THE COMPLEMENTARITY OF CONTINUOUS AND DISCRETE STATE ANALYSES OF FAMILY INTERACTION

by

Gloria L. Krahn

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ABSTRACT

Two distinct methodologies to analyze social interactions have been developed recently. The continuous state or correlational approach uses quantitatively rated data and determines the interdependencies in behaviours as manifest across the entire observation time. The discrete state or lag sequential approach on the other hand, uses qualitatively defined data and searches the behaviour streams for sequences of behaviour which occur significantly more often than chance. The potential complementarity of these methodologies has been suggested but has not been demonstrated.

In the present study, observational data of individual triads of mother, father, and child interactions were analyzed for relationships across interactants' behaviours using the two methodologies of the correlational approach and the lag sequential approach. Multidimensional scaling techniques (MDS) were employed to condense the data from their original codings as categories of the Behavior Coding System to a quantitative form amenable to correlational analyses. The MDS results identified the two conceptual dimensions of Prosocial--Deviance and level of Involvement as underlying the behaviour categories. Univariate and multivariate correlations were performed on the time-lagged data on these two dimensions for six family triads. A relatively high degree of interdependence across interactants' behaviours was generally evident. Interactional patterns manifested across the six families could be identified, as well as patterns unique to individual families. The multivariate regressions were seen to increase predictability in many cases, but made summarizing across families difficult. One triad's data were used to demonstrate the complementarity between the continuous and the discrete state approaches. The multivariate regression results were seen to indicate general interdependencies in interactants' behaviour which were then verified by the lag sequential results. The lag sequential analyses identified specific behaviour categories which illustrated these interdependencies. Joint use of both methodologies appears to be most informative. Inaccuracies in attempting to conceptualize these time-based data as sequences of discrete events are demonstrated. The results are discussed in the context of viewing the family as a continuously interactive system.

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INTRODUCTION

The manner in which parents relate with their children has been of virtually universal interest. For the past four or five decades social scientists have attempted to investigate this phenomenon in a systematic manner. During this time tremendous advances have been made in the general approach of research directed toward this subject and in the methodologies employed. Direct observation of children interacting with their parents has become the preferred and popular method of collecting data and computer processing of data has facilitated much more complex and informative analyses. Various techniques for the examination of interactions have been developed recently.

The increased utilization of observation as a method of data collection has necessitated greater understanding of the classic psychometric issues of reliability and validity as they relate to observation. Extensive investigations have been evident recently, resulting in a voluminous and valuable literature devoted to factors influencing the generalizability of observational data. This literature is reviewed briefly in the present paper.

Concurrent with the development of observation as a technology has been an increasing sophistication in the methodologies used for analyzing those data. It is to this area of statistical methodology that the current study is primarily addressed. The recently developed analytic approaches facilitate a fuller investigation of the interactive nature of interaction. That is, they facilitate an investigation into the mutual interdependence of family members' behaviours as they occur in time.

A variety of techniques have been developed, many of which can be classified into one of two general methodologies. The first methodology has been termed the continuous state approach since it employs data that are rated quantitatively along a continuum. This approach considers the simultaneous behaviour streams of the interactants and provides an overall finding regarding their inter-correlation. This approach may be viewed as a macro-level approach. The second group of methodologies has focussed on discrete categories of behaviour and searches what might be labelled the "streams of behaviour" for interactive sequences which occur more frequently than chance. This is a more micro-level approach.

The potential complementarity of these two methodologies is easily seen. The continuous state methodology provides a more general context for viewing the interaction, essentially a skeletal outline, while the discrete state methodology provides a more minute and specific explication of the interaction. The present study was addressed to the specific task of investigating the comparability and complementarity of employing both the continuous state and the discrete state approaches on a single set of data. If these procedures could both be implemented effectively with the same observational data, they should provide a much richer and more complete description of family interaction.

Each methodology utilizes a different type of data. The continuous state or correlational approach utilizes data that are scaled along some continuum (e.g., degree of intensity or positivity). The discrete state or lag-sequential approach utilizes data that are coded as discrete categories (e.g., talk, hit). Since observational data are typically coded in discrete categories, it is necessary to transform the categorical data into continuous data in order to conduct the correlational analyses (Gottman & Bakeman, 1979; Bakeman & Dabbs, 1976). A method regarded as well-suited to this task is multidimensional scaling. This method refers to a group of techniques which utilize ratings of conceptual similarity of objects within a set (e.g., behaviour categories within a coding system). The techniques can determine both the number of conceptual dimensions underlying the coding system and can assign scale values to each category for each dimension.

With few exceptions both the continuous state methodology and the discrete state methodology have been employed with groups no larger than dyads and, for the continuous state approach, examining only one variable at a time. Interactions are, however, rarely so simple. Consequently, the current study examined the interactions of family triads -- mother, father and child. This triad is considered much more representative of the family unit without creating a confusingly complex interactional network. Additionally, social interaction is regarded as a multi-variable process with numerous preceding behaviours influencing a host of resultant behaviours. Investigations of interaction examining only one behaviour at a time cannot possibly capture the complexity of interactive behaviour. Therefore, a multivariate approach to the correlational methodology was employed.

Before the reader becomes either disinterested with or intimidated by the statistical analyses discussed, it might be helpful to present the general historical context for this study in the area of parent-child interaction.

Orientations of Earlier Research

In the earlier social science literature on parent-child relations, at least two distinct theoretical orientations can be identified, one stemming from the child study movement and the second from clinical work with families. The literature from the child study area has provided quantified descriptions of the relationship between selected parent variables (e.g., education, attitudes, degree of permissiveness) and selected child variables (e.g., cognitive style, academic performance, dependency). The Fels longitudinal study (Baldwin, Kalhorn & Breese, 1945, 1949) is an early example of this approach. With a few exceptions most of these studies examined only the mother-child dyad, with fathers and siblings being virtually ignored. As well, although theoretical orientation determined the selection of variables to be investigated, the scope of the studies was characteristically broad and not designed to test specific theoretical hypotheses. The major aim was to increase understanding of the process of child development. Lytton (1971) provides an extensive review of the earlier observational studies of this genre.

The literature originating in the clinician's office began with the early investigations of families with a schizophrenic child (Wynne & Singer, 1963; Mishler & Waxler, 1965, 1966). These studies frequently included father and siblings as well as mother and the identified child. In addition, the studies were typically designed to test specific theoretical hypotheses about how the "deviant" family functions. Such concepts as the double-bind, pseudomutuality, and marital schisms and skews were investigated in searching for an etiological explanation for schizophrenia (Mishler & Waxler, 1965). Since this early work the focus of the clinically-based investigations has broadened to include families experiencing other difficulties. The thrust of much of this research has been to facilitate therapeutic intervention with distresssed families. This literature has been reviewed by Riskin and Faunce (1972) and more recently by Jacob (1975).

During the earlier decades there was little overlap between these two streams of research. Riskin and Faunce, in their evaluative review of family interaction research, lamented the extent to which family interaction research has been limited by interdisciplinary isolation. Yet the problem persisted. A comparison of the references of Riskin and Faunce (1972) with those of Lytton (1971) in his review of observational studies of parent-child interaction reveals that of the 373 studies cited by either author, only seven were cited by both. Despite their surveying different areas in the literature, both authors recognized the need for a broader scope in the approach to family interactions and for greater attention to methodology. The family interaction research of the past decade has demonstrated significant advancement in both these areas and has increasingly integrated findings from the clinical and the child experimental streams.

Recent Advances in Orientation

One of the most significant developments in the area has been a broadened perspective in viewing parent-child interaction. This has been accomplished by expanding the scope of research with respect both to the type and level of the behaviours observed, and with respect to the family members studied.

Perhaps foremost in advancing a wider scope in the study of mother-child interaction is Blurton Jones. His comparisons of the mother-child contact of humans with that of other mammals (Blurton Jones, 1972) and his highly descriptive investigation of mother and child behaviours at separation and reunion (Blurton Jones & Leach, 1972) have demonstrated the value of extensive observation of a multitude of behaviours. The feeding behaviours of mother and infant during the first ten days post partum have been documented by Richards and Bernal (1972). Stern (1974) conducted a micro-analysis of a mother's differential interaction with her three and one-half month old twins and indicated its usefulness in predicting later child behaviours. Also utilizing a more descriptive approach, Lytton (1976) provided some normative data on the social behaviour of two and one-half year old boys with their parents.

As well as broadening the perspective on the types of behaviours observed, the recent literature has begun to examine the complexity of influences in family interaction. This has been reflected in an increased tendency to view the family as an interactive system. This systems orientation has been manifested both by consideration of the reciprocal nature of interaction and by the inclusion of many family members as subjects for study.

Historically, the literature on parent-child interaction has reflected a change from a uni-directional to a bi-directional model of influence. The parent's influence on the child occurs concomitantly with the child's influence on the parent. This increasing trend to a bi-directional model was noted by Lytton (1971) and discussed more fully by Fox (1978). A refined example of this model is the dyadic dialogue approach which has been utilized recently, primarily in mother-infant studies (e.g., Brazelton, Koslowski & Main, 1974; Tronick, Als & Brazelton, 1977; Thoman, 1974; Bakeman & Brown, 1975; Bronson, 1974; Goldberg, 1977; Stern, 1974).

Increased attention has also been paid to the inclusion of family members in addition to the mother and the target child. Kogan (1971) and Stern (1974) have both made comparisons within individual families of dyadic interaction patterns between mothers and two offspring. Changes in sibling behaviour as a result of a parent-training program implemented to alter a target child's behaviour have been investigated by Arnold, Levine and Patterson (1975). Fathers have also been included more frequently in the observer's field of vision (e.g., Eyberg & Johnson, 1975) and this has facilitated the investigation of the differential effects of mothers and fathers (e.g., Patterson, 1973; Lytton & Zwirner, 1975) and of parents and siblings (Wahl, Johnson, Johansson & Martin, 1974) on the behaviours of the target child. More recently, Fox and Hogan (1978) employed an interacting system model in studying the interactive behaviour of mother-father-child triads. The family unit being observed becomes much more representative of the total family when fathers and siblings are included.

This broader orientation has also been apparent in the increased overlap between the clinically-based and the experimentally-based research. This is perhaps most apparent in the research stemming from the behaviourally oriented types of treatment for child and family disturbances.

Employing a social learning model, these studies have typically sought to determine the specific antecedent and consequent behaviours which maintain certain deviant child behaviours and have done so in order to facilitate therapeutic intervention. In addition both to increasing the understanding of parent-child interaction and to providing empirical validation of the effectiveness of the therapeutic procedures, this body of research has made major contributions to developing and refining methods for data collection.

Methodological Advances

The methods used to study family interactions can be grouped into the two general categories of data collection procedures and of statistical analysis procedures. The extent and nature of the developments during the past decade in both these areas was anticipated in a general way by Lytton (1971) and by Riskin and Faunce (1972).

A major change has been the tremendous popularity of observation as a procedure for collecting data on family interaction. These observations have been made most frequently under structured to semi-structured conditions with little use of truly ethological observation. Hughes and Haynes (1978) have reviewed many of the studies employing structured laboratory observations. Perhaps more important than the popularity of observation is the extent to which observational technology has been investigated and developed. Numerous issues surrounding its use have been outlined in the literature and are reviewed in a later section of this paper.

In addition, several researchers have investigated the comparability of observation with other methods of data collection. Lytton (1973, 1974) compared several methods of data collection in studying the interactions of 2 1/2 year old boys with their parents. By utilizing a global trait approach he found that experimenters' ratings based on home observation, interview and mother-maintained diaries were of greater heuristic value than home observation or laboratory measures alone. His report on later analyses of these same data (Lytton, 1977), however, indicates that experimenter ratings of child compliance could not be predicted to a greater degree ($R = .40$) than could behavioural counts of compliance ($R = .47$). Thus the superiority of any one method of data collection was not clearly demonstrated, even for a global trait approach. Eyberg and Johnson (1974) employed multiple measures in assessing the effectiveness of a parent training program and found that results from parental observations and parental reported attitudes were generally convergent, but were not always supported by trained observers' home observation data which reflected less treatment success. On the other hand, Karoly and Rosenthal (1977) found parental reports and home observations to be quite convergent, but with a tendency for the parental reports of behavioural change to be considerably more conservative than the observational data. In comparing the utility of parental behaviours, parental reports and child behaviours for predicting child noncompliant behaviour, Forehand, Wells and Sturgis (1978) found certain maternal behaviours to be the best predictors and parental reports and child behaviours to be nonsignificant predictors.

This general finding of incomplete convergence among measures both underscores the importance of selecting the data collection method(s) most appropriate to the experimental questions and indicates the value of employing several methods of data collection in treatment effectiveness studies. Multiple measures are being employed more frequently in this area of research (e.g., Eyberg & Johnson, 1974; Karoly & Rosenthal, 1977; Ferber, Keeley & Shemberg, 1974; Johnson & Christensen, 1975), although the relative credence attached to these different measures is still a matter of some debate (Gordon, 1975; Johnson & Eyberg, 1975). A major thrust of many of these studies employing and investigating multiple measures has been to define the utility of observational procedures. As such, they further emphasize the transition of the past decade's research in parent-child interaction from relying on parental reports and interviews to primarily utilizing observations of parents and children as the preferred method of data collection. Numerous factors influencing the generalizability of observational data have been identified and investigated.

Generalizability of Observational Data

Observation as a data collection procedure entails the direct observation and recording of overt behaviour. Although relatively atheoretical in itself, observation as a methodology has been advanced perhaps most by researchers in behavioural assessment. As a measuring instrument, it is subject to the same classic psychometric concerns of reliability and validity as more traditional assessment procedures. The literature is replete with theoretical and empirical accountings of these concerns as they apply to the method of observation in general and to parent-child interactions specifically. These issues will be reviewed here briefly.

As demonstrated so cogently by Cone (1977), all reliability and validity issues can be viewed in the framework of generalizability theory as introduced by Cronbach, Gleser, Nanda and Rajaratnam (1972). As such, each of the concerns can be seen as defining the areas to which the results can be generalized. Following Cone (1977) and Hughes and Haynes (1978) these areas will be classified into the categories of generalizability across (a) behaviours observed, (b) observational procedures used, (c) observers, (d) time, (e) setting, and (f) dimensions.

Behaviours observed

From the infinite number of behaviours that are continuously observable, the researcher must decide which behaviours to attend to and record. This entails decisions about both the content of behaviours to be observed and the level of inference to be employed. The content of behaviours is determined in a general way by the theoretical premises and the research hypotheses of the study. A study designed to examine the family interactions of elementary school children who are academically underachieving would likely designate different behaviours for observation from a study investigating families of adolescent schizophrenics.

The level of inference utilized in defining behaviours for observation varies greatly. Ethological approaches employ a micro-analytic definition of behaviours (e.g., Stern, 1974; Richards & Bernal, 1972) while superordinate categories of more conceptually defined behaviours have been employed in much of the earlier observational research (see the reviews by Lytton, 1971 and by Hughes & Haynes, 1978). An additional concern in interactional research has been the level of inference about the interactional nature of the behaviour. For example, assumptions about the interactional contingencies of behaviours are an integral part of the Patterson, Ray, Shaw and Cobb (1969) coding system as it is most frequently applied, while Bakeman and Brown (1977) considered simultaneously the behaviours of both mother and infant in defining states of the dyadic unit.

Both the content of behaviour categories and the level of inference employed necessarily depend upon the nature of the investigation. Since different levels of inference provide different types of information, the use of several levels of inference has been advocated (Schachter, Elmer, Ragins Wimberly & Lachin, 1977). As well, collecting information on several types of collateral behaviour has been suggested to provide a greater contextual understanding of the target behaviours (e.g., Cone, 1977).

Several systems for coding behaviours are in existence and are used frequently. Their use in numerous studies facilitates greater comparability across findings and allows for a body of knowledge about a particular system to accumulate. A disadvantage encountered in the use of available systems has been lack of sensitivity in the measurement process when the behaviours of interest to the researcher have not been defined with sufficient specificity in the coding system (Ferber, Keeley & Shemberg, 1974). Instructions for the development of specialized observational systems are provided by Reid (1978).

Observational procedures

The manner in which observational data are collected affects generalizability of the data. Technical variations such as mode of recording interactions differ in utility and reliability. Video recording is generally acknowledged to be preferred (e.g., Hughes & Haynes, 1978) since it provides a permanent record of interactions which can then be examined in greater detail than *in vivo* codings and since it allows for the inclusion of nonverbal behaviours which audio recording does not. Regarding sampling of behaviours, Gonzalez, Martin and Dysart (1973) demonstrated that time sampling compared favourably with continuous sampling of several categories of behaviours when total frequencies of behaviours were being compared. Bakeman and Dabbs (1976) have demonstrated how social interaction data types can be categorized on the basis of whether the behaviours are sequential or concurrent, and whether they are event or time based. The four data types arising from the combinations of these factors are seen to vary in complexity and in the manner in which they would be analyzed. The sampling procedures and data type(s) regarded as most appropriate for any research endeavor will be determined in part by the experimental intent, the subjects of study and the intended analysis methods.

Reactivity to observation has been investigated to determine the nature and degree of its effects. Johnson and Lobitz (1974) demonstrated that upon instruction parents could manipulate their child's behaviour to make him look "good" or "bad". Mothers display more "good parenting behaviours" when they are aware of being observed than when unaware (Zegiob, Arnold & Forehand, 1975; Zegiob & Forehand, 1978). Observed positive behaviours of fathers were twice as great when an observer was present compared to when mothers were the unobtrusive observers (Patterson & Reid, 1970). White (1977) found the activity level of all family members to be reduced by an average of 50% when an observer was present. On the other hand, when using a "bugging" device to make audio records of behaviours, Johnson and Bolstad (1975) found both no significant differences between conditions of observer present and absent, and found significant positive correlations across behaviours when observers were present and when absent. The general conclusions appear to be that reactivity to observation likely influences different types of behaviours to different degrees, and that the behaviours of all family members are likely affected to some extent with adults' perhaps more so than children's (Barker & Wright, 1955). Whether or not an observer's presence affects the patterns of interactions as well as the levels of frequency has not been investigated.

Johnson and Bolstad (1973) reviewed the earlier literature on the observer effect and outlined four factors which contributed to the extent of observer effect. They are: (a) conspicuousness of the observer, (b) individual differences of the subjects, (c) personal attributes of the observer, and (d) the purported rationale for why the observation is being conducted. Manipulating any of the above factors in order to minimize observer effect will increase the generalizability of findings from the observed to the unobserved condition. General recommendations to reduce observer effect would include (a) minimizing the intrusiveness of the observation, (b) allowing a brief time for "habituation" to observation to occur, (c) ensuring that the appearance of the observer conforms to the presumed standards of the family being observed with respect to style of dress and manner of speech, and (d) explaining the rationale of the study in terms that are both understandable and believable to the family and which would de-emphasize the concern that their behaviours are being judged as correct or incorrect.

Observers

Generalizability across observers is measured by interobserver agreement. Previously considered only in terms of total percentage of agreement, assessment of interobserver reliability and validity is currently recognized as being influenced by numerous factors (Hollenbeck, 1978). Kazdin (1977) has recently reviewed the relevant research on observer reliability and validity. Agreement between observers has been demonstrated to increase when they are aware that accuracy is being checked (e.g., Reid, 1970; Kent, Kanowitz, O'Leary & Cheiken, 1977; Romanczk, Kent, Diament & O'Leary, 1973; Taplin & Reid, 1973) and when they are aware of the identity of the calibrating observer (Romanczk et al., 1973). Frequent, random and unobtrusive checks on reliability are recommended. Additionally, Cone (1977) recommends analyzing the unreliabilities and instituting selective retraining for either the observer or the coding categories which account for the most disagreement.

Observer expectancy or bias has been demonstrated to influence observations in some studies (Schuller & McNamara, 1976), while not in others (e.g., Kent, O'Leary, Diament &

Dietz, 1974). Expectancies combined with differential feedback for reporting the expected or unexpected findings has proved effective in influencing observer data (O'Leary, Kent & Kanowitz, 1973). These results could be interpreted as a caution against making observers aware of expected findings, and certainly against providing intermittent feedback on how well the observed results substantiate experimental predictions.

The complexity of the coding systems has been demonstrated to influence reliability estimates, with more complex systems typically having lower reliabilities (Taplin & Reid, 1973; Mash & McElwee, 1974). Both the number of alternative codes and the relative frequencies with which they are used contribute to the complexity of the system. In addition, Mash and McElwee (1974) and Mash and Makohoniuk (1975) demonstrated that when observers were experienced in observing predictable behaviour sequences they had lower reliabilities than when their prior experience was with unpredictable sequences. Training of raters using training videotapes with relatively unpredictable behaviour sequences may require longer training periods to achieve criterion reliability, but will likely result in sustained higher reliability coefficients in the coding of the observational data.

While observers may maintain high reliability among themselves, they may all drift away from an accepted standard interpretation of the codes. This observer drift or inaccuracy limits generalizability to other studies and can be a particular problem in studies in which changes over time are predicted (e.g., clinical outcome studies). To prevent this source of invalidity, it is recommended that periodic retraining occur on a video-taped observation session for which a standard coding has been established. Where observations are video-taped, randomization of order of coding the tapes would be recommended, particularly when change over time is predicted.

Time

Temporal generalizability can be considered both in terms of interindividual and intraindividual stability. Interindividual stability refers to stability over time as calculated across a group of subjects. It has been assessed most frequently in classic psychometric research with test-retest reliability coefficients used as the index of stability. Correlational comparisons are made across subjects to determine the extent to which the data obtained on a single behavioural score at one point in time are generalizable to other times. There has been seemingly little research directed at determining interdividual temporal stability in observational measures of family interaction.

Observational studies, including those examining family interactions, have been concerned more frequently with determining the intraindividual stability of behaviour within a session or treatment phase. Temporal stability is assessed not so much to demonstrate the consistency of a theoretical trait or the reliability of a particular measure, as it is to ensure that the data collected during one phase of the study (e.g., baseline period) is sufficiently stable to allow meaningful comparisons with other phases (e.g., treatment periods). This distinction between types of temporal stability has been discussed more fully by Jones, Reid and Patterson (1975).

Different measures of intraindividual stability have been employed. Jones et al. (1975) used correlation coefficients to compare the standardized distribution of scores over behavioural codes between the first and the second half of the baseline period for individual subjects. Similar split-half reliability procedures have been used by Shaw (1971). Their results, both based on the Behavioral Coding System (Patterson et al., 1969), indicate that families vary considerably in the length of time required to reach asymptotic levels of stability. In general, most of Shaw's families reached asymptotic levels by fifty minutes of observation time which was spread over ten observation sessions of five minutes each, while 70% of the stability coefficients of the Jones et al. study were significant by six or ten observation sessions of ten minutes each.

Although high or asymptotic levels of stability may be preferred for certain experimental designs, it may not always be possible or desirable for such stability to be obtained. At other times the process of reaching asymptotic stability may itself be of interest. In such cases, time-series analyses may be of particular value (Jones, Vaught & Weinrott, 1977). At this point it should be noted that these assessments of temporal stability have all utilized data based on frequency aggregates of behaviours. At present there are no known studies aimed at determining temporal stability of the contingencies in family interaction behaviours and no known procedures developed for examining stability of contingencies.

Setting

The comparability of parent-child behaviours across settings has received considerable attention (O'Rourke, 1963; Lytton, 1974; Belsky, 1977; Fox & Hogan, 1978). Of increasing practical importance is the generalizability of trained behaviours from clinic to home in assessing the value of parent training programs (e.g., Reisinger & Ora, 1977; Eyberg & Johnson, 1974). The research results have not always been consistent and reveal that several components of setting must be considered in generalizing from one setting to another. These include the physical and instructional structure of each setting, the family members included in the observation, and the behaviours being observed.

Comparisons of family interaction behaviour between settings have been made almost exclusively between home observations and those in the laboratory or the clinic. Real physical differences existing between these conditions include architecture, furnishings, and noise and lighting levels, all of which may be considered as stimuli eliciting different behaviours. In addition, the psychological structuring of the settings also vary. Home settings are typically more familiar and less controlled, less physically constraining and have frequently been less structured with tasks for family members. Since most of these are naturally occurring differences in structure between the home and the clinic or laboratory, researchers have intentionally allowed these differences to be present in their experimentally defined conditions (e.g., Fox & Hogan, 1978; Eyberg & Johnson, 1974).

The membership of the family unit being observed is of importance. Though the actual members formally included in the observation are the same between settings in all the relevant studies reviewed, the relative degree of participation of each member likely varies between settings. Belsky (1977) reported that the mothers of his study were more likely to engage in non-interactional household tasks when at home than in the laboratory. In addition, when all family members are not included for observation, family members not included frequently have more opportunity to influence the observed interactants' behaviours when in the home than in the laboratory.

Finally, the types of behaviours being compared between settings have not always been comparable across studies and even between settings within a single study. Additionally, order of setting has not always been controlled. The classic study in this area is that of O'Rourke (1963). Using the Bales Interaction system he compared the levels of positivity displayed by mother, father and teenage child in home and laboratory situations. Since the home condition was the first for all families, the finding of greater positivity in the home setting may reflect the effect of unfamiliarity rather than of physical setting. Lytton (1974) collected different types of behavioural data in the home (continuous observation) and in the laboratory (behavioural ratings) on mother, father and preschool sons. Then, in the context of a trait approach, he compared the extent to which each substantiated theoretical predictions. He found ratings based on home observation, interview, and diary were of greatest heuristic value. Again it appears that order of condition was not counterbalanced. More recently, Belsky (1977) controlled for order of setting in his observation of mother-infant dyads. Though infant behaviour did not appear to be significantly influenced by setting, mothers were found to be more active and more responsive to their infants in the laboratory than in the home. Dyadic interaction also occurred more frequently in the laboratory.

Dimensions

In traditional psychometric analyses, generalization across dimensions entails examining the relationships between data on different behaviours. Determining the relationship between child compliance and positive parental behaviours would be an example of this form of construct validity. Unfortunately, the parent-child research has yet to define a common set of dimensions for examination and comparison.

Previous researchers have dealt with the concern of dimensions of parent-child behaviours in different ways. An attempt to determine the factor structure (Dielman, Cattell, Lepper & Rhoades, 1971) of a portion of the Sears, Maccoby and Levine (1957) questionnaire on child-rearing practices resulted in a complex and unwieldy factor structure. Kogan and Wimberger in their series of observational studies (1966; 1969a, 1969b, 1972) have examined mother-child interaction along one or more of three hypothesized dimensions with two possible positions on each dimension: status (high/low), affect (warm/hostile), and involvement (high/low). There have been no known research attempts to validate these dimensions. Lytton (1976), using the Parent-Child Interaction Code, summarized the parent and child behaviours using five child behaviour categories which were "partly based on factor analytic studies" (activity, speech, demands/compliance, positively/negatively toned behaviour, and seeking closeness) and three parent categories (speech, control/compliance, and positively/negatively toned behaviours), with subcategories used within these categories for finer-grained analyses (e.g., Lytton & Zwirner, 1975). When the Behavioral Coding System (Patterson et al., 1969) has been used, the 29 behaviour codes have been variously categorized into prosocial, neutral and deviant behaviours by different authors primarily on the basis of face validity.

The number and nature of the dimensions that are hypothesized or partially validated will of necessity be determined by the theoretical interests of the researcher and the measuring instruments employed. No one study could attempt to definitively determine all relevant dimensions of parent-child interaction of all research. Yet within individual studies and particularly within individual observational coding systems, more attempts at validating hypothesized dimensions or determining dimensional structures are needed. Cone (1977) has suggested that the Behavioral Coding System (BCS) categories of prosocial, neutral and deviant behaviours be examined for internal consistency. This would serve to validate the single hypothesized dimension. A more fruitful approach might be to investigate the underlying dimensional structure of the system, allowing for a number of possible dimensions to emerge. If several conceptual dimensions could be identified as underlying the BCS, their consideration should serve to provide a fuller understanding of the observed interactions. One procedure which could be utilized to this effect is the application of multidimensional scaling techniques to the behaviour codes. Such a procedure of transforming the data codings to a number of identified dimensions would be regarded as a necessary first step prior to examining the comparability across dimensions.

