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ABSTRACT

Research on family interaction patterns suggests that delinquent behaviors of children and adolescents may be related to, if not a direct function of, disordered interpersonal interaction within the family unit. Family interaction can be seen as a sequence of interlocking events occurring over time and consisting of the three basic characteristics of sequentiality, flexibility, and constraint. Although researchers have been reasonably successful in identifying certain recurrent behavior patterns in family interaction, overall progress has been constrained by limitations of the methods typically employed. Three methods of discrete sequential analysis appear to hold promise for the study of family interaction processes and delinquency. Each is a technique used for analyzing sequences of behavior in order to search for sequential patterns or redundancies among behaviors. Markov chain analysis, lag sequential analysis, and information theory are all procedures which would allow researchers to identify recurrent patterns and test the hypothesized relationships between family interactions and delinquent behavior, while retaining the sequential ordering of the family's responses and recognizing the reciprocal nature of their interaction. (NRB)

# METHODS OF SEQUENTIAL ANALYSES FOR STUDYING FAMILY INTERACTIONS

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## Abstract

Developing lines of research on family interaction patterns suggest that delinquent behaviors of children and adolescents may be related to, if not a direct function of, disordered interpersonal interaction within the family unit. But although researchers have been reasonably successful in identifying certain recurrent behavior patterns in family interaction, overall progress has been constrained by limitations of the methods typically employed. This paper presents three methods of discrete sequential analysis which appear to hold promise for the study of family interaction processes and delinquency.

# METHODS OF SEQUENTIAL ANALYSES FOR STUDYING FAMILY INTERACTIONS

The family as a correlate to adolescent delinquency has been a consideration within a variety of perspectives for some time (e.g., Andrew, 1981, Empey, Lubeck & LaPorte, 1971, Johnson, 1979). Of recent and particular interest in this area, however, has been focus on family interaction and its relationship to delinquent behavior. Psychologists from many perspectives agree that the family is a crucial influence on the interpersonal functioning of the child. Focus on the family as one contributing factor to delinquency is prevalent in the various theories of delinquency. Jackson (1965) underscores the importance of identifying family processes:

> Since the family is the most influential learning context, surely a more detailed study of family process would yield valuable clues to the etiology of such typical modes of interaction. (p. 1)

Developing lines of research on family interaction patterns suggest that delinquent behaviors of children and adolescents are related to, if not a direct function of, disordered interpersonal interaction within the family unit. Theory and speculation exist as to whether these purported disordered interaction patterns (a) are a result of the deviant behavior(s) of the "problematic" family member, (b) are the cause of the delinquent behavior of the family member, or (c) are an interpersonal operational definition of delinquency itself. While theoretical debate over these perspectives continues, an empirical investigation of the interaction patterns which characterize and differentiate the interaction patterns of delinquent and non-delinquent families remains a fruitful area for investigation.

Evidence of the fruitfulness of studying family interaction patterns lies in the great wealth of literature which has developed describing families with schizophrenic members (for reviews, see Riskin & Faunce, 1973; Dell, 1980). The general consensus seems to be that families with schizophrenic members evidence distinct and different communication patterns from families with "normal" children. This literature also suggests that differentiation among families can be made based upon observed interaction patterns. The descriptions generated by this body of research have provided a better understanding of the nature and process of the interactions of individuals labelled schizophrenic.

A similar approach would seem to be beneficial in the area of juvenile delinquency as well. While some research has focused on delinquency as the identified problem, much of the existing research focuses on comparisons of "normal" and "abnormal" families. An "abnormal" family is typically defined as any family that has a member with an identified problem. Delinquent families are generally not separated out for comparisons. Thus, the most that can be said about delinquency per se is only what can be said about "abnormal" families in general. How delinquent families specifically compare to "normal" families or to other "abnormal" families is impossible to determine from these studies.

In a study which is typical of the "grouping" approach to research, Haley (1964) observed the order in which family members spoke and obtained a frequency count of which persons followed each other. He found that while individual families demonstrated distinct patterns of communication, it was nevertheless possible to differentiate most "normal" from most "disturbed" families based on their communication patterns.

