Three-month old infants' reaction to simulated maternal depression in the context of face-to-face interaction.

THREE MONTH OLD INFANTS' REACTION TO SIMULATED MATERNAL DEPRESSION IN THE CONTEXT OF FACE-TO-FACE INTERACTION

A Thesis Presented

By

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CHAPTER I

INTRODUCTION

Investigations of caregiver-infant interaction have increasingly suggested a three pronged thesis about its structure, development and function: a) that such interactions conform to a hierarchically organized, rule governed exchange of message carrying displays (e.g., Stern et al., 1977; Tronick et al., 1979); b) that such exchanges evolve over time "shifting from a prominently biosocial to a more clearly psychosocial level" (Sander, 1977); and c) that it is within the ontogeny of this exchange that the precursors of adult communication are found (Kaye, 1977, 1979; Sander, 1977; Tronick et al., 1979). A central hypothesis of the first prong of this thesis is that caregiver displays which convey contradictory messages violate the rules governing the exchange and that such violations produce negative affect and disturbance in the infant. The goal of this project is to test this hypothesis and alternative hypotheses by evaluating the infants' response to simulated maternal depression using appropriate sequential analyses. This display presents the infant with powerful contradictory messages, and sequential analyses produce powerful descriptions of the quality of the infant's response to it.

The organization of this paper includes two major sections. The first and introductory section includes the following topics: the rule violation hypothesis and its underlying assumptions; clinical and experimental evidence in support of the hypothesis; and alternative interpretations of the experimental literature. Following this introductory section, the project report will be presented.

The Rule Violation Hypothesis and Its Underlying Assumptions

The rule violation hypothesis entails three assumptions regarding the nature of communication between caregiver and infant: a) that caregiver-infant communication consists of the mutual exchange of message carrying displays; b) that one of the functions, and indeed, within the first year of life the primary function, of communicative displays is the regulation of the partner's behavior; and c) that the organization of communicative displays is hierarchical.

There is broad support for each of these assumptions. Concerning the first assumption about message bearing displays, the work of Bowlby (1969), Brazelton et al.(1975), Kaye (1977), Fogel (1977), and Ainsworth et al. (1974), among others, has strongly indicated that infants demonstrate specificity of response both to their own internal states and to the stimulus displays of the surround, the most important of which are the displays of caregivers.

The second assumption, that one of the functions of pre-linguistic communication and language in general, is to regulate behavior is widely maintained across a range of academic fields including: infant social development (Kaye, 1977, 1979; Sander, 1977; Tronick et al., 1979); communications theory (Watzlawick et al., 1967); linguistics (Searle, 1971); and evolutionary theory (Fishbein, 1976). From a developmental perspective, Tronick et al. (1979) argue that the message value of behavior displays is initially "almost purely regulatory in character in that they refer only to the ongoing state of the interaction and not to objects or events." Fishbein, from an evolutionary perspective, marshals substantial evidence to suggest that the ability of humans to reciprocally regulate each other's behavior is a consequence of evolutionary pressures and represents a highly canalized, phenotypic characteristic. Only if individuals are reared in the most atypical of environments can the preadaptation to engage in reciprocally structured exchanges be compromised. This position is, of course, highly consonant with that of other developmentalists (e.g., Ainsworth et al., 1974).

Of central importance to the assumption that communicative displays regulate behavior is the further assumption that communicative displays are hierarchically organized. The communication theorists define context as a "<u>meta</u>message which <u>classifies</u> the elementary signal" (Bateson, 1972, p. 289). A stimulus that has this function is a "context marker." To use one of Bateson's illustrations, when an audience hears Hamlet discussing suicide, no one pushes to intervene because everyone has been informed through numerous markers of context--handbills, the arrangement of seats in the theatre--that the soliloquy is within the context of a play.

This conceptualization is paralleled by the learning theorists (Kantor, 1959; Gerwitz, 1969, 1972; Bloom, 1974). Bloom's work is of particular importance because of her attention to gaze contact between infants and adults. Gaze contact has been studied in connection with attachment (Robson, 1967) and with mother-infant interaction (Stern, 1974), and it will figure prominently in the present paper.

Bloom (1974) from her perspective refers to context markers as "setting events." A setting event is a stimulus that is concurrent with behavior and by its presence provides for the effectiveness of a reinforcement relationship. Studying 2½ month old infants, Bloom found that the effectiveness of adult communicative displays as reinforcers of vocalization is attenuated in the absence of the setting event, gaze contact. In operant terms, the setting event signals that a contingency is in effect. In communications theory terms, the context marker gaze contact is a metamessage that provides the infant with information about the meaning of the contingent displays.

Within the developmental literature (to add further terminology), the concept of the context marker or setting event has been discussed as a "frame." A frame is an "asymmetrical relationship between two individuals" (Kaye, 1977). In the example of gaze, there is an "asymmetry of timing and of duration between the partner's periods of gazing --either at or away from the other" (Kaye, 1977). For example, while infants alternate gaze patterns toward and away from mothers, mothers are almost always looking at infants during dyadic exchanges (Brazelton et al., 1974; Stern, 1974).

The assumptions of the rule violation hypothesis give rise to at least two specific formulations. These formulations can be referred to as concurrent and as sequential-contingent violations of context. A concurrent violation of context arises when a caregiver is concurrently expressing two orders of message (message and metamessage) and these messages are contradictory. Onset of the classificatory stimulus (metamessage, setting event, frame) may precede the elementary stimulus, but following onset of the latter both are maintained concurrently. This joint occurrence may be contingent upon some response of the infant, but its continuation is not. An example would be a mother who picks up her crying infant, thus signaling comfort, but then fails to allow for reciprocal body molding, thus indicating rejection.

Concurrent violations are similar to the kinds of mismatching discussed by Stern et al. (1977). Mismatching differs from concurrent violations insofar as it is of shorter duration and serves to facilitate rather than impede mutual readjustment of the dyadic exchange. For example, a sensitive mother tends to adjust the stimulus level of her behavioral displays within an optimal and appropriate range. When that range is exceeded, the infant's reaction informs the mother and cues appropriate readjustment of the level of her displays. This mismatching and subsequent goal correction is an integral and valuable aspect of mother-infant interaction. However, when mismatching becomes a chronic feature of the caregiver-infant interaction and no longer occasions appropriate goal correcting responses, as outlined by Stern et al., then the distinction between mismatching and concurrent violation becomes tenuous.

Sequential-contingent violations occur when a caregiver is sequentially expressing two orders of conflicting message and the timing of each message is contingent upon the infant's response to the one preceding. In the clinical literature, rule violations of this sort have been referred to as double binds (Bateson et al., 1956). Bateson et al. (1956) were interested in the following example: A mother who is expressing a) hostile or withdrawing behavior which is aroused whenever the child approaches her, and b) simulated loving or approach behavior which is aroused when the child responds to her hostile and withdrawing behavior, as a way of denying that she is withdrawing.

It should be noted that each segment of a sequential-contingent violation of context consists of a concurrent violation. Simulated loving, for instance, involves a behavioral display, loving behavior, which is analogically qualified by the message, "this is not what it seems." Sequential-contingent violations are comprised of a sequence of concurrent violations, each of which is contingent upon the infant's response to the preceding violation. And it is hypothesized as a critical part of this hypothesis that such violations produce upset in the child because he is unable to appropriately respond to both messages at the same time. As discussed below, there is some evidence to support this part of the hypothesis.

Empirical evidence related to the rule violation hypothesis.

Clinical studies. Both King (1975) and Massie (1978, 1977) found that repeated experience with rule violation during infancy was associated with childhood psychosis. King (1975) studied the clinical records of twelve children diagnosed autistic along with those of two psychiatric control groups. Average age of diagnosis for the autistic group was 18½ months with initial signs appearing during the first year. Clinical records were reports of subsequent interviews with children and mothers. King found that mothers of children who had earlier been diagnosed autistic were more likely to emit double binds (King's term, taken from Bateson et al., 1956). For example, one mother treated her child without affection; instead treating the child as if a possession.

King does not, however, provide evidence germane to consideration of differential violations.

Massie's (1978, 1977) explanatory model is within an analytic tradition, but at a descriptive level he is concerned with disturbances of attachment.[1] His data consist of fine-grained analyses of these disturbances, culled from early home movies of infants later diagnosed as psychotic. Both types of violation--concurrent and sequential-contingent--are extensively evidenced throughout each of the children's film records. Massie describes the following sequential-contingent violation at age 3 months:

> Mrs. L. is holding Joan and both appear relaxed. Smiling, Joan turns her head and eyes toward her mother's face. Mrs. L's expression becomes tense; and as Mrs. L tenses instead of smiling and turning to her child, Joan loses her smile. Mrs. L. then inclines her head backwards and to the side of Joan's face so that the child's head is blocked from turning. Joan cannot turn her head further to bring herself face to face with her mother; her eyes are as far to the right as she can look, but she cannot see her mother's face or eyes. Joan's affect in quick succession becomes tense, then desperate, then dejected. Finally, she gives up trying to turn to her mother; the mother herself is more relaxed, the evasive actions having been successful. Mrs. L. and Joan then resume the same postures as in the beginning of the sequence, although Joan's affect is depressed. Mrs. L. then begins to caress her daughter's head; Joan smiles and drools. Then the whole interactional sequence repeats itself as Joan again attempts unsuccessfully to look at her mother.

Mrs. L's tenseness and evasion are contingent upon her daughter's approach. When the evasion is sufficient to frustrate the infant and depress her affect, M then responds in a superficially loving way which denies her previous communication of rejection. Her communications repeatedly violate the context of the interaction as she has previously signaled it.

Stern (1977, 1971) discusses a very similar interaction, which he calls paradoxical stimulation, with particular attention to the mutual cueing of both mother and infant:

> If Fred and mother are facing one another in a moment of mutual gaze, a moment of unusually short duration between them, Fred would invariably avert his gaze slightly as Mother moved toward him. Instead of considering Fred's face aversion as a signal to back off ... she treats it as a signal to approach closer. ... This sends Fred even farther away into an exaggerated face aversion. From that position as Fred turns back toward her, she withdraws and turns away.

Stern's account is instructive in that it emphasizes the reciprocal nature of sequential-contingent violations. Either partner may initiate the sequence, and both become equally entrapped. The consequences for each are not equal. Stern does not provide an account of Fred's affective responses at three months to such violations, but he does follow-up with what seem to be the consequences at 15 months: Fred cannot successfully initiate contact with other people. He "greets people with a fearful expression, refuses to make prolonged eye contact, and regularly executes extreme face aversions in social situations (usually to the side and down)." He is a fearful and dependent child (Stern, 1971). Notice that at 15 months the pattern is sufficiently established that other adults need not provide paradoxical stimulation in order to affect the response pattern.

Concurrent violations of context are especially common in Massie' data. Consider the following examples:

a In ventral-ventral position, baby (2 months) attempts to cling to mother's blouse, but mother does not maintain chest-chest contact

> or nuzzle baby. The child falls away, unsupported at mother's chest, her irritability heightened.
>
> b Supported in an infant seat, the baby (6 months) arches chest toward mother, smiles broadly at mother's face, and places hand on mother's blouse. Mother returns smile, but her torso remains inflexible.

Parents, through one or more attachment displays, including eye contact and approach, frame the interaction. They then violate that frame in one of two ways: they do not allow the infant to attach in one or more modalities; or they do not "reciprocate[2] their child's attachment to them, by dint of the parents' stiffness, lack of body molding in holding, rhythmic dyssynchrony of movements and frequent inattention to their child's intention, activity, mood or affect" (Massie, 1978).