Advances in Statistical Analyses

The expanding availability of high speed computing facilities has had tremendous impact on the statistical analysis of family interaction data. Earlier studies of family relations were based on comparisons of summary measures of target variables. Lytton (1973) has termed this the "trait approach" in which the aggregate of behaviours or ratings represent the quantification of a trait. These measures were then compared across different data collection methods or experimental conditions. For example, the total frequencies of compliance behaviours (Patterson, 1974; Arnold, Levine & Patterson, 1975) were compared before and after treatment. When summary measures are employed, the relative position of the behaviour in the ongoing sequence of behaviours is not taken into account.

Though these earlier studies employing a trait approach were useful in providing general descriptive information on parent-child relations, they fail to address the concept of interaction. Investigation of the reciprocal nature of interaction requires examining the contingencies of behaviours. Determining how a child's behaviour is influenced by that of his mother and father requires looking at the parent's preceding and/or succeeding behaviours. Observational data are necessary for such analyses.

In the past decade, researchers of different types of social interaction including mother-infant, parent-child and marital interaction have become increasingly involved in studying the reciprocity of interactions. The numerous approaches developed can be grouped into two basic categories which have been outlined by Thomas and Martin (1976) for parent-infant interaction. They are: (1) the continuous state approach, which utilizes data rated along a continuum and which provides a more general contextual description of the interaction, and (2) the discrete state approach, which utilizes categorical data and which describes the more minute and specific steps of interaction. These approaches provide alternative types of information. They are discussed more fully below with illustrations of their use in the literature.

Continuous State Approach

As indicated previously, the continuous state aproach provides an overall description of the entire interaction period observed and as such provides a broader context for conceptualizing the interaction. It requires that each interactant's behaviour is characterized as a continuous variable and that these variables are measured in the same units. This results in each interactant's behaviour being recorded continuously and on a scale comparable to that of the other interactants. As it has been used to date, this approach has typically sacrificed some of the specificity of interaction by conceptualizing it along a single dimension such as "positivity/negativity" or "intensity", or by attending to only one dimension of interaction such as eye contact. Thomas and Martin describe this approach as leading "naturally to an analysis of the data as two interlocked continuous time-series and to a description of reciprocity in these terms" (p. 142).

Several investigators have looked at mother-infant interaction from this unidimensional continuous state perspective, with different investigators utilizing different types of statistical analyses. Stern (1974) examined the behaviours of a mother and each of her 3 1/2 month old twins in terms of initiation and termination of facing and eye contact. Analyses indicated differences between the two mother-infant dyads in terms of responsitivity to maternal motion, in initiation of a mutual approach-withdrawal pattern, and in motor responsiveness as contingent upon maternal motion. Schachter, Elmer, Ragins, Wimberly and Rachlin (1977) conducted a comparison of schizophrenic and control mothers interacting with their infants. While their analyses were primarily aimed at discrete state analyses, a relative comparison of the number of significant analyses indicated a generally higher degree of contingency between schizophrenic mother-infant dyads than controls. Tronick, Als and Brazelton (1977) scaled mother-infant behaviours along a maximum negative involvement dimension. They then calculated synchrony/dissynchrony as running correlations between these scaled scores of involvement.

Discrete State Approach

Much research has also been directed at identifying discrete sequences within the general flow of interaction. This approach requires that the interactants' behaviours be coded as streams of discrete (categorical) behaviours. The basic rationale behind these interactive analyses is delightfully simple. In essence, the base rate probability of behaviour B occurring for person C, p(Bc), is compared with the probability of B occurring if behaviour A has preceded it, p(Bc/A). The preceding behaviour A can be considered in terms of the behaviour of different interactants, (e.g., self (Ac), or others, e.g., M(Am) or F(Af), where the subscripts c, m, and f represent child, mother and father respectively), and/or in terms of different time intervals (e.g., time t(At) or time t-1(At-1)). Different combinations of preceding and/or succeeding behaviours can be considered (e.g., more than one predictor), as can different ways of defining target behaviour B. A procedure frequently used is like Markov chain statistics but differs in not assuming that behaviours at time t are constrained only by those at time t-1 and not by any other preceding behaviours. Again, various modifications of this approach have been employed in the parent-child research.

Bobbitt, Gourevitch, Miller and Jensen (1969) were among the first to develop computer programs to search for all patterns of behaviour present in observational data. Contingencies of both concurrent patterns and sequences of one lag were identified in the interactive behaviour of monkey mother-infant dyads. Chi-square tests were employed to identify those patterns which occurred significantly more often than predicted by base rate probabilities. These programs were adapted by Haupt and Gewirtz (1968) and applied to interactions between human infants and their caretakers (Gewirtz & Gewirtz, 1967). Kogan and Wimberger (1971) have also used the identification of concurrent patterns and one-transition sequences to describe the interactions of individual mother-child dyads.

The identification of all apparent patterns of behaviours considering all behaviours rapidly becomes unwieldy under any one of a number of situations: when larger sets of behaviour codes are used, when the number of time lags are increased, or when more than two interactants are observed.

An alternate approach has been to focus on a specific target behaviour and outline those behaviours which precede or succede it significantly frequently. In 1974 Patterson published a much cited study which demonstrated this approach. Focusing solely on the deviant behaviours of a single child, Patterson sought to identify those family members and those preceding behaviours which served as facilitating stimuli for the deviant behaviour. The probability of a deviant behaviour occurring given the prior occurrence of facilitating behaviour A was compared with the probability of the deviant behaviour occurring without behaviour A having preceded it. Separate chi-square analyses were conducted for persons and for behaviours as facilitating stimuli. The base rate probability of behaviour A occurring was also considered in determining the importance of behaviour A as a facilitator. Though fairly rudimentary in approach relative to recent research, this study is frequently cited for its early efforts in determining stimulus control of interactive behaviours. This approach of identifying immediate antecedents or precedents of target behaviours has been used quite extensively in the family interaction research of the Oregon group (e.g., Wahl, Johnson, Johansson & Martin, 1974; Patterson 1974; Shaw, 1971), and by other researchers using the Behavioral Coding System (e.g., Snyder, 1977), typically to identify the unique interactional patterns of individual distressed families.

In a more ambitious but much less expeditious manner, Schachter et al. (1977) coded the presence and absence of a number of behaviours for each second of observed interaction between infants and their schizophrenic or control mothers. An unspecified but exhaustingly large number (indications of over 2000!) of 2x2 chi-square analyses were conducted in determining the time lags of maximal contingency in behaviour and the specific nature of these contingencies. Considering both the dependency in the set of behaviour codes and the extremely large number of analyses conducted, these analytic techniques are certainly not recommended.

A truly pioneering effort at employing sequence identification procedures in the study of parent-child interaction and in extending the analysis beyond one transition step is the study of child compliance by Lytton and Zwirner (1975). Their observational data were searched for all sequences of Parental Antecedent Behavior at time t-2, Parental Verbal Control at t-1, and Child Response at time t. Conditional probabilities of the child behaviours at time t were calculated for each of four parental verbal controls and for each of the four parental antecedents. Separate conditional probabilities were calculated for mothers and fathers and tested for significant differences from base rate probability using chi-square tests of independence. The relative likelihood of different antecedent and different control behaviours leading to compliance or noncompliance were then demonstrated separately for mothers and fathers. Analyses were terminated at three stages because of the rapidly expanding number of possible patterns (4 antecedents x 4 controls = 16 possible patterns for each type of child response). Among the many results were the findings that fathers' commands were more likely to be complied with than were those of mothers and that Suggestion as a parental antecedent was more likely to facilitate compliance than noncompliance on the part of the child, whereas Reasoning and Command-prohibition were more likely to lead to noncompliance.

By outlining sequences to a third step in this manner Lytton and Zwirner were moving beyond a Markov model, demonstrating that behaviour at time t is influenced by behaviours occurring at time t-2 as well as those at t-1. That is, they no longer assumed that behaviour of a system depends only on the behaviour at the immediately preceding time interval. They did not test the fit of the Markov model to their data, although this is a testable assumption (see Gottman, Markman & Notarius, 1977). Lytton and Zwirner's sequence identification procedure is similar to the lag sequential technique developed by Sackett (1974) and described in Gottman and Notarius (1978), Gottman, Markman and Notarius (1977), and Gottman and Bakeman (1979).

The Sackett procedure begins with the designation of a criterion behaviour A. Then the conditional probabilities of each of the other behaviours is calculated for every succeeding time lag until they are no longer of interest. These conditional probabilities are examined to determine the behaviour with the highest conditional probability at lag 1 (e.g., behaviour B), lag 2 (e.g., behaviour C), and so on until the conditional probabilities no longer differ from the unconditional. A sequence of behaviours A-->B and A-->-->C might be identified in this manner. The next step is to confirm a peaking in the conditional probability of behaviour C immediately following behaviour B (B-->C). Z-scores are used to test the conditional probabilities for significance. This procedure can be repeated using any other or all of the other behaviours as the criterion behaviour which initiates the sequence.

The lag sequential procedures have been employed by Bakeman and Brown (1977) to describe interactions between mother-infant dyads, and by Gottman et al. (1977) to examine the interaction patterns of maritally distressed and nondistressed couples, demonstrating differences in the interactional patterns between the two groups. Its applicability to parent-child and particularly triadic (mother-father-child) interactions has not been demonstrated, but has been suggested by Parke, Power and Gottman (1979).

Comparability of the Two Methodologies

The two methodologies are seen as providing different types of information: the continuous state methodology presents information about the behaviour stream as a whole, describing it as high or low in predictability, as more variable or more random. When considering multiple behaviour streams it can describe the interactants' behaviours as highly interdependent or relatively independent. When more than one dimension of behaviour is examined this methodology could indicate those dimensions which reflect greater or lesser degrees of interdependence. On the other hand, the discrete state methodology detects recurrent patterns of behaviour within the total behaviour stream. As such, it appears that the two methodologies could provide very complementary types of information. Though the application of both types of analyses to a single set of data has been suggested by Thomas and Martin (1976) and by Gottman (1979), no such attempt has been reported in the literature to date.

Purpose and Outline of the Present Study

> We feel strongly that our science has underplayed the importance of the descriptive phase of scientific investigation. Somehow it seems logical that the interaction of organisms must be described by attention to pattern and sequence. Once we have good descriptive data, we may identify new phenomena that enrich our theories. (Gottman & Notarius, 1978, p. 279).

The present study stemmed from an acknowledgement of the need for more descriptive data on family interaction. Its purpose was to investigate and compare these two alternative statistical methodologies for examining interaction. With the exception of the Fox and Hogan (1978) study, neither technique has been applied to groups larger than dyads, and the feasibility of employing them with triads requires investigation. Additionally, the use of multiple dimensions in the continuous state description of interaction is unique to the present study. As a demonstration of relatively descriptive methodologies, the present study postulated few experimental hypotheses as they are commonly known. Its specific focus was to determine the feasibility and utility of employing each methodology in examining triadic interaction and to investigate the complementarity of the two methodologies.

The examination of individual family interactions rather than groups of families was seen as necessary at this point in time. Little is currently known about the contingencies and interdependencies of family interactive behaviour. The risk of averaging away the unique interactive patterns of individual families was regarded as too great to summarize data across families. Before the search for group effects or group differences is initiated, it appeared necessary to have demonstrated that individual patterns have been identified by the methodologies employed. The observed interactions of six family triads served as the data sets with which these statistical methodologies would be investigated.

In keeping with the advances of the past decade, observational data of mother-father-child interactions which have been collected under rigorously controlled conditions were investigated. These observations were coded to generate timed-multiple event sequential data. The present study used the behaviour categories of the Behavioral Coding System (Patterson, Ray, Shaw & Cobb, 1969). Earlier work in adapting this system to time-based coding indicated the utility of coding in six-second intervals as had been done previously (e.g., Cobb & Ray, 1970). In addition, since an interactant's behaviour relative to the two recipient interactants frequently differed between recipients (e.g., father talking to mother and not attending to child), it was necessary to code direction of behaviour as two separate streams for each interactant (e.g., father --> child, father --> mother). When the behaviour directed to each recipient was the same (e.g., father reading the newspaper) both behaviour streams received the same code.

The first step in the demonstration of the methodology is altering the data from their categorical format to a quantified format to allow a continuous state analysis to be performed. Several alternative methods for quantifying categorical data are currently used. Gottman (1979) outlines several of these methods. Some are based on the frequency of occurrence of the category in the data set, such as density of discrete behaviours for given time periods (e.g., as employed by Tronick, Als & Brazelton, 1977). Other approaches are based on assigned scale values on some single conceptual dimension (e.g., positivity). Thomas & Martin (1977) empirically determined scale values for categories through trial and error, using the criterion of maximizing the calculated correlations. The procedure used most frequently with the categories of the Behavioral Coding System (BCS) has been to collapse the categories into the groupings of prosocial, neutral, and deviant behaviours on the basis of face validity. These groupings can then be assigned values of 3, 2, and 1 on a dimension of positivity. Familiarity with the coding system had led the present author to believe that more than one dimension likely underlies the behaviour categories. It was anticipated that identification of additional dimensions could then lead both to an increase in the amount of variance accounted for, and could provide additional qualitative information. In addition, it was regarded as important to assign scale values to each behaviour category on each dimension on some basis other than only face validity. A group of techniques seen as particularly well-suited to perform both these tasks was multidimensional scaling procedures.

Multidimensional scaling (MDS) is a class of techniques that can be used to develop a spatial configuration of multiple dimensions of a set of psychological stimuli or objects. The techniques are typically based on judgments of the perceived similarity or proximity among all members of a set of stimulus objects. The judges ratings of similarity for all possible pairs of objects comprise the matrix or matrices of similarity which serve as the input data. These judgments are then used to project the stimulus objects onto a configuration of specified dimensions. By analyzing the configurations of different dimensions the MDS researcher can: (1) determine the number of dimensions needed to best account for the judged similarities, and (2) solve for the scale values of each of the stimulus objects on each of the dimensions.

Determination of the most appropriate dimensional configuration is not a strictly statistical concern. Kruskal and Wish (1978, pp. 48-60) discuss the need to consider the statistical goodness of fit (termed Stress), the interpretability, and the stability of obtained dimensions in deciding upon the most appropriate dimensional configuration. MDS techniques can perhaps be understood better by considering them in relation to another data reduction technique, principal components analysis, which is better known and may seem an obvious alternative method. At least two important distinctions warrant attention. The first is that MDS is primarily a scaling technique while PCA is primarily an empirical technique. As a scaling technique, the basic function of the MDS is to provide a clearer conceptual representation of the measuring instrument employed. As used here the MDS is performed upon a second set of data, a matrix of similarity judgments derived independently of the empirical data set of interaction observations. In contrast, PCA as frequently used, is applied to the empirical data set. The second chief distinction between MDS and PCA is that MDS is intended for use with qualitatively differing stimuli, using matrices of similarity judgments, whereas PCA requires quantitative data, using correlational matrices as the input data. Since the initial intent was to alter categorical data to quantitative data, MDS was clearly the preferred method.

The general MDS techniques are very versatile and are being used increasingly in educational and psychological research. A description and comparison of different approaches is presented by Green and Rao (1972). Subkoviak (1975) presents a very readable and relatively recent review of the different approaches of MDS as used in educational research. Subkoviak's review also describes the newer nonmetric MDS procedures. A Monte Carlo comparison of metric and nonmetric MDS procedures under varying conditions of data distortion is presented by Weeks and Bentler (1979). Their results indicate that nonmetric analyses provide very similar results to those of a valid linear MDS analysis while requiring only ordinal rather than interval scale data. Seemingly little accuracy is lost in employing a nonmetric solution even if the data are interval.

As applied to the Behavioral Coding System, MDS was expected to aid in identifying the dimensions perceived in the behaviour categories. It was anticipated that the traditionally used positive to negative (or prosocial to deviant) dimension would be identified and would account for the largest amount of variance. The presence and importance of the Prosocial--Deviant dimension was predicted because that is the single dimension typically attributed to the BCS. Two potential dimensions which were additionally postulated as possibly appearing in the solution came from the literature: the dimensions of High--Low Involvement and Submissive--Dominant (Kogan & Wimberger, 1966). Finally, the dimension of Frequent--Infrequent Usage was predicted as possibly appearing. It was included since it might reflect information about the application of the coding system rather than about its theoretical dimensionality. The last three dimensions were proposed in advance to facilitate later labelling of the recovered dimensions. Failure to confirm any or all of them was not considered failure to support experimental hypotheses. Dimensions and scale values resulting from the MDS analyses were then used for the subsequent analyses.

The second stage of analysis is a description of family interaction in the continuous state manner discussed earlier. The categorical coding of behaviour would be transformed to continuous scale data by employing the scale values obtained through the MDS procedure. Then, if the behaviours of the different family members are considered to be several simultaneously occurring streams of behaviour, it is the interdependence of these behaviour streams that was explored in the manner described below.

The way in which one interactant's behaviour relates to the behaviours of the other two interactants was examined. The simultaneously occurring behaviours and the succeeding behaviours of the other two interactants were examined for relatedness with the criterion behaviour. The relation with these succeeding behaviours was examined by time-lagging the data. In a procedure analogous to the time-lagged autocorrelations of time-series analysis, the current procedure time-lagged correlations of behaviours across interactants. Then in predicting child behaviour, the behaviours of mother and father in the simultaneous and succeeding time lags were considered. This time-lagging procedure is depicted below graphically in Figure 1. To portray the manner in which the data shift by one time interval with each lag, the values of the time intervals have been presented as "data points" for lags 0, 1 and 2. The values in the columns shift up one position for each time interval lagged. The correlations are then calculated by moving across the rows, as indicated by the boxed values. In correlating the child's behaviour at time 1, the associated father behaviours considered are those at lag 0 (value=1), lag 1 (value=2) and lag 2 (value=3). The parenthesized numbers above these indicate the values which have been "displaced" because of the lagging shift. Likewise for mother behaviours, the values of 1, 2, 3 indicate the time interval from which they originate.

Insert Figure 1 about here

When the analyses are conducted at the individual family level, each time-point (i.e., interval) becomes a case replication.

Given the six behaviour streams (father-->mother, father--> child, mother-->father, mother-->child, child-->father, child--> mother), each stream is further subdivided into the dimensions of behaviour as identified by the MDS results. Then, in the case of two dimensions being identified as important, there would be 12 behaviour streams (3 interactants x 2 directions x 2 dimensions). This subdivision into dimensions allowed for an examination of the relative importance of each dimension to the measures of interdependence.

The interdependence of these behaviours could then be examined in both a univariate and a multivariate fashion. A series of multiple regressions could be calculated in which one "target" behaviour (as defined by interactant, direction

Figure 1: Illustration of Child's Behaviour being Correlated with the Behaviours of Father and Mother in the Simultaneous and in Succeeding Time Intervals

Criterion		Predictors					
Child Behaviour		Father Behaviour			Mother Behaviour		
Time Intervals	Lag 0	Lag 0	Lag 1	Lag 2	Lag 0	Lag 1	Lag 2
	-	-		(1)			(1)
	-	-	(1)	(2)		(1)	(2)
1	1	1	2	3	1	2	3
2	2	2	3	4	2	3	4
3	3	3	4	5	3	4	5

and dimension; e.g., child to father in dimension one) was regarded as the criterion behaviour and was regressed onto the behaviours of the other interactants (e.g., father's and mother's behaviours toward each other and toward the child in all dimensions). These correlational analyses could address such questions as: How highly related are each interactant's behaviour streams with the behaviour streams of the other interactants? How comparable is this level of relatedness across interactants? Which behaviours are most important in determining the relatedness of a criterion behaviour? Does one dimension of behaviour show higher levels of relatedness than other dimensions?

In addition to the univariate regression approach the simultaneous consideration of all dimensions of a behaviour stream was regarded as important, since these dimensions occur together naturally. That is, it is the package of dimensions operating together that may be important in determining the interdependence structure of the interaction. This speaks to the need for a multivariate approach. Canonical correlation is typically viewed as the multivariate extension of multiple linear regression (e.g., Kerlinger & Pedhauzer, 1973, p. 341), with $\underline{k}$ predictor variables and $\underline{m}$ criterion variables. The basic procedure is the formation of two linear composites, one of the predictor variables and one of the criterion variables. These composites are formed so as to maximize the correlation between them. The number of possible correlations is equal to the minimum number of variables in either set (i.e., minimum of k or m). Regression equations with associated weights are derived for each canonical variate. Interpretation of the canonical variates and the composite weights is not without its difficulties (Kerlinger & Pedhauzer, 1973). However, use of the redundancy index described by Stewart and Love (1968) and Darlington, Weinberg and Walberg (1973) and illustrated by Cooley and Lohnes (1971) can facilitate interpretation with respect to the amount of variance accounted for. The use of canonical variate analysis could address the question of whether or not considering all dimensions of a behaviour together added new information above and beyond that which was available when considering each dimension separately. Given the "pioneering" nature of this study, no specific predictions were attempted in advance.

The third stage in the methodology is the examination of the interactional data using the discrete state approach. This was intended to identify specific sequential chains of interactive behaviour. The lag sequential analyses developed by Sackett and described earlier were employed. The behaviour streams were examined in their categorical (i.e., discrete) form for sequential chains of behaviour across interactants. The lag sequential procedure requires specifying an initial behaviour and then plotting out the probabilities of lagged behaviours following this "initiator".

Given the large number of behaviour categories in the BCS, not all behaviours could be considered as chain initiators for analysis purposes. Two approaches seemed promising for selecting "initiator" behaviours. The first procedure involved examining the results from the correlational analyses. A behaviour category with a high frequency of occurrence and with a high scale value on the dimension(s) of the criterion behaviour which interrelated highly with the other interactants' behaviours would be selected as an initiator behaviour. To the extent that the two procedures are immediately complementary, it was anticipated that the lagged sequences of categorical data would "spell out" the general interdependencies identified in the correlational analyses. The second approach would be to select initiator behaviour categories on the basis of theoretical interest. For example, behaviours such as commands and negative commands by mother and father separately could serve as initiator. If chains of categorical behaviours were identified in this fashion, it would then be possible to go back to the correlational analyses to investigate whether or not indications of these relationships had been evident there.

In summary, the procedure involved the following steps:

1. altering the observational data from its categorical form to a quantified form on a number of conceptually defined dimensions,

2. considering the data as 6 X number of behaviour streams for the family triad (where X = number of important dimensions identified) and calculating the degree of relatedness of each interactants' behaviours given the simultaneous and succeeding behaviours of the other two interactants,

3. searching for recurring interactive patterns among the discrete behaviours of the family triad and attempting to relate these to the results of stage (2).

The use of this three-stage methodology in examining family interactions is intended to investigate a methodological procedure which should provide a fuller and richer description of these interactions than has been present in the literature to date.

METHOD

Observational Data

The data used for investigating these methodologies were home observations of six mother-father-child triads of non-clinical families.

The Families Observed

Numerous demographic characteristics of families have been identified as influencing parent-child interaction. These include sex of child (Moss, 1967; Lewis, 1972), sex of parent (Osofsky & Oldfield, 1971), education level of mother (Minton, Kagan & Levine, 1971), social class of the family (Greenberg & Formaneck, 1974; Kogan & Wimberger, 1969; Hore, 1970), birth order of the child (Rothbart, 1971) and sibling network (Ciricelli, 1976). Consequently, the following stringent criteria were employed: (a) that the child be male, (b) the child be between 4 1/2 and 7 years of age, (c) the child be either the first-born child of the family or be at least 5 years younger than all other siblings, (d) that both parents had completed high school and/or some additional training, (e) that the triad had lived together continuously for the preceding two years, (f) that no member of the triad had sought extensive psychiatric or psychological treatment during the previous two years, and (g) that English was the language spoken in the home. Families were recruited from daycare centres, nursery schools and churches in the Ft. Garry, Manitoba area.

The families met the selection criteria with the following exceptions: one child was the oldest son in the family but had a sister 3 1/2 years older than himself (Family #1), and one mother had completed only the tenth grade and additional secretarial training (#3). Most parents were in their mid to late twenties, with both parents of one family being in their early forties (#5). All families had two or three children with siblings typically being younger than the target child. All parents had lived together continuously since marriage with length of marriage ranging from seven to eighteen years.

Observational Procedures

The rationale of the study was outlined to the parents as being "to see how ordinary children behave around their parents". Acknowledging that the parents might feel somewhat constrained in their behaviour, they were assured that there are no "right" or "wrong" ways of behaving, and that videotapes would be handled in a confidential manner.

All families were observed for approximately fifty minutes in their own homes. Structuring of the session was left primarily to the individual family, with the following restrictions being imposed: (a) no guests or other family members were to be present, (b) that they remain within one room to ensure interaction and to facilitate observation, (c) telephone calls were to be minimized, (d) no television viewing was to occur, (e) the observer and her equipment were to be ignored. All observation sessions were videotaped by the author and subsequently coded. These observational data had been collected previously by the author (Fox & Hogan, 1978).

Coding of Observations

Coding of the videotaped interactions was done using the behaviour categories of the Behavioral Coding System (Patterson, Ray, Shaw & Cobb, 1969).[1] This system was employed because it is used extensively in clinical research, is appropriate for use with a wide range of ages and behaviours, makes relatively fine-grained distinctions in behaviour, can be learned fairly readily, and requires few modifications to allow for continuous coding of all interactants' behaviour. Additionally, it may well be the coding system whose properties have been most thoroughly investigated. Development of the BCS and investigation of its reliability via a factorial model is described in Jones,

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[1]These same categories also comprise the Family Interaction Coding System (Patterson, Reid & Maerov, 1978, in Reid, 1978).

Reid and Patterson (1975). The BCS was initially developed for use with behaviour disordered children and their families. It consists of 29 behaviour categories which were expanded to 31 categories for the present study.[2] The codes are sufficiently inclusive to allow for continuous coding of both child and adult behaviours (see Appendix A for a list of the codes and their definitions).

For the present study, observed interactions were coded in six-second intervals as has been done previously (e.g., Cobb & Ray, 1970; Jones, Reid & Patterson, 1975). The time intervals were recorded on the audio track of the tape with a brief tone sounding every six seconds, a longer one at every one at every minutes (i.e., every 10 intervals). Early pilot testing indicated few coding conflicts arising with this duration of interval. Conflicts were experienced, however, in trying to code the behaviour of an interactant toward both of the other two members with the use of a single code. Consequently, each interactant's behaviour as directed toward each of the other two interactants was coded separately. This resulted in six streams of behaviour being coded every six seconds for approximately 50 minutes. Coding of all behaviours frequently required several viewings of the taped intervals, making videotaping of interaction essential for this type of coding. session were discarded

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[2]The code of No Attention is added, and the Code Play is subdivided into Play Social and Play Individual.

to allow for some habituation to the situation.

One-half of the videotaped observations were coded by a trained rater who was unaware of the experimental intent; the other half were rated by the author. Tape assignment for coding was random. A total of three reliability spot-checks on randomly selected portions of tape were conducted by the raters on the coding of the other rater. At any time when these checks revealed inter-rater reliability to have dropped below .80, retraining for both raters was reinstated. Reliability when calculated as the number of time interval agreements over the number of agreements plus disagreements averaged .81 (range = .78-.85). Kappa reliabilities, which take into account the chance probability of the coding categories, were also calculated and averaged .76 (range = .73-.79).

Multidimensional Scale Dissimilarity Ratings

The multidimensional procedures require dissimilarity (or similarity) ratings on all possible pairs of stimulus objects (e.g., rated similarity of Talk-No Attention, Talk-Yell, etc.). For the 31 behaviour categories of the BCS as presently used, this resulted in 465 pairwise comparisons of the categories, with a scale of one (very similar) to seven (very dissimilar) employed for the dissimilarity ratings. Fifteen pairs were repeated as a check on the reliability of the ratings. In addition, each of the 31 categories was further rated on each of four dimensions anticipated as possibly describing the underlying dimensional configuration. These are: prosocial--deviant, low--high involvement, submissive--dominant, and frequently--infrequently used.

These judgments were completed by the two raters who coded the families' interactions, since completing the ratings on the MDS task requires the judge to have a working familiarity with the behaviour categories of the BCS. This expertise is not readily obtained without extensive training on the BCS. The small number of raters is not considered as a problem with respect to stability of the resultant configuration of the MDS analysis. Rules of thumb for stability of MDS results are frequently discussed in terms of the ratio of number of stimulus points in the set to number of dimensions recovered, with a general recommendation of approximately 5 to 1 (Subkoviak, 1975). In the present study we have 31 stimulus points which would safely allow for up to 6 stable dimensions to be recovered. Using only two raters, however, places some limitations on the generalizability of the results. The configurational representation of the BCS which was derived is expected to be valid for the present study, but should be interpreted with some caution when generalizing to other studies.

