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ABSTRACT

To identify maternal scaffolding behaviors, this study used conventional sequential analysis to examine mother-child dyads interacting in problem-solving and exploration contexts. Conventional sequential analysis estimates the temporal contingency between the antecedent behavior of one person and the consequent behavior of a second person. Subjects were 16 mothers and their children, ranging from 24 to 32 months, from upper middle-class families. Each mother-child dyad was observed and videotaped for 20 minutes at the child's preschool. The session consisted of 10 minutes of a problem-solving activity and 10 minutes of an exploration activity. Analysis indicated that four maternal behaviors (focusing, seeking assistance, pretend-playing, and listening) were associated with an increased probability that the child would subsequently exhibit exploratory behavior. Two behaviors (focusing and directing) were associated with a decreased probability that the child would be off-task. In the problem-solving task, three maternal behaviors (directing, positively evaluating, and seeking assistance) were associated with an increased probability of the child solving a piece of the puzzle, and two behaviors (focusing and directing) were associated with a reduced probability of the child being off-task. Results suggest that children's exploratory behavior is influenced by antecedent maternal behaviors. (MM)

The Use of Sequential Analysis to Identify Functionally Equivalent Behaviors in Mother-Child Interactions

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Abstract

To identify maternal scaffolding behaviors, sequential analysis was performed on 16 mother-child dyads interacting in problem-solving and exploration contexts. The children were 8 girls and 8 boys (mean age 26 months) from upper middle class Caucasian families. Maternal behaviors with similar functional relationships to targeted child behaviors were combined to create molar codes. Although based on molecular codes with seemingly reliable effects on the targeted behaviors, several of the molar codes were nonsignificant predictors of the targeted behaviors when autocontingency in the child behavior was statistically controlled. These results underscore the importance of controlling for autocontingency when identifying functionally equivalent behaviors in observational research.

Observational coding schemes of interpersonal behavior typically include numerous categorical codes. Although these codes enable fine-grained analysis of social interaction, it is sometimes desirable to combine codes into a smaller number of molar codes or dimensions. Gottman (1978, 1979; Bakeman & Gottman, 1986) has discouraged the use of factor analysis for this data reduction task. "The problem with factor analysis...is that it lumps two codes on the basis of high correlations between these two codes across subjects. However, just because subjects who do a lot of code A also do a lot of code B does not imply that these two codes are functionally equivalent" (1979, p. 91). For example, the degree to which children hit other children may be positively correlated with their helping other children simply because more socially interactive children do more of both. Clearly one would not want to treat hitting and helping as functionally equivalent.

Gottman (1979) suggests using sequential analysis to identify functionally equivalent codes that may be combined to create more molar codes. For example, sequential analysis can show that mother's DIRECTING her child to do something and her FOCUSING her child on something both have the effect of reducing the child's OFF-TASK behavior. Creating a molar code by combining these codes makes sense.

Problem Statement

In conventional sequential analysis one estimates the temporal contingency between the antecedent behavior of person A and the consequent behavior of person B. A criticism of this analysis is that the failure to control for the autocontingency in person B's behavior when estimating the influence of person A's antecedent behavior can produce spurious results (Allison & Liker, 1982). The analysis of sequential data within a log-linear model that includes the autocontingency effect (See Figure 1) eliminates this threat to the internal validity of the results (Cook, Asarnow, Goldstein, Marshall, & Weber, 1990).

In the present study conventional sequential analysis (Bakeman & Gottman, 1985) were performed on 16 mother-child dyads interacting in two contexts--a problem-solving task and an exploration task--to identify maternal behaviors that might be combined to operationalize aspects of scaffolding (See Troutman, Hazen, & Cook, 1992). Child EXPLORES and OFF-TASK were the target variables in the exploration task, and child SOLVES and OFF-TASK were the target variables in the problem-solving task. Maternal behaviors that appeared to be functionally equivalent were combined to create molar codes that might operationalize "scaffolding." Log-linear analyses were then used to estimate the effect of the molar codes on the targeted child behaviors after controlling for autocontingency in the child's behavior. These analyses also tested for interaction effects, an often neglected parameter in sequential analysis studies.

Method

Subjects

Participants were 16 children (8 boys and 8 girls) whose ages ranged from 24 to 32 months (mean age = 26.2 months) and their mothers. Families were predominantly Caucasian, upper middle class, with intact marriages.

Procedures

Each mother-child dyad was observed for 20 minutes. The session took place at the child's preschool and was videotaped. The session consisted of 10 minutes of a problem-solving activity (puzzle) and 10 minutes of an exploration activity (curiosity box). Order of presentation was counterbalanced. Mothers were instructed to do whatever they would normally do to assist their child.

Discourse Coding

Transcriptions of each activity were coded for verbal and nonverbal communications.