Decision-making tasks are utilized frequently in family interaction research because these types of tasks facilitate discussion and provide the opportunity for dysfunctional interaction styles to present themselves. Ferreira, Winter and colleagues have done a series of experiments looking at decision-making in "normal" and "abnormal" families. Their "abnormal" families were divided into "schizophrenia-producing" families, "delinquency-producing" families, and "maladjusted" families. Ferreira and Winter (1965) found that normal families, when contrasted with abnormal families (a) had much greater agreement on likes and dislikes prior to discussions, (b) spent less time in making family decisions and (c) arrived at more appropriate decisions in terms of better fulfillment of family members' individual choices. When the delinquent families were separated out, they fit the same general pattern for spontaneous agreement and choice-fulfillment. However, their decision-time was much faster than the other "abnormal" families, which suggested a tendency for impulsivity. As a follow-up, the authors then attempted to break down the variables leading to the longer decision-time for "abnormal" families. They found that significantly larger amounts of information were exchaned in the normal families. They also found that there was more silence in the abnormal family process. They noted that this breakdown in communication in abnormal families was characteristic of the whole family and not a function of any one individual.

Ferreira, Winter and Poindexter (1966) used a somewhat different task to study interaction patterns of the same groups of families previously reported. In this study, they had the families generate stories about TAT (Thematic Apperception Test) cards. These discussions were recorded and analyzed for the relative amount of talk among family members, the amount of talk overlap among family members, and relative amounts of silence. The only significant difference between "normal" and "abnormal" families was the larger amount of silence in the "abnormal" families' discussions. Across all three TAT stories, there were more silences in the schizophrenic and delinquent families.

Stabenau, Tupin, Werner and Pollin (1965) found that delinquent families demonstrated qualitative differences from "normal" families in their manner of interaction. The delinquent families' interactions exhibited uncontrolled and intense affect. Family organization was unstable with an "absence of clear role differentiation" (p. 50). The quantified interactions (interaction time, the time family members spoke, overlaps, interruptions and pauses) did not show statistically significant differences but did demonstrate patterns consistent with other literature and with that expected from "intense affect" and "unclear role differentiation."

Harbin and Madden (1983) compared the interaction patterns of families with violent adolescents with those of families with normal adolescents. Families with assualtive teenagers had: (a) less agreement when making choices as a group, (b) le[illegible]eement between mother and violent son when making choices a[illegible] [illegible]ctivities, (c) sons who had less influence in families' choices of activities, and (d) mothers who "dictated" the families' decisions more often.

The potential power of intervening in family interaction processes has been examined by Alexander and colleagues in a series of studies in which they evaluated the effectiveness of a short-term behaviorally oriented intervention program. The focus of the intervention was to increase family reciprocity, clarity of communication and contigency contracting. As a result of this intervention, the desired changes in family communication processes among delinquent families were obtained (Parsons & Alexander, 1973). These changes in communication directly resulted in reduced recidivism rates among the delinquent adolescents (Alexander & Parsons, 1973); and the treatment was found to be more effective than no treatment, a client-centered family approach or an eclectic-dynamic approach (Klein, Alexander & Parsons, 1977).

Although researchers have attempted, and have been somewhat successful in, identifying recurrent behavior patterns in interactional sequences, overall progress has been constrained by the limitations of the methodologies typically employed. In this regard, the purpose of this paper is to present a description of three methods of discrete sequential analysis which we believe hold promise for the examination of family interaction processes and delinquency. This paper is by no means intended to provide an exhaustive, much less technical, presentation of these methods; rather it is intended as an introduction to stimulate interest in these approaches and in their research potential.

Characteristics of Family Interaction

Family interaction as social interaction has three basic characteristics: sequentiality, flexibility and constraint (Raush, 1965). Although frequently treated as such, family interaction is not an event; rather it is a sequence of interlocking events occurring over time. While these events may be construed as determined, empirically they occur as "random" phenomena obeying probabilistic rules, rather than strictly deterministic laws (Hertel, 1972). A position of "probabilistic determinism" proposes that while the effects of various stimuli (antecedent behaviors) upon the behavior of another may be quite predictable, we are at least for the present, limited to general probabilistic statements of the sort, "In the presence of certain stimuli, certain behaviors may be more or less likely to occur." Such randomness or uncertainty permits for behavioral flexibility and variation (and through it, the possibility of change through social interaction) that would not be possible were social responses strictly determined.

