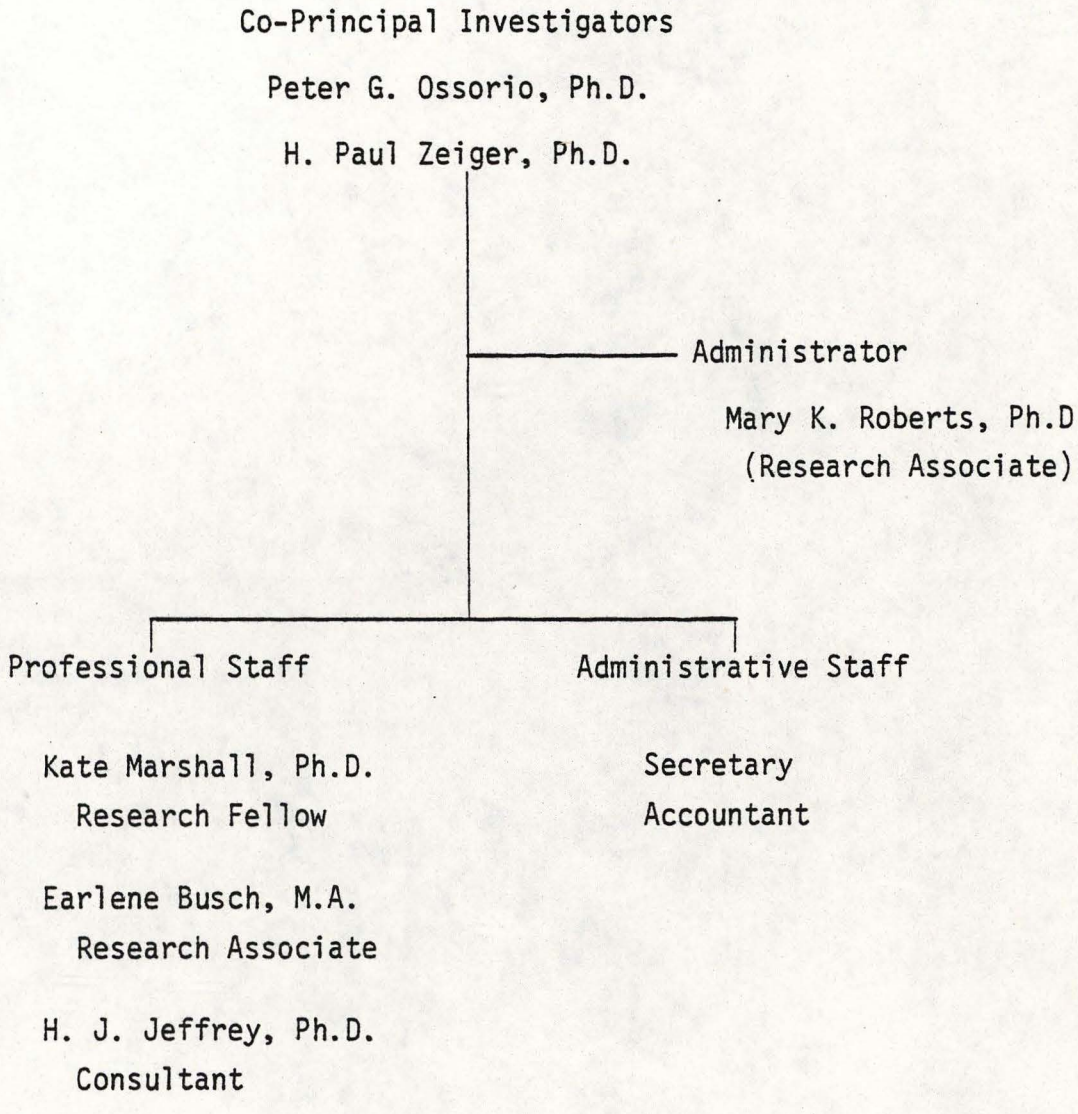
Several evaluation procedures will be carried out.