ANALYSES AND RESULTS

The data analyses were conducted in three stages and will be presented in that order. The first stage was the multidimensional scaling (MDS) analysis performed on the dissimilarity ratings of the behaviour categories of the Behaviour Coding System. The results of the MDS procedures allowed for the assigning of quantitative values to the different behaviour categories. The second stage of analysis then used these MDS values to transform the observational data from a categorical to a quantitative form. These quantitative observations were then examined via correlational methods both to determine how interrelated the interactants' behaviours were and to determine the nature of those interrelationships. The third stage of analysis examined the observational data in their categorical form. The results of the correlational analyses were used in searching for discrete chains of behaviour that were evident in the behaviour streams. In presenting the following analyses and results, the author has taken the liberty of interpreting these results to a greater degree than is usual in a Results chapter. It was anticipated that with an interpretation of the results given along with their presentation, the reader could better understand both the findings and the rationale for proceeding to the next type or step in the data analysis.

Multidimensional Scaling Analyses and Results

The purpose of this first stage of analysis was to facilitate the transformation of the categorical data into a quantitative form by identifying the underlying dimensional structure of the Behavioral Coding System and assigning values to each category on each dimension. The reliabilities of the multidimensional scaling pair-wise dissimilarity judgments were calculated. The intra-rater reliabilities, calculated on the 15 repeated pairs of behaviour categories, were found to be .88 and .89 and the agreement between raters to be .80 (calculated as simple Pearson correlations). As the first step in the MDS procedures, these 465 pairwise judgments of dissimilarities were averaged across the two judges and these average judgments submitted to the nonmetric MDS program KYST (Kruskal, Young & Seery, 1973).

These dissimilarity ratings are then regarded to represent the distance between all pairs of points and the KYST program attempts to portray all points in an N-dimensional space. The program operates in an iterative fashion. It begins with an initial configuration of specified dimensionality (this starting configuration may be either randomly generated, derived internally through preliminary scaling techniques, or provided by the user) and then moves through a number of iterations, shifting points in the configuration slightly at each step so as to maximize the fit of the configuration to the data. When the fit cannot be significantly improved, the final solution for that dimensionality has been obtained. In addition, the dimensions unfold in order of decreasing importance with respect to the way they represent the dissimilarity judgments. That is, the first dimension of an N-dimensional configuration is the most important, the second is second most important, and so on. These dimensions are orthogonal to each other. The program solves for a maximum of six dimensions.

Solutions for all dimensionalities from six to one were obtained, with the coordinates being rotated to derive principal components. Appendix B provides a more complete description of the KYST program analyses that were performed. The procedures for determining dimensionality as outlined by Kruskal and Wish (1978) were then employed. These procedures include the examination of Stress (a goodness-of-fit measure), the stability of the dimensions, and their interpretability.

Stress

The Stress index is a measure of how well the obtained configuration fits the original data and is calculated as a residual sum of squares. The formula for its calculation is contained in Appendix B. The Stress values obtained for the six dimensional run were: 1D = .32, 2D = .17, 3D = .12,

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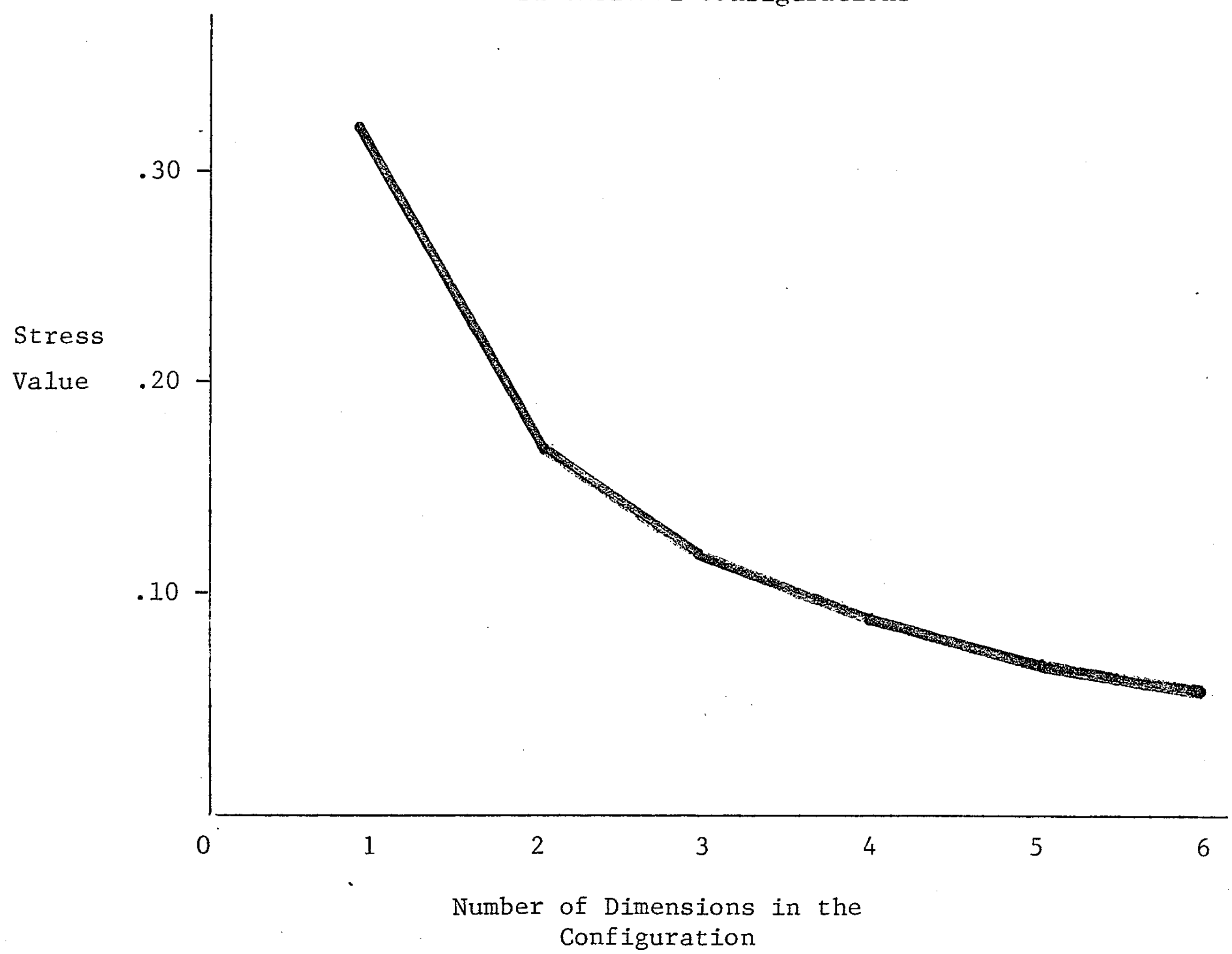
Insert Figure 2 about here

4D = .09, 5D = .07, 6D = .06. As shown in Figure 2, Stress demonstrates a sharp drop from one to two dimensions, and then a more gradually decreasing decline. As a general rule of thumb, a Stress value of .10 or less is regarded as good (e.g., Kruskal, 1964, p. 9). More recently, Wagenaar and Padmos (1971) noted that the number of initial stimuli strongly influences the Stress value, although they did not examine sets of stimuli as large as that of the present study. Consequently, for the present analyses with the large number of initial stimuli (N = 31), Stress values below .20 were regarded as acceptable. Because the five and six dimensional solutions demonstrated little improvement in Stress and because of the difficulty in conceptualizing and working with a configuration of that size, these solutions were not investigated further. Instead, the two and three dimensional solutions were examined most closely with the four-dimensional solution receiving limited attention.

Stability

The stability of the obtained dimensions was examined in two ways. The first procedure was intended to determine how similar the dimensional structure of a given dimensional configuration (e.g., two dimensions) would be if the

Figure 2: Stress Values for Dimensional Configurations



configurations were derived in several different ways. To do this, several solutions of the same dimensionality (e.g., 2D) were obtained but solutions which had been derived from different initial starting points. These initial starting points were determined by specifying different dimensionalities of the initial configuration for the entire run. (Please refer to Appendix B for a more thorough explanation of the procedures).

Comparisons of the dimensional structures of the two-dimensional configurations indicated a high degree of consistency in the location of individual behaviour categories from one 2D solution to the other 2D solution. Similar observations were made for the three-dimensional configurations. The only behaviour which demonstrated meaningful shifting across solutions of the same dimensionality was the behaviour category "TH--touch", which shifted in both the 2D and the 3D configurations. Overall, these results indicated a high degree of stability for the 2D and 3D dimensional structures when compared across figures which had the same dimensionality but which differed in their initial configurations.

The second examination of stability was to determine how stable the composition of the dimensional structures were as the dimensionality of the configuration was increased in steps from one to four dimensions. To do this, the configurations of one to four dimensionalities as derived from the run beginning with an initial configuration of six dimensions were examined. For each behaviour category, the value on dimension one of the 1D configuration was compared with the corresponding value on dimension one of the 2D, 3D and 4D configurations; values on dimension two for the 2D, 3D and 4D configurations; and dimension three for the 3D and 4D configurations. Simple Pearson correlations were calculated and are presented in Table 1. Again, the dimensions appear

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Insert Table 1 about here

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to be relatively stable, particularly for configurations of two and three dimensions. Stated another way, it would appear that the nature of dimensions one and two change little when going from a two to a three to a four dimensional solution.

The slightly lower correlations for the first dimension values derived from a one dimensional solution (D11) compared with the first dimensions of subsequent solutions (D12, D13, D14) prompted visual inspection of the plotted behaviours. It was observed that several behaviours (e.g., NA--No Attention, SS--Self Stimulate, NR--No Response) which had anchored one end of the D11 dimension, shifted to more intermediate positions on the first dimension of the two-dimensional solution (D12), but became anchor points for the

Table 1: Correlations of Values Assigned to Behaviour Categories on the First, Second and Third Dimensions of One, Two, Three and Four Dimensional Configurations

Dimension 1:

	D12*	D13	D14
D11	.95	.93	.93
D12	1.00	.99	.99
D13		1.00	.99
D14			1.00

Dimension 2:

	D23	D24
D22	.98	.97
D23	1.00	.99
D24		1.00

Dimension 3:

	D34
D33	.96

* where D12 refers to the first dimension of a two-dimensional configuration

second dimension (D22). That is, the unfolding of the second dimension in the two-dimensional solution also altered the interpretation or meaning of the first dimension. This change in meaning of the first dimension and the large improvement in Stress when moving from a one to a two dimensional solution suggested discarding the one-dimensional solution. The transition from two to three dimensions was also inspected to see whether a similar change in meaning of the second dimension would appear. Although slight shifting in relative positions did occur (as reflected by r < 1.0), these shifts were minor and were not regarded as affecting the interpretation of the dimensions. At this point, therefore, the dimensional values of both the 2D and the 3D configurations were regarded as stable across different solutions of the same dimensionality and with respect to the unfolding of subsequent dimensions.

Interpretability

While good fit with the data, and stability of the dimensions were certainly regarded as important, the dimensions also needed to be conceptually meaningful to be of value in explaining the data. Plots of the behaviour categories on the first four dimensions were visually inspected as an initial step in interpreting the dimensions. The first dimension clearly represented a Prosocial--Deviant dimension, the second appeared to be an Involvement dimension, while the third could not be readily labelled. In addition to this initial intuitive approach to interpretation of the dimensions, their labelling was also approached in a statistical fashion.

The ratings of each behaviour category on the four hypothesized dimensions (Prosocial--Deviant, High--Low Involvement, Submissive--Dominant, and Frequently--Infrequently Used) were compared with the dimensional values of each category as they were obtained through the MDS analyses. An iterative correlational procedure as performed by the program PROFIT (Property Fitting) by Chang and Carroll (1974) was used to accomplish this.

The PROFIT program operates by regarding the ratings of each of the hypothesized dimensions (Prosocial--Deviant, High--Low Involvement, Submissive--Dominant, and Frequently--Infrequently Used) as an external property of the stimuli. For each property the program then finds a vector in the specified N-dimensional space (as defined by the MDS results) such that the MDS defined values of the 31 points when projected on the vector correspond optimally with the given property values. The results of analyses using four properties in a three-dimensional space and using linear correlation as a measure of optimal fit are presented here. The reader is referred to Appendix B for a discussion of additional PROFIT analyses performed. Table 2 presents the

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Insert Table 2 about here

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maximum correlation between the property and the projections on the fitted vector. Stated another way, these correlations represent how well the property values of the behaviour categories correspond with composites of the dimensional values of the categories. These results indicate that the property Prosocial--Deviant can be highly predicted by a composite of the dimensions (.942), while the remaining three properties can be predicted less well (.717, .663, .634). The weighting of each dimension in predicting the property vectors (as expressed by the regression weights) is presented in Table 3, while the amount of similarity between vectors (as expressed by the intercorrelations between vectors) is presented in Table 4. The consideration of Tables 3 and 4 together reveals the following

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Insert Tables 3 and 4 about here

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results. In interpreting the vectors, the values of Table 3 indicate that vector 1 (Prosocial--Deviant) is almost entirely accounted for by dimension 1 (-.957), while vector 2 (High--Low Involvement) relates almost exclusively to dimension 2 (-.987). Vector 3 (Submissive--Dominant) relates moderately with the first two dimensions (-.418,

Table 2: Maximum Correlation Between Each Property and the MDS Value Projections on the Fitted Vectors

Vector	R	Property
1	.942	Prosocial-Deviant
2	.717	High-Low Involvement
3	.663	Submissive-Dominant
4	.634	Frequently-Infrequently Used

Table 3: Regression Weights of the Dimensions in Predicting the Property Vectors

Vector	Dimension 1	Dimension 2	Dimension 3
1	-.957	-.052	.285
2	.147	-.987	-.066
3	-.418	-.417	-.808
4	-.741	-.169	.651

Table 4: Intercorrelations Between Vectors

Vector	1	2	3
2	-.108		
3	.192	.403	
4	.903	.011	-.147

-.417) and more highly with dimension 3 (-.808), while vector 4 also relates moderately highly with dimensions 3 (.651) and 1 (-.741). Using this information about the vectors to interpret the dimensions, one can see that dimension 1 is almost entirely responsible for the variance of vector 1 and less so for vector 4. Table 4 reveals that vectors 1 and 4 are highly related (.903). That is, the vectors of Prosocial--Deviance and Frequency of Usage overlap in meaning to a high degree. Since Frequency of Usage is regarded as more of an artifact of the application of the coding system rather than as a conceptual characteristic, dimension one can perhaps best be conceptually labelled as a Prosocial--Deviance dimension. Similarly, dimension 2 is highly related (-.987) to vector 2 (Level of Involvement) and less related (-.417) to vector 3 (Submissive--Dominant) and these vectors are somewhat overlapping (.403). Dimension 2 can consequently be regarded as reflecting a Level of Involvement dimension. Dimension 3 relates to both the Submissive--Dominant vector (-.808) and the Frequency of Usage vector (.651), but is not uniquely defined by either and does not account for the total variance of either. These vectors overlap little in meaning (-.147). Consequently, this third dimension was again found to be difficult to interpret.

Dimensional Solution Adopted

The results on Stress, on the stability of the dimensions, and on their interpretability were taken into account in determining the final dimensional configuration to be adopted. The high Stress value and the instability of dimensional interpretation argued against adopting a one-dimensional solution. The failure to satisfactorily interpret the third dimension argued against adopting a three-dimensional solution. Consequently the two-dimensional solution was adopted, with the first dimension regarded as representing a Prosocial--Deviant continuum and the second dimension as representing a High--Low Involvement continuum.

The precise dimensional weights for each behaviour category as obtained in the MDS analyses were considered likely to be somewhat unstable. Categories were reassigned values ranging from one to six on each of the dimensions, with a high score indicating a highly prosocial behaviour on dimension one and a high score on dimension two indicating a high level of involvement. Figure 3 presents a configurational plot depicting each behaviour in its two dimensional position as determined by the MDS results, with the superimposed grid and corresponding marginal numbers indicating the reassigned values of one to six. Thus each behaviour category is assigned two coordinates, one indicating its position on the Prosocial--Deviant dimension, the second its position on High--Low Involvement. These values are presented in Appendix C.

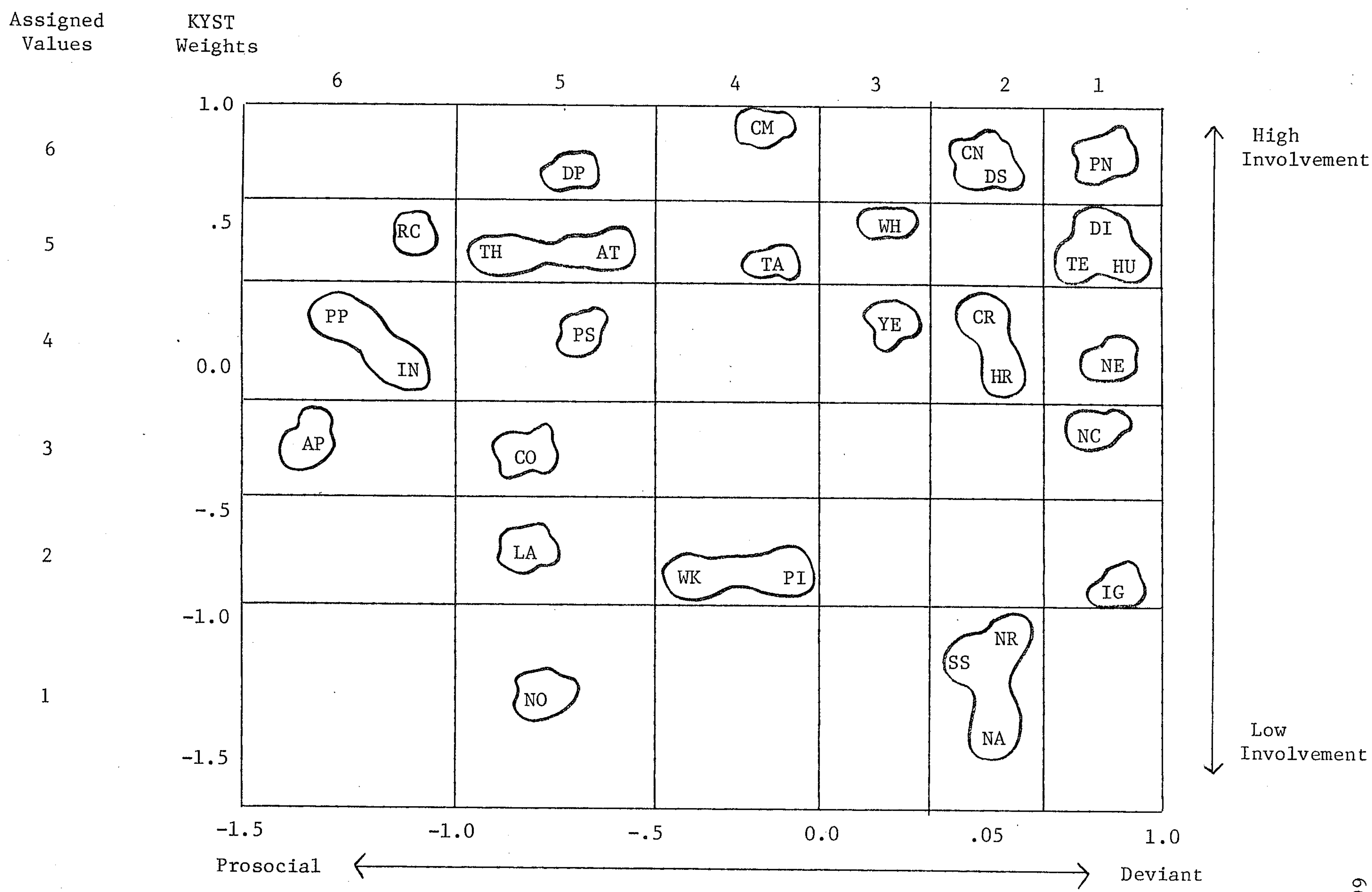
Insert Figure 3 about here

A brief examination of the assigned weights of several behaviour categories reveals the face validity of this two-dimensional representation. Behaviour categories obtaining high scores on both the Prosocial and Involvement dimensions include RC--Receive, PP--Physical Positive, and IN--Indulgence. Categories receiving both low Prosocial and low Involvement scores include IG--Ignore and NC--Noncompliance. The merit of employing two dimensions is perhaps best exemplified by considering those categories in the off-diagonal quadrants. Examples are PN--Physical Negative and DI--Disapproval which receive low Prosocial scores but high Involvement scores, while NO--Normative and LA--Laugh receive fairly high Prosocial scores and moderately low Involvement scores. This two-dimensional configuration does appear to depict the behaviour categories in a meaningful way. These derived values on the two dimensions can then be used to transform the actual observations of data from a categorical form to a quantified form.

Time-Lagged Correlational Analyses and Results

These correlational analyses and results represent the second stage of the analytic procedures. It should be recognized that one of the chief merits of the correlational

Dimensions of Prosocial-Deviant and High-Low Involvement



procedure is that it examines the data from <u>all</u> time points. In determining how father's behaviour toward the child relates to the succeeding child and mother behaviours, the correlational procedure considers each interval of behaviour and arrives at a correlation and a regression equation which best describes the relation between these behaviours as depicted in the entire observation time. The results of both univariate (multiple regression) and multivariate (canonical correlation) regressions are presented. The univariate regressions were used tc demonstrate stability in the interdepencencies of interactants' behaviours and were useful in summarizing patterns of findings across families. The multivariate regressions simultaneously considered both dimensions of a behaviour, thus allowing the correlational findings to predict to possible lag sequential patterns.

As a preliminary step in beginning to investigate the observational data, it was informative to determine how frequently the different behaviour categories were used. The frequency of use of a behaviour category as used by each interactant in behaving toward the other two interactants was calculated separately for each family. These data are too voluminous to present here but are available in Appendix D. Inspection of these data indicates that typically the child's behaviour demonstrates a wider range of behaviour categories than do the parents', and that the parent behaviours directed toward each other usually show the least range. In addition, interactants' behaviours typically relied heavily on one or two categories (e.g., Talk, Attention).

These observational data were then recoded from their categorical form to a quantitative form using the scale values obtained from the MDS results on the Prosocial--Deviant and High--Low Involvement dimensions. This resulted in twelve behaviour streams as portrayed in Table 5, where the target interactant is indicated in the far left column (e.g., Father), then the recipient to whom the behaviour is directed (e.g., to Mother), followed by the dimension of the behaviour (e.g., Prosocial--Deviant), and finally the abbreviation used for that behaviour stream (e.g., FMP).

Insert Table 5 about here

Univariate Regression

Procedures employed. In determining how best to examine the observed interactions through the time-lagged correlational procedures, several procedural guidelines were adopted which merit brief explanation here. The first is that the simultaneously occurring and succeeding, rather than preceding, behaviours of the other two interactants were employed in determining the degree of relationship of a

Table 5: The Twelve Behaviour Streams Resulting from Considering Interactant by Direction by Dimension of Behaviour

Interactant	Direction	Dimension	Abbreviation
Father	to Mother	in Prosocial-Deviant dimension	(FMP)
		in High-Low Involvement dimension	(FMI)
	to Child	in Prosocial-Deviant dimension	(FCP)
		in High-Low Involvement dimension	(FCI)
Mother	to Father	in Prosocial-Deviant dimension	(MFP)
		in High-Low Involvement dimension	(MFI)
	to Child	in Prosocial-Deviant dimension	(MCP)
		in High-Low Involvement dimension	(MCI)
Child	to Father	in Prosocial-Deviant dimension	(CFP)
		in High-Low Involvement dimension	(CFI)
	to Mother	in Prosocial-Deviant dimension	(CMP)
		in High-Low Involvement dimension	(CMI)

target interactant's behaviour. This means that, in correlational terms, the "predictor" variables are really succeeding behaviours. In the context of the present study, these "predictor" variables are not regarded as predicting the criterion behaviour. Instead, the degree of their relationship with the criterion variable reflects the extent to which they are related with and possibly influenced by that criterion behaviour (the statistical maxim of correlation not equalling causation needing to be recalled at this point). This interpretation of the criterion behaviour influencing the "predictor" variables is particularly applicable to the time-lagged succeeding behaviours. It is less applicable to simultaneously occurring behaviours, where temporal order and inferred causality cannot be determined. It is hoped that this somewhat unusual application of regression terminology is not overly confusing for the reader.

A second procedural decision involved the order of entry of "predictor" variables into the regression equation. It seemed reasonable to expect that all things being equal, the influence of an event on later behaviours should be attributed to the immediately succeeding behaviours rather than behaviours occurring later in time. To incorporate this notion of temporal priority into the regression analyses, hierarchical stepwise regressions were performed in which concurrent behaviours were given first opportunity to enter the equation, those of lag 1 given second priority, lag 2 third priority, and so on to lag 8. Only behaviours of the other two interactants, not self behaviours, were included. This resulted in 72 potential "predictor" variables (2 interactants x 2 directions x 2 dimensions x 9 time points). To illustrate, in "predicting" father's prosocial behaviour toward the child (FCP), the data from each of the approximately 4a00 time intervals were used as the criterion variable, and the simultaneous and lag one to eight interval data for child and mother behaviours (i.e., CFP, CFI, CMP, CMI, MFP, MFI, MCP, MCI) were used as the predictor variables.

To ensure that each new variable entering the equation contributed meaningfully to the correlation with the criterion behaviour, entry criteria were set at F=3.0, T=.30. This means that a significance test of the regression coefficient of an entering variable would need to equal or exceed 3.0, and that at least 30% of the variance of the new variable did not overlap with the variables already in the equation. Multiple regressions were initially calculated allowing a maximum of ten "predictors" to enter the equation. Examination of these results indicated that much of the variance being accounted for came with the first three or four variables. Consequently the maximum number of "predictors" allowed to enter the equation was reduced to five. Regressions were performed using the Regression subprogram of the Statistical Package for the Social Sciences

(Nie, Hull, Jenkins, Steinbrenner & Bent, 1975) with the time-lagging feature of the 1977 update (Nie & Hull, 1977).

Cross-Validation

Before plunging into examining the magnitude and composition of these interdependencies, it was regarded as important to first determine that these composites were relatively stable and were not merely statistical artifacts capitalizing on chance. The procedures outlined by Kerlinger and Pedhauzer (1973) for cross-validation were followed. A regression equation was derived on one portion of the observational data points (the screening sample) and applied to a separate portion of the data (the calibration sample). The fit of the regression equation was determined by calculating Pearson correlations between the observed criterion scores and those predicted by the equation.

The first attempt at cross-validation proved to be an erroneous false start, yet one which provided some very interesting results. In the first attempt one family was randomly selected (Family #6) and the first two thirds of its observation intervals were treated as the screening sample on which the regression equations were derived. The last one-third of the intervals became the calibration sample to which the equation was then applied. The resulting cross-validation correlations were surprisingly low (mean correlation = .231; range = .076 to .590), considering that the levels of interdependence of behaviours on the calibrating sample were moderately high (mean MR = .458; range = .250 to .576). To determine that the behaviours were equally highly predictable in the last one-third of the time intervals, multiple regressions were conducted on this final third, allowing its own "best" equations to be obtained. These correlations were even higher than those of the first two-thirds. This confirmed that the level of interdependence was high in both the screening and the calibration samples but indicated that the "prediction" equation for the first two-thirds of the data did not fit the last third. That is, the nature of the interdependence composite was changing over time. A comparison of the variables and their beta weights of the regression equations for the first two-thirds with the last one-third indicated little similarity, thus supporting this hypothesis. Taking this approach one step further, it seemed likely that if the last third differed in the nature of the interdependence composite from the first two-thirds, it was likely that differences would also be found in the first two-thirds if considered as separate thirds. Further, the magnitude of the MRs would then be predicted to be larger for each of the thirds considered individually compared to summarizing across the two-thirds of the intervals. This was found to be the case. For all 12 behaviour streams, the average MR of these two separate thirds was larger than the MR calculated across the combined two-third intervals. (These data are presented in Appendix E).

These results clearly indicate that the nature of the interdependence of behaviours was changing over time. That is, those behaviours relating to (influenced by) a particular criterion behaviour early in the observation period were not necessarily the same behaviours as those relating to it later. Therefore, the nature of the interdependence composite as obtained across all time intervals was a "compromise" solution which may not accurately represent any single segment of the data. This could have negative implications for its usefulness in predicting specific chains of sequential behaviour in the behaviour streams.