Reliabilities (Kappa) ranged from .62 to .85 for the exploration task and from .71 to .83 for the problem-solving task. Maternal discourse codes relevant to this presentation are:

Focus: Mother tries to get her child to attend to task.

Seeks Assistance: Mother asks child to repeat or clarify statement.

Pretend Play: Mother engages in make believe concerning puzzle pieces or curiosity objects.

Listens: A coding device for separating contiguous child codes. Results in a "turn-taking" pattern in the stream of behavior.

Directs: Mother directly tells the child to do something relevant to achieving the goal.

Positive Evaluation: Mother provides encouragement or praise when child makes some progress toward goal.

Analysis

In the conventional sequential analysis, the contingency of the target child behavior on the mother's prior (lag 1) behavior was estimated using the Allison-Liker $\underline{Z}$ score. The average $\underline{Z}$ score based on 16 dyads was then tested for its difference for zero using a two-tailed $\underline{t}$ test. A significant $\underline{t}$ indicates that the antecedent behavior is (on the average) a reliable predictor of the consequent behavior.

In the log-linear analysis, a saturated model of the child's time 1 behavior (C1), the mother's time 2 behavior (M2), and the child's time 3 behavior (C3) was tested in order to obtain Lambda estimates for each of the model parameters (paths), including the interaction effect. The average Lambda (based on 16 dyads) for each parameter was then tested for its difference from zero using a two-tailed $\underline{t}$ test.

Results

Conventional sequential analysis indicated that four maternal behaviors (i.e., FOCUS, SEEKS ASSISTANCE, PRETEND PLAY, & LISTENS) were associated with an increase in the probability that the child would subsequently be involved in exploratory behavior (see Table 1). Two behaviors (i.e., FOCUS & DIRECTS) were associated with a decrease in the probability that the child would be OFF-TASK. In the problem-solving task, mother DIRECTS, POSITIVE EVALUATION, and SEEKS ASSISTANCE were associated with an increased probability of the child solving a piece of a puzzle, and mother FOCUS and DIRECTS were again associated with a reduced probability of the child being OFF TASK.

Maternal behaviors with similar functional relationships to the targeted child behaviors were combined to create molar variables. These molar variables were then used in log-linear sequential analyses predicting the respective target behaviors. The autocontingency of the child's behavior and the interaction effect of the child' behavior at time 1 with mother's behavior at time 2 were included in these analyses (see Table 2). In the exploration task maternal behavior was a significant antecedent of child exploratory behavior (mean Lambda = .12). The interaction effect was also significant, indicating that maternal behavior is only associated with greater odds of child exploratory behavior if the child was not already involved in exploratory behavior. Maternal behavior had no effect on child OFF TASK behavior. In the problem-solving task maternal behavior was a marginally significant antecedent of the child's puzzle-solving (mean Lambda = .11), and again, maternal behavior had no effect on the child' being OFF TASK. Significant autocontingency was found for all the child target behaviors with the exception of EXPLORES.

Conclusions

Methodological

(1) Sequential analysis can be used to identify functionally equivalent behaviors within a dyadic interaction context. These behaviors may be combined to create molar variables.

(2) Only one of the four molar variables identified via conventional sequential analysis was a significant antecedent of targeted child behaviors in subsequent log-linear analysis. The conventional sequential analysis produced spurious results because autocontingency in the child behaviors was not statistically controlled.

(3) Higher-order interaction effects (e.g., that mother's influence on the child depends on the previous behavior of the child) may be a significant factor in dyadic interaction processes. The presence of these effects should be routinely evaluated in sequential analysis studies.

Substantive

(1) Children's exploratory behavior is influenced by antecedent maternal behaviors in a manner consistent with Bruner's (1982) notion of scaffolding.

(2) The effect of maternal scaffolding on children's problem-solving behavior was not as apparent in the data, though a marginally significant effect was found.

(3) Maternal antecedents of child OFF-TASK behaviors were nonsignificant. It may be that OFF-TASK behavior is as strongly motivated as on-task behavior and the influence of the mother is limited to shaping or educating the child's attention within the motivated domain of activity.