Massie found a very strong relationship between repeated experience with these violations and the occurrence of atypical developmental signs beginning within the first six months and the diagnosis of childhood psychosis. While normal children sometimes display some of the atypical signs in comparable home movies, they are "transient, not fully developed, and ... (do) not recur over a period of time" (Massie, 1978). At a microanalytic level, there is a very close relation, as well, between violations of context and autistic and psychotic signs. Infants respond with initial anger and then dejection, lack of interest and loss of affect and eye contact.[3]

The importance of noncontradictory experience in reversing the effects of repeated experience with violations of context is suggested by two studies. Brazelton et al. (1976) observed what they refer to as the "inception and resolution of early developmental pathology." The mother held her infant (Mary) "away from her body at all times, and handled her as if she were a stiff, lifeless object. When Mary became upset with this insensitive handling and turned for comfort to sucking on her fist, her mother pulled the fist out of her mouth roughly." Mother's behavior consistently violated the context of their interactions, and when Mary attempted to seek comfort by turning her attention away from mother her efforts to escape from the field were obstructed. It is important to note that together with concurrent violations of context Mary also experienced a deficit of contact with mother and other people. She was left in her crib for extended periods and was frequently fed with a propped-up bottle. By 3 months of age her head was beginning to flatten on the left occiput. The infant increasingly evidenced "detachment from her surroundings, stereotyped body movements, and preoccupation with her own body." These developments were reversed, however, and more adequate development commenced at about 8 months ...

> after the mother had been confronted with the neurologist's dire prognosis. This shook the mother out of her apathy. Her reaction was to focus attention on her child and to set to work suddenly and anxiously eliciting responses from her baby whom she had previously seemed to disregard.

Adamson (Adamson et al., 1977) studied the sighted infant of blind parents:

> The parents' blindness presented the infant with a naturally occurring and persistent violation of the face-to-face communication system. The violation involved both receptive and emissive aspects of their communication. These parents of necessity could not respond to their infant's visual cues of affect and attention; moreover, their faces lacked the appropriate animation and modulation which would convey affective information to her. Contingent

> gazing patterns were not possible, and the face-to-face orientation so commonly observed between infant-parent dyads was difficult to achieve.

During the first three months, while the infant maintained eye-to-eye contact with sighted adults, "with her mother she actively averted her gaze. She turned her eyes and her head away from the mother, moving into and maintaining atypically awkward positions such as tonic-neck reflex position arching away from the mother as the mother held her horizontally in her arms." Adjustments that allowed for "the establishment of affectively reciprocal interaction patterns" included: structuring dyadic exchanges such that face-to-face interaction was not necessary; maternal emphasis on vocal and haptic stimulation; experience with sighted adults. Perhaps most important within the first six months was dyadic experience in the context of caretaking activities. Bathing, for example, became a frame in which play episodes could occur. And, within the second half of the year, the incorporation of objects into mother-infant play was particularly important.

Experimental evidence. Tronick (Tronick et al., 1978, for example) provides experimental support for the immediate impact of concurrent violations of context among a nonclinical population of infants. Tronick asked mothers to interact with their infants both in a normal and in a distorted still-face fashion. In the latter procedure, the mother's entrance and *en face* position is "setting the stage for an interaction, but then her lack of response indicates a disengagement or withdrawal" (Tronick et al., 1978). Typically, as mother turns to her baby with a still-face:

> the infant first orients toward the mother and then

> he greets her expectantly. As she fails to respond appropriately, he rapidly sobers and grows wary. He makes repeated attempts to get the interaction into its usual reciprocal pattern. When these attempts fail, the infant withdraws, orients his face and body away from his mother with a withdrawn, hopeless facial expression.

The infant is "trapped in a contradiction: he initiates and greets but then turns away and withdraws, only to initiate again. If the infant's efforts fail to establish a reciprocal interaction, his eventual withdrawal reaction results. No infants cried in response to the still-face. The brevity of the procedure, three minutes, may, however, have attenuated the extent of negative affect, although it would be expected that crying would precede affective withdrawal. There were no order effects for the still-face, but order of presentation did affect the normal interactions if they followed the still-face.

Summary. Concurrent and sequential-contingent violations differ in the way in which they frustrate the infant's goals. Concurrent violations frustrate the infant's attempts at contact (attachment) and social engagement (reciprocity) with mother. Sequential-contingent violations while frustrating contact do allow for a reciprocity, but it is quickly distorted. There is contingency experience or "mutual cueing" but the consequences are repeatedly unsatisfactory.

The two violations also differ insofar as they may permit resolution. Sequential-contingent violations present the infant with a conflict in which escape from the interactive matrix is especially difficult. If s/he withdraws, mother follows. The only form of escape may be a radical disengagement as presented by autism, or less severely, the kind of fearful pattern Stern describes.

The infant presented with concurrent violations, on the other hand, may find the potential for escape developmentally regulated. At nine months, Tronick and colleagues find that some infants during the still-face procedure are able to redirect their attention away from mother and toward positive object play. Some are also more skilled at eliciting their mothers to discontinue the still-face and respond reciprocally and appropriately. The older infant's greater repertoire of communicative displays and his/her greater competence in switching goals may make escape or modification of caregiver behavior more likely. Older infants may then be more resistant to repeated experience with concurrent violations than are younger infants. Developmentally, as infant goals become more flexible, failure of reciprocity may, within limits become less damaging.

In order for the rule violation hypothesis and the rule oriented model from which it is derived to be more widely validated, however, laboratory investigations other than the still-face would seem essential. No less important is the need for more rigorous description of and tests for the impact of rule violation on the patterning of infants' response. While studies from several orientations present a consistent picture of infants' response to rule violations, those accounts are based either on narrative descriptions of selected episodes or on statistical analyses of nonsequential data. Techniques for the analysis of sequential data are becoming more widely available (see, for instance, the review by Gottman and Bakeman, 1979) and they should provide for a better test both of the rule violation hypothesis and of alternative hypotheses: discrepancy related hypotheses; stimulus intensity hypotheses; and maternal deprivation hypotheses (see below).

Alternative interpretations of the empirical literature.

Discrepancy related hypotheses. Stated more generally, the discrepancy hypothesis suggests that an infant's affective response to a new stimulus will be related to both the magnitude of stimulus-schema mismatch and the infant's success at assimilating the event. One of the most comprehensive discrepancy hypotheses is that of McCall and McGhee (1977) who recast discrepancy in terms of "subjective uncertainty." Subjective uncertainty is produced "by the scanning of memory and the continual comparing of a new stimulus with the memory of the standard. ... (W)hile negative affect is most likely to occur during the infant's as yet unsuccessful attempt to resolve severe amounts of subjective uncertainty produced by extreme discrepancies ... positive affect is most likely to occur after the infant successfully reduces the subjective uncertainty occasioned by moderately to severely discrepant stimuli." Factors other than discrepancy that may influence subjective uncertainty are: transformations of stimuli representing security; response uncertainty; loss of control (McCall and McGhee, 1977); and stimuli which are inappropriate to (or in violtion of) their context (Kagan, 1974). This comprehensiveness has its price, however. When one considers factors other than sheer stimulus discrepancy, as do McCall and McGhee, the parameters of the discrepancy hypothesis begin to resemble those of rule violation.

The two hypotheses would seem to most clearly differ insofar as they make assumptions about the regulative meaning of stimulus displays.

The discrepancy hypothesis emphasizes the occasioning of subjective uncertainty. The infant's initial goal is the assimilation of a conceptually bifurcated (discrepant) event. Approach (positive or negative) or withdrawal is secondary to cognitive processing and concomitant affective displays. According to the rule violation hypothesis, however, the infant's initial goals are interactive. The infant will demonstrate different, more normal responses both to the context marker and the stimulus display which contradicts it. The behavior will have the quality of attempting to restructure the interaction into its normal pattern. The eventual consequences of exposure to contradictory displays involve modification of the regulative meanings of displays. This distinction between the emphases of each hypothesis suggests that each may best address a separate range of stimulus situations.

One difficulty in applying the discrepancy hypothesis to data from other orientations (such as the still-face procedure) is that no specification is made for degree of discrepancy. This difficulty is, however, endemic to the discrepancy literature: there have been no studies "directly examining negative affective responses to a set of stimuli scaled for discrepancy" (McCall and McGhee, 1977). This problem notwithstanding, one may consider the following set of predictions:

> Moderate amounts of subjective uncertainty initially produce occasional displays of negative affect accompanied by maximum attention and later maximum displays of positive affect;
>
> Extreme amounts of subjective uncertainty initially elicit maximum negative affect and possibly motivated inattention followed by (1) prolonged attention and positive affect if the subject is successful at retrieving the relevant memory and comparing the new stimulus with the engram; (2) continued

> negative affect and motivated inattention if the infant is not successful but continues the struggle; or (3) neutral affect and attention to the new stimulus in proportion to its stimulus information potential if the infant eventually stops dealing with the familiarity aspect of the new stimulus (McCall and McGhee, 1977).

While these predictions cover a wide range of outcomes, they do not encompass the findings from the still-face procedure. These findings include: attenuated positive displays; alternating cycles of negative and positive displays; and a continuation of negative displays into the following period of normal maternal behavior. These findings contraindicate discrepancy based explanations in three respects. First, attenuated positive displays are not among the behaviors predicted by discrepancy formulations. Second, since positive displays ipso facto are said to indicate resolution of discrepancy (subjective uncertainty), there is no theoretically acceptable set of conditions under which such displays may be followed by negative affect in response to the same stimulus presentation. Third, since affective response is hypothesized to be a function of current discrepancy parameters, there is no acceptable means of accommodating the observed carryover of negative displays into the following period of normal maternal interaction. In response to normal maternal play, affective responses should be positive, not negative, according to the discrepancy hypothesis.

To these discordant findings may be added a less damaging but not altogether unimportant difficulty with discrepancy based explanations of the still-face findings. That is, while extreme upset is not beyond the pale of the discrepancy hypothesis, it is not altogehter clear that a mother's still face should engender such pronounced and unyielding upset in young infants.

Stimulus intensity. The second hypothesis that need be considered is that of stimulus intensity. Stern's (1974, 1977) and also Field's (1980) writing about stimulus intensity would suggest that infants' response to reduced maternal expression should result in loss of interest, gaze directed away from mother and perhaps eventual restlessness. Stern's discussion is of particular interest in that he defines low levels of maternal expression in face-to-face interaction in terms of minimal discrepancy. Minimal discrepancy is, for Stern, synonymous with understimulation.

Maternal deprivation. Closely related to the hypothesis of understimulation is that of maternal deprivation, the prototype of which is the classic work of Spitz (1946, 1965). Spitz distinguished two syndromes, anaclytic depression and hospitalism, both of which he related to longstanding interruptions of object relations. As such, hypotheses concerning alternately deprivation and distortion of object relations would seem to constitute two distinct and even complementary genres. Indeed, Spitz himself clearly differentiated between what he termed emotional deficiency diseases associated with separation and psychotoxic disturbances associated with distortions of on-going object relations. Among the latter he included the presentation of "ambiguous and inconsistent signals" (1965).