Cross-validation was then approached in a second way, predicting from odd-numbered to even-numberd time intervals. These cross-validation correlations for Family #6 are presented in Table 6 along with the size of the multiple correlation for the even-numbered intervals. These latter multiple correlations provide an estimate of the ceiling

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Insert Table 6 about here

"predictability" that could be expected. With few exceptions, the odd to even cross-validation correlations are high, especially when related to the possible predictabil-

Table 6

Cross-Validation Correlations from

Odd to Even Numbered Intervals

Behaviour	Cross-Validation r	MR for Even Intervals
FMP	.516	.664
FMI	.589	.692
FCP	.291	.487
FCI	.399	.540
MFP	.463	.576
MFI	.404	.572
MCP	.513	.566
MCI	.305	.563
CFP	.477	.622
CFI	.456	.547
CMP	.233	.424
CMI	.014	.364

ity. As a check for generalizability, cross-validations were conducted for a second randomly selected family (Family #2). Although both MRs and cross-validation correlations were generally lower (see Appendix E), their overall results were consistent with those for Family #6.

These cross-validation results indicate that the equation that "best" describes the nature of the behaviours' interdependence over time is relatively stable. The overall manner in which the behaviours of family members interrelate is consistent and appears not to be a statistical artifact. Additionally, these interrelationships seemingly change over time. Given this confidence in the reliability of the regression equations obtained to describe the interactions over time, we can proceed to examine these multiple regression results.

Magnitude of the Univariate Regressions

A multiple correlation (MR) for each of the twelve behaviours was calculated for each of the six families over all time intervals in the manner already described. That is, stepwise hierarchical regressions were used with entry criteria of N=5, F=3.0, and T=.30. These correlations indicate the degree to which each interactant's behaviour is related with and possibly influential in determining the simultaneous and succeeding behaviours of the other two interactants. They are presented in Table 7. The mean MR for each family and for each behaviour are reported in the margins.

Insert Table 7 about here

Several findings are apparent through inspection of the table. The first is that overall, there is a moderately high degree (in the order of R=.4) of interdependence in the behaviours of family interactants. Second, though the families vary somewhat in their mean degree of interdependence (Family #2 = .363 to Family #6 = .452) none of the families differ markedly from the others. Similarly across behaviours, some variability is evident (e.g., FCP = .348 to MFP = .463), but no behaviours appear deviantly high or low in magnitude of relatedness. One trend that is suggested is that parent to parent (FMP, FMI, MFP, MFI) and mother to child (MCP, MCI) behaviours are more highly related, while child (CFP, CFI, CMP) and father to child (FCP, FCI) behaviours are less highly related. When this pattern is applied to the data of the individual families, however, no families consistently fit the pattern.

Perhaps more noteworthy than consistency is the variability across families. No two families show the same pattern in magnitude of correlations. While MC behaviours have the highest correlations for Family #1, they have among the low-

Table 7: Regressions Reflecting Interdependence of Behaviours within Families

Behaviour	Family 1	Family 2	Family 3	Family 4	Family 5	Family 6	Average MR Across Families	
FMP	.273	.436	.422	.479	.468	.575	.442	
FMI	.299	.413	.417	.526	.441	.588		.447
FCP	.324	.279	.378	.452	.278	.379	.348	
FCI	.352	.353	.324	.477	.275	.452		.372
MFP	.359	.459	.525	.426	.518	.491	.463	
MFI	.328	.425	.492	.501	.364	.463		.429
MCP	.641	.353	.269	.401	.492	.470	.438	
MCI	.616	.366	.320	.472	.532	.444		.458
CFP	.316	.272	.317	.332	.374	.504	.353	
CFI	.372	.330	.368	.371	.400	.473		.386
CMP	.571	.306	.350	.369	.523	.297	.403	
CMI	.255	.362	.400	.378	.644	.293		.387
	.392	.363	.382	.432	.442	.452		

est correlations for Family #3. This speaks to the variability of interdependence in the interactional behaviour of different families.

Finally, a comparison of the average size of correlations across the two dimensions of Prosocial--Deviant and High-Low Involvement indicates no meaningful difference in degree of relatedness (mean for Prosocial--Deviant = .408, mean for High--Low Involvement =.413). When the correlations for individual families are examined, one family (#4) consistently shows higher correlations on the Involvement than the Prosocial--Deviant dimension; all other families show mixed dimensional salience.

In summary, the findings regarding the magnitude of correlations indicate that the families generally show moderately high levels of interdependence, that their interactional behaviour is about equally interrelated on the dimensions of Prosocial--Deviant and High--Low Involvement, and that there is marked variability in the magnitude of interdependence between interactants' behaviours within a family, and between families for the same interactants.

Nature of the Interdependence

Having determined that the interactional behaviours of family members are interdependent to a moderately high degree, investigating the nature of that interdependence becomes of interest. This can be done by examining the composition of the regression equations. Interpretation of a regression equation is straightforward when all the predictor variables are uncorrelated with each other. In the present study, however, as in virtually all research, the "predictor" variables are correlated with each other to varying degrees and interpretation of the regression equation becomes more complex. Several approaches for determining the "importance" of the predictor variables have been used in previous research and are discussed by Darlington (1968). The reader is referred to Appendix F for a further discussion of alternative approaches.

The approach adopted for the present study is similar to that recommended by Levine (1977) for the interpretation of canonical correlations. As indicated in greater length in Appendix F, direct interpretation of the component variables and weights of the regression equation fails to acknowledge those variables not entering the equation because of multicollinearity with variables already in the equation. On the other hand, variables that share relatively little variance with the composite but variance which is unique, may enter the equation, thus complicating interpretation. Instead, in the approach used here the five variable regression equation was regarded as an abstract composite which merely indicates how to calculate for maximum relatedness of the criterion variable. The meaning of the composite is then deciphered by correlating it with all predictor variables, not only those in the equation. These resultant correlations are termed structure coefficients and reflect how highly related each variable is with that portion of the criterion variable which is interdependent upon the "predictor" variables.

Examination of the variables in the regression equations indicated that a total of only 6% of the "predictors" were behaviours from time lags greater than two. That is, using the present procedures, most of the interdependence of the family interactants behaviour was accounted for within the first three time intervals. (Appendix F presents the standardized beta weights for variables entering the regression equations). Therefore, examination of the structure coefficients was restricted to all variables of those three time intervals and to those few variables in the regression equations of lags greater than two.

In order to condense these expanding data, the five variables with the highest structure coefficients were selected as representing the "meaning" of the regression composite, and, therefore, of the interdependence of the criterion behaviour. In summary, for each behaviour a regression equation with a maximum of five variables was obtained; correlations between this composite and all variables of the simultaneous, lag one and lag two intervals were calculated (structure coefficients); and the variables with the five highest correlations were selected for interpreting the nature of this composite. These procedures were followed for all 12 behaviours of all six families.

The presentation of the results necessarily needs to be limited, and the focus will be on identifying those patterns which seemingly generalize across all families. Even so, summarizing the results of individually analyzed data sets results in a somewhat cumbersome presentation, but one regarded necessary to support the generalizations made. Consequently, the results for each interactant for each behaviour stream (e.g., FMP, FMI, FCP, FCI) are presented in some detail first, followed by a brief summary for that interactant's behaviours, and finally a brief summary for all univariate regression results. The reader may then choose either to follow the detailed descriptions of the results or to skim the detailed results and attend more to the summaries.

The structure coefficients for the behaviour streams are presented in Tables 8-19, each table containing the results of all families for one behaviour. For all tables the variables are grouped so that the immediately reciprocal behaviours (e.g., mother-->father when FMP is the criterion behaviour as in Table 8) appear first, followed by the behaviours of the third person to the initiator (e.g., child-->father), and finally the behaviours of the recipient with the third person (e.g., mother-->child, child-->mother). The numerals at the end of the behaviour indicate their time interval, with zero (0) indicating concurrent behaviours, 1 indicating lag one behaviours, 2 indicating lag two. Reading across rows presents findings across families for each behaviour, while reading down columns presents findings for individual families.

Father Behaviours

FMP. Consideration of the values of Table 8 reveals a general pattern across families in the interdependence of

Insert Table 8 about here

behaviour FMP, father-->mother in the Prosocial--Deviant dimension. Behaviour FMP is highly positively related with the reciprocal MFP behaviour (indicated by the values of +.8, +.5, +.7, +.8, +.7, in the first row) and related, but with mixed directionality, with the MFI behaviours (values of -.3, +.6, -.6, -.4, +.5 in the second row) of both the concurrent and time-lagged intervals. Child-->father behaviours are generally negatively correlated in both dimensions with FMP (indicated by the negative values of the third and fourth rows). Child-->mother positivity again relates with mixed directionality (values of -.4, -.2, +.5, -.4, +.8, +.4). The other behaviours do not consistently correlate

Table 8

Size of Structure Coefficients for Variables Relating

to the Interdependence Composite of Behaviour FMP

	Family					
Variable	1	2	3	4	5	6
MFP0		.8	.7	.8		.7
MFP1		.5				
MFI0			.6	-.6		.5
MFI1	-.3					
MFI2					-.4	
CFP0		-.2		-.3		-.6
CFI0			-.5			-.6
CFI1			-.4			-.4
MCP0						
MCP3	-.4					
MCI0	-.3			-.3		
MCI1	-.4					
CMP0		-.4	.5	-.4	.8	
CMP1		-.2			.4	
CMI0					.8	
CMI1					.4	
CMI2	.3					

with the FMP composite. Family #5 is a clear exception to this pattern, with FMP primarily related to the child to mother behaviours, CMP (+.8, +.4) and CMI (+.8, +.4). For Family #1, the MF behaviours are again less important and FMP is largely related with the mother to child behaviours, MCP (-.4) and MCI (-.3, -.4). For the majority of families, however, when father behaves towards mother in a prosocial fashion, she is likely behaving towards him in a prosocial way and is either quite involved or uninvolved with him. In addition, the child is likely not highly prosocial or involved with father.

FMI. In similar fashion, degree of father's involvement with mother can be interpreted by examining Table 9. FMI is highly positively related with the reciprocal MFI, and also

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Insert Table 9 about here

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with MFP but again in both a positive and negative direction.[3] CF is generally negatively correlated with FMI on

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[3]This finding that the MF behaviours of the alternate dimension have both negative and positive correlations with the FM criterion behaviours is largely a reflection of the differing correlations between MFP and MFI for the different families (see Appendix G). As such it probably indicates frequent usage of particular behaviour categories that have different loadings on the two dimensions. The alternate dimension is likely also contributing some independent information, since different directions of correlation for the two dimensions of one behaviour (e.g., MFI+, MFP-) also occur when their overall correlation is positive (e.g., for MFP and MFI of Family #1 r = .474).

Table 9

Size of Structure Coefficients for Variables Relating to the Interdependence Composite of Behaviour FMI

	Family					
Variable	1	2	3	4	5	6
MFI0	.5	.9	.7	.9		.5
MFI1				.7		
MFP0	-.2	.3	.7	-.5		.5
MFP1	-.3		.4			
CFI0	.5		-.5			-.6
CFI1						
CFI3		-.3				
CFP0						-.7
CFP1		-.3				-.4
MCI0	.4	.4	-.4	.7	.5	
MCI1				.6		
MCP0						
CMI0					.5	
CMI1					.6	
CMP0					.8	
CMP1					.6	

both the prosocial and involvement dimensions for both simultaneous and lagged intervals, suggesting that high FMI may lead to reduced positivity and involvement from child to father. Unlike the findings for FMP where FMP was negatively associated with MC behaviours, FMI is generally positively related with mother's involvement with the child. Again, Family #5 deviates from this general pattern and FMI is highly negatively related with CF behaviours. But for most families when father is highly involved with mother, she is likely highly involved with both him and the child and is either quite prosocial or quite deviant in her behaviour towards father. The child is more likely behaving towards father in a low involvement and low prosocial way. When father is not highly involved with mother, she is likely not very involved with either him or the child, and it is more likely that the child would be prosocial and involved with the father.

FCP. Father's prosocial behaviour towards the child (FCP), as indicated in Table 10, is not highly related to

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Insert Table 10 about here

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its immediately reciprocal behaviour, CFP. Instead, FCP is highly positively related to CMI and negatively related to MFI, with this continuing for lag 1 MFI behaviours. CFI for some families is negatively related with FCP, as is MCI.

Table 10

Size of Structure Coefficients for Variables

Relating to the Interdependence Composite of Behaviour

FCP

Variable	1	2	3	4	5	6
CFPO		.5				
CFIO	-.5				-.5	-.3
MFPO			-.6			
MFP1		.2	-.5	.4	-.5	-.3
MFIO	-.3		-.7	-.6		
MFI1				-.4		-.4
CMPO	.4			-.5	.5	
CMP1		-.5				
CMIO	.3	.4	.6		.6	
CMI1			.7			
MCPO						.6
MCP1					-.5	-.3
MCIO	-.5	-.4		-.5		

The relatedness with MFP comes largely after one time lag, and is positive for some families, negative for others. Taken together, it appears that when father is highly prosocial towards the child, the child is involved with mother, although she is not likely highly involved with the child or with father. Alternately, when father is less prosocial towards the child, mother is more involved with father and she may be involved with the child, although the child is not very involved with mother. The correlations between FCP and mother's time-lagged behaviour towards father implies that her behaviour towards him may be in response to his behaviour towards the child.

FCI. Father's level of involvement with the child (FCI) can be interpreted by referring to Table 11. Again mother's

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Insert Table 11 about here

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behaviours seem to be the most highly related with FCI, with MCI positively related and MFP negatively related with FCI, and MFI primarily negatively related. These correlations again continue with mother's behaviour in succeeding time lags. FCI is less clearly related with CF behaviours but appears negatively related with CFP in the next time lag for two families, and is negatively related with CFI for some families, positively for others. Overall it appears that when father is less involved with the child, mother will

Table 11

Size of Structure Coefficients for Variables

Relating to the Interdependence Composite of Behaviour FCI

	Family					
Variable	1	2	3	4	5	6
CFIO	.4		-.4	.5		-.4
CFPO					-.5	
CFP1		-.3			-.7	
MFIO	.3	.7	-.4	.8		
MFI1				.7		
MFI2			-.5			
MFPO					-.6	-.3
MFP1	-.3				-.6	
MFP2			-.5		-.5	
MCIO	.6	.7		.8		.8
MCI1		.3		.6		
MCPO						-.4
CMIO	.4	-.3				
CMPO						.3
CMP4			.6			

also be less involved both with the child and perhaps with father and will be more prosocial towards father. In some families this may be followed by the child being more prosocial towards father in the next time interval.

As a brief summary for the father behaviours, the findings suggest that father's behaviours towards mother are primarily related to her reciprocal behaviours towards him and, to a lesser degree, negatively related to the child's behaviour towards father. Father's behaviours towards the child are not as immediately reciprocally related to child-->father behaviours as are his behaviours to mother. Instead, they again appear to be more related to mother's behaviours. More prosocial and involved behaviour of father to child are associated with less prosocial mother to father behaviour, and perhaps with more mother to child involvement. What this could be reflecting is a pattern of father relating reciprocally with mother and somewhat to the exclusion of the child. When the child establishes contact with father, the parents' interaction is interrupted and mother turns away from father more. When child and mother become more involved, however, father seemingly joins in, being both more positive and involved with the child.

Mother Behaviours

MFP. Mother's prosocial behaviour to father, as indicated in Table 12, is highly related to the reciprocal FMP

Insert Table 12 about here

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behaviour for the simultaneous and time lagged intervals and positively related with FMI. In addition, it is negatively related with CMI and CMP behaviours. For Families #1 and 5, MFP is less influenced by FM behaviours and more influenced by CF behaviours. For the majority of families, mother's being prosocial towards father occurs with and likely leads to his being prosocial towards her. In addition, it is more likely to be occurring when the child is being prosocial and less involved with mother. For two families (#1, 5), mothers prosocial behaviour towards father is less related with father's reciprocal behaviours in both directions, and more related with child's behaviour in both dimensions.

MFI. Table 13 presents the resulting structure coefficients for interpreting mother's level of involvement with father. MFI is again highly positively related with its

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Insert Table 13 about here

Table 12

Size of Structure Coefficients for Variables Relating to the Interdependence Composite of Behaviour MFP

Variable	Family 1	2	3	4	5	6
FMPO FMP1 FMP2		.8 .4 .3	.5 .4	.8		.8 .3
FMIO FMI1		.3	.5	-.6		.7 .3
CMPO CMP1	-.4				-.5	-.3
CMIO CMI1		 -.3	-.5		-.7 -.4	
CFPO CFP1	.5 .8				.7	
CFIO CFI1	.4 .6			-.3	.4	
FCPO			-.5	.3		
FCIO				-.4		

Table 13

Size of Structure Coefficients for Variables Relating to the Interdependence Composite of Behaviour MFI

Variable	Family 1	2	3	4	5	6
FMI0	.5	.8	.5	.9		.6
FMI1			.5		-.5	
FMP0		-.1	.5	-.5		.7
FMP1					-.5	
CMI0			-.5			
CMP0	-.5					
CMP2		.3				
CFI0	.5			.4	.8	.2
CFI1	.5				.7	
CFI6		.2				
CFP0					.6	.3
FCI0		.6		.8		-.3
FCP0	-.4		-.5	-.4		

reciprocal behaviour FMI and less clearly related (mixed directionality) with FMP. It is also highly positively related with CFI for simultaneous and lagged intervals, and negatively related with FCP. Family #5 is again an exception regarding the influence of father's behaviours, with FM behaviours being negatively related with the criterion MFI. For most families, these results mean that when mother is highly involved with father, he is also highly involved with her and is less prosocial towards the child. This pattern of mother-father behaviour occurs with and may be followed by greater involvement of the child with the father.

MCP. Table 14 presents the results regarding mother's prosocial behaviour towards the child. The typical pattern

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Insert Table 14 about here

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for four of the families (#1, 2, 4, 5) is one where MCP is negatively related with CMI and CFI and positively related with CMP in simultaneous and time-lagged intervals. For the other two families, MCP is more highly related with father behaviours, being negatively related with FMP and FMI (#3), or negatively related with father involvement behaviours FMI and FCI and positively related with the prosocial behaviours FCP and CFP (#6). For the majority of families when mother is less prosocial towards the child, the child will be more involved with both mother and father and will continue to be

Table 14

Size of Structure Coefficients for Variables Relating to the Interdependence Composite of Behaviour MCP

	Family					
Variable	1	2	3	4	5	6
CMPO	.7			.5		
CMP1	.7					
CMP2	.5					
CMIO	-.2	-.8		-.6	-.6	
CMI1		-.4		-.2	-.3	
CMI2					-.2	
FMPO			-.6			
FMP1			-.5			
FMIO			-.6			-.5
FMI1			-.5	-.2		
FCPO					-.2	.5
FCIO					-.3	-.4
CFPO						.5
CFIO	-.2	-.5	.5	-.3		.5
CFI1		-.4				
CFI2		-.4				

so for at least one time interval, and is likely to be less prosocial towards mother. For the other families, mother is more prosocial towards the child when father is less prosocial and less involved with her (Family #3), or when father is less involved with both mother and the child and he is more prosocial to the child, and the child is more positive towards father (Family #6).

MCI. The structure coefficients for mothers level of involvement for the child are presented in Table 15. MCI

Insert Table 15 about here

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appears positively related with FCI and CMI. Few other findings are common to a majority of families. Instead, the other behaviours related to MCI appear idiosyncratic to the individual families. In general, it seems that mother is highly involved with the child when father is also involved with the child and when the child is involved with mother. Beyond that mother's level of involvement with the child determines or is determined by different behaviours for each family.

As a brief summary of mother's behaviours, it appears that her behaviour towards father is, like his to her, largely related to the reciprocal FM behaviours. To a lesser extent, her behaviours towards father are interdependent

Table 15

Size of Structure Coefficients for Variables Relating to the Interdependence Composite of Behaviour MCI

	Family					
Variable	1	2	3	4	5	6
CMI0			.6	.5	.9	-.3
CMI1					.7	
CMI2					.4	
CMP0	-.7		.5		.5	
CMP1	-.5				.4	
CMP2	-.3					
FMI0		.4	-.4	.8		-.4
FMP0						
FCI0	.4	.6		.8		.8
FCI2				.5		
FCP0	-.2	-.4				
FCP1			.5			
CFI0		.5		.5		
CFI1		.3	-.4			
CFP0						.4
CFP1						.4

upon child behaviours, being negatively related for prosocial behaviours and positively for involvement behaviours. Again it may be that the parental interaction occurs when the child is not engaging with either parent; but when the child interacts with mother, her interaction with father is discontinued. The finding that mother's behaviours towards father are related to his lagged reciprocal behaviours may indicate the importance of MF behaviours in influencing FM behaviours. That is, that mother's behaviours cue father's behaviours. Mother's behaviours toward the child are more difficult to summarize because they are less consistent across families. For some families, mother's prosocial behaviour towards the child relates primarily to the child's behaviour towards mother and father; for other's it relates more to fathers behaviours to mother and the child. There is again, however, the finding that the parent's level of involvement with the child, in this case mother's, is highly interdependent upon involvement behaviours of the rest of the triad. It may be that the family operates more triadically in terms of involvement (e.g., playing a game together) but that contingencies in positivity are more apparent in dyads.

Child Behaviours

CFP. The interdependence of the child's prosocial behaviour towards father, as presented by the structure

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Insert Table 16 about here

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coefficients in Table 16, is difficult to interpret across families. CFP appears negatively related with FMI and related, but with mixed directionality, with FMP and MFP. Its interdependence with the father to child behaviours is not generally apparent. Instead, individual patterns can be deciphered. For Family #6, CFP is largely determined by FM behaviours, for #5 by MF behaviours. Family #2 presents the only case where the largest coefficients for CFP appear in behaviours directed toward the child (FCP and MCP), while for families #1, 3, and 4, CFP is primarily related to FM and MF behaviours. This relation with behaviours between the parents is also highly evident in the time-lagged intervals, possibly suggesting that the CFP behaviours are influencing these prosocial and involvement behaviours between the parents.

CFI. Table 17 presents the results indicating the interdependence nature of the child's involvement with father.

Insert Table 17 about here

Table 16

Size of Structure Coefficients for Variables Relating to the Interdependence Composite of Behaviour CFP

	Family					
Variable	1	2	3	4	5	6
FCPO		.5	−.5	.3		
FCIO						
MCPO		−.5				
MCIO		.2				
MCI1				−.3		
MCI3						
MFPO	.5	−.2	.5	−.3	.9	
MFP1	.3				.9	
MFP2	.2				.8	
MFIO			.5			
MFI1					.8	
MFI2					.7	
FMPO		.2		−.4		−.7
FMP1			−.5			−.7
FMP2				−.5		
FMP4	.7					
FMIO	−.8					−.8
FMI1			−.5			−.7
FMI2						−.5

Table 17

Size of Structure Coefficients for Variables Relating to the Interdependence Composite of Behaviour CFI

	Family					
Variable	1	2	3	4	5	6
FCIO	.4			.6		
FCI1				.6		
FCPO	-.4					
FCP4	.6					
MCIO		.6		.7		.5
MCI1		.4				
MCI2				.6		
MCPO		-.6				
MCP1		-.4				
MCP2		-.3				
MFIO	.2			.6	.7	
MFI1					.5	
MFI2					.5	
MFPO	.4				.6	
MFP1					.5	
FMIO			-.5			-.7
FMI1			-.8			-.5
FMPO			-.5			-.6
FMP1			-.8			-.4
FMP2			-.6			

For two families (#3, 6), CFI is highly and negatively related with FMI and FMP for simultaneous and lagged times. For the other families, CFI was positively related with MCI, MFI, and FCI. Again, the immediately reciprocal behaviour (FCI) is not a generally important "predictor" for CFI. On the whole, these results again indicate considerable idiosyncrasy in the interdependence of CFI. For some families, the child's being less involved with father occurs with and likely influences father's being more involved and more prosocial with mother. For the majority of families, when the child is involved with father, mother is involved with both father and the child and father is involved with the child.

CMP. Child's prosocial behaviour towards mother demonstrates few commonalities across families, as indicated in

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Insert Table 18 about here

Table 18. CMP seems most clearly related positively with FMI and less clearly with MCI. Its reciprocal, MCP, is meaningfully related for two families (#1, 4), while FMP is an important variable for most families but correlates positively with CMP for some families and negatively for others. Again patterns unique to individual families are apparent, with MC behaviours being the most important variables for Family #1 and FM behaviours for Families #5 and 6. The generalities that are indicated across families suggest that

Table 18

Size of Structure Coefficients for Variables Relating to the Interdependence Composite of Behaviour CMP

Variable	1	2	3	4	5	6
MCPO	.8			.5		
MCP1	.6					
MCP2	.6					
MCIO	-.8		.6		.5	
MCI2	-.4	.3				
FCPO			.4	-.5		
FCP2			.4	-.2		
FCIO						
FCI1						
FMPO		-.6	.6	-.3	.8	
FMP1					.6	.8
FMP2				-.5		.7
FMIO			.5		.7	.5
FMI1		-.4			.7	.8
FMI2						.8
MFPO						
MFP4		.4				
MFIO						
MFI1		-.2				

the child's being prosocial towards mother occurs with and possibly influences father's being involved with mother, and for some families, with mother's being involved with the child or with her being prosocial towards the child.

CMI. Table 19 presents the structure coefficients for

Insert Table 19 about here

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interpreting the interdependence of child's level of involvement with mother. CMI is seen to be generally positively correlated with MCI and generally negatively correlated with MCP and MFP. This indicates that the child is most likely involved with the mother when she is also involved with the child and is not behaving prosocially towards father. Considerable variability is again evident across families and these interpretations must be regarded as tentative.

Perhaps the most important finding regarding the child's behaviour is that its interdependence upon other behaviours is more variable across families than was the case for either father or mother's behaviour, despite the finding that the child's behaviours are not meaningfully less predictable than mother's or father's. Underlying this at least in part is the finding that reciprocal behaviours play a much less important role in interpreting the interdependence

Table 19

Size of Structure Coefficients for Variables Relating

to the Interdependence Composite of Behaviour CMI

Variable	1	2	3	4	5	6
MCI0 MCI1		 .4		.7 .7	.7 .6	−.5
MCP0 MCP1	−.4	−.7 −.4		−.7		
FCI0 FCI2	.6	−.3				 −.4
FCP0 FCP8		 .4	.6			
FMI0 FMI1	.3 .5				.6	
FMP0 FMP1	 .4				.6	
MFI0 MFI1			−.6 −.6	.6 .6		−.2
MFP0 MFP1			−.6 −.6		−.6	.5 −.3

structure of the child's behaviour than the parents'. The child's behaviour is seemingly more related with the behaviour between the other two interactants (i.e., the parents). Since this relationship is evident in the parents' lagged behaviours, it appears that the child is not only responding to parental interactions, but likely also influencing them.

Summary of Interdependence Results. In addition to the more specific patterns of results through which the reader has just waded, several overall generalizations can be observed. Perhaps so apparent as to not need mention is the finding that all interactants' behaviours were interdependent upon all other interactants' behaviours. This includes not only the behaviours of the other two interactants as directed towards the target interactant, but also the behaviours between those two other interactants. Second, that the parents' behaviours between themselves are highly interdependent upon the reciprocal behaviours, but that the child's behaviours are largely interdependent upon the parent to parent behaviours and not upon the reciprocal parent to child behaviours. And finally, the results indicate that behaviours on both the Prosocial--Deviant and the High--Low Involvement Dimensions are moderately highly interdependent.

Multivariate Regression

The preceding univariate analyses allowed for the examination of the interdependence of a single dimension of an interactant's behaviour with behaviours of the other interactants. Canonical variate analysis (CVA) allows us to simultaneously consider both dimensions of the interactant's behaviour in examining the interdependence. There are at least two reasons why this might be important in the present study. First, it is this multidimensional "package" of behaviours that represent what that person is actually doing.[4] Second, it is the behaviour combined across dimensions that is employed in the lag sequential analyses. To facilitate interpretation to those procedures, the correlational procedures might most usefully be conducted by simultaneously considering both dimensions.