(1) Standard methodology for evaluating indexing and retrieval systems is to conduct tests of Precision and Accuracy. Precision is defined as the proportion of wanted items to unwanted items generated by retrieval requests. Accuracy is the likelihood that a given retrieval request will generate the wanted item(s). In general, either measure can be improved at the cost of making the other worse, hence both tests will be performed.

(2) Homogeneity tests will be conducted in order to screen the data in the files. Screening involves identifying the major cluster of crime descriptions associated with a given name and then identifying those descriptions which, though associated with that name, are significantly deviant, in a statistical sense, from the major cluster. A sample of such deviant entries will be investigated for errors at the source. If no error is detected, a more complex indexing will be instituted, allowing more than one distinct crime pattern for the person. The effect of such data clean-up on Precision and Accuracy will be established for both the current system and the judgment-based system.

V. Management Plan

The Behavior Pattern Indexing project is organized as follows.



The co-principal investigators will have the primary responsibility for the professional effort involved in the psychometric aspects, the programming and systems aspects, the experimental optimization and methodological demonstrations, and the final report. They will be assisted by Kate Marshall, Ph.D., Earlene Busch, M.A., and consultant H. J. Jeffrey.

Dr. Peter Ossorio is the originator of the judgment space methodology and has an extensive background in computer simulation of human judgment, in psychometric instrument construction and data gathering, and evaluation of information systems. He is the author of the original LRI factor analysis package.

Dr. H. P. Zeiger is a psychologically knowledgeable computer scientist whose areas of expertise include file structures and system programming, as well as the use of computers in behavioral science.

Dr. H. J. Jeffrey is a behaviorally oriented computer scientist who has adapted the judgment space methodology to a variety of problems such as medical diagnosis, stock market simulation, and metallurgical quality control. He has also programmed various functional classification space storage and retrieval systems.

Both Dr. Marshall and Ms. Busch have extensive backgrounds in criminal justice systems and in behavioral research within the justice system.

Dr. Mary Roberts has prior experience in research administration. She will be assisted by consultant Charles Des Jardins, Business Manager of the Park East MHC, in setting up and maintaining an accounting system for the project which is in accordance with the Federal Audit Guidelines.

Resumes of the professional staff are presented in Appendix B.

VI. Time Frame and Cost Estimates

Task		Begin Week	End Week	Hours	Item/ Person	Rate	Cost
A 1	Scenario Analysis	1	3	60	CP*	20/hr	1,200
				40	RF**	15/hr	600
				120	RA***	10/hr	1,200
					Travel	.185/mile	222
					*Co-Principal Investigator		
					**Research Fellow		
					***Research Associate		
	Classification Space I						
A 2	Sample literature, Select descriptors, including synonyms	2	5	80	CP	20	1,600
				20	RF	15	300
				40	RA	10	400
					Travel	.185/mi	148
A 3	Select C-Space variables	2	3	8	RF	15	120
				4	RA	10	40
A 4-1	Prepare materials for 60 x 500 matrix, 5 deepl. 5,000 orig. pages, 20,000 copies	5	8	20	RF	15	300
				120	RA	10	1,200
					Paper	8.00/M	40
					Repro	.04/page	800
A 4-2	Collect C-Space data: 15 judges 5 days ea., convene at Woodmoor or similar location	9	10	40	CP	20	800
				40	RF	15	600
				60	RA	10	600
				350	CBI	10.30	3,600
					Travel	.185/mi	360
					Per diem	40/day	3,600
A 5-1	Keypunch, verify duplicate	10	12	16	RF	15	240
				30	Ra	10	300
					Service	10.00/M	1,500
A 5-2	Preliminary data handling	12	13	20	RF	15	300
				20	RA	10	200
					Computing	109/hr	200
A 5-3	Factor Analysis and Factor Scoring	13	14	30	CP	20	600
					Computing	109/hr +IO, print	600