The distinction between the phenomena subsumed under deprivational and contradiction hypotheses has become less clear as clinicians and researchers have become interested in "relative" deprivation. Relative deprivation may refer to either the impoverishment of maternal responses or to a low rate of mother-infant interaction. An illustration of the former is Stern's (1977) observation that the "depressed caregiver will be unable to play with her own behavior in order to play with her infant." Bettleheim (1967) advances the hypothesis that such restricted exchanges are inherently painful for the infant and, when they become characteristic of the relationship, their consequences resemble those of hospitalism. An example of attention to a reduced rate of interaction is evidenced in the Brazelton (Brazelton et al., 1971) case study referred to above. Indeed, in light of Spitz' syndromes, one might ask if the autistic course which Mary seemed to be following was set by maternal neglect alone.

The importance of limited affective range and reduced rate of interaction becomes especially evident when one considers interactions between depressed mothers and their infants. Sameroff and Zax (1972) found that chronically depressed mothers provided minimal care for their infants, making infrequent checks and attending to their physical and social needs less than normal mothers. Weissman and Paykel (1974) observed a similar pattern among depressed mothers, although they observed other patterns as well.

It is important to recognize that the developmental adequacy of stimulation and the appropriateness of stimulation to its context are two related but separable concerns. A caregiver may provide a narrow range of stimulation and yet remain responsive and appropriate to particular interactional contexts. A depressed mother may, for instance, find ways in which to attend to her infant while remaining relatively passive. She may nurse the infant for long periods or otherwise occupy him/her in a passive, repetitive way that is appropriate to that context and sufficient to satisfy primitive goals. Within limits that are not well understood, such custodial nurturance is probably of little detriment to developmental outcome.

Reduction of affective range (understimulation) may also violate the context in which it occurs. For example, in a recent pilot study, normal mothers were asked to play with their infants in a depressed way. Free to interpret the instruction, mothers tended to adopt one of two strategies. Four of the mothers spoke to their infant in a flat, uninteresting way, while resting their hands in the infant's lap. Gaze was directed toward the hands and fingers. The infants of these mothers tended to direct their own gaze toward their mother's hands and to slowly manipulate her fingers. Their activity levels tended to match those of their mother, and there was no visible wariness or distress. Response latency to subsequent normal interactions was observed. Mothers observed that it was difficult to resume mutual visual regard.

Three of the mothers also spoke to their infant in a flat, uninteresting way, but they looked toward their infant's eyes and refrained from touching the baby. The infants of these mothers, as in the still-face procedure, attempted to elicit positive responses with facial brightenings and vocalization and then began a pattern of looking away, checking back with wary glances and occasional brief protests. One of the infants burst into tears at first and the manipulation had to be terminated. When his mother later adopted the other strategy of touch contact and gaze aversion, no such distress was in evidence.

Gross measures such as frequency of contact, while important for some purposes, cannot sufficiently differentiate between contradictory and impoverished interactions. Not only are the infant response patterns to each expected to differ, but these differences between interactional patterns may become established at the level of relationship. Insofar as existing forms of interaction give rise to constraints limiting re-organization, it is important to investigate the types of constraints generated from impoverished and contradictory patterns of interaction. Clinically, an informed understanding of relational organization is essential if patterns of "poor circular feedback" (Brazelton et al., 1971) are to be overcome. Thus appropriate tests to distinguish between infant response to impoverished and to contradictory displays must construct a contradiction and analyze both the quality and the sequence of infant affective displays during periods of perturbation and during later periods of normal maternal behavior.

CHAPTER II

EXPERIMENT AND RATIONALE

The following study provides a further test of a hierarchically organized rule governed model of mother-infant interaction. Two questions are addressed: How do infants respond to concurrent violations of context? What indication is there of continuing disturbance after mothers resume normal interaction?

The manipulation is derived from the pilot study (see above) and asks mothers to interact with either normal or simulated depressed expression. The descriptors of depressed behaviors were taken from the few descriptive studies of depressed women that are available (Brown & Harris, 1978; Weissman & Paykel, 1974): slowed, soft and relatively expressionless vocal expression; minimal facial expression or physical activity; generalized appearance of lack of interest. Experimental instructions, to be presented below, were intended to elicit these qualities.

This manipulation was chosen for three reasons. First, controlled investigations of infants' response to violations other than the still face have been infrequent. Most reported studies of infants' response to rule violations have entailed some variant of the still-face procedure. Utilization of an alternative procedure, therefore, provides for better validation of the hypothesis. Second, an investigation of infants' response to simulated maternal depression, in particular, allows for a test of three hypotheses--rule violation, understimulation and discrepancy.

Third, and no less important, is the clinical significance of the relationship between infants and depressed mothers. Women are far more likely than men to suffer depression (Weissman & Klerman, 1977). And, although little academic or clinical attention has been given to maternal depression during the first year following delivery (a review of several prominent texts produced no discussion of the topic), there is reason to believe that it is an underassessed risk factor in perinatal and pediatric social development. The elevated incidence of depression among women along with the very considerable stress of the post partum period would suggest that the topic requires increased attention from developmental, clinical and sociological perspectives.

It should be noted that one feature of the manipulation may not be indicative of depressed mothers. That is, mothers in the study were asked to maintain gaze toward their infants' face. An often noted feature of depressed individuals, however, is gaze aversion (Izard, 1971). Descriptive studies of maternal depression have not indicated whether this is characteristic of depressed mothers in their interactions with infants.

In terms of a hierarchical rule model, it is hypothesized that simulated maternal depression in the context of face-to-face interaction presents the infant with a concurrent violation of context. The contextual marker for play is the mother's _en face_ position and gaze directed toward her infant. The concurrent denial of this message is enacted through reduced maternal affect in all salient stimulus modalities. It is predicted that infants will respond with increased proportions of both Negative and attenuated Positive affective displays and with reduced proportions of Play. It is further predicted that Brief Positive displays will be interspersed among Negative displays and that transitions from Positive to Protest will be more likely than in the normal condition. These predictions are extrapolated from the studies by Tronick and others reviewed above and from the work of Carpenter (Carpenter et al., 1970).

From a stimulus intensity perspective, simulated maternal depression presents the infants solely with a level of stimulation that is less than adequate (Stern, 1974, 1977). It is expected that the mothers will not capture their infants' attention. Infants will demonstrate higher proportions of Look Away and lower proportions of Play. No predictions are made about Negative displays although they are probably not to be expected. One might, however, find that restlessness eventually leads to some Protest toward the end of the manipulation. It should be noted that there is no basis from an infant stimulation perspective for predictions about the structuring of infant behavior.

From a discrepancy perspective, predictions are indeterminant insofar as it is difficult to establish the degree of discrepancy produced by the manipulation. Stern (1974) would seem to suggest that understimulation provides for minimal discrepancy. One might, however, argue that mothers rarely demonstrate reduced expression with their infants. Hence, the manipulation should engender moderate levels of discrepancy. Alternately, one might argue that reduced maternal expression within a context of face-to-face interaction severely differs from the infants' schema for maternal behavior in that situation. The latter, however, entails the assumption of hypothesis activation (Kagan, 1974) which would seem premature, according to Kagan, at 3 months.

The problems encountered in attempting to determine degree of discrepancy in quasi naturalistic manipulations have been discussed within the discrepancy literature (McCall & McGhee, 1977). One possible solution in the present case is to make predictions for each level of discrepancy. While this solution does not provide for a rigorous test of discrepancy based formulations, failure to produce results consistent with any of the attending predictions would be powerful evidence contraindicating the hypothesis. Predictions for each level of discrepancy--conceived broadly in terms of subjective discrepancy--are given above in the latter part of the review section.

In the present study, two sets of sequential analyses are pursued following nonsequential analyses of proportion data. The first considers between group (Simulated Depressed and Normal conditions) differences in conditional probabilities of event sequence data. Conditional probabilities are tested by Analysis of Variance as suggested by Bakeman and Brown (1977). These tests indicate whether infant behavior follows different descriptive rules between conditions. For instance, although infants in the Simulated Depressed condition may be in Play less than infants in the Normal condition, as indicated by nonsequential analyses of proportion, one can ask whether once in Play they are likely to make the same or different transitions. Less descriptively, one can infer that infant states have differential meaning or functions between conditions. If, for instance, infants in the

Simulated Depressed condition are more likely to transit from Brief Positive displays to Protest, this difference suggests that the meaning or function of Brief Positive displays is different depending on how the mother is behaving in the interaction.

If between subjects comparisons indicate that infants are following differential rules, one can then proceed to ask about the structure of behavior within each condition. That is, what is the modal organization of infant behavior within each condition? At one level, one can merely refer again to the conditional probability data. This is commonly done through state probability matrices (e.g., Gottman and Bakeman, 1979). A more sensitive inspection involves comparing conditional with unconditional probabilities for transitions to and from each state. Such a test is useful for identifying specific contingencies among codes.

Sackett's (1977) lag sequential test of contingency is used in the present study for the identification of inhibitory and excitatory contingencies in the data. An excitatory contingency is one for which the conditional probability of a transition is significantly greater than its unconditional probability (i.e., expected frequency). Conversely, an inhibitory contingency is one for which the conditional probability is significantly less than the unconditional probability (i.e., expected frequency). If no contingency exists between a code and any of the possible transitions, no reduction in uncertainty is provided by knowing that the infant is in that particular state.

CHAPTER III

METHOD

Subjects

Subjects were 12 female and 12 male infants and their mothers. Infants ranged in age from 96 to 110 days (mean age, 103 days). Fifteen infants were firstborn and 9 infants were laterborn. The average educational level of mothers was three years of college (Range: 12 to 20+ years of education; Standard deviation = 2.4 years). Each mother was her infant's primary caretaker. Ten additional subjects participated in at least some of the experimental procedure, but their data was not included in the analyses on one of four *a priori* grounds. These grounds were: equipment failure during filming (5 infants); mother in violation of procedure (inclusion of toy in play sequence, 1 infant); infant found to be physically ill or facially deformed (2 infants); and infant cried when first placed in infant seat (2 infants). Appropriate aged infants were identified from published birth announcements, and their mothers were contacted by telephone. The acceptance rate of mothers asked to participate was highly variable over the course of the study. Acceptance levels were highest (about 60-70 percent) in the early fall and dropped as the winter holidays and bad weather approached. The overall average was about 30-40 percent. Mothers without access to a car were generally unable to accept even if otherwise interested.

Setting and Materials

The laboratory consisted of a television studio with adjoining interview room. The studio was equipped with an infant seat mounted on a table, facing adjustable stool for the mother, two videocameras and a microphone. One camera was focused on the mother and one on the infant. Both pictures were transmitted through a digital timer and split-screen generator into a videorecorder. Digital timer, split-screen generator, recorder and monitor were located in the interview room.

Experimental Personnel

Personnel included the Experimenter and three undergraduate research assistants. All experimental sessions were conducted by either the Experimenter or by the chief research assistant.

Procedure

Infants by sex were assigned randomly to one of three treatment orders. Treatment orders consisted of two contiguous 3-minute epochs of mother-infant interaction. Two experimental treatments were counterbalanced for order of presentation; they each consisted of one epoch during which mothers were instructed to interact with Normal expression and one epoch during which they were instructed to interact with Simulated Depressed expression. A control treatment called for mothers to interact with Normal expression for both 3-minute epochs. Mothers were instructed to change (or continue) mode of expression on signal at the end of the first 3 minutes. They were also told that should their infant begin to cry, the procedure would be interrupted after 25 seconds of hard, steady crying.

The mothers were told that their infants would be assigned to one of the three treatment orders. Orders and conditions (Normal and Simulated Depressed interaction) were described verbally in an informal, semi-standardized format. Table 1 contains descriptions of each condition. In addition to the verbal instructions, the mothers observed a videotape demonstration of the Simulated Depressed condition. Specific assignments were made after the infant was placed in the infant seat and the procedure was ready to begin.