Since the results of the univariate regressions had indicated that all behaviour streams seemed important but that much of the "predictable" variability was accounted for by the second time lag these were the variables entered as the "predictor" variable set. For each family six canonical correlations were performed (3 interactants X 2 directions), with two criterion variables (2 dimensions) and 24 "predictor" variables (2 interactants X 2 directions X 2 dimensions

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[4]Simultaneous consideration of both dimensions in both directions of one interactant (e.g., FMP, FMI, FCP, FCI) might be seen as representing this even more fully, but would make interpretation to the lag sequential analyses more difficult.

X 3 time points). Because of its supplementary output, Version VI of the Multivariance computer program (Finn, 1977) was used for calculating these correlations. The presentation of these results is organized into three sections: one dealing with the number of significant correlations, the second with the increase in (parsimony of) predictability, and finally the interpretation of the interdependence. The emphasis in presentation will be on those areas where CVA provides information additional to that from the univariate regressions.

Number and Magnitude of the Canonical Correlations

The CVA results were examined in two ways. First, the number of significant canonical correlations were determined. This indicates whether one or two shared traits would need to be controlled to make the dependent variable set unrelated to the independent variable set.[5] Second, the amount of variance accounted for in the dependent variables was calculated for each canonical correlation to determine whether the joint consideration of both dimensions could boost the "predictability" beyond that of the univariate regression. These procedures will be explained more fully in a later section.

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[5]Some of the terminology used here is borrowed from Darlington (1973). The reader is referred to this paper for a most readable and useful discussion of canonical variate analysis.

Number of Correlations. Table 20 presents the size of the squared canonical correlations as calculated for each

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Insert Table 20 about here

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behaviour in each family.[6] Significance of the correlations has been calculated using Bartlett's chi-square approximation with 48 (k X m) degrees of freedom for the first correlation, and 23 ((k -1)(m -1)) degrees of freedom for the second. As indicated in the table, in all cases the first canonical correlation is highly significant and for all but 10 cases the second canonical correlation is also significant at at least the .05 level. This latter result is perhaps the more important: that for the majority of behaviours two unique traits can be identified as being shared by the dependent and the independent variable sets. Stated in another way, if we wished to eliminate the interdependence between one interactant's behaviour on both dimensions and the behaviours of the other two interactants, we would typically need to control for not just one, but two traits which link the two sets of variables.

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[6]It is important to note that these squared correlations represent the amount of overlap between the paired canonical variates, and do not represent the amount of variance accounted for in either the dependent or the independent variables set.

Table 20

Squared Canonical Correlations Between the Two Dimensions of an Interactant's Behaviour and the Behaviours of the Other Two Interactants

Behaviour		Family 1	2	3	4	5	6
FM:	$CC1^2$	.25	.40	.32	.34	.24	.45
	$CC2^2$	.05*	.20	.18	.23	.11	.21
FC:	$CC1^2$	.25	.24	.19	.32	.24	.25
	$CC2^2$	.09*	.16	.11	.13	.08*	.18
MF:	$CC1^2$	.19	.41	.34	.28	.54	.27
	$CC2^2$	.12	.19	.11*	.19	.21	.21
MC:	$CC1^2$	.51	.19	.16	.28	.46	.28
	$CC2^2$	.19	.17	.10*	.22	.13	.21
CF:	$CC1^2$	.19	.17	.20	.25	.36	.39
	$CC2^2$	.09*	.12	.13	.19	.17	.10*
CM:	$CC1^2$	.55	.18	.30	.23	.42	.16
	$CC2^2$	.10*	.11*	.19	.19	.31	.12*

* correlations <u>not</u> reaching at least $p < .05$ level of significance.

Increased "Predictability":. A second way in which CVA may add information, above and beyond that obtained through the univariate regressions, is in accounting for variance in the set of criterion variables more parsimoniously. More specifically, by simultaneously considering both dimensions of a behaviour we may account for more variance in the dependent variable set than that accounted for by either of the dimensions considered separately.

The amount of criterion or dependent variables (DV) variance accounted for by a variate was calculated by squaring the structure coefficients of each variable, multiplying these values by the squared canonical correlation and then summing these values for the two dependent variables. (The reader is referred to Levine (1977) and Cooley and Lohnes (1971) for more information on this procedure.) To the extent that this variance exceeds the variance accounted for through either of the corresponding univariate regressions, the multivariate approach can be seen as providing additional "predictability".[7]

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[7]Strictly speaking, the amount of variance accounted for in the dependent variables is a fixed quantity and is identical in the univariate and multivariate regressions. This can be verified by summing for a dependent variable the amount of variance accounted for by each of the canonical variates. These sums will always equal the amount of variance accounted for by the univariate regression. What the multivariate regression does do is provide the opportunity for accountable variance of both dependent variables to load onto one canonical variate, thereby increasing the predictive power of that variate.

These estimates of amount of DV variance accounted for were calculated for all canonical correlations. Comparisons were made between these shared variances and those derived from univariate regressions employing the same 24 independent variables. These results are presented in full in Appendix H, but Table 21 presents a brief summary.

Insert Table 21 about here

The values indicate the canonical variates which accounted for at least .05 more of the DV variance than either of the univariate regressions (e.g., FM:CV1 > .40 if R for FMP or FMI < .35). For 17 of the 36 behaviours, more variance of the dependent variable set was accounted for when both dimensions were considered simultaneously than when either was considered separately.[8] In some instances, this increase was very large (e.g., Family #6, FM=.417; Family #1, MC=.326). No pattern in this boost in predictability is evident, since it is seen to occur in different behaviours for different families.

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[8]This increase in predictability typically occurred on the first canonical variate as might be expected, since the first canonical correlation must be the greater. Interestingly, in two cases (Family #3 CM, and #4 CF) it was the second variate that showed the boost in predictability, illustrating that size of canonical correlation is not equivalent to amount of shared variance with the dependent variable set.

Table 21

Canonical Variates which Meaningfully Increase the Predictability of the DV Variance Relative to the Largest Univariate Regression

Behaviour		Family 1	2	3	4	5	6
FM:	CV1		.061	.089	.180	.218	.417
	CV2						
FC:	CV1	.065			.197		
	CV2						
MF:	CV1		.063	.232	.057		.186
	CV2						
MC:	CV1	.326	.117			.213	
	CV2						
CF:	CV1					.146	.247
	CV2				.106		
CM:	CV1					.159	
	CV2			.147			

The value indicates the difference between the variance accounted for by the canonical correlation and the variance accounted for by the largest multiple correlation. Only values greater than .05 are reported.

Nature of the Canonical Variates:

In the deriving of the canonical variates, both the dependent and the independent variable composites are free to vary in order to maximize correlation. This makes summarizing across variates for different families difficult.

A somewhat crude method was used to look for patterns. The relation between the two structure coefficients of the dependent variables relating to each canonical variate were examined. Coefficients less than .30 were ignored. These relations could be classified into one of four types: (1) where both variables were relating positively to the variate and the smaller was at least half as large as the bigger (B), (2) where the variables were being contrasted, both being sufficiently large but with positive and negative correlations (C), (3) where only one variable was correlating meaningfully (i.e., $r > .30$, and twice as large as the second), (O), and (4) where neither variable related meaningfully to the variate (N). Of the 72 variates, 27 had high positive correlations with both variables, 16 were based on contrasts between the variables, 27 used only one dimension and 2 related to neither meaningfully. The reader is referred to Appendix I for tabled results and for pictoral illustrations of these relationships between behaviours. These relations were examined relative to type of behaviour, to importance in accounting for variance, and with respect to intercorrelation between the two dependent variables. No consistent patterns could be detected across families.

Whether or not these canonical variates differed in nature from the five-predictor univariate variates which have already been summarized was also investigated. When the behaviours having the five highest structure coefficients for the canonical variate were examined, it was typically found that most of them (4-5) also had high coefficients on one or both of the univariate variates. That is, few new behaviours were coming in to account for the DV variance. Those new behaviours entering were frequently of greater time lag, reflecting the different procedures in entering the variables in stepwise hierarchical fashion.

Although there is difficulty in generalizing across families, the canonical variates can be meaningfully interpreted for individual families. The nature of these variates describes the interdependence of interactants' behaviours by expressing it in terms of both prosocial deviance and level of involvement. This is a more complete description than that obtained by the univariate regression results and it allows for prediction to particular behaviour categories as defined by both dimensional values. The data for Family #6 were selected to demonstrate this. (These data were also previously used for the cross-validational analyses.) Summary results of the canonical variate analyses of this family will be presented in the text, while more detailed results are presented in Appendix J. The tables in the text present the amount of variance accounted for in the dependent variable set, the value of the squared canonical correlations, the structure coefficients for the two dependent variables, and the structure coefficients for the five highest independent variables with the alternate dimension coefficient indicated in parentheses. Values for variates not interpreted here will not be tabled in the text but do appear in the appendix.

Father Behaviours

FM:. As seen in Table 22, the squared canonical correlations for father to mother behaviours are .455 and .211 for correlations 1 and 2 respectively. The first canonical

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Insert Table 22 about here

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variate accounts for 87% of the variance of the dependent variable set while the second accounts for less than 2%. Therefore only the variates for the first canonical correlation will be interpreted. In the dependent variable set, both FMP and FMI are highly positively related to this variate (.960, .996), indicating that highest interdependence is realized when the sum of the two dimensions of the behaviour is considered (B-type relation). Low prosocial/low involvement behaviours would get lowest values while high prosocial/high involvement behaviours would receive the highest scores. In examining the structure coefficients of the

Table 22

Summary Results of the Canonical Correlations

for Father Behaviours (Family #6)

FM: Squared Canonical Correlations: 1 = .455 2 = .211
DV Variance Accounted for: 1 = .870 2 = .018
Structure Coefficients:

Dependent Variables	CV1	CV2
FMP	.960	-.281
FMI	.996	.091
Independent Variables:		
MFPO	.501	
MFIO	(.466)	
CFPO	-.566	
CFIO	-.505	
CFP1	-.568	
CFI1	(-.494)	
CFP2	-.561	
CFI2	(-.427)	

FC: Squared Canonical Correlations: 1 = .245 2 = .180
DV Variance Accounted for: 1 = .254 2 = .173
Structure Coefficients:

Dependent Variables	CV1	CV2
FCP	-.236	.972
FCI	.991	.136
Independent Variables		
MCPO	-.445	.470
MCIO	.724	(.097)
MCP2	-.252	
MCI2	(.002)	
CFPO	(-.097)	(-.161)
CFIO	-.351	-.387
CFP1	(-.054)	-.312
CFI1	-.261	-.401
MFP1		(-.257)
MFI1		-.346

independent variables, we see that high prosocial/high involvement FM behaviours frequently occur with MF prosocial behaviours (MFPO = .501), and with low prosocial/low negative CF behaviours which then continue for two time lags (CFPO, CFIO, CFPI, CFI1, CFP2, CFI2). Possible behaviour categories reflecting this, taking into consideration the behaviours used by this family (Appendix D), might be Attention (AT: P=5, I=5) or Receive (RC=6,5); and for low prosocial/low involvement behaviours, No Attention (NA=2,1). Then, father not attending to mother might occur with mother not attending to father and lead to high prosocial/high involvement child to father behaviours such as Talk or Attention.

FC:. Father to child behaviours are not highly related with others' behaviours, as reflected by the smaller amount of DV variance accounted for, and their relatedness occurs in two distinct ways as reflected by the two canonical correlations which are about equally valuable in accounting for the DV variance. The first variate essentially reflects the Involvement dimension (FCP=-.236, FCI=.991) and is positively related with MCIO (.724), negatively with MCPO (-.445) and with CFIO (-.351), CFI1 (-.261), and MCP2 (-.252). The alternate dimensions of these behaviours (i.e., CFPO, CFP1, and MCI2) do not appear to be important. These results indicate that fathers' low involvement with the child occurs with mother's high prosocial/low involvement with the child, and occurs with and is followed by the child's high involvement with father. Mother's prosocial behaviour to the child is again evident two time intervals later. This could have predictive potential for the lag sequence analyses, although the relatively small amount of variance accounted for may limit its usefulness. A behavioural pattern which might depict this would be father working (WK=4,2) while mother is laughing with the child (LA=5,2), and the child then talking (TA=4,5) to father.

The second FC variate reflects the Prosocial--Deviant dimension (FCP=.972, FCI=.136), and is positively related with MCPO (.470) and negatively with CFIO (-.387), CFI1 (-.401), MFI1 (-.346), and CFP1 (-.312). High prosocial behaviour from father to child occurs with prosocial mother to child behaviour and with low child involvement with father. In the next time interval the child will continue to be relatively uninvolved and not prosocial towards father, and mother will also be uninvolved and not highly prosocial towards father. An example of this would be mother and child conversing with each other while father looks on but is not attended to by the others.

Mother Behaviours

MF:. The CVA results of mother's behaviours are reported in Table 23. Again the first variate accounts for most

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Insert Table 23 about here

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of the "predictable" variance of the dependent variable set (46%), and the second variate (7% of DV variance) will not be interpreted. Maximum predictability of the MF behaviours comes by considering the sum of their scores, with high prosocial/high involvement behaviours at the end of the continuum and low prosocial/low involvement behaviours at the other end. These behaviours are positively related to FMP and FMI at lags zero and two, and negatively related to FCIO and CMIO. That is, mother's being highly prosocial and involved towards father would be occurring at the same time that father was highly positive and involved with mother, and when he was not very involved with the child and the child was not very involved with mother. Father's prosocial and involved behaviour to be evident at time lag 2. Possible behaviour categories to reflect this would be mother and father talking and attending to each other (TA=4,5; AT=5,5) while father was not attending to child and child was not attending to mother.

Table 23

Summary Results of the Canonical Correlations

for Mother Behaviours (Family #6)

MF: Squared Canonical Correlations: 1 = .271 2 = .206
DV Variance Accounted for: 1 = .455 2 = .066
Structure Coefficients:

Dependent Variables	CV1	CV2
MFP	.990	.143
MFI	.837	.547

Independent Variables	CV1
FMPO	.734
FMIO	.596
FMP2	.245
FMI2	.237
FCPO	(-.014)
FCIO	-.257
CMPO	(.027)
CMIO	-.328

MC:. The canonical correlation for mother's behaviour towards child did not improve the "predictability" of her behaviour. The canonical variates accounted for 27% (CV1) and 22% (CV2) of the dependent variable set variance and the univariate regressions also accounted for 27% (MCP) and 22% (MCI) of the variance. Since the interpretation of the canonical variates is less clear than the univariate regressions, (structure coefficients of MCP=.912, MCI=.359 for variate 1 and MCP=-.411 and MCI=.219 for variate 2), the canonical variates will not be interpreted and the reader could refer back to the univariate regression results for this family.

Child Behaviours

CF:. Child's behaviour towards father can be described parsimoniously by the first canonical correlation which accounts for 59% of its variance (see Table 24). The second

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Insert Table 24 about here

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variate adds little new information (5% of DV variance). Again, this important variate reflects a prosocial plus involvement trait (CFP=.825, CFI=.918) and is highly negatively related with father's behaviour towards mother on both the prosocial and involvement dimension. That is, when child is highly involved in a prosocial way with father,

Table 24

Summary Results of the Canonical Correlations

for Child Behaviours (Family #6)

CF: Squared Canonical Correlations: 1 = .385 2 = .097
DV Variance Accounted for: 1 = .587 2 = .046
Structure Coefficients

Dependent Variables	CV1	CV2
CFP	.825	-.565
CFI	.918	.396

Independent Variables	CV1
FMPO	-.607
FMIO	-.659
FMP1	-.587
FMI1	-.649
FMP2	(-.574)
FMI2	-.616

CM: Squared Canonical Correlations: 1 = .160 2 = .125
DV Variance Accounted for: 1 = .165 2 = .121
Structure Coefficients

Dependent Variables	CV1	CV2
CMP	.748	-.664
CMI	.687	.727

Independent Variables	CV1	CV2
FMPO	(.224)	
FMIO	.343	
FMP1	.398	-.475
FMI1	(.336)	-.528
FMP2	(.292)	-.433
FMI2	.379	-.474
MFPO		-.371
MFIO		(-.276)
MCPO	(-.264)	
MCIO	-.350	
MCP2	(-.135)	
MCI2	-.412	

father will be behaving towards mother in a low prosocial/low involvement way and will continue to be less involved and less prosocial towards her for at least two time intervals. This strong and unambiguous relationship between CF behaviours and FM time-lagged behaviours may reflect a causal relationship between CF and FM behaviours. For example, child's playing with father (PS=5,4) would increase the likelihood of father not attending to mother.

CM:. Results of the CM canonical correlations are also presented in Table 24. Although these results do not describe the data in a more parsimonious fashion than the univariate regressions, (DV variance accounted for is CV1=.1646, CV2=.1214 compared with MRs of CMP=.1445, CMI=.1415), they are presented here for their interpretive interest. As an instance of one dependent variate combining the scores in a summative fashion (B-type) and the other dependent variate contrasting the two dimensions (C-type), they are representative of the results of many of the other families' variates. The first canonical variate again combines the dimensions in a summative fashion (CMP=.748, CMI=.687) so that high prosocial/high involvement behaviours represent one end of the continuum, low prosocial/low involvement the other end. These CM behaviours are positively related to FM behaviours in both dimensions for concurrent and lagged intervals 1 and 2, and negatively related to MC behaviours in both dimensions. The child is more likely to be prosocial and involved with mother when father is also prosocially involved with her and continues to be so, and when mother is less prosocial and involved with the child. The kind of interaction which would exemplify this would be the child talking to mother (TA=4,5) and father talking to her as well, mother not attending to child (NA=2,1), and father continuing to talk to mother.

The second canonical variate represents those behaviours which differ in scale values along the two dimensions (CMP=-.664, CMI=.727) with high involvement/low positivity representing one end of the continuum, and high involvement/low positivity representing the other end. These behaviours are negatively correlated with MFP and MFI behaviours at lag 0, and FMP and FMI at time lags 1 and 2. That is, low prosocial/high involvement CM behaviours occur with low prosocial/low involvement MF behaviours and are followed by low prosocial/low involvement FM behaviours. An example might be child expressing disapproval towards mother (DI=1,5) while mother is not attending to father (NA=2,1) and father subsequently not attending to mother. Conversely, high prosocial/low involvement CM behaviours occur with high prosocial/high involvement MF behaviours and are followed by high prosocial/high involvement FM behaviours. This might be represented by child playing individually with respect to mother (PI=4,2), while mother and father talk and attend to each other for a short time (TA =4,5; AT=5,5).

Summary of Multivariate Results. There are several general findings of the CVA results which merit summarizing. From the number of significant correlations it was seen that two orthogonal traits are typically shared by the dependent and independent variable sets. In addition, the simultaneous consideration of both dimensions of an interactant's behaviours can increase the predictability of one variate. This makes accounting for DV variance more parsimonious. Finally, as was demonstrated with one family's data, CVA can make interpretation of the nature of the interdependence more meaningful by describing an interactant's behaviour in both dimensions. This allows for particular behaviour categories to be identified as possibly representing these interactional patterns.

Lag Sequential Analysis

This final stage of analysis was intended to identify recurrent chains of behaviour in the ongoing behaviour streams. Since the lag sequential analysis (LSA) is applied to the data in its categorical form, these chains are spelled out in terms of concrete categories. This has the advantage of providing more immediate interpretability than the continuously coded correlational analyses.

To review briefly, the procedure (for lag 1) involves comparing the probability of behaviour B occurring given that behaviour A occurred in the previous time interval (p(B/A)) with the base rate probability for behaviour B (p(B)). These conditional probabilities are tested for greater than chance differences using the binomial test Z-score. Behaviours B and C may be identified as having the highest Z-scores at lags 1 and 2 respectively. A second step in the procedure is then to ensure that C shows a high conditional probability at time lag 1 following behaviour B (see Bakeman & Dabbs, 1976; Gottman & Bakeman, 1979). Increased probabilities for selected behaviours were tested for lags 0 to 4. Roger Bakeman's JNT4 computer program (Bakeman, 1976) for timed-multiple event sequence data was used to compute the joint frequencies, the marginal probabilities and the Z-scores.

Given the multitude of potential chains of behaviour, the selection of the initiator (A) behaviours required careful consideration. Two approaches were used. The correlational analyses helped indicate which behaviour categories might be important, as will be described below. In addition, categories of more theoretical interest were also selected for initiator behaviours. The results of the sequential analyses will be presented in three sections. The first describes the procedures for selecting the initiator based on the correlational results, and the categories which occur with and follow after it more frequently than chance. The second section presents the results of attempting to validate the intermediate links (i.e., B-->C), and the erroneous inferences that may be drawn. The final section presents the sequence analysis results of initiators selected on the basis of theoretical interest.

Correlation Inferred Initiators

The data for Family #6 were used in these analyses. From the canonical correlation results for this family, two behaviour streams, FM and CF, were selected for examination. Both of these streams could be described parsimoniously by one canonical variate which accounted for a large portion of the DV variance, 87% and 59% respectively. The composition of both of these variates was summative (B-type) in which it was the sum of the prosocial and involvement values that shared high interdependence with other interactant's behaviours. Behaviour categories scoring at the high end of this continuum include Attention (AT=5,5), Talk (TA=4,5), Play Social (PS=5,4) while categories at the low end include No Attention (NA=2,1) and self stimulate (SS=2,1). The categories selected for FM were AT and NA, and for CF were TA and NA. They are the categories used most frequently which represent the two ends of the variate continuum.

FM Initiators:. The canonical correlation results had indicated that a high score on this P+I composite for FM was positively correlated with MFP and MFI at the simultaneous time interval and negatively with CFP and CFI at the simultaneous, lag 1 and lag 2 times. Therefore, we would expect

FM AT to be occurring with highly positive and involved MF behaviours, and to be occurring with and followed by low prosocial/low involvement CF behaviour. The sequential analysis results for FM AT are summarized in Table 25. Listed are behaviours obtaining a Z-score greater than ± 1.96[9] and are organized in the table such that behaviours relevant to the correlational "prediction" are listed above the line, others below. The bottom row indicates the likelihood

Insert Table 25 about here

that FM will continue for the next time interval. A positive Z-score indicates significantly greater than chance occurrence, while a negative score indicates significantly less frequent than chance occurrence (Z ± 1.96 indicates $p<.05$ assuming a normal distribution).

The sequential analysis results for FM AT substantiate the correlational results well. The MF behaviour with the greatest conditional probability of occurring is Work (Z-score =.427). Although WK is not a high prosocial/high involvement behaviour in an absolute sense (WK=4,2), it is a relatively high P+I behaviour given this mother's propensity to demonstrate No Attention to father (frequency of MF NA =

[9]To facilitate presentation, behaviours obtaining a z-score greater than +1.96 based on a frequency of only 1 are not included in this table. These are MC Command, MF Receive, CM Command, and CM Play Individual.

Table 25

Behaviours Occurring Significantly often with or Following

FMAT (Frequency=17%)

Time Lag 0	1	2	3	4
MFWK (4.27)	MFWK (4.35)	MFWK (3.06)	MFWK (3.06)	MFWK (3.52)
MFNA (-2.73)	MFNA (-2.83)			MFNA (-2.01)
CFNA (10.33)	CFNA (10.00)	CFNA (9.20)	CFNA (7.81)	CFNA (6.88)
CFTA (-5.79)	CFTA (-4.90)	CFTA (-3.99)	CFTA (-2.93)	CFTA (-3.46)
CFRC (2.84)				
MCAT (-7.24)	MCAT (-5.57)	MCAT (-5.46)	MCAT (-4.66)	MCAT (-5.20)
MCTA (6.76)	MCTA (4.86)	MCTA (4.10)	MCTA (4.10)	MCTA (3.52)
MCWK (3.11)	MCWK (4.85)	MCWK (5.49)	MCWK (4.36)	MCWK (5.49)
CMAT (6.59)	CMAT (6.21)	CMAT (6.30)	CMAT (6.78)	CMAT (5.35)
CMTA (-3.46)	CMTA (-2.71)	CMTA (-2.81)	CMTA (-3.40)	CMTA (-3.46)
CMPP (2.84)			CMPA (2.91)	CMPA (2.15)
CMAP (2.09)				
	FMAT (10.69)	FMAT (9.45)	FMAT (9.45)	FMAT (8.75)

The numbers in parentheses indicate associated z-score values.

75%). And, in fact, she uses NA significantly less often (Z-score for MF NA = -.273) when father is attentive towards her at the same time. The CF behaviour is, as predicted, low in positivity and involvement, with the highest conditional probability for No Attention to be occurring (Z=10.33) and for Talking not to be occurring (Z=-5.79). This CF behaviour following FM Attention persists through all 4 time lags investigated.

Also meriting special attention are those behaviours below the line in the table, those behaviours not anticipated by the results of the correlational analyses. A clear pattern of FM AT being associated with and followed by the child attending to mother and mother talking to the child is evident at lags 0 through 4. Mother's apparent decrease in Attending to child is the mirror reflection of her increased usage of the mutually exclusive category Talk. That is, mother talks to the child, not just attends, and the child attends to mother but does not talk to her. Because Attention and Talk are both high prosocial/high involvement behaviours and because of the "trade-off" in their conditional probabilities (i.e., increased use of one results in decreased use of the other), this pattern of behaviour was not detected by the correlational analyses, being revealed for the first time with the lag sequential procedures.

The low prosocial/low involvement behaviour NA was also used as an initiator for FM. The correlational results would predict FM NA to be associated with low prosocial/low involvement MF behaviours at lag 0, and high prosocial/high involvement CF behaviours at lags 0 through 2. The sequential analysis results are presented in Table 26. These results show strong support for the correlational results.

Insert Table 26 about here

Mother's predicted low positivity and low involvement with father are reflected in her greater likelihood of being non-attentive to him (Z=3.91) and her decreased probability of talking to him (Z=2.64). This association is only evident at time lag 0. The child's high prosocial/high involvement behaviour towards father predicted by the correlational analyses are specifically identified as an increase in likelihood of talking to father (Z=2.56) and decrease in not attending to him (Z=-4.41). Both CF behaviours persist through time lags 0 to 2, with CF NA continuing through lag 4.

Again the behaviours between child and mother demonstrate a clear and persistent pattern, this time with the child not attending to mother and mother attending to but not talking to the child. The triadic picture would be one of the child talking to father and not attending to mother, father not

Table 26

Behaviours Occurring Significantly often with or Following

FMNA (Frequency=75%)

Time Lag

0	1	2	3	4
MFNA (3.91) MFTA (-2.64)	MFWK (-2.18)	*	*	*
CFTA (2.56) CFNA (-4.41)	CFTA (2.31) CFNA (-4.41)	CFTA (2.18) CFNA (-3.97)	CFNA (-3.54)	CFNA (-3.31)
MCAT (3.40) MCTA (-2.33)	MCAT (2.91) MCTA (-2.20) MCWK (-2.67)	MCAT (2.66) MCTA (-2.06) MCWK (-2.14)	*	MCAT (2.23) MCWK (-2.39)
CMAT (-3.31)	CMAT (-3.31)	CMAT (-2.86)	CMAT (-2.64)	CMAT (-2.18)
	FMNA (4.62)	FMNA (3.77)	FMNA (3.20)	FMNA (3.03)

Numbers in parentheses indicate associated z-score values, and asterisks indicate no behaviours with $z > \pm 1.96$

attending to mother and mother not attending to father but attending to the child. Conversely, when mother is talking to the child, both child and father attend to her.

CF Initiators:. On the basis of the correlational results we would anticipate high prosocial/high involvement CF behaviours to be associated with and followed by low prosocial/low involvement FM behaviours. Table 27 presents the specific behaviours which occur with and follow the CF behaviour Talk (TA=4,5). Again, the correlational

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Insert Table 27 about here

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predictions are neatly verified. CF Talk is associated with significantly more frequent FM No Attention (3.37), and significantly less FM Attention (-4.17). This FM behaviour continues through the first three time lags following the occurrence of CF Talk. And again the unpredicted pattern of mothers attending to but not talking to the child is evident.