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FIGURE 1
Log-Linear Model

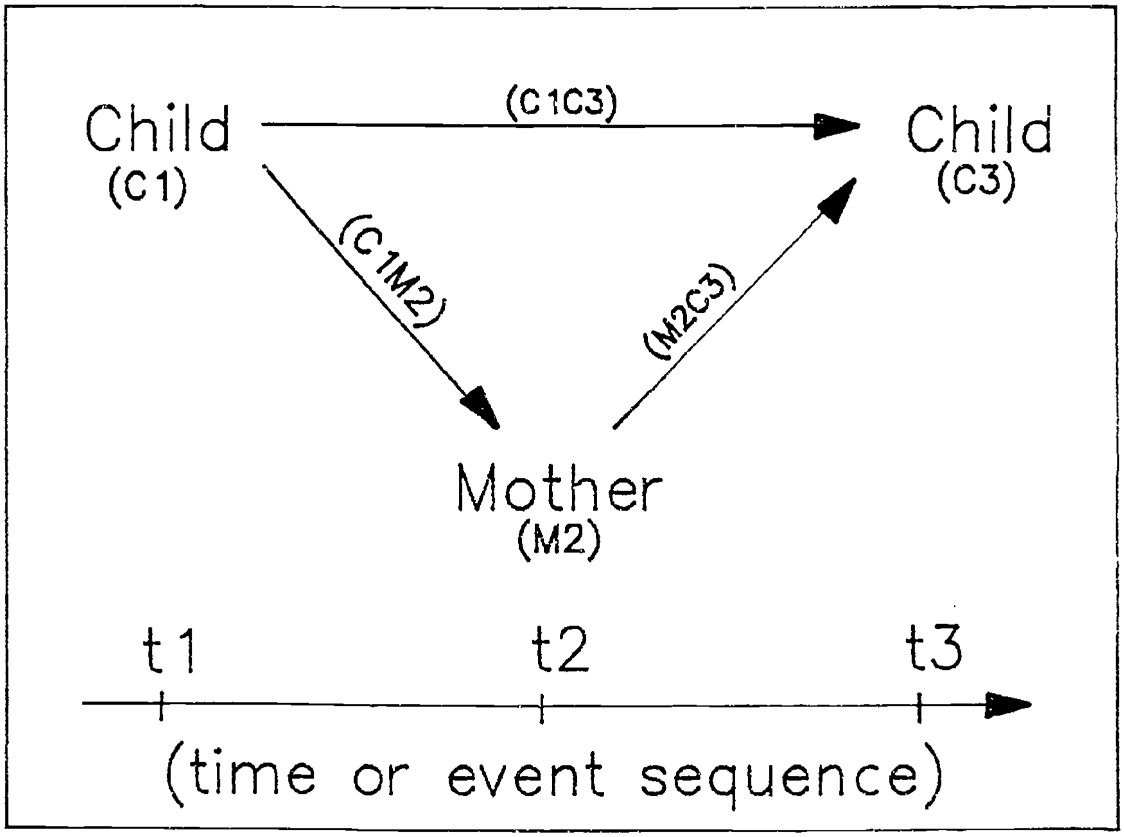

TABLE 1

CONVENTIONAL SEQUENTIAL ANALYSES:

EFFECTS OF MATERNAL BEHAVIOR ON CHILD BEHAVIOR

Exploration Task

Mother Code	Function	Child Code	Average* Z	
Focus	increases	Exploration	$Z = .30$	$p < .08$
Seeks Assistance	increases	Exploration	$Z = .33$	$p < .02$
Pretend Play	increases	Exploration	$Z = .44$	$p < .05$
Listens	increases	Exploration	$Z = 1.44$	$p = .004$
Focus	reduces	Off Task	$Z = -1.21$	$p = .001$
Directs	reduces	Off Task	$Z = -1.80$	$p = .001$

Problem–Solving Task

Mother Code	Function	Child Code	Average* Z	
Directs	increases	Solves	$Z = .65$	$p < .01$
Pos. Evaluation	increases	Solves	$Z = .80$	$p < .02$
Seeks Assistance	increases	Solves	$Z = 1.00$	$p < .07$
Focus	reduces	Off Task	$Z = -1.20$	$p < .001$
Directs	reduces	Off Task	$Z = -.48$	$p = .02$

* Z is the mean Z score for N = 16 cases. Significance is based on a two–tailed t–test that the mean Z differs from zero.

TABLE 2

LOG–LINEAR ANALYSIS OF MATERNAL MOLAR CODES PREDICTING CHILD TARGET BEHAVIORS

		Child Behavior			
		Exploration Task		Problem–Solving Task	
Selected Log–linear Parameters		Explores	Off Task	Solves	Off Task
M2C3	Maternal Antecedent (molar aggregate)	.12*** (.11)	–.07 (.20)	.11* (.24)	.00 (.20)
C1C3	Autocontingency	.02 (.10)	.51*** (.24)	.33*** (.28)	.71** (.32)
C1M2C3	Interaction Effect	–.09** (.11)	.00 (.07)	–.09 (.20)	–.07 (.24)

Note: Table entries are mean log–linear (Lambda) effects based on 16 mother–child dyads. A positive mean indicates that the effect increases the odds of the target behavior relative to even (i.e., 50/50) odds. Standard deviations are in parenthesis. C1 = Child (target) behavior at time 1. M2 = mother (molar) behavior at time 2. C3 = Child (target) behavior at time 3.

* $p < .10$, two–tailed t–test that mean differs from zero.

** $p < .05$, two–tailed t–test that mean differs from zero.

*** $p < .002$, two–tailed t–test that mean differs from zero.