Behavior Codes and Scoring System

The coding system was comprised of five mutually exclusive codes: Look Away, Protest, Wary Monitor, Social Monitor, and Positive. Positive was subdivided into Brief Positive and Play. Look Away, Wary Monitor and Social Monitor included two to three subcodes each. Table 2 contains infant codes and subcodes with descriptors. Codes and descriptors were developed from the Monadic Phases system of Tronick and associates (Tronick, Als, & Brazelton, 1980; Tronick & Brazelton, 1979).

Each 3-minute epoch was divided into 36 5-second intervals. The method of scoring provided for the recording of modified and absolute frequencies such that the original ordering of codes was preserved.

Reliability

Interobserver reliability was defined as the number of agreements

TABLE 1

Descriptive Instructions for Simulated Depressed and Normal Conditions

Simulated Depressed Interaction	
1	Sit facing your infant at your usual distance for play.
2	Talk to your infant in a flat, uninteresting monotone. You might talk to the baby about your trip to the laboratory or events planned for later in the day.
3	Keep your face relatively expressionless. Try not to move your head or raise your eyebrows.
4	Do not use your hands. Keep them at your side or resting on the table.
5	If the baby attempts to avoid your gaze, do not chase after him/her in order to maintain eye contact. Maintain your gaze toward the baby so that if he/she does look at you, you will make eye-contact.
Normal Interaction	
	You may touch the baby with your hands or face, show animation with your voice, face, etc., and, in brief, play as you normally would given the constraint that the baby remain in the seat.

TABLE 2

Infant Behaviors

1-1	Look Away	Gaze is away from mother. Facial expression is slightly negative to bright.
1-2	Sweep	Face is to the side (level, down or up) and then makes a continuous sweep toward mother and on to complete other side without clearly glancing at mother.
1-3	Glance Towards	Brief glance from Look Away toward mother and then away. Duration less than 1.25 seconds.
2-1	Wary Monitor	Gaze is toward mother. Facial expression is serious-sober, with eyebrows somewhat narrowed. Head may be positioned down or partside.
2-2	Glance Away	From Wary Monitor infant does brief glance to Look Away. Duration is less than 1.25 seconds. Return may be to either Wary Monitor or Social Monitor.
2-3	Flash	Infant remains in Wary Monitor. Eyebrows briefly are raised and then lowered. Duration of a single flash is less than 2.5 seconds.
3-1	Social Monitor	Gaze is toward mother. Head position is level or up and _en face_. Eyebrows and cheeks may be slightly raised. Absense of smile.
3-2	Glance Away	From Social Monitor, brief glance to Look Away. Duration is less than 1.25 seconds. Gaze return may be to ether Social or Wary Monitor.
3-3	Flash	Infant remains in Social Monitor. Eyebrows are briefly raised and then lowered. Duration of a single flash is less than 1.25 seconds.

TABLE 2 (continued)

4-1	Positive	Brief Positive or Play
4-2	Brief Positive	Facial expression brightens but duration is brief (less than 3.0 seconds) and appears attenuated. Gaze is toward mother.
4-3	Play	Facial expression is bright with smile or play face. Must begin with gaze toward mother.
5-1	Protest	Negative facial expressions of cry-face or grimace along with crying, fussing, or arching back or writhing movements. Gaze may be toward mother or away.

divided by the number of agreements plus disagreements. Coders began working with experimental data only after training to 80 percent agreement on pilot tapes and tapes from related studies of mother-infant interaction. The chief research assistant scored the videotapes with reliability checks provided by the Experimenter on a weekly basis. Reliability was consistently above 80 percent for each of the five codes. Within Positive there was inadequate agreement between Play and Brief Positive with the initial cut-off set at 1¼ seconds. That criterion was changed to the present 3 seconds. A second research assistant rescored Positive displays, and the chief research assistant checked reliability. Subsequent tapes were then coded with the 3-second criterion. Interobserver reliability with the 3-second criterion was 93 percent for Brief Positive and 92 percent for Play. Too few instances of Glances, Flashes, and Sweeps appeared in the reliability data for adequate estimates of reliability to be made. Table 3 contains reliability data for each code.

Dependent Measures

For nonsequential analyses, both modified and absolute frequency data were available for each code. Because the two data types can be redundant, it was decided to use the modified frequency alone for those codes with correlations of .7 or higher between measurements per epoch. For those codes with correlations below .7 it was decided to use both sets of measurements. One exception was Brief Positive. Because Brief Positive was potentially a low frequency behavior and because it was, without exception, less than 3 seconds in duration, it was decided *a*

TABLE 3

Reliability Results for Infant Codes

Code	Agreements	Agree + Disagree	Proportion
Look Away	269	299	.90
Protest	89	106	.84
Wary Monitor	73	84	.87
Social Monitor	44	52	.85
Positive	160	184	.87
Brief Positive	28	30	.93
Play	46	50	.92
Total	709	805	.88

priori that absolute frequency would be the appropriate index for analysis. To analyze the modified frequency of Brief Positive would disproportionately inflate the importance of those displays which began and ended in contiguous intervals and would under-record instances in which two occurrences were documented within one interval. Glances, flashes, and sweeps were not analyzed.

Sequential analyses were conducted on event sequence data. Event codes were Look Away, Protest, Wary Monitor, Social Monitor, Brief Positive and Play. Because the coding system functionally excluded transitions between Brief Positive and Play, there were 36-6-2 or 28 possible event-sequence transitions at lag 1. Parametric tests (Analysis of Variance) of conditional probabilities were made after appropriate arcsine square root transformation (Myers, 1979). Conditional probabilities were not transformed for non-parametric tests.

CHAPTER IV

RESULTS

Correlations between Data Types

Correlations of .7 or higher were obtained for Protest, Social and Wary Monitor. Correlations below .7 were obtained for Look Away and Play. Correlations were not computed for Brief Positive. Table 4 contains correlations for each code per epoch.

Order Effects

Order effects were analyzed prior to condition effects for two reasons: The results of the former would guide the appropriate test of condition effects; and the presence of condition carryover effects (i.e., the influence of Simulated Depressed interactions on the infants' reaction to Normal maternal interaction in the following epoch) would be the first indication of condition effects. A nonspecific test of order effects is provided through a comparison of experimental orders. A test of condition carryover effects is provided through a comparison of the Normal condition of orders Depressed-Normal and Normal-Normal.

Comparing experimental orders, there was a significant main effect of order for Wary Monitor, $\underline{F}$ $(1,18) = 5.00$, $p < .05$. Infants who experienced the Simulated Depressed condition prior to Normal spent more of their time in Wary Monitor than did infants for whom order of presentation was reversed. The mean for Order Simulated Depressed-Normal was 12.375; the mean for Order Normal-Simulated Depressed was 6.125. There

TABLE 4

Correlations between Modified and Absolute Frequencies per Epoch[a]

Code	Correlation Coeffecient	
	Epoch 1	Epoch 2
Look Away	.39	.34
Protest	.89	.71
Wary Monitor	.88	.90
Social Monitor	.76	.94
Play	.88	.46

[a]Correlation coefficients not computed for Positive or for Brief Positive.

was no significant effect for sex of infant or sex by order interaction. Table 5 contains Analysis of Variance summary tables for results referred to in this section.

Two comparisons were made pertaining condition carryover effects. The first considered infants' reaction during the first 60 seconds (12 intervals) of the epoch 2 Normal condition. The second considered their reaction during the entire 3 minutes in order to determine how long such effects persisted. Both comparisons include data for one subject in the Simulated Depressed-Normal Order for whom interruption of the procedure became necessary during the Simulated Depressed condition. He resumed the procedure with maternal Normal interaction after being comforted. There was a significant main effect of condition carryover for Wary Monitor, $\underline{F}$ (1,12) = 6.77, $\underline{p}$ < .025. Infants in the experimental order averaged 4.38 intervals of Wary Monitor while control infants averaged less than 1 interval of Wary Monitor. There was no effect of sex or of sex by condition interaction. The condition carryover effect was not distinguishable over the entire interval. Table 6 contains the Analysis of Variance summary table for condition carryover analyses.

Condition Effects

Condition effects were tested by comparing Simulated Depressed and Normal interactions of the first epoch (see Table 7). There was a significant main effect of condition for three codes: Wary Monitor, $\underline{F}$ (1,20) = 17.27, $\underline{p}$ < .001, Protest, $\underline{F}$ (1,20) = 9.75, $\underline{p}$ < .005; and Brief Positive, $\underline{F}$ (1,20) = 7.18, $\underline{p}$ < .025. Infants in the Simulated

TABLE 5

Analysis of Variance Summary Table for Wary Monitor,

Epochs 1 and 2

	SS	df	F	p<
Experimental Orders	312.50	1	5.00	.05
Sex (within Experimental Orders)	28.13	1	<1	
Experimental Orders x Sex	136.13	1	2.18	
Control vs. Orders	155.04	1	2.48	
Remainder	45.62	1	<1	
Error	1124.13	18		

TABLE 6

Analysis of Variance Summary Table for Wary Monitor,

First 12 Intervals of Epoch-2 Normal Conditions

Source	SS	df	F	p<
Condition of Prior Epoch	64.00	1	6.77	.025
Sex	4.00	1	<1	
Sex by Condition	12.25	1	1.30	
Error	113.50	12		

Depressed condition spent more time in each of the three codes. Cell means were 15.25 vs. 3.38 for Wary Monitor, 11.88 vs. 3.00 for Protest, and 3.25 vs. 1.38 for Brief Positive. One infant in the Simulated Depressed condition, as mentioned above became sufficiently upset to require interruption of the procedure. A second infant in the Simulated Depressed condition also cried steadily for 25 seconds but the procedure was not interrupted. No babies in the Normal condition became comparably upset.

The effect of condition on Play was marginally significant, $F\ (1,20) = 4.07$, $p < .06$. Infants in the Simulated Depressed condition averaged 2.13 intervals of Play vs. 11.00 intervals for infants in the Normal condition. However, the variability of Play was substantially greater in the Normal condition. Scores ranged from 0 to 32 intervals of Play in the Normal condition vs. 0 to 2 in the Simulated Depressed condition. This difference in variability was significant beyond the .001 level, $F_{(max)}\ (2,7) = 27.02$.

There was a significant sex of subject effect for Brief Positive, $F\ (1,20) = 6.26$, $p < .025$. Girls had higher rates of Brief Positive than did boys. There was no sex by condition interaction.

Table 7 contains Analysis of Variance summary tables for results referred to in this section.

Differences in the Structure of Behavior between Conditions

In order to determine whether different sequential rules were in effect between conditions, lag 1 conditional probabilities were analyzed. Transitions from Play were omitted from the analyses given the

TABLE 7

Analysis of Variance Summary Tables for Reduced vs. Normal

First Epoch

Code: Wary Monitor

Source	SS	df	F	p<
Condition	752.08	1	17.27	.001
Sex	.33	1	<1	
Condition x Sex	8.33	1	<	
Error	870.75	20		

Code: Protest

Source	SS	df	F	p<
Condition	420.08	1	9.75	.005
Sex	5.33	1	<1	
Condition x Sex	27.00	1	<1	
Error	861.50	20		

Code: Brief Positive

Source	SS	df	F	p<
Condition	18.75	1	7.18	.025
Sex	16.33	1	6.25	.025
Condition x Sex	.33	1	<1	
Error	52.25	20		

TABLE 7 (continued)

Code: Play

Source	SS	df	F	p<
Condition	363.00	1	4.07	.06
Sex	8.33	1	<1	
Condition x Sex	108.00	1	1.21	
Error	1785.25	20		

infrequency of transitions from Play in the Simulated Depressed condition. Of 183 transitions in that condition, only 8 (4 percent) were from Play. Of those 8 transitions, 5 were to Look Away. (See Tables 8 and 9 for Transition Frequency Matrices of Simulated Depressed and Normal conditions, respectively.)