The low prosocial/low involvement CF behaviour of NA would be expected to occur with and be followed by high prosocial/high involvement FM behaviours. Table 28 presents

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Insert Table 28 about here

Table 27

Behaviours Occurring Significantly often with or Following

CFTA (Frequency=57%)

Time Lag

0	1	2	3	4
FMNA (3.37) FMAT (-4.17)	FMNA (3.21) FMAT (-3.60)	FMNA (3.37) FMAT (-4.17)	FMNA (3.21) FMAT (-4.73)	*
MCAT (4.20) MCTA (-4.63) MFWK (-2.76)	MCAT (3.63) MCTA (-3.68) MFWK (-2.27)	MCAT (3.20) MCTA (-3.52)	MCAT (3.20)	MCAT (3.34)
	CFTA (6.58)	CFTA (4.72)	CFTA (4.00)	CFTA (3.72)

Table 28

Behaviours Occurring Significantly often with or Following

CFNA (Frequency=9%)

Time Lag

0	1	2	3	4
FMAT (10.83) FMNA (-8.45)	FMAT (10.83) FMNA (-8.45)	FMAT (10.35) FMNA (-8.04)	FMAT (9.88) FMNA (-7.62)	FMAT (8.44) FMNA (-7.62)
FCAT (3.59) FCTA (-2.32)	FCAT (3.19)	FCAT (2.80)	FCAT (2.01)	FCAT (2.01)
MCTA (5.80) MCAT (-6.52) MCWK (4.83)	MCTA (5.80) MCAT (-6.16) MCWK (3.28) MFWK (1.98)	MCTA (4.19) MCAT (-5.07) MCWK (4.06)	MCTA (3.79) MCAT (-5.07) MCWK (4.83)	MCTA (2.58) MCAT (-4.70) MCWK (5.60)
	CFNA (14.09)	CFNA (11.56)	CFNA (9.66)	CFNA (8.39)

the results. Father is, indeed, more likely to be attentive towards mother (Z=10.83) and less likely to be non-attentive to her (Z=-.845). This continues through the fourth lag. In addition, mother is also more likely to be talking to the child or working (Z=5.80, 4.83), while father is more likely to be attending to the child (Z=3.59), these behaviours also continuing through the fourth lag. The scenario depicted is one where mother is talking to the child, the child is attending to mother but not father, and father is attending to both. On other occasions when the child is talking to father, mother attends to the child and father does not attend to her.

Validating the Intermediate Links

The usual next step in the LSA would be identifying the behaviours with the highest conditional probabilities at lags 1 and 2 and determining whether or not an immediate link was evident between them. Before that step is demonstrated, however, a fundamental problem in applying these lag sequential techniques to time-interval data should be recognized. Up to this point the interpretational inference has been made that the initiator behaviour occurs first and starts a chain of succeeding behaviours, but that the initiator itself no longer occurs. And, in data that are event-coded, the data are coded so that this is the case. This is not necessarily so, however, with time-coded data. The observant reader will have noted that each of the initiator behaviours examined (FM AT, FM NA, CF TA, CF NA) did not terminate at the end of the first interval, but instead merrily proceeded through the next four time lags at healthily high levels of conditional probability. That is, this "initiator" could be exerting immediate influence (or be the recipient of influence) at almost every simultaneous time interval.

The erroneous conclusions that could be drawn regarding "chains of behaviour" can perhaps best be appreciated by way of illustration. The extremely tedious process of mapping out a chain and validating the intermediate links was done for behaviour FM AT. Figure 4 presents the behaviour category in each of the four other-interactant behaviour streams which obtained the highest positive Z-score in time

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Insert Figure 4 about here

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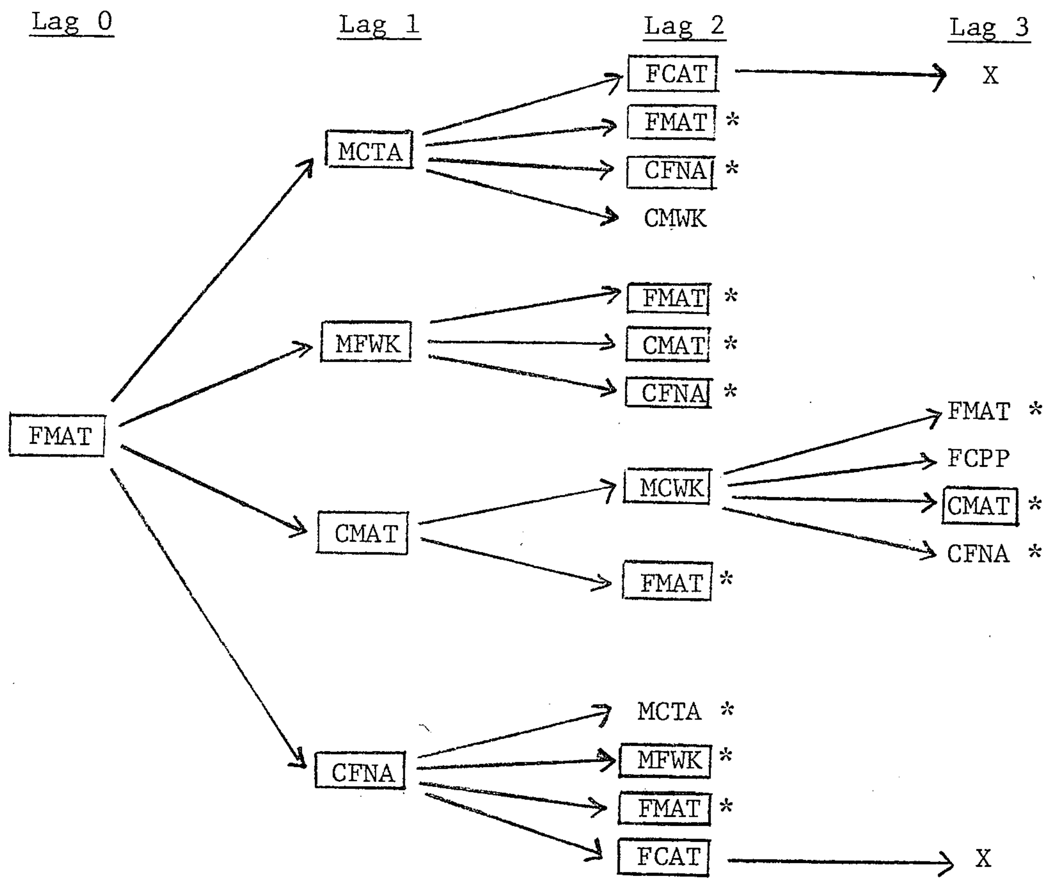
lag 1. These behaviours then served as the next set of initiators for which lag 1 probabilities were calculated. That is, the categories with the highest conditional probabilities at lag 1 following FM AT were MC TA, MF WK, CM AT and CF NA; those with the highest Z scores at lag 1 after MC TA were FC AT, FM AT, CF NA and CM WK. Boxes around the behaviours indicate which behaviours also obtained the highest Z scores at the appropriate lag following FMAT - i.e., the

Figure 4

Plotted Chain of "Sequential" Behaviours



* indicates that the succeeding behaviours for this category have already been plotted at an earlier lag

☐ indicates this behaviour occurred significantly more often than chance at the appropriate lag when FMAT was the "initiator" behaviour.

intermediate link was validated. Asterisks indicate that the category has already occurred at an earlier lag. This might be interpreted as an indication of cyclicity in the behavioural streams. One might infer that behaviours may cycle through FM Attention --> CF No Attention --> MF Work --> FM Attention. Another cyclic chain might be FM Attention --> MC Talk --> CF No Attention --> FM Attention.

Re-examination of Table 25, however, reveals that each of these behaviours whose occurrence has been uniquely attributed to a specific lag was occurring significantly frequently at <u>all</u> lags. To infer that FMAT leads to or even is followed by categories MC TA, MF WK, CM AT and CF NA would be a misrepresentation of the data since all these behaviours are typically occurring together. Yet they are interdependent, as reflected in their greater than chance Z-scores. Therefore, rather than attempting to describe these data in terms of sequential chains of behaviour, they might more accurately be viewed as mutually interdependent behaviours moving together across the time intervals.

<u>Initiators of Theoretical Interest</u>:

The lag sequential procedures have been seen to explicitly identify the discrete behaviour categories that express the more generalized correlational results. At other times, the overall interdependencies of behaviour streams may be of less interest and the concomitants and consequences of particular behaviours may be more important. In those instances, the lag sequential procedures should be particularly appropriate. The behaviours of MC Command and FC Command were selected because earlier results (Lytton & Zwirner, 1975) had indicated greater likelihood for fathers' commands to be complied with than mothers'. Additionally, in accordance with the Behavioural Coding System format, Command (CM) and Compliance (CO) were coded in an event-based manner. CM was typically coded in one interval, while Co or Noncompliance (NC) was required to be coded after it, but only for the first interval in which it was initiated after which another appropriate category (e.g., Talk) was coded. Six instances of MC Command were present in the data and 4 of FC Command.

The succeeding behaviours for both MC CM and FC CM are presented in Table 29 with their absolute frequencies and

Insert Table 29 about here

Z-scores reported in parentheses. Both father's and mother's Commands were always complied with, although it appears that one of mother's commands was immediately (lag 0) not complied with but later received compliance.[10] It is interesting to note the finding in this family, that

[10]Since compliance is only coded in the first interval when it occurs, the equal number of MC CM and CM CO indicates that all commands were complied with.

Table 29

Behaviours Occurring Significantly often with or Following

MC CM and FC CM (Family #6)

Time Lag

MC CM 0	1	2	3	4
CMNC (1,7.53)	CMCO (5,15.42)	*		CMCO (1,2.83)
CMTA (1,-3.00)	CMTA (0,-3.91)			
CMPI (2,2.12)	CMAP (1,4.21)			
CFDI (1,4.21)	CFDI (1,4.21)			
CFTA (0,-2.82)	CFCO (1,3.58)			
FMAP (1,2.57)			FMAT (3,2.14)	FMRC (1,5.24)

Time Lag

FC CM 0	1	2	3	4
CFCO (1,4.50)		CFCO (3,13.92)	CFPS (1,1.96)	CFTA (0,-2.30)
				CFPS (1,1.96)
	CMPI (2.90)	CMCO (1,3.59)		CMDI (1,6.49)
	CMTA (1,-2.08)			
				MCCM (1,3.59)
			FCCM (1,4.50)	

The first number in parentheses indicates the absolute frequency, the second indicates the associated z-score.

Behaviours with frequencies greater than one are underlined.

compliance to mother occurred most often in lag 1 while compliance to father occurred in lag 2. Since the absolute frequencies of succeeding behaviours was rarely greater than one (exceptions are underlined in the table), we cannot make inferences about repeating patterns of behaviour.

The interdependence of MC Approval and FC Approval were similarly investigated and the results are presented in Table 30. Again, focussing on those behaviours with

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Insert Table 30 about here

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high Z-scores and absolute frequencies greater than 1 (those behaviours underlined in the table), few inferences about chains of behaviour can be made. What is apparent is the prosocial nature of all interactants' behaviours when either parent is expressing approval to the child. Mother's Approval towards the child is associated with father's simultaneous expression of approval towards both mother and child, and with a later increased likelihood for the child to talk to mother. Father's approval towards the child is associated with increased likelihood for the child to talk to father and later play socially with father, and for mother to be approving and attentive to the child. In these interactions, positivity seems to be the emotional climate of the entire system and not limited to any particular dyad.

Table 30

Behaviours Occurring Significantly often with or Following

MC AP and FC AP (Family #6)

Time Lag

MC AP	0	1	2	3	4
	CFCM (1,5.01)	CFCO (1,2.23)			
		CFDI (1,2.68)	CFDI (1,2.68)		
		CMNC (1,5.01)	CMTA (13,2.26)		CFDI (1,2.68)
	FMAP (2,3.45)	FMLA (1,2.68)			
	FMRC (1,3.41)				
	FCCO (1,5.01)	FCCM (1,2.23)			
	FCAP (5,4.79)				
	FCAT (5,-2.55)				
	FCNA (1,2.68)	FCNA (1,2.68)	FCNA (1,2.68)		
				MCAP (2,2.23)	

Time Lag

FC AP	0	1	2	3	4
	CFTA (18,2.35)	CFDI (2,4.20)	*	CFPS (3,2.04)	
	CMNC (1,3.75)				CMNC (1,3.75)
	MCAP (5,4.72)	MCAT (19,2.71)			
	MCTA (1,-2.42)	MCTA (1,-2.42)			
	MFPP (1,3.75)				MFPP (1,3.75)
		FCAP (4,2.31)			FCAP (4,2.31)

The first number in parentheses indicates the absolute frequency, the second indicates the associated z-score.

Behaviours with frequencies greater than one are underlined.

In summary, the lag sequential analyses identified interdependencies in the categorical data which corroborated the correlational results. In addition, it identified several interdependencies not determined in the correlational analyses because of the categories' nearly identical scale values. LSA could also plot out the interdependencies of theoretically interesting behaviours, but because of their low frequency of occurrence few inferences could be made. The limitations of LSA with the present timed-multiple event data are most apparent in attempting to infer chains of behaviour. Conclusions which misrepresent the nature of the data could be reached.

DISCUSSION

In investigating these two statistical methodologies, namely the correlational (continuous state) and the lag sequential (discrete state) approaches as applied to observational data of family interactions, the present study made several important and interesting findings. Given the focus of the study most of these findings are of a methodological nature, although some are more theoretical.

A major contribution of the present study was its demonstration of the feasibility and the value of using multivariate techniques to examine triadic interaction. Earlier studies employing a continuous state approach have, without exception, condensed the complexity of interaction into one dimension such as intensity of behaviour (see Thomas & Martin, 1976). The resulting sacrifice of information well may have deterred researchers from employing this approach in the past (Gottman, 1979). Instead, the present study used multidimensional scaling procedures to identify the two dimensions, Prosocial--Deviant and High--Low Involvement, as underlying the Behavioral Coding System. These dimensions were seen to provide good fit to the scaling judgments, to be stable, and to be interpretable. The value of employing both dimensions was demonstrated empirically in the observational data analyses. In the univariate regressions behaviours on both the Prosocial--Deviant and the level of Involvement behaviour streams were found to be interrelated with others' behaviours to a moderately high degree. When combined in the multivariate regressions, the simultaneous consideration of the two dimensions was seen to meaningfully increase predictability for 17 of the 36 behaviour streams. While the results of these multivariate procedures are more complex to interpret and understand than the usual univariate results (a point with which the reader will likely readily agree), they do provide the means for describing more completely a process which is itself highly complex.

In accordance with the primary intent of the current investigation, the capabilities and the limitations of each of the methodologies and the complementarity between them in examining the present observational data became evident. The correlational approach, using continuously scaled data, is seemingly the more all-encompassing methodology in the sense that its results express the interrelationships apparent across all time points. As well, the scale values of data coded along a continuum consider the degree to which a trait or dimension is present. Categorical values only allow for present-absent distinctions to be made. This makes the continuous state approach more sensitive to detecting interrelationships and changes in those interrelationships.

The univariate regressions considered each dimension of an interactant's behaviour separately. These results were both more immediately interpretable than the multivariate regression results and also allowed for comparisons to be made across families. Generalizations could be made regarding degree of interdependence, nature of the interdependencies, and relative importance of each of the dimensions. The canonical correlation procedures simultaneously considered both dimensions of an interactant's behaviour. Including this second dimension was seen to increase predictability meaningfully. Additionally, it is this joint inclusion of both dimensions, this viewing of behavioural interdependencies in terms both of the degree of Prosocial--Deviance and degree of Involvement that facilitates translating the correlational findings back to the discrete categories. A problem encountered with the canonical correlational approach was the difficulty in making comparisons across families regarding the nature of the correlations. The need to summarize across individually analysed family interactions, however, would not be encountered in research which examines only one family's interactions or which examines group data for numerous families. A shortcoming of the correlational approach is that findings are expressed in the general terms of behaviours being high or low in Prosocial-Deviance and Involvement. They do not provide understanding of what these relationships mean in more concrete terms.

The strength of the lag sequential approach, as applied to the present data, lies in its ability to identify the specific behaviour categories which underlie the interdependence measured by the correlations. Several clear examples were presented in the results. Knowing which particular behaviour categories of one interactant are associated with the particular categories of the other people makes the interaction more concretely understandable. The lag sequential approach appears to spell out the correlation-inferred interrelationships in just this way despite the fact that the correlational results represent a "compromise" solution which might not accurately reflect any single time segment of the data used. It was also seen to identify additional associated interactional relationships in behaviours which, because of their near identical scale values and their cancelling out effect, had not been identified by the correlational approach. The lag sequential procedures used alone, however, could not have determined the overall nature of the interactional interdependencies. As the number of behaviour streams and the number of behaviour categories increase this approach becomes increasingly cumbersome and impractical. If the correlational analyses see the "forest" of the interaction, then the lag sequential analyses see the "trees". The difficulty is that there are just so many individual trees at which one can look.

A more basic limitation to the use of the lag sequential analysis with the present data is identified when one attempts to map out sequential chains of behaviours. As it is typically used the lag sequential approach plots out sequences of discrete behaviours across two interactants. An example would be: Father Talk --> Mother Approval --> Father Laugh --> Mother Talk. These data are usually coded as discrete events. An underlying assumption is that there are specific onsets and offsets to these behaviours, and that the offset of one coincides with the onset of another. When observations are event-coded, these conditions are built into the coding system. Continuous event-coding becomes more difficult in moving from a dyadic to a triadic situation and time-based coding may be preferred. When the data are time interval-coded, however, as are the present data these conditions of simultaneous onset/offset need not apply. Any particular behaviour can occur through one or more time intervals. This was seen to occur in the present data, making inferences about sequencing of behaviours difficult. This difficulty has been recognized by Bakeman (personal communication, 1980) who has suggested that the lag sequential approach is perhaps best used with event-coded data. Such data, however, are not amenable to the correlational procedures.

This difficulty of differing data-types might be circumvented by transforming the data from a time-based type to an event-based type (see Bakeman & Dabbs, 1976 for a discussion of data types, and Bakeman & Brown, 1977 for an example of such data-type transformation). Then an event could be defined as any unique combination of all behaviour streams, and an event change would mean that any one of these behaviours had changed. With dyads this transformation could result in a manageable number of unique events. In considering all 6 behaviour streams of our triads, however, the result would be a horrendously large number of unique events.

The only other research group working with triadic interaction of which the author is aware, is that of Ross Parke and his colleagues (e.g., Parke, Power & Gottman, 1979). To reduce the complexity of triadic interaction, they choose to conceptualize it in terms of pairs of dyads within the triad. They propose employing lag sequential procedures with these dyadic interactions. The type of sequence that might then be identified would be: Father kisses mother --> mother nuzzles infant --> infant coos. No actual attempts to apply the lag sequential techniques have yet been reported. This is not surprising considering the complexity and potential pitfalls of such an endeavour.

An even more fundamental difference than differing data types exists between the two approaches. This difference relates to the differing models of interaction from which each approach seemingly stems. In the model underlying the correlational approach the behaviours of all interactants at all times are regarded as important. They are recorded at all times and all are considered in determining interdependence of behaviours. In the lag sequential approach using event-coded data, only selected events are recorded and considered. That is, each interactant's behaviours are not recorded continuously and are, consequently, not taken into account. We don't know what mother and infant are doing when father kisses mother. Nagging questions arise such as: is father as likely to kiss mother if she is diapering the infant and the infant is protesting, compared to her cuddling the infant and the infant responding? Is father's kiss as likely to lead to mother's nuzzling the infant if the infant is fussing and father turns away, compared to the infant smiling and father focusing on it? That is, can triadic interaction be explained adequately without considering the behaviours of all interactants at both the time of the "initiator" event and subsequently?

The author's bias is to more of a systems model as reflected by the correlational approach in which all interactants' behaviours are considered to be continuously interdependent upon all others. The present data are seen to support this view. In the correlational results it was seen that the predictors of the behaviour streams included the behaviours of the recipient and the third person, both as directed toward the target interactant and as directed toward each other. For example, father's prosocial behaviour towards the child was interdependent upon both the behaviour of mother and child towards father and their behaviour towards each other. The lag sequential results also emphasize the interdependence of all interactants' behaviours. It identified prosocial behaviours for all interactants to occur with or to follow either parent's expression of approval towards the child. These results indicate that the behaviour of an interactant in a triadic context is influenced by and/or influences the behaviours of all other interactants.

Notwithstanding these interpretational limitations in inferring sequential chaining of behaviour the lag sequential approach is regarded as valuable in identifying the specific behaviour categories that share interdependence. It is this function which essentially defines the complementarity of the two methodologies. The correlational approach identifies relationships which are characteristic of the entire behaviour streams of the interactants, but relationships which are expressed in more abstract terms. The lag sequential approach can identify concrete behaviours which define those relationships. The sequential approach used alone, however, cannot identify those relationships generally characteristic of the entire time period, nor can it identify the patterns where a particular behaviour (e.g., Cry) is followed by functionally equivalent behaviour categories (i.e. same scale values), but categories which vary across occasions (e.g., Attention, Touch). The joint use of the continuous state and the discrete state approach is seen to most fully describe these family interaction data, each methodology making a unique and complementary contribution to this description.

An obvious question arises regarding the utility of employing such complex analytic methodologies. Are the results really worth all the effort? One argument in support of employing these or similar statistical methodologies relates back to the data. The collection and coding of observational data is itself a costly and time-consuming endeavor. Gottman, Markman and Notarius (1977) estimated that 28 hours of transcribing and coding were needed for every hour of videotaped interaction of their marital couples; for the present study the cost was a relatively cheap 10:1 ratio. Such intensive collection and coding of data would seem to warrant thorough and intensive statistical examination.

More importantly, these methodologies can identify patterns in interactions that are not obviously apparent. Gottman et al. (1977) discovered that when the interactional patterns of maritally distressed and non-distressed couples were thoroughly analyzed, widely held assumptions about "normal" marital recipocity were not generally supported, though other patterns distinguishing the two groups of couples were evident. The present study identified particular patterns in the triadic interactions which could not be identified readily through simple observation. With numerous concurrent behaviours to observe which are of relatively brief duration, the observer would have great difficulty in noting more than a few of the repeated interactional patterns. Quantification of these patterns would be even more difficult. The problems in numerically capturing the complexity of family interaction are reflected in the dearth of clinical and non-clinical studies examining the process of interaction. Yet assumptions about the nature of behavioural interdependencies are at the heart of numerous theories and therapies. The statistical methodologies examined in the present study when applied to appropriate observational data should provide a means of measuring and defining important aspects of family interactional processes.

The sensitivity of the correlational methodology in detecting interactional patterns of individual families was perhaps most apparent in the univariate regression results. Considerable variability was evident across families both in the magnitude of the correlations and the nature of the interdependence. Differences in the nature of interdependence were particularly apparent in the child behaviours, where families differed in the parental behaviours which occurred with and followed the child behaviours. Such idiographic data can be especially valuable in a number of ways, such as in clinical intervention programs with individual families, in generating hypotheses about family interaction, or in developing and demonstrating new methodologies. Additionally, meaningful generalizations could be drawn across families suggesting that these analytic procedures also could be employed profitably with group data. Of interest is the repeated finding that Family # 5's parental behaviours deviated from the general pattern. Specifically, their parent to parent behaviours were more related to the child's behaviour and less influenced by the reciprocal parent behaviour than was the case for most other families. The parents of Family # 5 were older and had been married for a longer period of time than was typical for the group of families. It may be that because of increased familiarity between the parents, their behavioural changes were more contingent upon their child's behaviour than their spouse's. These possible differences due to age or length of marriage could be examined further in a group study of interactional patterns.

An additional and unexpected methodological finding arose in the first and erroneous attempt at cross-validating the univariate interdependence. It was observed that the nature of the interdependence of virtually all behaviours changed over the course of the hour-long observation period. Behaviours which were good predictors of a particular behaviour stream early in the hour might be almost unrelated at the end of the observation. This finding may reflect an adjustment phenomenon in which the family members' interactional patterns change as the members adjust to the novel experience of being observed. Future research aimed at monitoring this possible adjustment process would be a challenging but fascinating research endeavor, and one which might give some insights as to how the family system responds to situational changes or stresses.

Although this study was primarily a methodological investigation, several more theoretical findings meriting mention were also made. The univariate regression results indicate that moderately high levels of interdependence between family interactants' behaviours are evident when the behaviours of only a relatively short period of time (i.e. three time intervals or 18 seconds) are considered. The influence of family members on each other's behaviour seemingly can be quite immediate. Additionally, this interdependence is based upon all behaviours of both of the other interactants; that is, both the behaviours directed toward the target individual and the behaviours between the other two interactants. These results support the position of viewing the family as a totally interactive system, in which events occurring between any two interactants affect other behaviours within the family system. Also indicated were the findings that for most of the families observed, the parents' behaviours between themselves were largely interdependent upon the other parent's reciprocal behaviours, while the child's behaviours were largely interdependent upon parent to parent behaviours and not the reciprocal parent to child behaviours. This could mean that the child's behaviour to a large extent influences what the parents do between themselves. Parents, particulary under observation, may relate directly to each other only until the child interrupts at which time one or both of them turns away from the spouse to respond to the child. Conversely or in addition, these findings might mean that the child is highly responsive to what transpires between his parents, regulating his own behaviour in accordance with theirs. Additional research to replicate these findings might discover more causal interpretability in the interaction by manipulating the behaviour of the child and/or the parents.

In summary, the present study demonstrates that employing both the continuous state and the discrete state approaches in the analysis of family interactional data is both possible and valuable. The two approaches serve complementary functions in describing the process of family interaction. Although at the expense of increasing complexity, it was seen that analysis of interaction using these methodologies could be expanded from dyadic to triadic interactions and from a univariate to a multivariate approach. The empirical value of employing these methodologies was indicated by the theoretical findings made. The joint use of both the continuous state and the discrete state approaches is recommended to researchers in this area.

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APPENDICES A-J

APPENDIX A

Behaviour Codes[11] and Coding Priorities

This section is divided into two main sections, First Order Behaviours and Second Order Behaviours. The reason for the division into two sections is for the observer to have a knowledge of priorities in coding behaviours. It is impossible to code every behaviour emitted, and many times a person will emit three or four of the behaviours listed in the manual. In order to resolve the problem and keep the number of behaviours attributable to one individual down to one per sequence, some behaviours are designated as Second Order Behaviours, which means that they are never coded when a First Order Behaviour can be coded. It is up to the discretion of the observer what behaviours to choose among several behaviours within the same order. Since the observer can code only one, she/he must pick those behaviours that best describe the social interaction that is occurring.

Not only have behaviours been divided on a priority basis, but also on whether they are verbal, non-verbal, or a combination. This is to aid the observer in cataloguing the

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[11] Behaviour codes from G.R. Patterson, R.S. Ray, D.A. Shaw & J.A. Cobb. "Manual for coding of family interactions" (sixth revision, 1969). All modifications for the present study are indicated in the following text.

codes, and perhaps in learning them with greater ease. Behaviours are listed alphabetically within each subarea.

First Order Verbal Behaviours

CM(COMMAND): This category is used when a direct, reasonable, and clearly-stated request or command is made to another person. The statement must be sufficiently specific as to indicate clearly the behaviour which is expected from the person to whom the command is directed. The command need not request immediate compliance, e.g., father tells the son that he has to mow the lawn on Saturday. However, the observer is always to indicate whether the command is complied with. In the example cited, the son could indicate verbally that he is or is not going to comply with the father's request. In those instances where the compliance will not follow directly, but is likely to occur before the observer is finished coding on the subject's observation sheet, the immediate response should be coded and when compliance or non-compliance occurs, that should be coded. For example, mother tells the child, who is the subject, to wash his hands before coming to dinner. The child tells his mother that he will and continues whatever he was doing, but in a minute he goes to the sink and washes his hands. The response to the mother's command would be the child's talking and compliance would be coded when he began washing his hands. Note that many questions are most appropriately coded as talk (TA) rather than as CM. For example, "What's for dinner" or "What time is it" would be coded TA, while "Would you go into the living room and tell your father that dinner is ready" or "Will you help me lift this table" would be coded as CM.

CN (COMMAND NEGATIVE): This is a command which is very different in "attitude" from the reasonable command or request described above. This kind of command has some of the following characteristics:

1. Immediate compliance is demanded.

2. Aversive consequences are implicitly or actually threatened if compliance is not immediate.

3. It is a kind of sarcasm or humiliation directed to the receiver.

An example of the implicit use of aversive consequences is indicated by the tone of voice as well as the statement: Mother tells Johnny to shut the door in a normal tone of voice; he does not comply; she then raises her voice and says, "You'd better shut that door, young man."

CR (CRY): Use this category whenever a person cries. There are no exceptions.