Social interaction within the family may be thought of as a process of constraint and modification on the initial variability of the family system, i.e., on the behavioral variability of the individual family members (Raush, 1965). Such constraint occurs mutually and reciprocally among all family members: Parents affect children; parents affect each other. Children affect parents; children affect each other. Although specifically addressing verbal behavior, Skinner (1957) acknowledges the reciprocal and interlocking nature of behavior within social interaction. In paradigmatic form, family interaction can be understood as a sequence of interlocked behaviors among individual family members--behaviors which, by their stimulus properties, modify and constrain the responding of others, thereby giving rise to the behavioral complexity we see in family interaction processes. By virtue of this constraint on an inherently probabilistic process, the interactive behaviors of the family become predictable, at least to some extent. It is this predictability, the recurrence of behaviors and sequences of behaviors within the interaction, that become identified as "family interaction patterns" (Bateson, 1973).

Studying Family Interactions

The raw material for studying family interaction patterns are the various interactive behaviors of family members as they occur and order themselves over time. It has been noted, however, that while the observational protocols or codings of these events are gathered in a temporal order, generally it is simply because the events occur that way (Raush, 1969). Most often in the conversion to data for analysis, the ordering of these events is either lost or ignored.

Consistent with this view, most methods of investigation employed to date, although acknowledging these interlocking contingencies among the events, have generally employed unidirectional analysis in which the influences of person A on person B are studied in methodological isolation from the effects of person B on person A. This is exemplified in the traditional child development literature. For example, early research has included studies of the effects of parental behavior on the development of intelligence (Willerman,

1979) and sex typing (Johnson, 1981). More recently, the studies have included the effects of children's behavior on that of adults (Bell, 1979). Note that the latter "child-effects" approach, while taking into account the child's contribution to the interaction, nevertheless still examines influence in an unidirectional manner.

Single-subject designs which are frequently employed by behavior analysts are almost by definition, studies of interaction from a unidirectional perspective. Although permitting study of the effects of a stimulus (be it a reinforcer, discriminative stimulus, or etc.) on another's behavior, such analyses ignore the effect the respondent has on the occurrence of the stimulus. This relationship may be examined in a separate study, but rarely are the two interlocking relationships studied within the same design.

To date, our research methods have, thereby, necessarily "punctuated" the ongoing sequences of events which potentially constitute problematic interaction sequences, and in doing so have destroyed the very pattern investigators are trying to find. To the extent that our theories and hypotheses relate to interaction patterns, it would seem important to systematically and methodologically investigate the mutual and reciprocal causality between interactants.

In this regard, Raush (1969) has noted the desirability of models and methods for process research whereby researchers could capture and investigate the temporal nature of family interaction through analysis of the sequential ordering of family members' responses. Such models and methods would potentially move process research from investigation premised on static states to one more capable of dealing with both structural continuities and continuous changes, and toward the illumination and documentation of the kinds of sequential phenomena that provide the inference base for our views of family process as it relates to delinquency.

The three approaches to be presented here attempt to address Raush's concern. Each approach may generally be referred to as a method of discrete "sequential analysis". Sequential analysis is the term given to a number of statistical techniques used for analyzing sequences of behavior. Common to each of these techniques is the search for sequential patterns or redundancies among behaviors. While the specifics of the approaches differ, each is derived, at least conceptually, from the conditional, sequential dependencies among events in the sequence. Sequential analysis may thus reveal the interaction patterning between two or more individuals (Raush, 1965). That is, to the degree that the actions of one person "depend" on the preceding behavior of another, the first person's response probabilities have altered in response to the behaviors of the other. In the three methods presented here (Markov chain analysis, lag sequential analysis, information theory analysis), the dependency need not necessarily be limited to the effect of the immediately preceding event, but instead may allow for the discovery of more complex patterns of interactive dependency among the communicative events of all of the family members.

Markov Chain Analysis

It is possible to describe a family interaction response sequence by specifying the likelihood of each of the various response to response transitions A transition consists of two temporally continguous responses within the interaction sequence. The likelihood of occurrence of any given transition, the transition probability, is computed as the frequency of occurrence of the transition divided by the number of times the antecedent response in the transition serves as an antecedent for any transition in the interaction sequence. These probabilities can then be arranged in a matrix called a transition matrix in which the rows (i) represent the antecedent response and the columns (j) are the consequents. The matrix summarizes the probabilities of each response following every other response at the next ($t$) instance. For each antecedent response at time $t$-1, the sum of the probabilities for each of the possible consequent events equals 1.0.