Infants in the Simulated Depressed condition had significantly higher conditional probabilities for three transitions, and two others were marginally significant. The probability of (Wary/Protest) was .444 for Simulated Depressed vs. .158 for Normal, F (1,20) = 5.38, $p < .05$. (See Tables 10 and 11 for the respective Transition Probability Matrices and Table 12 for F ratios.) The probability of (Protest/Wary) was .372 for Simulated Depressed and only .031 for Normal, F (1, 20) = 10.33, $p < .005$. There was a significant sex by condition interaction for the conditional probability of transition from Protest to Wary, with girls having higher conditional probabilities than boys in the Simulated Depressed condition, F (1, 20) = 6.90, $p < .025$.

Infants in the Simulated Depressed condition were more likely to make transitions to Protest from Brief Positive and, reciprocally, to Brief Positive from Protest. The probability of (Protest/Brief Positive) was .077 for infants in the Simulated Depressed condition vs. 0 in the Normal condition, F (1, 20) = 4.25, $p = .05$. The probability of (Brief Positive/Protest) was .056 for the Simulated Depressed condition vs. 0 for the Normal condition, F (1,20) = 4.42, $p < .05$. There was also a significant effect of sex of subjects and sex by condition interaction for the probability of (Brief Positive/Protest). Boys in the Simulated Depressed condition had higher conditional probabilities than

TABLE 8

Lag 1 Transition Frequency Matrix for Simulated

Depressed Condition

	Look Away	Protest	Wary	Social	Brief	Play	X[a]	Total[a]
Look Away	--	20	23	4	11	2	1	60
Protest	18	--	16	0	2	0	4	36
Wary	14	16	--	0	9	4	3	43
Social	2	2	0	--	4	2	0	10
Brief	18	2	3	3	--	--	0	26
Play	5	0	2	1	--	--	0	8

Note: Number of Subjects = 8.

[a]"X" indicates the number of times that row code was final code in sequence. The value of X is ignored in the computation of conditional probabilities. "Total" refers to number of criterion events available for matching. Absolute frequency of a code is equal to the value of X for the row plus the row "total."

TABLE 9

Lag 1 Transition Frequency Matrix for Normal Condition

	Look Away	Protest	Wary	Social	Brief	Play	X[a]	Total[a]
Look Away	--	15	21	12	13	8	10	69
Protest	14	--	3	1	0	1	2	19
Wary	13	1	--	1	7	10	0	32
Social	11	0	0	--	10	16	2	37
Brief	15	0	2	11	--	--	0	28
Play	14	4	5	14	--	--	2	37

Note: Number of Subjects = 16.

[a]"X" indicates the number of times that row code was final code in sequence. The value of X is ignored in the computation of conditional probabilities. "Total" refers to number of criterion events available for matching. Absolute frequency of a code is equal to the value of X for the row plus the row "total."

TABLE 10

Lag 1 Transition Probability Matrix,

Simulated Depressed Condition

	Look Away	Protest	Wary	Social	Brief	Play
Look Away	----	.333	.383	.067	.183	.033
Protest	.500	----	.444	.000	.056	.000
Wary	.325	.372	----	.000	.209	.093
Social	.200	.200	.000	----	.400	.200
Brief	.690	.077	.115	.115	----	----
Play	.625	.000	.250	.125	----	----

Note: Number of Subjects = 8.

TABLE 11

Lag 1 Transition Probability Matrix

Normal Condition

	Look Away	Protest	Wary	Social	Brief	Play
Look Away	----	.217	.304	.174	.188	.116
Protest	.737	----	.158	.053	.000	.053
Wary	.406	.031	----	.031	.219	.313
Social	.297	.000	.000	----	.270	.432
Brief	.536	.000	.071	.393	----	----
Play	.378	.108	.135	.378	----	----

Note: Number of Subjects = 16.

TABLE 12

Analysis of Variance Summary Tables for Lag 1

Conditional Probabilities (After Arcsine Square Root Transformation)

P(Social/Look Away)

Source	Sum of Squares	DF	F	p<
Condition	.0242	1	1.12	
Sex	.1338	1	6.21	.025
Condition x Sex	.0400	1	1.86	
Error	.4304	20		

P(Brief Positive/Look Away)

Source	Sum of Squares	DF	F	p<
Condition	.0020	1	.05	
Sex	.2714	1	7.25	.025
Condition x Sex	.0046	1	.12	
Error	.7487	20		

P(Wary/Protest)

Source	Sum of Squares	DF	F	p<
Condition	1.6276	1	5.38	.05
Sex	.2895	1	.96	
Condition x Sex	2.0878	1	6.90	.025
Error	6.0474	20		

TABLE 12 (continued)

P(Brief Positive/Protest)

Source	Sum of Squares	DF	F	p<
Condition	.0094	1	4.42	.05
Sex	.0094	1	4.42	.05
Condition x Sex	.0094	1	4.42	.05
Error	.0426	20		

P(Protest/Wary)

Source	Sum of Squares	DF	F	p<
Condition	.5790	1	10.33	.005
Sex	.0115	1	.21	
Condition x Sex	.0422	1	.75	
Error	1.1207	20		

P(Protest/Social)

Source	Sum of Squares	DF	F	p=
Condition	.0502	1	3.96	.06
Sex	.0061	1	.48	
Condition x Sex	.0061	1	.48	
Error	.2535	20		

TABLE 12 (continued)

P(Protest/Brief Positive)

Source	Sum of Squares	DF	F	p=
Condition	.0621	1	4.25	.05
Sex	.0028	1	.19	
Condition x Sex	.0028	1	.19	
Error	.2922	20		

girls, F (1, 20) = 4.42, $p < .05$.

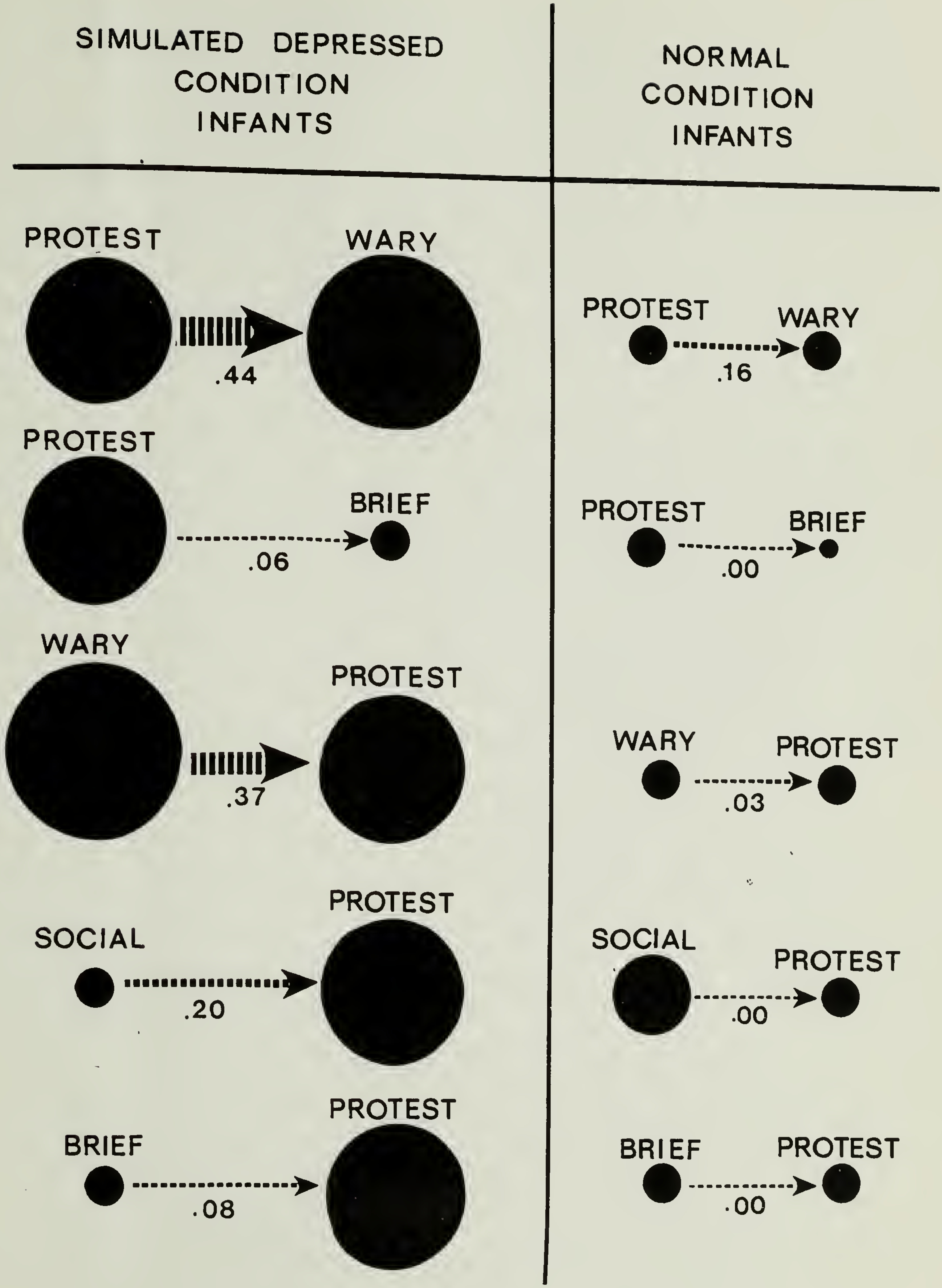
Infants in the Simulated Depressed condition tended to have higher conditional probabilities for the transition from Social Monitor to Protest. The probability of (Protest/Social Monitor) was .200 for infants in the Simulated Depressed condition and 0 for infants in the Normal condition, F (1,20) = 3.96, $p = .06$. There were two conditional probabilities for which there was a significant effect alone of sex of subject. Girls had higher conditional probabilities for the transitions from Look Away to Social, F (1,20) = 6.21, $p < .025$, and from Look Away to Brief Positive, F (1,20) = 7.25, $p < .025$.

Figure 1 summarizes the results of this section.

Sequential Structure of Behavior within Each Condition

In order to determine what rules are in effect within each condition, Sackett's (1977) lag analysis of contingency was applied to the lag 1 transition frequency matrix of each group. The Sackett analysis utilizes the normal approximation to the binomial distribution and provides a means of comparing conditional with unconditional (expected) probabilities. Goodness of fit between normal and binomial probabilities requires that N (the number of instances of the criterion) be at least 25 and that expected probabilities be greater than .10 except for very large N (Sackett, 1977). In the present case, criterion behaviors with frequencies of less than 25 were not analyzed (i.e, Social Monitor and Play). Transitions for which the expected probability of the matching code was less than .1 were also not analyzed (i.e., again, Social Monitor and Play).

Figure 1. Principal between group differences in lag 1 conditional probabilities. The thickness of the arrows corresponds (approximately) to the size of the conditional probabilities depicted. The size of each state representation corresponds (approximately) to the proportion of infant time spent in that state.