HU (HUMILIATE): This category should be used when the agent makes fun of, shames, or embarrasses the subject intentionally. Examples: laughing in a derisive manner at the subject when he attempts to tie The correlational approach identifies relationships which are characteristic his shoes; telling the subject in a firm tone of voice, "Boy, you are really stupid"; telling the subject in a strong tone of voice, "You are a cheater", when the subject is playing a game. The observer must be careful to differentiate between playful verbal statements or nicknames and humiliate, e.g., some people call each other "stupid" but more in terms of endearment than of humiliation. The tone of voice, as well as the language used should be considered by the observer before a decision is made to code HU or some other appropriate code.

LA (LAUGH): Used whenever a person laughs in a non-humiliating way. For example, a person tells a joke and the other people laugh at the joke. However, if one of the people who heard the joke laughed in a derogatory manner at the person for the way he told the joke, that would be coded as HU and not as LA.

NE (NEGATIVISM): This category is only used when a person makes a statement in which the verbal message is neutral, but which is delivered in a tone of voice that conveys an attitude of "Don't bug me; don't bother me". This code is never used if the verbal meaning of the statement is interpreted as disapproving or humiliating. For example, mother asks where one of the child's friends lives; the child answers, "On 14th Street" in a tone of voice that tends to cut off further communication.

TA (TALK): This code is used if none of the other verbal codes are applicable. This code is not to be used in cases where talk is part of the ongoing activity required in PL or WK. (Note that this rule was not adhered to in the present study, with PL and WK being used as second order behaviour codes and TA being used as a first order code.) Thus in a game where one family member says, "It's your turn", that is not to be coded as TA but simply as PL. Likewise, in a work situation when one member of a dishwashing team says, "Here are some more dishes", the proper code is WK and not TA. However, any verbal behaviours other than TA are to be coded in WK and PL situations, i.e., HU, CM, CN, NC, DI, TE, YE, CR, LA, WH, and AP; since they are not second order, then they shall be doubled coded.

WH (WHINE): Use this category when a person states something in a slurring, nasal, high-pitched, falsetto voice. The content of the statement can be of an approving, disapproving, or neutral quality; the main element is the voice quality.

YE (YELL): This category is to be used whenever the person shouts, yells, or talks loudly. The sound must be intense enough that if carried on for a sufficient time, it would be extremely unpleasant.

Non-Verbal Behaviours of the First Order

DS (DESTRUCTIVENESS): Use of this category is applicable to those behaviours by which the person destroys, damages, or attempts to damage any object; attacks on people are covered by PN. The damage need not actually occur, but the potential for damage must exist, e.g., the child starts to throw a glass, but is stopped by the father. The value of the object is of no consideration nor is the actual amount of damage done.

HR (HIGH RATE): This category is applicable to any behaviour not covered by other categories that if carried on for a long period of time would be aversive, e.g., running back and forth in the living room, jumping up and down on the floor, "rough housing". If the behaviours can be covered by other categories, e.g., YE, PN, DS, then HR is not to be used. It may happen that in a sequence of behaviours e.g., the children are playing leap frog in the house and at times one of them gives out with a scream; the code would be the following: 1HR 4HR 1YE 4HR 1HR 4HR 1YE etc.[12]

IG (IGNORE): Use this category when person A has directed behaviour at person B and person B appears to have recognized that the behaviour was directed at him, but does not respond in an active fashion. For example, mother is

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[12]This type of sequential coding was not used in the present study. Instead a behaviour code was assigned to each of the six behaviours (Fm, Fc, MF, MC, Cf, Cm) for each time interval.

preparing dinner and the child comes into the kitchen and asks, "Can I help set the table". The mother looks at the child and then turns away to continue her work without having responded. In this case it is quite clear that the mother heard the behaviour directed to her, and that her response to the behaviour was to ignore it. However, the observer must be certain that the mother did hear the child before the code IG is appropriate. In those cases where there is doubt whether the person knows that the behaviour has been directed at him the appropriate code to use is NR (No Response) whose definition is explained in a forthcoming section.

PN (PHYSICAL NEGATIVE): Used whenever a subject physically attacks or attempts to attack another person. The attack must be of sufficient intensity to potentially inflict pain, e.g., biting, kicking, slapping, hitting, spanking, and taking an object roughly from another person. The circumstances surrounding the act need not concern the observer, only the potential of inflicting pain. For example, children may be playing and part of the game involves wrestling. If during the wrestling, one child hits the other child or pins him down to the point where pain could result, then the act of hitting or pinning own should be coded PN.

PP (PHYSICAL POSITIVE): Use this category whenever a person touches another person in a friendly or affectionate manner, e.g., hug, pat, kiss, arm around shoulders, holding hands, ruffling hair, etc.

<u>First Order Behaviour that may be Verbal or Non-Verbal</u>

AP (APPROVAL): Used whenever a person gives clear gestural or verbal approval to another individual. Approval is more than attention, in that approval must include some clear indication of positive interest or phrases such as, "That's a good boy", "Thank you", and "That's right".

DI (DISAPPROVAL): Use this category whenever the person gives verbal or gestural disapproval of another person's behaviour or characteristics. Shaking the head or finger are examples of gestural disapproval. "I do not like that dress", "You didn't pick up your clothes again this morning", "You're eating too fast", are examples of verbal disapproval. In verbal statements it is essential that the content of the statement explicitly states disapproval of the subject's behaviour or attributes, e.g., looks, clothes, possessions, etc. DI can be coded simultaneously with CM, but never with CN, as CN always implies disapproval.[13]

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[13]In the present study, no codes could be used simultaneously.

DP (DEPENDENCY): Behaviour is coded DP when person A is requesting assistance in doing a task that he is capable of doing himself. For example, mother is reading the newspaper in the evening and a child who is in junior high school requests her to look up a word in the dictionary; or a child, age 10, asks his mother to tie his shoes. Everyday requests should not be coded as DP; they must meet two criteria: That the person is capable of doing the act himself and it is an imposition on the other person to fulfill the request. For example, asking someone to pass the newspaper which is very close to the individual to whom the request is directed would not be considered DP, since the person would be able to hand the newspaper to the other individual without an undue amount of effort. If the paper were across the room from where the person is to whom the request has been made, and the person would have to move to get the paper, thus unduly interrupting whatever he were doing, then the request is coded DP.

IN (INDULGE): Behavior is coded IN when a family member stops what he is doing in order to do some behavior for another person which that person is fully capable of doing for himself. Common kindnesses, e.g., pouring a cup of coffee for another while also pouring one's own, handing a nearby dictionary to someone who has asked how to spell a word, are not to be coded IN. IN takes a special effort (even when it is habitual) of the helping person to stop his own ongoing chain of behaviour and perform an unnecessary act for a capable person, without having been asked to do so. Note that when help is asked, the usual code is DP followed by CO or NC. Examples of IN include the following: 1) the family members are eating; only father is drinking coffee. Mother notices that his cup is empty, stops feeding the baby, gets up and refills his cup. 2) Mother takes off seven-year-old child's coat and washes his hands before dinner. 3) mother cuts meat for child old enough to do this for himself. 4) Father does boy's arithmetic problems for him. Generally the consequence of IN is RC. Care must be taken to distinguish this category from DP and WK.

NC (NON-COMPLIANCE): This code is used when a person does not do what is requested of him by CM, CN, or DP. The non-compliance can be of a verbal or non-verbal nature. If the request is not to be complied with until some later time and the person says he will not comply, then the appropriate code is NC. Care must be taken to distinguish DI from NC. For example, mother tells daughter to do the dishes; daughter says that mother is always making her work; daughter goes to the sink and begins to do the dishes; the proper coding is 3CM 4DI CO.

TE (TEASE): Use this category when a person is teasing another person in such a way that the other person is likely to show displeasure and disapproval or when the person being teased is trying to do some behaviour, bit is unable to because of the teasing. For example, a child is trying to do homework and another child keeps tickling him in the ribs or turns the pages of the book that the child is using for studying. Another example would be two parents teasing a young child by saying, "You're not my boy; go away from me", and when the child goes to the other parent, he hears the same remarks. This category should be distinguiished from PL, LA, HU, and PN. Many cases of teasing will fall into the PL category.

Behaviours of the Second Order[14]

The following are lists of behaviours that should be considered by the observer as secondary in coding. If it is possible to code behaviours using the first order behaviours, the second order codes should not be employed.

Non-verbal Second Order Codes

AT (ATTENTION): This category is to be used when one person listens to or looks at another person, and the categories AP or DI are not appropriate. Sometimes when listening is used as a reason for coding AT, it may be difficult

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[14] Note that in the Patterson, Ray, Shaw & Cobb system (1969), PL and WK are first order behaviours while TA is a second order behaviour. In the present study, TA has been used as a first order behaviour, while PL (divided into PI and PS) ans WK have become second order.

to tell if the person is listening. The situation will generally resolve the question, as the person who has been "listening" may make some comment and the content of the comment will indicate that he has been listening.

NO (NORMATIVE): Use this code when a person is behaving in an appropriate fashion and no other code is applicable. For example, the family is eating dinner, someone is reading the newspaper, or someone is walking from one room to another room.

NR (NO RESPONSE): This category is to be used when a person does not respond to another person. This category is applicable when a behaviour does not require a response, or when behaviour is directed at another person, but the person to whom the behaviour is directed fails to perceive the behaviour. There is a clear differentiation between NR and IG. IG is intentional non-responding and NR may be accidental, e.g., there could be a great deal of noise in the house so that person chould not hear the behaviour to which a response is expected, or the person may be attending to something else in the environment, e.g., mother may be feeding the baby when an older child comes in and asks a question. Whenever behaviour is specifically directed toward another person and the person does not respond it is necessary to code either NR or IG.

RC (RECEIVE): Use this category when a person receives a physical object form another person or is touched by another person and does not do anything as a result of the contact. For example, mother combs daughter's hair, mother hugs baby, father puts his arm around son's shoulders. If the person responds in some way, then the response should be coded rather than RC. e.g., mother combs daughter's hair and daughter says, "That feels good"; this would be coded 3WK 4AP.

TH (TOUCH): This category is to be used when young children touch other perople or hand an object ot another person. Examples are a young child touching mother, small child passing blocks to other family members.

Verbal and Non-Verbal Second Order Codes

NA (NO ATTENTION)[15] This code is to be used only when the individual's behaviour to another cannot be coded in any other way: to be used when the interactant is responding to one individual but not to the other. Unlike NR and IG in that there is no request that he respond. Use when no doubt whatsoever, otherwise code AT e.g., when the person's back is turned to one interactant.

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[15] This code was added for the present study.

PL (PLAY): This category is used when a person is playing either alone or with other persons. Play need not be restricted to games in which clear rules are defined, e.g., monopoly, scrabble, but is applicable to many activities from playing with a pet to playing with toys. This category is to be distinguished from WK or NO. This category is applicable whether the play is verbal or non-verbal, e.g., playing with a pet may involve no verbalisms and playing a card game may involve considerable conversation. For the purposes of the present study PL was further divided into PI (PLAY INDIVIDUAL) which involved only one person in play, and PS (PLAY SOCIAL) which meant play with at least two people involved. "Noises" made during play are not to be coded separately, but conversation during play should be coded with the appropriate first order code e.g., TA, AP, DI, etc. Code the behaviour as PS rather than PI or AT if the interactants are engaged in the same play (e.g., all working on the same task) even though some may be more active than the others.

SS(SELF-STIMULATION): Use this category for behaviours which the individual does to himself and cannot be coded by any other codes. For instance, reading can be coded as NO if someone is reading the newspaper or WK if someone is reading a school assignment. But activities like swinging a foot, humming, scratching oneself, rocking, etc. are coded SS.

WK (WORK): Use this category whenever a person is working, either alone or with other people. A clear distinction between work and play, WK and PL, is made by two rules: 1) the behaviour is necessary for the smooth functioning of the household, and/or 2) the behaviour is necessary for a child to perform in order to learn behaviours that will help him assume an adult role. Examples of the first rule are mother doing the dishes or cooking, father doing the income taxes, son emptying the garbage, and daughter setting the table. Examples of the second rule are children doing homework, daughter combing younger sister's hair, son taking apart a carburetor, son tightening the wheels of his bicycle, and daughter learning to bake cookies. Whether the person enjoys the work is of no importance in coding and behaviour.

LIST OF CODING PRIORITIES

1. First order categories are given priority above second order categories.

2. TA becomes first order, but is to be coded only when other first order positive or negative behaviours cannot be coded. PL and WK become second order.

3. PL becomes PI (PLAY INDIVIDUAL) when there is only one person involved in play, and PS (PLAY SOCIAL) when there are at least two persons involved.

4. If two behaviours occur within a six-second interval, code the prosocial or deviant rather than the neutral.

5. If more than one of prosocial or deviant behaviours occur within one time interval, then code the one that best describes the interaction, or if that cannot be done, then code the one that occupies the most time, or if still not codable, then code the one that was initiated first.

6. Include NA in the coding system (to be used when responding differentially to the other two inter-

actants). It is to be used as a second order code.

7. If TA occurs in conjunction with WK or NO, TA takes precedence.

8. If it is not clear to whom TA is directed, score to both other persons.

9. If there is a time interval where one of the members is missing or there is interaction with additional members, do not code that interval.

10. If the coder cannot hear well enough to distinguish between TA and other verbal codes, code TA.

11. When in doubt between CM and TA, code TA (including comments like "...one does...").

12. Compliance or noncompliance is only coded for one interval, during the interval in which it is initiated. If the behaviour that demonstrates the CO or NC continues over several intervals, then on succeeding intervals code the behaviour itself.

APPENDIX B

Multidimensional Scaling Procedures

KYST Program

The KYST programs was run using the following standard options for all runs: generation of initial configuration = TORSCA; preiterations = 1; coordinates = rotate; maximum number of iteractions = 50; R = 2.0; Stress formula = 1; scale factor of the gradient minimum = 0.0; Stress ratio stop = .999; Stress minimum = .01. Readers seeking further information regarding the parameters are referred to the KYST manual (Kruskal, Young & Seery, 1973).

Two additional parameters were varied to examine differences in the resultant solutions. The first parameter varied was the one dealing with tied data. In the standard option (primary) no restrictions are put on the tied values as to their assigned equality or inequality. In the secondary option, tied data must assume equal values. This places a restrictive constraint on the solution. Results consistently indicated slightly higher Stress values when the secondary option was employed. Consequently, the primary or standard option was used for the final analyses.

Second, the maximum number of dimensions at which the program was to begin solving for a configuration was set at 6 and at 3 on separate runs, and each was then successively reduced by one dimension at a time to obtain a final one-dimensional configuration. For the 6 dimensional runs, then, configurations of 6, 5, 4, 3, 2 and one dimensions were obtained; for the 3 dimensional run, 3, 2 and one dimensional xonfigurations were obtained. The program operates in such a fashion that for the six dimension (6D) run, it begins by deriving a 6D solution; this solution then serves as the starting configuration for arriving at a 5D solution, and so on. Consequently, when the program begins with a 3D solution, the initial starting configuration will be different from that of the 3D solution obtained with the 6D run. The extent to which the resultant configurations are artifactual because of the structure of the initial configuration should then be reflected in differences in the dimensional compositions of solutions of the same dimensionality (e.g., 3D), but which are derived from different initial-dimensionality runs (i.e., 6D, 3D).

Stress

The formula for Stress (Formula 1) is:

$$\sqrt{\frac{\sum_{m=1}^{mm} \left(DIST(m) - DHAT(m)\right)^2}{\sum_{m=1}^{mm} \left(DIST(m) - d_o\right)^2}}$$

where M is an index of all interpoint distances, MM equals 465 in this case, DIST(M) is the observed interpoint distance, DHAT(M) is the interpoint distance estimated in the monotonic regression of the program, and do is the arithmetic average of the DIST values.

Profit

Input for the PROFIT program included the ratings of each behaviour category on each of the initially hypothesized dimensions averaged across the two raters. In addition, the dimensional scale values of each behaviour category as derived through KYST were input. These weights were always those of the correct dimensional solution as obtained through the KYST run beginning with an initial configuration of six dimensions. As an example, when projecting the properties into a three dimensional space, this space was defined by the three dimensions of the 3D KYST configuration from the 6D run. Projections into a four-dimensional space were also made, in which case the weights of each behaviour category on the four dimensions of the 4D solution from the 6D run were used. It is important to note that the dimensional weights of the first three dimensions of a 4D solution are not identical with those of a 3D solution. Consequently, care must be taken to ensure that the appropriate KYST scale values are input. The results of projections into four-dimensional space did not clarify the interpretation of dimensions three and four and are not reported here.

Both linear and nonlinear regressions to define the "optimal correspondence" between dimensions and properties were performed with the PROFIT program to investigate the possibility that a nonlinear solution might be more helpful in explaining the data. The results were generally consistent across the two solutions. Since the interpretation of nonlinear regression results is less straightforward, only the linear results have been presented.

APPENDIX C

Dimensional Coordinates of Behaviour Categories

Behaviour Category	Dim. P	Dim. I	Behaviour Category	Dim. P	Dim. I
IG--Ignore	1	2	PI--Play Individual	4	2
NC--Noncompliance	1	3	WK--Work	4	2
NE--Negativism	1	4	TA--Talk	4	5
HU--Humiliate	1	5	CM--Command	4	6
TE--Tease	1	5	NO--Normative	5	1
DI--Disapprove	1	5	LA--Laugh	5	2
PN--Physical Negative	1	6	CO--Compliance	5	3
NA--No Attention	2	1	PS--Play Social	5	4
SS--Self Stimulation	2	1	TH--Touch	5	5
NR--No Response	2	1	AT--Attention	5	5
HR--High Rate	2	4	DP--Dependency	5	6
CR--Cry	2	4	AP--Approval	6	3
DS--Destructive	2	6	PP--Physical Positive	6	4
CN--Command Negative	2	6	IN--Indulge	6	4
YE--Yell	3	4	RC--Receive	6	5
WH--Whine	3	5			

Appendix D

Frequency of Category Usage

Percent of total time intervals in which each of the mutually exclusive behaviour categories was used by the interactants in each of the families. Behaviour codes indicate the category and the scale values on the Prosocial-Deviant (P-D) and High-Low Involvement (Inv.) dimensions, while behaviour stream indicates the interactant and the direction.

Family #1

Behaviour Code			Behaviour Stream					
Category	P-D	Inv.	FM	FC	MF	MC	CF	CM
missing	0	0	2	2	2	2	2	2
AP	6	3	4	6	1.2	3	.2	
AT	5	5	72	39	71	24	21	10
CO	5	3	.2				1	1.7
LA	5	2	2	2	6	4	10	8
NA	2	1	3	3	3	.2	27	13
TA	4	5	16	44	17	28	34	25
CM	4	6		1.5	.2	2		
PP	6	4		4		38	4	37
NC	1	3					.5	.5
PN	1	6					.7	
YE	3	4					.2	.2
TH	5	5						3

N = 400

Family #2

Behaviour Code			Behaviour Stream					
Category	P-D	Inv.	FM	FC	MF	MC	CF	CM
missing	0	0	5	5	5	5	5	5
AT	5	5	71	39	81	24	22	12
LA	5	2	3	3	1	2	4	4
PS	5	4	13	9	3		28	22
TA	4	5	8	36	10	68	32	49
AP	6	3		4		4		
CM	4	6		2		.5(2)		
CO	5	3		.2(1)			2	.5
PN	1	6		.2(1)				.2
PP	6	4		3		.2		.2
TH	5	5		.2(1)			2	3
NA	2	1			.2(1)	.2	2	.2
DP	5	6					.2	
NC	1	3					.5(2)	
PI	4	2					3	3
RC	6	5					.5	
WH	3	5					.2	.7
YE	3	4					.7	.7

N = 400

Family #3

Behaviour Code			Behaviour Stream					
Category	P-D	Inv.	FM	FC	MF	MC	CF	CM
missing	0	0	8	8	8	8	8	8
AT	5	5	18	39	29	56	7	8
CM	4	6	.3(1)	6		4	.8	
LA	5	2	.3	.3	.3	.5	1	1
NA	2	1	59	1	51	4	10	26
PS	5	4	5	.5	5	2	2	4
TA	4	5	9	42	5	20	63	48
WK	4	2	1	.3	.8(3)	.3	.8	1
AP	6	3		3	1			.3
CO	5	3		.5(2)	.3		4	3
NC	1	3		.3			1	
AP	6	3				4	.5	
DI	1	5				.5	.5	
IN	6	4				.8		
PP	6	4				.5		
PI	4	2					1(5)	1(5)

N = 375

Family #4

Behaviour Code			Behaviour Stream					
Category	P-D	Inv.	FM	FC	MF	MC	CF	CM
missing	0	0	7	7	7	7	7	7
AP	6	3	2	2	3	5	.2	
AT	5	5	22	14	26	19	11	16
CO	5	3	.2(1)	.5(2)		.7(3)		
LA	5	2	.7	.7	11	10	2	3
PS	5	4	39	38	35	33	20	23
TA	4	5	30	38	18	26	59	52
NC	1	3		.5		.2		
PP	6	4		.2			.2	
CM	4	6			.2		1	1

N = 400

Family #5

Category	Behaviour Code: P-D	Behaviour Code: Inv.	Behaviour Stream: FM	Behaviour Stream: FC	Behaviour Stream: MF	Behaviour Stream: MC	Behaviour Stream: CF	Behaviour Stream: CM
AP	6	3	4	9	9	10	2	.3
AT	5	5	66	40	38	21	21	19
CO	5	3	.3(1)	3		.3	2	.8
LA	5	2	4	4	3	3	11	8
NA	2	1	21		27		12	23
PI	4	2	2	2	17	13		4
TA	4	5	3	28	5	49	28	39
CM	4	6		3	.3	.8	4	.5
DI	1	5		.3(1)		.5	2	.8
NC	1	3		.5(2)			.5	
PP	6	4		1		2		2
PS	5	4		10			15	
IN	6	4				.3		
IG	1	2					.8(3)	
YE	3	4					2	2
NR	2	1						1(4)
RC	6	5						.5

N = 399

Family #6

Behaviour Code			Behaviour Stream					
Category	P-D	Inv.	FM	FC	MF	MC	CF	CM
AP	6	3	2	6	.9	4	.3(1)	.9
AT	5	5	17	71	11	58	11	8
LA	5	2	.9(3)	2.3	.6	1.7		
NA	2	1	75	.9	75		9	.6
RC	6	5	.6(2)		.3		.6	
TA	4	5	3	15	3	28	57	72
WK	4	2	.9	.9	9.1	6	.3	.6
CM	4	6		1.1(4)		1.7(6)	.3	.3
CO	5	3		.3		.3	1.1	1.7
DI	1	5		2.3		1.4	.9	.6
PP	6	4		.6	.3			.6
PI	4	2					15	9
PS	5	4					5	5
SS	2	1					.3	.3
NC	1	3					.3	.3

N = 351

Appendix E

Cross-Validation Results

1. Cross-validation from first two-thirds of the time intervals to the last one-third for Family #6. Procedure = stepwise hierarchical with inclusion criteria: N=5, F=3.0, T=.3.

Behaviour	M.R. for First 2/3	M.R. for Last 1/3	Cross-Val. r
FMP	.570	.731	.097
FMI	.497	.754	.152
FCP	.446	.454	.130
FCI	.598	.466	.283
MFP	.566	.464	.255
MFI	.519	.540	.590
MCP	.470	.578	.146
MCI	.576	.486	.208
CFP	.312	.679	.355
CFI	.366	.619	.379
CMP	.332	.480	.076
CMI	.250	.430	.102

2. Magnitude of the MRs for the first 1/3, middle 1/3 and first 2/3 of the time points for Family #6.

Behaviour	First 1/3	Middle 1/3	Average (F1/3+M1/3÷2)	First 2/3
FMP	.627	.615	.621	.570
FMI	.596	.670	.633	.497
FCP	.465	.538	.502	.446
FCI	.583	.733	.658	.598
MFP	.626	.629	.628	.556
MFI	.607	.664	.636	.519
MCP	.508	.562	.535	.470
MCI	.555	.738	.647	.576
CFP	.538	.241	.390	.312
CFI	.540	.243	.392	.366
CMP	.485	.467	.476	.332
CMI	.378	.460	.419	.250

3. Cross-validation from Odd Numbered to Even Numbered Intervals for Family #2.

Behaviour	MR for Odd #'d	Cross-val.r
FMP	.468	.235
FMI	.489	.564
FCP	.402	-.018
FCI	.431	.415
MFP	.514	.348
MFI	.408	.402
MCP	.443	.171
MCI	.493	.234
CFP	.299	.069
CFI	.425	.215
CMP	.427	.111
CMI	.382	.277

Appendix F

Interpretation of Univariate Regressions

Difficulties in interpreting the "importance" of individual variables in a regression equation stem from their intercorrelations. Darlington (1968) discusses several approaches to this, among the most pertinent being:

(1) use of simple correlations (r_{yx}, where Y is the criterion variable and X is one of the predictors),

(2) useof standardized beta weights,

(3) "usefulness" defined as the amount R^2 would drop if variable X were removed from the regression equation. This is frequently referred to as the "F to remove".

The approach adopted should depend on the experimental conditions and concerns. In the present study, using standardized beta weights would present the problem of attributing "importance" to only one of several "predictor" variables which are highly intercorrelated with each other; the others not being acknowledged because much of the criterion variable has already been accounted for. The "F to remove" approach is useful in determining unique contribution to predictability, but encounters the same difficulties in interpreting the "importance" of multicollinear predictor variables. Finally, simple correlations with the criterion variable are unaffected by the presence of other variables in the equation, but fail to reflect the total amount of variance accounted for in the criterion variable.

The structure coefficient approach that was adopted is essentially based on simple correlations. But these are correlations of the "predictor" variables with that portion of the dependent variable's variance which is accounted for by the five-variable regression equation. As such, the rank order of "importance" of variables (as defined by their structure coefficients) would be expected to be similar to their correlations with the dependent variable, but would also take into account the predictability due to the total composite (e.g., possible contribution of suppressor variables).