Task		Begin Week	End Week	Hours	Item/ Person	Rate	Cost
A 5-4	Additional vocabulary: prepare materials for 30 x 200 matrix 5 deep	14	15	8	CP	20	160
				40	RA	10	400
					Paper	8.00/M	8
					Repro	.04/page	160
A 5-5	Collect data: 5 judges 3 days	16	16	10	CP	20	200
				32	RA	10	320
				80	CBI	10/30	800
					Travel	.185/mi	106
					Per diem	40/day	690
A 5-6	Keypunch, verify, and duplicate	17	18	8	RA	10	80
					Service	10.00/M	300
A 5-7	Factor Scoring	19	19	8	CP	20	160
					Computing	109/hr	100
A 5	Staff Travel				Staff	.185/mi	296
	Classification Space II						
A 6-1	Select variables from crime reports and scenario analysis	19	22	60	CP	20	1,200
				12	RF	15	180
A 6-2	Prepare materials for 140 x 140 matrix 3 deep 3,300 pages, 6,600 copies	22	24	20	RF	15	300
				80	RA	10	800
					Paper	8.00/M	32
					Repro	.04/page	260
A 7	Collect data: 10 judges 4 days	24	25	30	CP	20	600
				20	RF	15	300
				30	RA	10	300
				250	CBI	10.30	2,600
					Travel	.185/mi	260
					Per diem	40/day	1,920
A 8-1	Keypunch, verify, and duplicate	25	27	20	RA	10	200
					Service	10.00/M	600
A 8-2	Preliminary data handling	27	28	8	RF	15	120
				16	RA	10	160
					Computing	109/hr	150
A 8-3	Revise Factor Analysis Program for 140 variables	25	28	60	CP	20	1,200
					Computing	109/hr	400

Task		Begin Week	End Week	Hours	Item/ Person	Rate	Cost
A 8-4	Factor Analysis and Factor Measurement	28	29	16	CP	20	320
					Computing	109/hr +IO, print	800
A 8-5	Prepare materials for 60 x 500 matrix 5 deep	30	33	20	RF	15	300
				120	RA	10	1,200
					Paper	8.00/M	40
					Repro	.04/page	800
A 8-6	Collect data 15 judges, 5 days	34	34	24	CP	20	480
				40	RF	15	600
				40	RA	10	400
				350	CBI	10.30	3,600
					Travel	.185/mi	310
					Per diem	40/day	3,400
A 8-7	Keypunch, verify, and duplicate	35	37	40	RA	10	400
					Service	10.00/M	1,500
A 8-8	Factor Scoring	38	38	10	CP	20	200
					Computing	109/hr	90
A 8	Staff Travel				Staff	.185/mi	148
B.	Set up functional MO system						
B 1	Program the indexing and retrieval in the C-Spaces	28	32	80	CP	20	1,600
				24	Consultant	16.87	345
					Travel		677
					Computing	109/hr	500
B 2	Integrate C-Space IR system with existing MO file data base	33	38	160	CP	20	3,200
				24	Consultant	16.87	345
					Travel		677
					Computing	109/hr	300
C	Optimize C-Space IR and system indexing and retrieval; conduct empirical tests	38	48	144	CP	20	2,880
				16	RF	15	240
				40	RA	10	400
					Computing	109/hr	2,000
					Travel	.185/mi	222
	Subtotal Functional System and Tests						13,065
D	Final report and computer program documentation	46	52	80	CP	20	1,600
				40	RA	10	400

BUDGET NARRATIVE

a. Personnel

2 - Co-Principal Investigator (Research Fellow)

Salary I	(.3 FTE)	600 hrs.	@ $20 per hour	$12000
Salary II	(.15 FTE)	300 hrs.	@ $20 per hour	6000

This position will be charged with the responsibility of establishing operational and methodological guidelines. Other responsibilities will involve direct supervision of Research Fellows and Research Associates; continuous evaluation of information system operation; maintaining liaison between LRI and the Colorado Bureau of Investigation; preparation of the final report.