SIMULATED DEPRESSED CONDITION INFANTS
NORMAL CONDITION INFANTS
PROTEST
WARY
.44
PROTEST
WARY
.16
PROTEST
BRIEF
.06
PROTEST
BRIEF
.00
WARY
PROTEST
.37
WARY
PROTEST
.03
SOCIAL
PROTEST
.20
SOCIAL
PROTEST
.00
BRIEF
PROTEST
.08
BRIEF
PROTEST
.00

Among the infants in the Simulated Depressed condition, Brief Positive had an excitatory function for Look Away, $z = 3.14$, $p < .005$. The conditional probability of (Look Away/Brief Positive) was .690. The expected probability was .389 (see Table 13 and Figure 2). Brief Positive had an inhibitory function for two codes, Protest and Wary Monitor, $z = -2.09$ and -2.0, respectively, $p < .05$ (see Figure 3). The conditional probability of (Protest/Brief Positive) was .077 whereas the expected probability was .255. The conditional probability of (Wary/Brief Positive) was .115. The expectecd probability of Wary was .293. No other significant lag 1 contingencies were detected in the Simulated Depressed condition.

For the Normal condition data, the number of criterion occurrences of Protest was insufficient for analysis (N = 19). Analysis of the remaining behavior codes indicated significant cycling among Play, Brief Positive and Social Monitor (see Table 14 and Figure 4). The most likely transition from Social Monitor was to Play, $z = 3.63$, $p < .0005$. The conditional probability of (Play/Social Monitor) was .432; the expected probability was .196. The conditional probability of (Brief Positive/Social Monitor) was .270 vs. an expected probability of Brief Positive of .141, z 2.26, $p < .025$. Brief Positive, in turn, had an excitatory function for Social Monitor. The conditional probability of (Social/Brief Positive) was .393; the expected probability was .228, $z = 2.09$, $p < .05$. From Play, the most likely contingency was to Social Monitor, $z = 2.17$, $p < .05$. The conditional probability of (Social Monitor/Play) was .378; the expected probability, .228.

Social Monitor, Brief Positive and Play inhibited transitions to

TABLE 13

Lag 1 Conditional Probabilities and Summary Statistics for the Simulated Depressed Condition

Criterion: Brief Positive

	Look Away	Protest	Wary	Social
P_{L1}	.690	.077	.115	.115
P_e	.389	.255	.293	.064
SD_{P_e}	.096	.085	.089	.048
z	3.14**	-2.09*	-2.00*	1.06

Note:

P_{L1} is the conditional probability at lag 1.

P_e is the expected (unconditional) probability at lag 1.

SD_{P_e} is the standard deviation of expected probability.

**$p < .005$

*$p < .05$

Figure 2. Transition diagram for the Simulated Depressed condition. The transitions depicted are: a) those for which the conditional probability is greater than the expected (unconditional) probability, $p < .05$; b) the highest two conditional probabilities from each state if not otherwise depicted. The thickness of the arrows corresponds (approximately) to the size of the conditional probabilities depicted. The size of each state representation corresponds (approximately) to the proportion of infant time spent in that state.

Key: striped arrow indicates the conditional probability is greater than the expected probability, $p < .05$.

solid arrow indicates the conditional probability is not greater than the expected probability, $p < .05$.

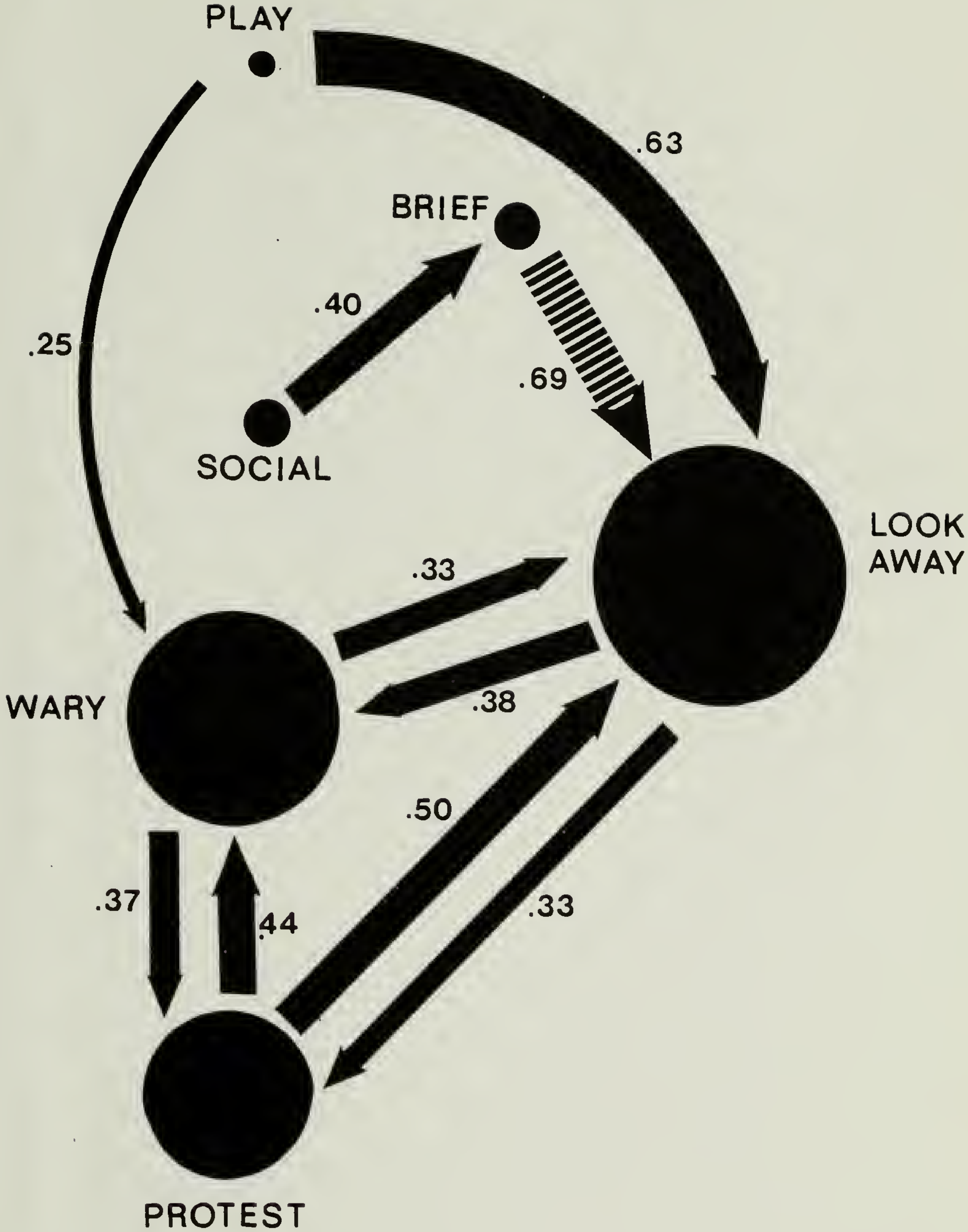

PLAY
.63
BRIEF
.40
.25
.69
SOCIAL
LOOK AWAY
.33
WARY
.38
.50
.37
.44
.33
PROTEST

Figure 3. Simulated Depressed condition transitions for which the conditional probability is less than the expected probability, $p < .05$.

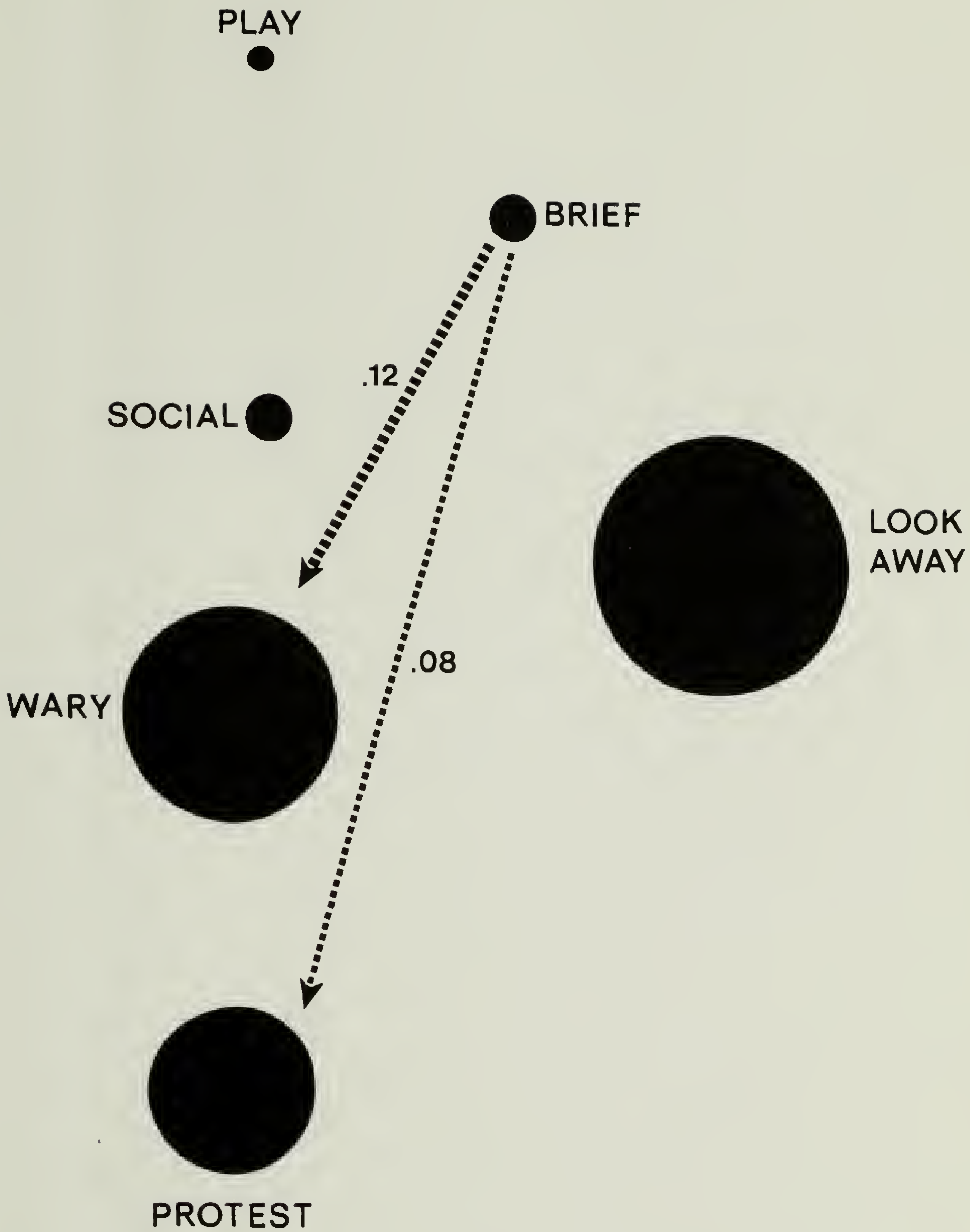

PLAY
BRIEF
.12
SOCIAL
LOOK AWAY
.08
WARY
PROTEST

TABLE 14

Lag 1 Conditional Probabilities and Summary Statistics for the Normal Condition

Criterion: Look Away

	Protest	Wary	Social	Brief	Play
P_{L1}	.217	.304	.174	.188	.116
P_e	.132	.201	.245	.176	.245
SD_{P_e}	.041	.048	.052	.046	.052
z	2.07*	2.15*	-1.37	.261	-2.48**

Criterion: Wary

	Look Away	Protest	Social	Brief	Play	Positive
P_{L1}	.406	.031	.031	.219	.313	.532
P_e	.383	.102	.189	.136	.189	.325
SD_{P_e}	.086	.054	.069	.061	.069	.083
z	.27	-1.31	-2.29*	1.36	1.80	2.49**

Criterion: Social Monitor

	Look Away	Protest	Wary	Brief	Play
P_{L1}	.297	0	0	.270	.432
P_e	.396	.106	.161	.141	.196
SD_{P_e}	.080	.051	.060	.057	.065
z	-1.23	-2.08*	-2.68***	+2.26**	+3.63****

TABLE 14 (continued)

Criterion: Brief Positive

	Look Away	Protest	Wary	Social
P_{L1}	.536	0	.071	.393
P_e	.461	.123	.187	.228
SD_{P_e}	.094	.062	.074	.079
z	.780	-1.98*	-1.57	2.09*

Criterion: Play

	Look Away	Protest	Wary	Social
P_{L1}	.378	.108	.135	.378
P_e	.462	.123	.187	.228
SD_{P_e}	.082	.054	.064	.069
z	1.02	-.28	-.81	2.17*

*$p < .05$

**$p < .025$

***$p < .01$

****$p < .0005$

Note:

P_{L1} is the conditional probability at lag 1.