Standardized Beta Weights for the Regression

Equations with a Maximum of Five Predictors

Family #1

FMP Adj R = .273

MCIO	-.138
CMI2	.082
MCP3	-.239
MCI1	-.016

FCP Adj R = .324

MCIO	-.209
CFIO	-.266
CMIO	.146
CFPO	.137
MCP3	-.147

MFP Adj R = .359

CFPO	.060
CMPO	-.162
CFP1	.259
FMP1	.110
CMI2	.091

MCP Adj R = .641

CMPO	.620
CMIO	-.466
CFPO	-.139
CFIO	.096
CMP1	.153

CFP Adj R = .316

MFPO	.155
FMP4	.274
MCI3	.106
FMI3	-.089
FMI4	-.132

CMP Adj R = .571

MCPO	.242
MCIO	-.409
FCIO	.157
MFPO	-.168
MFIO	.128

FMI Adj R = .299

MFIO	.220
MFPO	-.114
CFIO	.241
MFP1	-.016

FCI Adj R = .352

MCIO	.295
CMPO	.222
CFIO	.229
CFPO	-.116
MFP1	-.096

MFI Adj R = .328

FMIO	.253
FMPO	-.201
CMPO	-.129
CFIO	.074
CFI1	.111

MCI Adj R = .616

CMPO	-.633
CMIO	.275
FCIO	.287
FMPO	-.188
CMI2	.081

CFI Adj R = .372

FCPO	-.182
FCIO	.186
MFPO	.151
FMI2	-.091
FCP4	.201

CMI Adj R = .255

FCIO	.137
MCPO	-.203
MCIO	-.095
FMI1	.149
MCI1	-.124

Family #2

FMP Adj R = .436

MFPO	.322
CMPO	-.106
MCPO	-.113
MFP1	-.131
CFPO	-.092

FCP Adj R = .279

CFPO	.176
CMIO	.191
CFIO	-.135
MCIO	-.118
CMP1	-.138

MFP Adj R = .459

FMPO	.379
FMIO	.182
CMP1	-.129
FMP2	.100
CMP3	.098

MCP Adj R = .353

CMIO	-.247
CFPO	-.144
FCIO	-.108
CMP1	.114
CFI2	-.116

CFP Adj R = .272

FCPO	.287
MCPO	-.127
FMPO	-.152
FCIO	.257
FMIO	-.156

CMP Adj R = .306

FMPO	-.188
FMI1	-.130
MCI2	.126
MFP4	.157
FMI6	.101

FMI Adj R = .413

MFIO	.348
MFPO	.065
CFP1	-.109
CFI3	-.107
MF15	.099

FCI Adj R = .353

MFIO	.138
MCIO	.203
CMIO	-.121
MFI1	.122
CFP1	-.103

MFI Adj R = .425

FMIO	.415
FMI1	-.138
CMP2	.099
CFI6	.111
FCP7	-.094

MCI Adj R = .366

FCIO	.274
CFIO	.212
FMI1	-.104
CMP3	-.107
FMP3	-.093

CFI Adj R = .330

MCPO	-.065
MCIO	.253
MFIO	-.212
MCI1	.099
MCP2	-.094

CMI Adj R = .362

MCPO	-.272
FCIO	-.141
MCI1	.128
FCP8	.165

Family #3

FMP Adj R = .422

MFPO	.284
CMPO	.200
CFIO	-.119
MCPO	-.113
CFI2	-.127

FCP Adj R = .378

MFIO	-.185
CMIO	.084
CFPO	-.125
MCPO	.101
CMI1	.169

MFP Adj R = .525

FMIO	.241
CMIO	-.628
CMPO	.486
FCPO	-.183
FCIO	-.125

MCP Adj R = .269

FMIO	-.149
CFIO	.147
FCPO	.115
FCI3	-.109
CFI3	-.104

CFP Adj R = .317

MFPO	.148
FMIO	-.046
FCPO	-.118
FMP1	-.199
MFP2	.114

CMP Adj R = .350

FMPO	.303
MCIO	.191
FCPO	.092
FCP2	.131
FMI1	-.130

FMI Adj R = .417

MFPO	.327
CFIO	-.150
CMIO	.175
MCPO	-.164
CFI1	-.098

FCI Adj R = .324

CFIO	-.130
MFIO	-.061
MFP2	-.192
CMI1	-.162
CMP4	.219

MFI Adj R = .492

FMIO	.243
CMIO	-.528
CMPO	.372
FCPO	-.194
FCIO	-.130

MCI Adj R = .320

CMIO	.203
FMIO	-.165
CFI1	-.209
FCP2	.118
CFP1	.136

CFI Adj R = .368

FMPO	.038
FCIO	-.165
MCPO	.100
FCPO	-.122
FMI1	-.330

CMP Adj R = .400

MFPO	-.143
MCIO	.180
FM18	.166
FC18	.136
MFP1	-.179

Family #4

FMP Adj R = .479

MFPO	.365
MCPO	-.232
MFIO	-.188
CFPO	-.097
CMPO	-.097

FCP Adj R = .452

FMIO	-.218
CMPO	-.348
CFPO	.166
CFIO	-.141
MFI1	.157

MFP Adj R = .426

FMPO	.369
CMPO	.140
CFPO	-.199
CFIO	-.127
CMP1	.100

MCP Adj R = .401

CMIO	-.300
CFPO	-.357
CMPO	.196
FCPO	.162
FMPO	-.143

CFP Adj R = .332

FMPO	-.255
FCPO	.231
MCPO	.130
MCI1	-.123
FMP2	-.128

CMP Adj R = .369

FCPO	-.238
MCPO	.201
FMP2	-.173
FCI1	-.072
MFI2	-.106

FMI Adj R = .526

MFIO	.278
CMIO	.200
CMPO	-.113
MFPO	-.113
MFI1	.197

FCI Adj R = .477

MFIO	.338
CMIO	.178
CMPO	.125
MF18	.096
MFIO	.166

MFI Adj R = .501

FMIO	.292
CFIO	.227
CFPO	.175
FCIO	.121
CF27	.089

MCI Adj R = .472

FCIO	.246
CMIO	.170
FMIO	.108
FCI1	.089
FCI2	.098

CFI Adj R = .371

MCIO	.182
FCIO	.126
FMPO	.129
FCI1	.132
MCI2	.138

CMI Adj R = .378

MCIO	.080
MCPO	-.160
FMIO	.213
FMPO	.178
MCI1	.152

Family #5

FMP Adj R = .468

CMPO	.218
CMIO	.281
MCI1	-.109
MCPO	.096
MCI2	-.149

FCP Adj R = .278

CMIO	.152
CFIO	-.196
CFPO	.132
MCPO	-.038
MCP1	-.123

MFP Adj R = .518

CMIO	-.306
CFPO	.208
FCIO	-.203
FCPO	-.175
CFIO	.098

MCP Adj R = .492

CMIO	-.567
CMPO	.417
FCIO	-.167
FCPO	-.169
FMPO	.098

CFP Adj R = .374

MFPO	.141
FCIO	-.089
MFI1	.075
MFP2	.216
MCP2	-.131

CMP Adj R = .523

FMPO	.245
MCIO	.298
MFIO	-.214
MCPO	.183
FMI1	.179

FMI Adj R = .441

CMIO	.257
CMPO	.121
MFI1	-.204
MFI2	.141
CMP1	.113

FCI Adj R = .275

MFPO	-.319
MFIO	.204
CFPO	-.042
CFP1	-.132
CMI1	-.111

MFI Adj R = .364

CFIO	.146
CFPO	.116
CMIO	-.057
CFI1	.133
FMP1	-.119

MCI Adj R = .532

CMIO	.434
FCIO	.144
FCPO	.126
CMPO	-.124
FMP1	.186

CFI Adj R = .400

MFIO	.374
MCPO	-.269
MCIO	-.155
FCPO	-.147
FCIO	-.105

CMI Adj R = .644

MCIO	.288
FMPO	.301
MFPO	-.170
MCPO	-.135
MCI1	.162

Family #6

FMP Adj R = .575

MFPO	.425
CFPO	-.247
CFIO	-.201
CMIO	.114
MCPO	-.101

FMI Adj R = .588

CFPO	-.283
MFIO	.383
CFIO	-.186
MCPO	-.163
MCIO	-.118

FCP Adj R = .379

MCPO	.345
CFIO	-.211
CMIO	.135
MCP1	-.120
MFI1	-.101

FCI Adj R = .452

MCIO	.362
CFIO	-.147
CMPO	.128
MCPO	-.116
MFPO	-.085

MFP Adj R = .491

FMPO	.500
CFPO	.125
CMIO	-.200
CFIO	.160
CMP1	-.124

MFI Adj R = .463

FMPO	.458
CFPO	.140
CFIO	.222
CMIO	-.166
CMP1	-.122

MCP Adj R = .470

CFIO	.275
FCPO	.300
CMIO	-.185
FMIO	-.166
FCIO	-.128

MCI Adj R = .444

FCIO	.379
CFPO	.119
CMPO	-.096
CMIO	-.097
CFP1	.116

CFP Adj R = .504

FMIO	-.336
MFIO	.241
MCIO	.114
FCIO	-.084
FMI1	-.183

CFI Adj R = .473

FMIO	-.349
MFIO	.180
FCIO	-.147
MCPO	.167
FCPO	-.125

CMP Adj R = .297

FMIO	.021
FCIO	.150
MCIO	-.076
FMP1	.135
FMI2	.136

CMI Adj R = .293

MFPO	-.159
MCIO	-.134
FCI2	-.116
MCI5	-.139
FMP3	-.102

Appendix G

Correlations between the Two Dimensions

of each Behaviour Stream

Behaviour	Family 1	Family 2	Family 3	Family 4	Family 5	Family 6
FM	.391	−.083	.948	−.623	.857	.930
FC	.027	−.489	−.001	−.532	−.503	−.102
MF	.450	−.068	.952	−.447	.680	.907
MC	−.565	−.621	.396	−.481	−.165	−.055
CF	.649	.132	.467	−.655	.249	.534
CM	.510	−.289	.826	−.584	.643	.031

APPENDIX H

Variance Accounted for in the Department Variable Set

Results of the canonical correlation analyses, reporting values for the squared canonical correlations (CC^2), the structure coefficients of the dependent variables (SC), and the amount of DV variance accounted for by the canonical variates (VA) and the univariate regressions (MR).

Family #1

FM:

		SC	VA	MR^2
$CC1^2 = .2538$	FMP	-.4238	.1588	.0869
	FMI	.6678		.1411
$CC2^2 = .0504$	FMP	.9058	.0693	
	FMI	.7443		

FC:

		SC	VA	MR^2
$CC1^2 = .2524$	FCP	-.6358	.2456	.1535
	FCI	.7543		.1809
$CC2^2 = .0864$	FCP	.7719	.0887	
	FCI	.6565		

MF:

		SC	VA	MR^2
$CC1^2 = .1914$	FCP	.8014	.1287	.1651
	FCI	-.1738		.1201
$CC2^2 = .1179$	FCP	.5981	.1565	
	FCI	.9848		

MC:

		SC	VA	MR^2
$CC1^2 = .5124$	MCP	.9316	.7946	.4691
	MCI	-.8263		.4085
$CC2^2 = .1848$	MCP	.3636	.0830	
	MCI	.5632		

CF:

		SC	VA	MR^2
$CC1^2 = .1873$	CFP	.0852	.1252	.0931
	CFI	.8136		.1552
$CC2^2 = .0924$	CFP	.9964	.1230	
	CFI	.5814		

CM:

		SC	VA	MR^2
$CC1^2 = .5529$	CMP	.8501	.3998	.4266
	CMI	-.0194		.0977
$CC2^2 = .0976$	CMP	.5267	.1246	
	CMI	.9998		

Family #2

			SC	VA	MR^2
FM:					
	$CC1^2$ = .3987	FMP	.6270	.3660	.2786
		FMI	.7244		.3047
	$CC2^2$ = .2008	FMP	.7790	.2173	
		FMI	-.6894		
FC:					
	$CC1^2$ = .2437	FCP	-.0292	.1916	.1619
		FCI	.8863		.2261
	$CC2^2$ = .1619	FCP	.9996	.1965	
		FCI	-.4631		
MF:					
	$CC1^2$ = .4135	MFP	.7680	.3863	.3229
		MFI	.5868		.2686
	$CC2^2$ = .1924	MFP	.6404	.2051	
		MFI	.8098		
MC:					
	$CC1^2$ = .1862	MCP	.8725	.3010	.1820
		MCI	-.9249		.1837
	$CC2^2$ = .1684	MCP	.4886	.0645	
		MCI	.3802		
CF:					
	$CC1^2$ = .1705	CFP	.1876	.1760	.1182
		CFI	.9984		.1703
	$CC2^2$ = .1163	CFP	.9822	.1126	
		CFI	-.0567		
CM:					
	$CC1^2$ = .1802	CMP	.5837	.1286	.1281
		CMI	.6507		.1378
	$CC2^2$ = .1068	CMP	.8425	.1374	
		CMI	-.7594		

Family #3

FM:

		SC	VA	MR^2
$CC1^2 = .3180$	FMP	.8606	.3721	.2828
	FMI	.6553		.2406
$CC2^2 = .1823$	FMP	.5092	.1513	
	FMI	.7553		

FC:

		SC	VA	MR^2
$CC1^2 = .1857$	FCP	.9987	.1855	.1855
	FCI	.0496		.1132
$CC2^2 = .1131$	FCP	-.0510	.1131	
	FCI	.9988		

MF:

		SC	VA	MR^2
$CC1^2 = .3379$	MFP	.9654	.5534	.3225
	MFI	.8401		.2712
$CC2^2 = .1114$	MFP	.2607	.0403	
	MFI	.5424		

MC:

		SC	VA	MR^2
$CC1^2 = .1567$	MCP	.5674	.2012	.1202
	MCI	.9809		.1547
$CC2^2 = .1028$	MCP	.8235	.0739	
	MCI	-.1946		

CF:

		SC	VA	MR^2
$CC1^2 = .2018$	CFP	-.3249	.1158	.1370
	CFI	.6843		.1633
$CC2^2 = .1294$	CFP	.9457	.1845	
	CFI	.7292		

CM:

		SC	VA	MR^2
$CC1^2 = .2956$	CMP	-.2333	.0534	.1926
	CMI	.3552		.2004
$CC2^2 = .1867$	CMP	.9724	.3397	
	CMI	.9348		

Family #4

FM:

	SC		VA	MR^2
$CC1^2 = .3381$	FMP	.7425	.5154	.2880
	FMI	-.9865		.3351
$CC2^2 = .2265$	FMP	.6698	.1077	
	FMI	.1639		

FC:

	SC		VA	MR^2
$CC1^2 = .3191$	FCP	.8248	.4858	.2586
	FCI	-.9176		.2892
$CC2^2 = .1298$	FCP	.5654	.0620	
	FCI	.3975		

MF:

	SC		VA	MR^2
$CC1^2 = .2816$	MFP	-.4506	.3388	.2114
	MFI	1.0000		.2816
$CC2^2 = .1935$	MFP	.8927	.1542	
	MFI	.0039		

MC:

	SC		VA	MR^2
$CC1^2 = .2748$	MCP	-.3962	.3155	.2274
	MCI	.9955		.2743
$CC2^2 = .2186$	MCP	.9182	.1862	
	MCI	-.0943		

CF:

	SC		VA	MR^2
$CC1^2 = .2446$	CFP	.3054	.0887	.1949
	CFI	.5189		.2046
$CC2^2 = .1898$	CFP	.9522	.3107	
	CFI	-.8548		

CM:

	SC		VA	MR^2
$CC1^2 = .2258$	CMP	-.1331	.1799	.1868
	CMI	.8826		.2170
$CC2^2 = .1861$	CMP	.9911	.2239	
	CMI	-.4702		

Family #5

FM:

		SC	VA	MR^2
$CC1^2 = .2433$	FMP	.9636	.4517	.2340
	FMI	.9634		.2340
$CC2^2 = .1130$	FMP	-.2672	.0162	
	FMI	.2680		

FC:

		SC	VA	MR^2
$CC1^2 = .2360$	FCP	.5270	.1176	.1245
	FCI	.4697		.1157
$CC2^2 = .0816$	FCP	.8498	.1225	
	FCI	-.8828		

MF:

		SC	VA	MR^2
$CC1^2 = .5392$	MFP	.9246	.5266	.4907
	MFI	.3490		.2457
$CC2^2 = .2050$	MFP	.3809	.2098	
	MFI	.9371		

MC:

		SC	VA	MR^2
$CC1^2 = .4630$	MCP	.7702	.5395	.3263
	MCI	-.7563		.3191
$CC2^2 = .1269$	MCP	.6378	.1059	
	MCI	.6542		

CF:

		SC	VA	MR^2
$CC1^2 = .3600$	CFP	.7452	.4486	.2774
	CFI	.8311		.3025
$CC2^2 = .1742$	CFP	-.6669	.1313	
	CFI	.5561		

CM:

		SC	VA	MR^2
$CC1^2 = .4209$	CMP	.6156	.5799	.3510
	CMI	.9994		.4208
$CC2^2 = .3083$	CMP	.7880	.1918	
	CMI	.0347		

Family #6

FM:

		SC	VA	MR^2
$CC1^2 = .4550$	FMP	.9598	.8704	.4358
	FMI	.9959		.4530
$CC2^2 = .2107$	FMP	-.2808	.0183	
	FMI	.0907		

FC:

		SC	VA	MR^2
$CC1^2 = .2449$	FCP	-.2360	.2540	.1835
	FCI	.9907		.2437
$CC2^2 = .1798$	FCP	.9718	.1731	
	FCI	.1359		

MF:

		SC	VA	MR^2
$CC1^2 = .2709$	MFP	.9897	.4551	.2696
	MFI	.8369		.2516
$CC2^2 = .2064$	MFP	.1433	.0661	
	MFI	.5474		

MC:

		SC	VA	MR^2
$CC1^2 = .2786$	MCP	.9118	.2676	.2672
	MCI	.3594		.2198
$CC2^2 = .2111$	MCP	-.4106	.2194	
	MCI	.9332		

CF:

		SC	VA	MR^2
$CC1^2 = .3853$	CFP	.8251	.5872	.2932
	CFI	.9183		.3401
$CC2^2 = .0968$	CFP	-.5650	.0461	
	CFI	.3959		

CM:

		SC	VA	MR^2
$CC1^2 = .1597$	CMP	.7475	.1646	.1445
	CMI	.6868		.1415
$CC2^2 = .1252$	CMP	-.6643	.1214	
	CMI	.7269		

APPENDIX I

Summary of the Nature of the Canonical Correlations

The nature of the canonical variates was categorized into one of the following classifications based on the structure coefficients of the dependent variables:

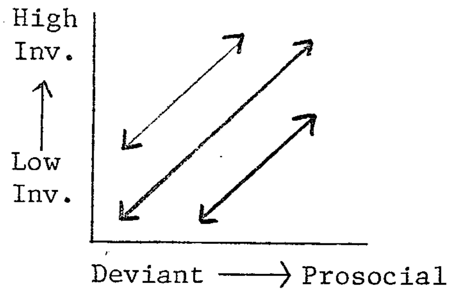
1) B - summing the two dimensions, with the larger being no more than twice the value of the smaller and both exceeding .30 (P + I).
2) C - contrasted the two dimensions with one having a positive sign and the other negative, and both exceeding .30 (P-I; I-P).
3) O - considering primarily one dimension, with the smaller less than half the value of the larger or being less than .30 (I; P).
4) N - neither dimension's structure coefficient exceeding .30.

The results tabled by family and behaviour follow:

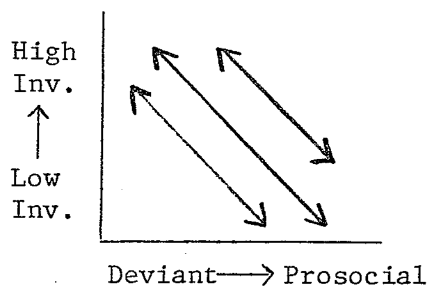
		Family					
Behaviour		1	2	3	4	5	6
FM	CV1:	C	B	B	C	B	B
	CV2:	B	C	B	O	N	N
FC	CV1:	C	O	O	C	B	O
	CV2:	B	O	O	B	C	O
MF	CV1:	O	B	B	O	O	B
	CV2:	B	C	O	O	O	O
MC	CV1:	C	C	B	O	C	O
	CV2:	B	B	O	O	B	O
CF	CV1:	O	O	O	B	B	B
	CV2:	B	O	B	C	C	C
CM	CV1:	O	B	O	O	B	B
	CV2:	B	C	B	C	O	C

Illustration of those behaviours which are best represented by the different classiciations of canonical variates.

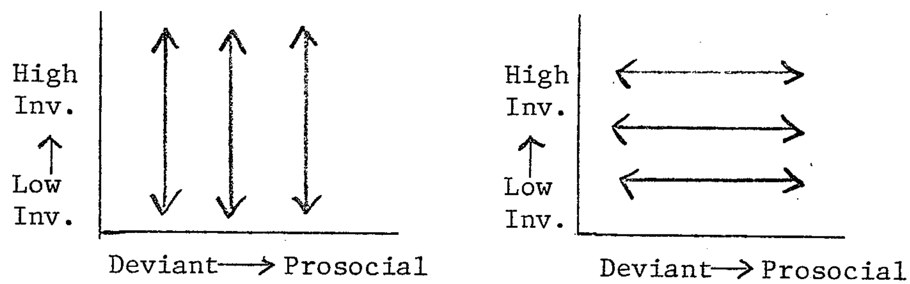
1) Both (P + I)



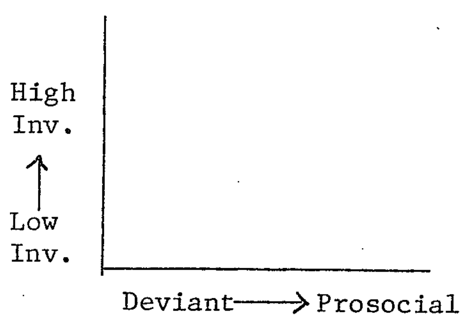
2) Contrast (P-I; I-P)



3) One dimension (P; I)



4) Neither



APPENDIX J

Detailed Canonical Correlation Results for Family #6, including Canonical Correlations Standardized Beta Weights, and Structure Coefficients

1) Father --> Mother Behaviours

Canonical Correlation 1: .675 Canonical Correlation 2: .459

Dependent Variables:	STN.B.	S.C.	STN.B.	S.C.
FMPO	.247	.960	-2.716	-.281
FMIO	.766	.996	2.618	.091
Independent Variables:				
MFPO	.271	.501	-1.946	-.411
MFIO	.345	.466	1.665	-.121
MCPO	-.139	-.313	-.239	-.227
MCIO	-.035	-.255	.002	.241
CFPO	-.242	-.566	-.160	-.100
CFIO	-.165	-.505	.050	-.084
CMPO	.073	.223	.324	.278
CMIO	.090	.040	-.051	.074
MFP1	-.138	.187	.233	-.077
MFI1	.225	.162	-.118	-.050
MCP1	-.119	-.354	.149	.176
MCI1	-.186	-.316	.119	-.041
CFP1	-.172	-.568	.262	-.045
CFI1	-.109	-.494	-.398	-.183
CMP1	.126	.220	-.223	-.157
CMI1	.056	.093	.170	.015
MFP2	-.035	.030	.329	-.192
MFI2	-.135	-.022	-.489	-.223
MCP2	-.007	-.293	-.088	-.111
MCI2	-.041	-.225	.104	.126
CFP2	-.194	-.561	-.344	-.166
CFI2	.024	-.427	.345	-.097
CMP2	.039	.193	-.007	.033
CMI2	-.041	.075	-.338	-.150

2) Father --> Child Behaviours

Canonical Correlation 1 = .495 Canonical Correlation 2 = .424

Dependent Variables:	STN.B.	S.C.	STN.B.	S.C.
FMPO	-.137	-.236	.996	.972
FCIO	.977	.991	.237	.136
Independent Variables:				
MFPO	-.418	-.250	-.108	-.106
MFIO	.176	-.184	.132	-.134
MCPO	-.300	-.445	.801	.470
MCIO	.674	.724	.295	.097
CFPO	.015	-.097	.270	-.161
CFIO	-.151	-.306	-.532	-.387
CMPO	.262	.251	-.112	-.069
CMIO	-.037	-.117	.357	.088
MFP1	.203	.022	.414	-.257
MFI1	-.174	-.035	-.635	-.346
MCP1	.044	-.057	-.300	-.263
MCI1	.151	.138	.026	.010
CFP1	.119	-.054	-.155	-.312
CFI1	-.140	-.261	-.151	-.401
CMP1	-.038	.012	.236	.124
CMI1	.139	-.066	.061	.051
MFP2	.501	.146	-.328	-.214
MFI2	-.364	.027	.303	-.233
MCP2	-.232	-.252	-.068	-.213
MCI2	-.083	.002	-.083	-.008
CFP2	-.153	-.093	-.083	-.301
CFI2	.153	-.235	-.055	-.250
CMP2	.113	.111	-.133	-.027
CMI2	-.193	-.157	.049	.167

3) Mother --> Father Behaviours

Canonical Correlation 1 = .521 Canonical Correlation 2 = .454

Dependent Variables:	STN.B.	S.C.	STN.B.	S.C.
MFPO	1.298	.990	-1.984	.143
MFIO	-.340	.837	2.347	.547
Independent Variables:				
FMPO	1.413	.734	-1.458	-.009
FMIO	-.445	.596	1.876	.195
FCPO	-.116	-.014	-.009	-.111
FCIO	-.048	-.257	-.009	.057
CFPO	.116	.097	.223	.349
CFIO	.197	-.030	.310	.488
CMPO	.070	.027	-.060	.051
CMIO	-.329	-.328	.004	.140
FMP1	.183	.191	-.097	.024
FMI1	-.249	.214	.153	-.009
FCP1	-.011	-.052	.132	.189
FCI1	.150	.033	-.213	-.292
CFP1	.276	.089	-.096	.226
CFI1	-.061	-.054	.343	.424
CMP1	-.267	-.148	-.007	-.059
CMI1	-.065	-.198	-.201	.144
FMP2	.196	.245	.637	-.130
FMI2	-.098	.237	-.790	-.217
FCP2	-.047	-.022	.020	-.002
FCI2	-.045	.050	.072	-.092
CFP2	-.064	-.057	.164	.191
CFI2	.081	-.034	-.069	.350
CMP2	-.051	-.039	.255	.212
CMI2	-.053	-.108	.290	.248

4) Mother --> Child Behaviours

Canonical Correlation 1 = .528 Canonical Correlation 2 = .456

Dependent Variables:	STN.B.	S.C.	STN.B.	S.C.
MCPO	.935	.912	-.360	-.411
MCIO	.411	.359	.913	.933
Independent Variables:				
FMPO	.082	-.460	-.028	-.254
FMIO	-.296	-.515	.128	-.148
FCPO	.549	.400	-.201	-.281
FCIO	.059	-.057	.845	.866
CFPO	-.126	.473	.211	.191
CFIO	.533	.493	-.136	-.118
CMPO	.030	-.178	-.186	-.087
CMIO	-.427	-.250	-.066	-.199
FMP1	.025	-.475	.063	-.141
FMI1	-.205	-.528	-.097	-.150
FCP1	.148	.151	.021	.120
FCI1	-.053	-.037	.051	.252
CFP1	.109	.410	.127	.219
CFI1	-.013	.354	.051	-.034
CMP1	-.247	-.355	.061	-.009
CMI1	-.162	-.191	-.019	-.125
FMP2	.015	-.478	-.058	-.183
FMI2	-.141	-.489	.009	-.217
FCP2	-.080	-.052	-.095	-.091
FCI2	.035	.039	.034	.139
CFP2	-.031	.328	.233	.184
CFI2	.067	.382	-.264	-.085
CMP2	.043	-.097	-.140	-.124
CMI2	.144	.044	.142	-.112

5) Child --> Father Behaviours

Canonical Correlation 1 = .621 | Canonical Correlation 2 = .311

Dependent Variables:	STN.B.	S.C.	STN.B.	S.C.
CFPO	.468	.825	-1.086	-.565
CFIO	.668	.918	.976	.396
Independent Variables:				
FMPO	-.017	-.607	.043	.242
FMIO	-.346	-.659	.576	.266
FCPO	-.074	-.175	-.362	-.197
FCIO	-.172	-.228	-.239	-.342
MFPO	-.286	.073	-1.058	-.203
MFIO	.509	.214	.528	-.111
MCPO	.134	.424	.310	.146
MCIO	.049	.176	-.408	-.464
FMP1	.048	-.587	-.499	.143
FMP1	-.330	-.649	.503	.230
FCP1	.034	-.089	-.051	-.187
FCI1	-.043	-.239	.098	-.111
MFP1	-.273	.048	.073	-.076
MFI1	.389	.175	-.135	.033
MCP1	.106	.481	.111	.066
MCI1	-.064	.115	.156	-.068
FMP2	-.330	-.574	-.682	.182
FMI2	.072	-.616	.473	.196
FCP2	.033	-.038	.105	.097
FCI2	-.183	-.266	-.470	-.426
MFP2	.029	.038	.150	.135
MFI2	.033	.121	.266	.193
MCP2	.139	.464	-.122	.075
MCI2	.020	.122	-.082	-.269

6) Child --> Mother Behaviours

	Canonical Correlation 1 = .400		Canonical Correlation 2 = .354	
Dependent Variables:	STN.B.	S.C.	STN.B.	S.C.
CMPO	.727	.748	-.687	-.664
CMIO	.665	.687	.748	.727
Independent Variables:				
FMPO	-.305	.224	.535	-.176
FMIO	.514	.343	-.231	-.250
FCPO	-.016	-.022	.344	.217
FCIO	.220	.130	-.279	-.342
MFPO	-.455	-.235	-.959	-.371
MFIO	.326	-.136	.517	-.276
MCPO	-.198	-.264	-.330	-.041
MCIO	-.368	-.350	-.289	-.142
FMP1	.798	.398	.372	-.475
FMI1	-.743	.336	-.787	-.528
FCP1	.135	.283	.041	-.165
FCI1	-.153	-.264	.122	-.078
MFP1	-.964	-.250	-.337	-.326
MFI1	.755	-.121	.315	-.272
MCP1	.104	-.017	-.026	.049
MCI1	.026	-.230	-.006	.001
FMP2	-.885	.292	-.441	-.433
FMI2	1.036	.379	-.045	-.474
FCP2	.159	.210	-.238	-.173
FCI2	-.244	-.252	-.331	-.233
MFP2	.025	-.178	.720	-.116
MFI2	-.093	-.138	-.483	-.130
MCP2	-.100	-.135	.143	.264
MCI2	-.196	-.412	.143	.035