To the extent that the probabilities within and across each row of the matrix are not equal (i.e. are non-random), the antecedent responses may be said to constrain or [illegible]ify the distribution of probabilities of the various consequents--and the probability of occurence of any given consequence is said to "depend on" the prior response. If the occurrence of a response is dependent on only the immediately preceding response of another, and if the probabilities are stationary (i.e., stable) across the interaction sequence, the sequence is said to exhibit first-order dependence and constitute a first-order Markov chain.

It is possible, and some would say probable, that the interaction among family members would show greater or higher-order dependency among responses; i.e., responses are constrained by (or the probability of occurrence depends on) more than the immediately preceding response. Rather it is constrained by a sequence of some $n$ number of preceding responses.

The procedure for testing the order of dependency among responses is essentially to test a series of models (of dependency) in which the number of antecedent responses in the sequence on which each response is considered dependent is increased by one response in each subsequent test. That is, a 1st-order dependency model is compared to a random (0-order) model with respect to its "goodness of fit" to the contingency data; a 2nd-order model is compared with the first-order model; a third-order model with a second-order model, etc. To do so, of course, requires the construction of successively larger contingency tables which consecutively present the contingencies between responses from the 1st to the nth order. Given such contingency tables as a data base, there are two methods generally employed to estimate the order of constraint of the sequential data summarized by the tables: the Chi square approach and the maximum likelihood approach.

The former approach is based on a comparison of observed and expected frequencies for each consecutive increase in the order of dependency. The difference between the values is subjected to a $X^2$ goodness-of-fit test for determining which model best describes/explains the contingent relationships among the responses in the family interaction (Suppes & Atkinson, 1960; Chatfield, 1973).

The maximum likelihood approach is similar to the $X^2$ approach but employs the log-linear ratio statistic ($G^2$) rather than the $X^2$ statistic. Generally speaking, the maximum likelihood approach is better than the $X^2$ approach (Bishop, Fienberg & Holland, 1975), but both are susceptible to difficulties associated with $X^2$ when applied to complex data. In particular, as the order of the sequential dependencies to be tested increases in number, the number of possible combinations of contingent response increases in a multiplicative fashion. Unless the number of actual responses in the interaction sequence is quite large, this results in an increase in the number of empty cells in the tables, thus weakening the $X^2$ test (see Chatfield & Lemon, 1970).

Given a Markov chain of some of _n_th order, it is possible to determine patterns of recurrence of responses (Howard, 1971; Gottman, 1979). Digraph's of chains -- graphs of the probabilistic interrelationships among responses (or if a higher-order chain, among _sets_ of responses) -- can also be made in order to visually present the patterns inherent in the transition probabilities (e.g., Brent & Sykes, 1979).

Lag Sequential Analysis

An alternative to the Markov chain approach to the study of contingency relationships in interaction sequences is the lag sequential analysis method (Sackett, 1979). As presented by Sackett, the particular advantage of this technique over the Markov approaches outlined above is that it allows for obtaining measures of contingency among responses which are far apart in the sequence (i.e., higher order dependency) without the concern of "empty cells" which plagues the previous approaches.

The basic procedure for lag analysis is as follows: Each interaction response class serves as a criterion code. For each specified criterion, the conditional probability of each other response class (including itself) is calculated as a function of the successive lags (n-steps) of each response from the criterion.

Having determined these conditional lag probabilities, they can be tested for statistical significance against the null hypothesis of equivaldnce to the unconditional probabilities of the responses -- a "match" of the conditional and unconditional probabilities suggesting independence of sequential responses, rather than dependence and patterning, at that lag (Allison & Liker, 1982; Wampold, & Margolin, 1982).

Using these lag probabilities, it is possible to then identify patterns among those responses within the sequence. This involves a three step procedure, referred to by Gottman (1979) as the "lag-one connection rule." First, starting with a criterion response, select for the next response the response with the highest lag-1 conditional probability from the criterion. Then select the response with the highest lag-2 probability from the criterion, the highest lag-3 probability, etc.