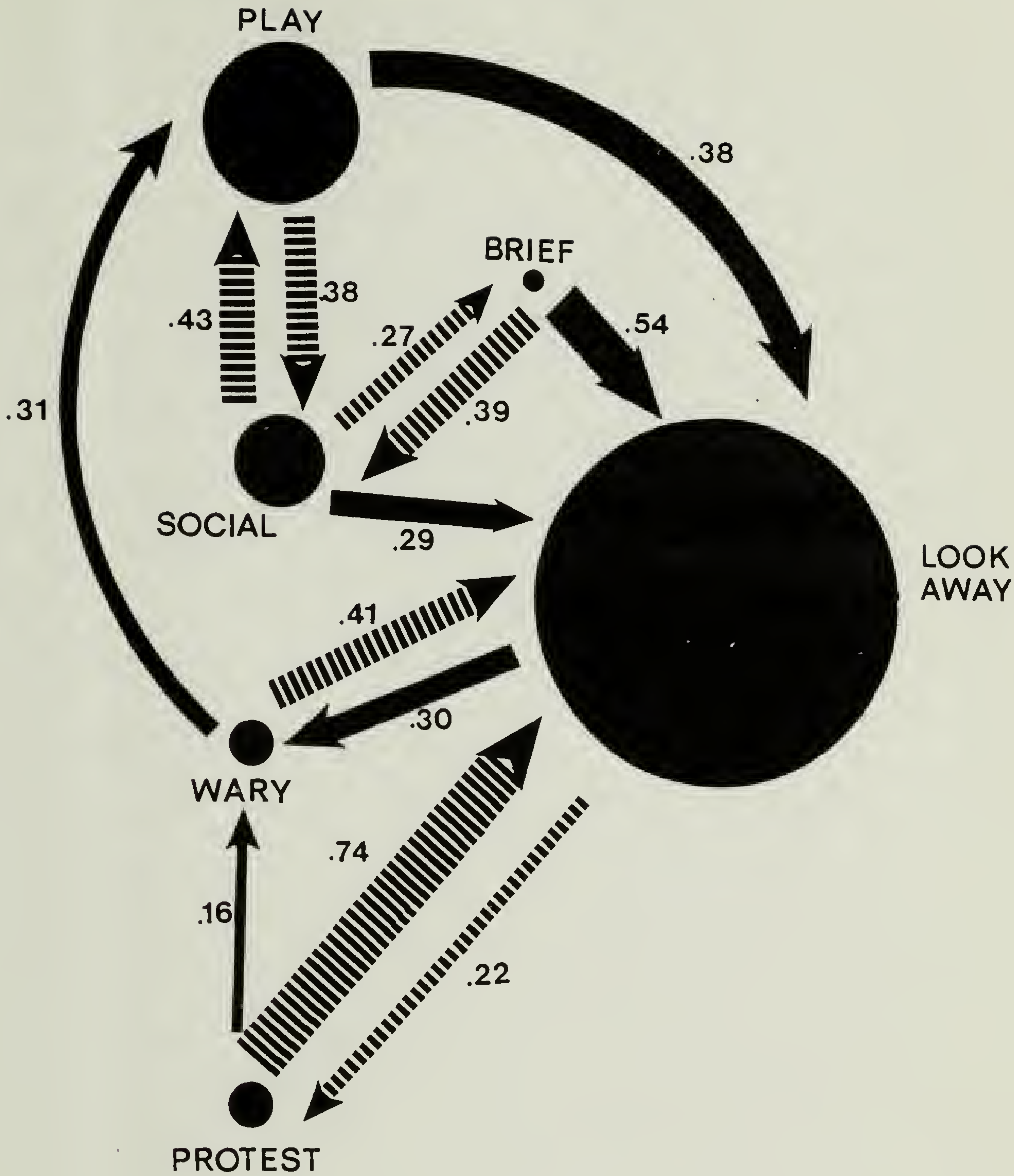
P_e is the expected (unconditional) probability at lag 1.

SD_{P_e} is the standard deviation of expected probability.

Figure 4. Transition diagram for the Normal condition. The transitions depicted are: a) those for which the conditional probability is greater than the expected (unconditional) probability, $p < .05$; b) the highest two conditional probabilities from each state if not otherwise depicted. The thickness of the arrows corresponds (approximately) to the size of the conditional probabilities depicted. The size of each state representation corresponds (approximately) to the proportion of infant time spent in that state.

Key: striped arrow indicates the conditional probability is greater than the expected probability, $p < .05$.

solid arrow indicates the conditional probability is not greater than the expected probability, $p < .05$.


PLAY
.38
BRIEF
.43
.38
.27
.54
.39
.31
SOCIAL
.29
LOOK AWAY
.41
.30
WARY
.74
.16
.22
PROTEST

Wary Monitor and Protest (see Table 14 and Figure 5). The conditional probability of (Protest/Social Monitor) was 0 vs. an expected probability of .106, $z = -2.08$, $p < .05$. The conditional probability of (Wary Monitor/Social Monitor) was 0 as well, vs. an expected probability of .161, $z = -2.68$, $p < .01$. Brief Positive inhibited transitions to Protest. The conditional probability of (Protest/Brief Positive) was 0 vs. an expected probability of .123, $z = -1.98$, $p < .05$.

Look Away in the Normal condition had an excitatory function for two negative codes, Protest and Wary. The conditional probability of (Protest/Look Away) was .217 vs. an expected probability of .132, $z = 2.07$, $p < .05$. The conditional probability of (Wary/Look Away was .304 vs. an expected probability of .201, $z = 2.15$, $p < .05$. Look Away also had an inhibitory function for Play. The conditional probability of (Play/Look Away) was .116 vs. an expected probability of .245, $z = -2.48$, $p < .025$.

Wary had an inhibitory function for Social Monitor. The conditional probability of (Social/Wary Monitor) was .031; the expected probability was .189, $z = -2.29$, $p < .025$. If one combines Brief Positive and Play, Wary Monitor has an excitatory function for a return to Positive (see Figure 6). The conditional probability of [(Brief Positive or Play)/Wary] was .531 vs. an expected probability of .325, $z = 2.48$, $p < .025$.

Figure 5. Principal pathways to Positive in the Normal Condition. The thickness of the arrows corresponds (approximately) to the size of the conditional probabilities depicted. The size of each state representation corresponds (approximately) to the proportion of infant time spent in that state.

Key: striped arrow indicates the conditional probability is greater than the expected probability, $p < .05$.

solid arrow indicates the conditional probability is not greater than the expected probability, $p < .05$.