Minimum requirements to perform these duties: Scientific competence in Descriptive Psychology and judgment space methodology, computer simulation, psychometric instrument construction, data gathering techniques, experience in file structure maintenance, systems analysis and systems programming. Educational requirements:
A. Ph.D. in Psychology with computer applications.
B. Ph.D. in Computer Science with applications in the Behavioral Sciences.

1 - Research Fellow

Salary	(.15 FTE)	300 hrs.	@ $15 per hour	$4500

This position will be charged with the analysis of the crime pattern scenarios; developing the materials for the C-Space construction; assisting in the factor analyses and factor scoring; management of the data files; maintaining liaison between the judgment space personnel and the Co-Principal Investigators, and assisting the Co-Principal Investigators.

Minimum requirements to perform these duties: Working experience with the criminal justice system; knowledge of behavioral research methodology; interviewing experience, knowledge of computer simulation and statistical procedures. Technical competence in Descriptive Psychology, and judgment space methodology.

2 - Research Associates

Salary I	(.25 FTE)	500 hrs.	@ $10 per hour	$5000
Salary II	(.45 FTE)	900 hrs.	@ $10 per hour	9000

I The position will be charged with administering the research monies: establishing the billing system, keeping time and attendance records for personnel. Other responsibilities will include tracking the progress of the project; maintaining contact with the accountant; co-ordinating research activities; scheduling data collection locations; assisting in the preparation of data collection materials.

The position requires a minimum of two years of progressively responsible research administration experience, knowledge of accounting and billing procedures, familiarity with Descriptive Psychology, research procedures in the behavioral sciences and with computer simulation and techniques of data summary. Educational requirements: Ph.D., Psychology

II This position will be primarily involved with assisting the Co-Principal Investigators and the Research Fellow. Duties will include data collection, assisting in the scenario analysis, overseeing the key punching and verification, assisting in the preparation of data collection materials.

The position requires at least three years of research experience in the behavioral sciences with a background in the criminal justice system, some familiarity with techniques of data collection, statistical procedures, and computer simulation. Familiarity with Descriptive Psychology and judgment space methods is required. Minimum educational requirement: M.B.A. or M.S. in Organizational Behavior or M.A. in Psychology.

1 - Secretary

Salary (½FTE) 1040 hours @ $4.80 per hour $5000

Implementation of this project will require the preparation of written materials for data collection and final reports. This position will assure timely preparation and distribution of the material. Other duties will include a variety of general office clerical and typing tasks, assuming the responsibility for keeping appropriate files and office records, answering the telephone and opening mail. General clerical experience as well as typing skills are required.

Total Personnel $41500

b. Fringe Benefits

None

c. Travel

In State

The project will require travel to and from a central location in Colorado for the judges and the project staff. Four separate data collections will be involved:

Judges & Staff		Person Days	Lodging @ $25	Meals @ $15	Total
18	5 days	90	2250	1350	3600
6	3 days	18	450	240	690
12	4 days	48	1200	720	1920
17	5 days	85	2125	1275	3400

Meals & Lodging $9610

Mileage 5600 mi.
@ 18.5¢ per mi. 1036

Staff Travel 1480

In addition to the trips required for data collection, it is anticipated that the staff will need to make a total of 20 trips from LRI to the Colorado Bureau of Investigation at 80 miles per round trip. Travel is calculated for five staff members, each of whom are anticipated to make 20 trips to CBI, for a total of 8000 miles at 18.5¢ per mile.