Gottman (1970) notes that such a sequence is a likely or common pattern only if the lag-1 probability from response 2 to response 3 is the highest conditional probability for that two-response sequence (with the second response now serving as the criterion). This process of verification continues--successively checking the one-step connections generated within the identified sequence.

Finally, the last step in identifying a probable response sequence pattern is to determine at any lag whether the conditional probability of occurrence of a response differs significantly from the unconditional probability of the response. Even if a response is the most likely response at some lag from the criterion, if it is not more probable (statistically speaking) than its simple unconditional likelihood of occurrence, that response should not be considered part of an identified common sequence. A computer program for determining lag probabilities and for testing the significance may be found in Sackett, Holm, Crowley and Henkins (1979; also see Morley, 1984).

Information Theory Analysis

The previously presented techniques have addressed the issue of "patterns" as a function of dependency among response. Information theory takes a somewhat different, but analogous, approach to the study of pattern in sequences of response. An interaction sequence (as a stochastic process) may be characterized by some degree of redundancy between 0 and 100 percent-- redundancy being essentially synonymous with the notion of pattern (or patterning). At the zero-redundancy extreme, all response have an equal likelihood of occurrence -- the history of the sequence prior to any given response has no effect on the predictability of the response That is to say, there is complete uncertainty with respect to the patterning of responses within the sequence (or even more specifically, to the extent that response in the sequence are equally probable, there is no patterning at all). At the other extreme -- that of 100 percent redundancy -- the sequence is entirely predictable (redundant) and one can predict with complete certainty what each subsequent response will be.

The information theory approach consists of calculating the average conditional uncertainty for the sequence for differing lengths of strings of antecedent responses. The decrease in uncertainty as the number of antecedent response increases may be used to assess the sequential dependency in the interaction sequence (Penman, 1980). A sequence has _n_th-order redundancy whenever some of the possible patterns of successive responses are more probable than others.

To calculate the degree of redundancy or patterning in a sequence, a decision must first be made on how high an order of redundancy one wishes to take into account. In a process similar to that in the Markov analysis, determination of the order of redundancy involves calculating the average conditional uncertainty for successive orders of redundancy and subtracting the average uncertainty of the previous order (Attneave, 1959).

The difference between successive values of conditional uncertainty provides a measure of how much information is gained (i.e., how much uncertainty is reduced) by basing prediction for a given response on the previous _n_ events, rather than the _n_-1 previous response. The statistical significance of these sequential differences can be tested using a $X^2$ approximation approach (Chatfield, 1973). Alternatively, one can plot the conditional uncertainty of an interaction sequence against its length (order of redundancy) in order to display visually the reduction in uncertainty as one considers sequence patterns of increasing length. The point at which the conditional uncertainty begins to decrease relatively slowly after initial sudden decreases, allows one to determine the order of redundancy among the responses. The point at which inclusion of an additional response no longer contributes to a reduction in the uncertainty of response occurrences is the indicator of the order of redundancy. This graphical technique is often more reliable than a series of significance tests based on the $X^2$ approximation, especially when the number of response classes and order of redundancy are quite large -- conditions under which the $X^2$ approximation becomes invalid (Chatfield, 1973).

In summary, three methods of discrete sequential analysis have been briefly described. Each is a technique used for analyzing sequences of behavior in order to search for sequential patterns or redundancies among behaviors. Markov chain analysis, lag sequential analysis, and information theory are three procedures which would allow researchers to identify these recurrent patterns and test the hypothesized relationships between family interactions and delinquent behavior while retaining the sequential ordering (patterning) of the family's responses and recognizing the reciprocal nature of their interaction.

## References

Allison, P. & Liker, J. (1982). Analyzing sequential categorical data on dyadic interaction: A comment on Gottman. Psychological Bulletin, 91, 393-403.

Alexander, J.F. & Parsons, B.V. (1973). Short-term behavioral intervention with delinquent families: Impact on family process and recidivism. Journal of Abnormal Psychology, 81, 219-223.

Andrew, J.M. (1981). Delinquency: Correlating variables. Journal of Clinical Child Psychology, 10, 136-140.

Attneave, F. (1959). Applications of information theory to psychology. New York: Holt.

Bateson, G. (1972). Steps to an ecology of mind. New York: Ballantine.

Bell, R.Q. (1979). Parent, child and reciprocal influences. American Psychologist, 34, 821-826.

Bishop, Y., Fienberg, S., & Holland, P. (1975). Discrete multivariate analysis. Cambridge, MA: MIT Press.

Chatfield, C. (1973). Statistical inference regarding Markov chain models. Applied Statistics, 22, 7-20.

Chatfield, C. & Lemon, R. (1970). Analyzing sequences of behavioral events. Journal of Theoretical Biology, 29, 427-445.

Dell, P. (1980). Researching the family theories of schizophrenia: An exercise in epistemological confusion. Family Process, 19, 321-335.

Empey, L.T., Lubeck, S.G., & LaPorte, R.L. (1971). Explaining delinquency: Construction, test, and reformation of a sociological theory. Lexington: D.C. Heath.

Ferreira, A.J. & Winter, W.D. (1965). Family interaction and decision-making. Archives of General Psychiatry, 13, 214-223.

Ferreira, A.J., Winter, W.D., & Poindexter, E.J. (1966). Some interactional variables in normal and abnormal families. Family Process, 5, 60-75.

Gottman, J. (1979). Marital interaction. New York: Academic Press.

Haley, J. (1964). Research on family patterns: An instrument measurement. Family Process, 3, 41-65.

Harbin, H.T. & Madden, D.J. (1983). Assaultive adolescents: Family decision-making parameters. Family Process, 22, 109-118.

Hertel, R. (1972). Application of stochastic process analysis to the study of psychotherapeutic process. Psychological Bulletin, 77, 421-430.

Howard, R (1971). Dynamic probabilistic systems. Vol. 1. Markov models. New York: Wiley.

Jackson, D.D. (1965). The study of the family. Family Process, 4, 1-20.

Johnson, M. M. (1981). Fathers, mothers and sex typing. In E. M. Hetherington & R. D. Parke (Eds.) (pp. 391-402). Contemporary readings in child psychology. New York: McGraw-Hill.

Johnson, R. (1979). Juvenile delinquency and its origins. Cambridge: Cambridge University.

Klein, N.C., Alexander, J.F., & Parsons, B.V. (1977). Impact of family systems intervention on recidivism and sibling delinquency: A model of primary prevention and program evaluation. Journal of Consulting and Clinical Psychology, 45, 469-474.

Morley, D. (1984). Corrections to lag sequential results in communication research: An introduction. Human Communication Research, 45, 121-123.

Parsons, B.V. & Alexander, J.F. (1973). Short-term family intervention: A therapy outcome study. Journal of Consulting and Clinical Psychology, 41, 195-201.

Penman, R. (1980). Communication processes and relationships. New York: Academic Press.

Raush, H. (1969). Naturalistic method and the clinical approach. In E. Willems & H. Raush (Eds.), Naturalistic viewpoints in psychological research (pp. 122-146). New York: Holt, Rinehart & Winston.

Raush, H. (1965). Interaction sequences. Journal of Personality and Social Psychology, 2, 215-238.

Riskin, J. & Faunce, E.E. (1972). An evaluative review of family interaction research. Family Process, 11, 365-455.

Sackett, G. (1979). The lag sequential analysis of contingency and cyclicity in behavioral interaction research. In J. Osofsky (Eds), Handbook of infant development (pp. 623-549). New York: Wiley.

Sackett, G., Holm, C., Crowley, C., & Henkins, A. (1979). A FORTAN program for lag sequential analysis of contingency and cyclicity in behavioral interaction data. Behavior Research Methods and Instrumentation, 11, 366-378.

Skinner, B. F. (1957). Verbal Behavior. Englewood Cliffs: Prentice-Hall.

Stabenau, J.R., Tupin, J., Werner, M., & Pollin, W. (1965). A comparative study of families of schizophrenics, delinquents and normals. Psychiatry, 28, 45-59.

Suppes, P. & Atkinson, R. (1960). Markov learning models for multi-person interactions. Stanford, CA: Stanford Press.

Wampold, B. & Margolin, G. (1982) Nonparametric strategies to test the independence of behavioral states in sequential data. Psychological Bulletin, 92, 755-765.

Willerman, L. (1979). Effects of families on intellectual development. American Psychologist, 34, 923-929.

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