Out of State 910

The consultant will need to make two trips to Colorado from Illinois during the project, which will require $290 for air fare each trip, plus 3 nights of per diem and ground transportation each trip. Per diem is figured on the basis of $25 for lodging and $15 for meals. Ground transportation will be needed from Naperville, Ill. to Chicago (80 miles round trip) and from Stapleton International Airport in Denver to Boulder (70 miles round trip) each trip at 18.5¢ per mile, plus $3.00 per day airport parking for 8 days.

Air fare	$294 x 2 trips	= $589
Per Diem	40 x 6 days	= 240
Ground Transportation		= 57
Parking		= 24

Total Transportation and Per Diem $13036

d. Equipment

None

e. Supplies and Operating

Office Supplies $200

This expense includes such items as paper and reproduction of materials for the operation of the project, folders, staplers, ledgers, forms, stamps, writing supplies and other necessary office materials to implement the project.

Research Supplies $2420

These costs reflect the need to prepare 14500 original pages of experimental rating sheets and four copies of each page at .04 per page. Paper costs are $120 for 30 reams at $4.00 per ream and $2320 for 58000 pages of reproduction.

Telephone $300

The co-ordination which will need to take place between LRI and the Colorado Bureau of Investigation and other law enforcement agencies can be effectively handled through use of the telephone. Costs are $25 per month for 12 months.

Space Rental $2400

A research space of approximately 900 sq. ft. will be required for six staff members for 12 months at $200 per month.

Janitorial/Maintenance $240

Equipment, supplies, and labor for maintaining and cleaning the research space will be required for 12 months at a rate of $20 per month.

Equipment Depreciation $300

A typewriter which will be used on the project will depreciate at the rate of $25 per month for the twelve months of the project.

Total Supplies and Operation $5860

f. Professional/Contract Services

Consulting Fee $690

The project requires the services of a consultant to modify an existing software system to meet the requirements of the proposed project. The programming of the functional classification space storage and retrieval system will require 48 hours of consulting time calculated at $16.87 per hour.

Computing Time $3100

A contract for computing service to develop C-Space I and C-Space II, and for developing and revising the Factor Analysis and Factor Scoring will be drawn up between LRI and the University of Colorado at Boulder. Also included in the computing costs is that required for 1) preliminary data handling, 2) programming the indexing and retrieval in the C-Spaces, 3) integrating the C-Space IR system with the existing modus operandi file, 4) optimizing the C-Space IR system indexing and retrieval system, and 5) conducting empirical tests. Computing costs include line printing costs, input-output costs, and other miscellaneous costs in addition to central processor time. Central processor time required is 26 hours at $109 per hour. Associated additional costs are estimated at 80% of the central processor costs. The CBI will contribute approximately 40% of the computing requirements for the project (See Section h, below).

Keypunching, verification, and duplication $3900

Keypunching the data for construction of the indexing systems, verification, and duplication will be arranged on a contract basis with a local firm. Costs for this service are based on an average of $10 per 1000 columns or data pieces. It is anticipated the project will require 390,000 columns of data.

Accounting $1800

An accounting firm will be hired for a period of twelve months at $150 per month to keep records of expenditures, assure the accuracy of the billing operation, and verify time and attendance requirements.

Total Professional/Contract Services $9490

g. Construction

None

h. In-Kind Contributions $13,500

Persons employed as investigators by the Colorado Bureau of Investigation will serve as judges for the construction of the C-Spaces. Their services are an in-kind contribution from the CBI. This will require 1,030 man hours, the average compensation for which is approximately $10.30 per hour, the total of which is $10,600.

A portion of the integration, optimization, and empirical testing of the system will take place at the computing facility of the CBI. The total contribution of computer services is $2,000 from the CBI.

Optimization and empirical testing require the keypunching of a minimum of 300 and perhaps as many as 500 crime reports. The cost of this data entry is estimated at $900 and will be provided by the CBI.

i. Total Direct Charges	$69,886
j. Indirect Charges (10% of Personnel)	4,150
k. TOTALS	$74,036

VII. References

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