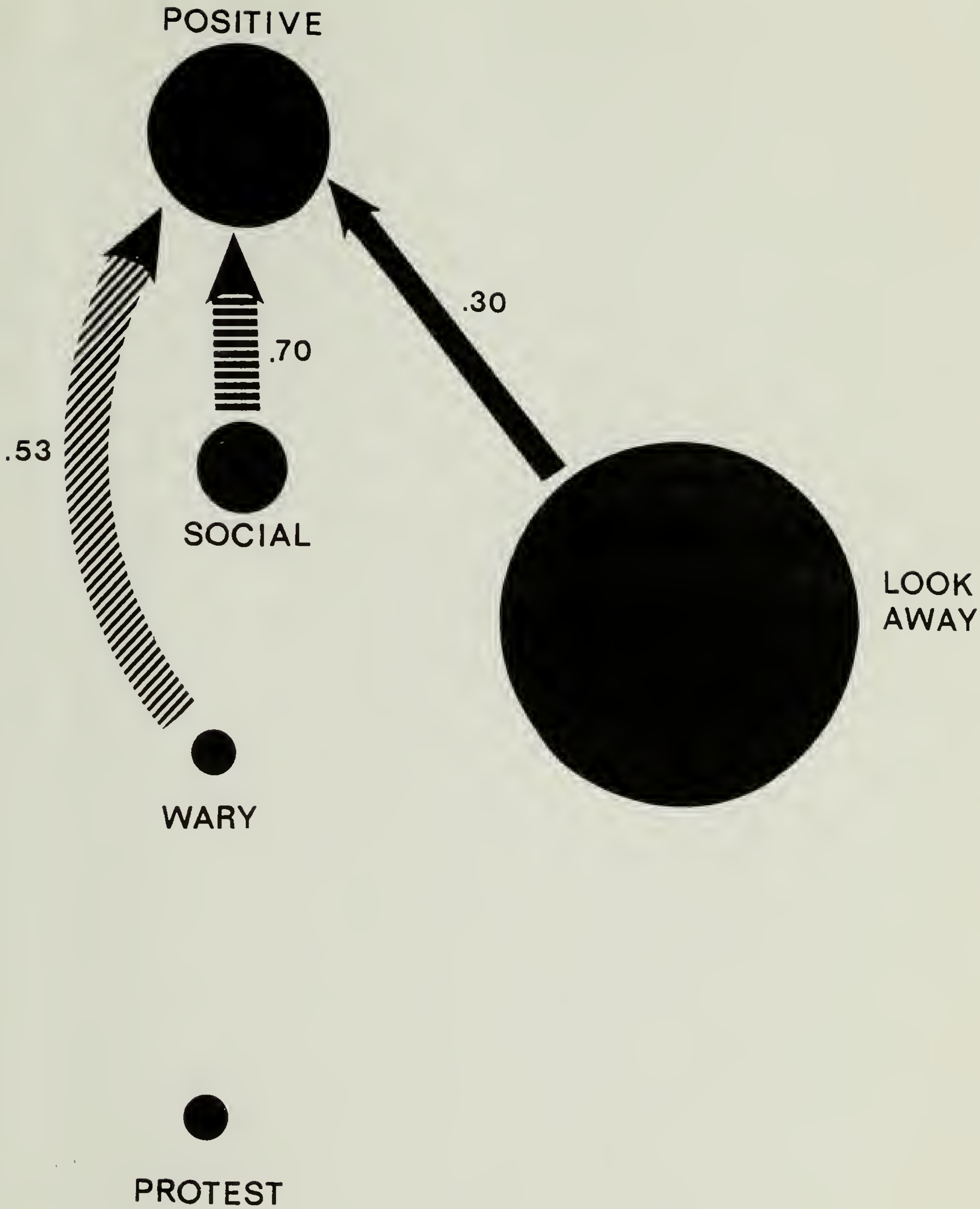
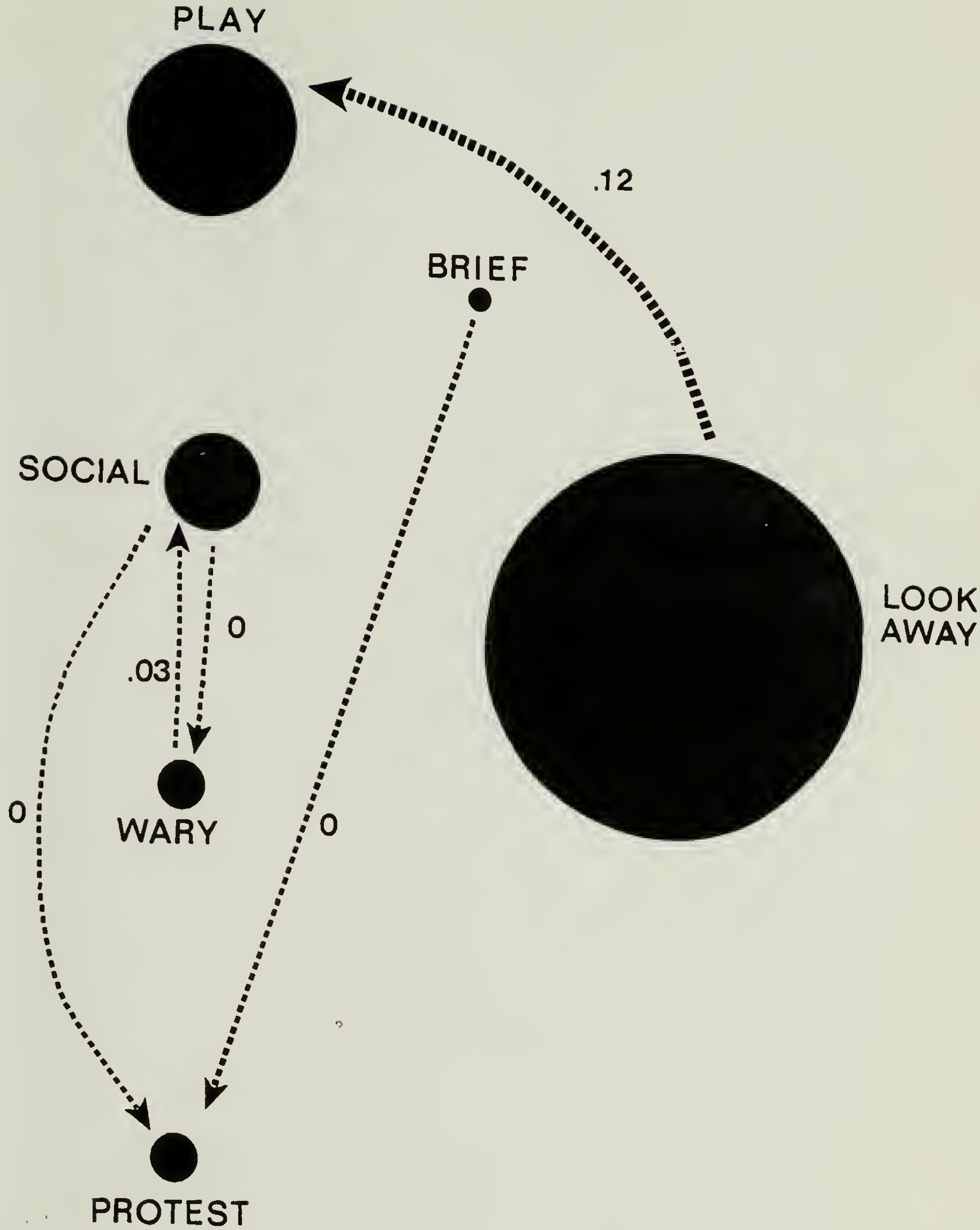

POSITIVE
.30
.70
.53
SOCIAL
LOOK
AWAY
WARY
PROTEST

Figure 6. Normal condition transitions for which the conditional probability is less than the expected probability, $\underline{p} < .05$.


PLAY
.12
BRIEF
SOCIAL
0
.03
LOOK
AWAY
0
WARY
0
PROTEST

CHAPTER V

DISCUSSION

This study provided a direct test of three hypotheses: rule violation, understimulation, and stimulus discrepancy. The data clearly supported the rule violation hypothesis and questioned formulations based on stimulus discrepancy or understimulation.

The rule violation hypothesis predicts that infants will respond to simulated maternal depression with increased frequencies of positive elicits (Brief Positive) and increased proportions of negative displays. And, it suggests that the structure of infant behavior will clearly differ between conditions. These predictions were confirmed. Infants in the Simulated Depressed condition had significantly higher rates of Brief Positive displays and significantly and markedly higher proportions of Protest and Wary. In fact, Simulated Depressed condition infants spent about half of their time in Protest or Wary. Normal condition infants, conversely, spent a minimal proportion of time in negative states (13 percent) and about 40 percent of their time in Positive or Social.

Sequential analyses of the data found that Simulated Depressed condition infants were not only far more negative and less positive, but that they structured their behavior in a radically different manner. Simulated Depressed condition infants were far more likely to cycle among negative codes and Look Away. On the few occasions when they did enter neutral or positive states, they were most likely to return to the negative orbit of Protest-Wary-Look Away. Normal condition infants, on the other hand, were more likely to cycle among Social Monitor, Play, and Brief Positive. On the few occasions when they did enter Wary or Protest, they were most likely to return to the positive orbit through a transition to either Brief Positive or Play. Significantly, certain transitions such as Brief Positive to Protest which had zero probability in the Normal condition, were decidedly not absent in the Simulated Depressed condition.

Discrepancy hypotheses cannot account for interwoven patterns of negative and positive affect or for higher rates of Brief Positive in the Simulated Depressed condition or for the differences in the response patterns shown by the conditional probabilities. Even taking the broad model of McCall and McGhee (1977) in which discrepancy is couched in terms of the more comprehensive concept of subjective uncertainty, there is no discrepancy condition in which one would expect to find these results. One would expect to find, in response to moderate amounts of subjective uncertainty, occasional displays of negative affect along with maximum attention and then maximum sustained displays of positive affect. In the case of extreme amounts of subjective uncertainty one would expect initial displays of maximum negative affect followed by prolonged attention and positive affect if the infant is successful at resolving the discrepancy. Neither expectation is compatable with the obtained results. There is simply no theoretically acceptable means of explaining higher rates of Brief Positive, higher conditional probabilities between Brief Positive and Protest or repeating patterns of Protest, Positive, and Look Away that is consistent with discrepancy hypotheses. Furthermore, the finding that the effect of Simulated Depressed condition carried forward into the next period of normal maternal interaction runs directly counter to the predictions of the discrepancy hypothesis. According to that hypothesis, affective response is a function of current discrepancy parameters. The finding that infant wariness carried over into the following period of normal maternal interaction strongly suggests that the discrepancy parameters are not responsible for the observed wariness. Contraindication of discrepancy hypotheses is particularly damaging given that post hoc the model has been considered nearly irrefutable (Hinde, 1974).

Understimulation hypotheses are at even a greater loss to account for the data. The very substantial upset observed in response to 3 brief minutes of Simulated Depression would not be expected were infants responding merely to the physical parameters of stimulus displays. Further, stimulus intensity formulations provide no basis with which to account for: a) the higher incidence of Brief Positive in the Simulated Depressed condition; b) the structural differences in the organization of infant behavior; and c) the fact that altered responding to Simulated Depression persisted well into the next period of Normal interaction.

In addition to providing a test of 3 alternative hypotheses, the present study is relevant to several additional concerns. One is an explication of the greater variability of Play in normal interactions. In the present data, while mean levels of Play differ markedly and as expected between conditions, the proportion of time spent in Play was far more variable in the Normal condition. This differential variability may be related to a concept of the infants' agenda. Agenda refers to a set of intentions for action (regarding the infants' capacity for intentional action, see Tronick, 1979). In learning theory terms, an agenda would refer to the probability of a pattern of (positive) responsiveness to appropriate maternal stage setting events and play. An infant brings to any interaction its own agenda and that agenda is one substantial source of variability in normal interactions. An infant's prior history with its caregiver and its internal state at the time of the interaction both impact powerfully on the composition of that agenda. The infant who is overtired or the infant who is recently fed and sleepy will be expected to have a very different agenda than the one who is optimally ready for a play episode.

When the normal rules regulating an interaction are violated, the infants' prior agenda is derailed. The infant responds by attempting to reinstate the normal rules governing the interaction. Brief Positive displays and what Ricks (1980) has referred to as negative elicits characterize the infant's instrumental efforts to redirect the interaction. If unsuccessful, the infants' behavior becomes characterized by cycling through the negative orbit of Protest-Wary-Look Away. Importantly, negative displays and the quality of emotion they reflect are likely to persist even after mothers resume normal maternal interaction. When the mothers do resume normal interaction, the infants do not reciprocate without much effort on their mothers' part. The infants profoundly experience their inability to reinstate the normal interaction rules.

A second concern germane to the present investigation is that of "step size" between transitions. Tronick, Als, and Brazelton (1980) conceptualized infant affective states along a positive to negative continuum and found that most infant transitions were of one step. Such a pattern provides a high degree of predictability to infant behavior. Considering the present set of infant codes along a continuum from positive (Play, Brief Positive) to neutral (Social Monitor) to avert (Look Away) and negative (Wary and Protest), one finds that most excitatory contingencies involve transitions of one step while most inhibitory transitions involve transitions of greater than one step. These findings are in essential agreement with those of Tronick, Als, and Brazelton (1980).

Several exceptions, however, are of interest. In the Simulated Depressed condition, Brief Positive had an excitatory function for transitions to Look Away. In the Normal condition Wary Monitor had an excitatory function for transitions to Positive, and there were inhibitory contingencies in effect between Wary and Social Monitor. These exceptions, especially in light of the nonsequential finding that the proportion of infant time spent in Play was very significantly more variable in the Normal condition, suggest that the particular set of transition rules in effect may depend upon whether interactions are satisfactory or are "stressed." The Normal condition, as suggested above, includes satisfactory as well as some "stressed" interactions whereas interactions in the Simulated Depressed condition are uniformly and severely stressed. One would expect, and the data would seem to bear out, that principle adherence to the one step rule should be found in the Normal condition. Further, the observed injunction involving transitions between Wary and Social Monitor would seem related to the occurrence of two types of interactions within the Normal condition, namely, satisfactory and "stressed" interactions.

A final concern to which the present data are applicable is the controversy about the genesis of true dialogue. Schaffer (1977) has briefly reviewed several studies of newborn-mother interaction and concluded that early dialogues are one-sided affairs in which mothers adjust or fit their own rhythms to their infants' endogenous responses. Mothers act as if the infants' responses had communicative intent. Tronick (1979) has argued that at least by 2-3 months the infant is engaging in true dialogue. Tronick, Als, and Brazelton (1977) argued from their data that "infants are capable of modifying their affective and attentional displays in a reciprocally coordinated manner." Gottman and Ringland (1980), however, reanalyzed the Tronick, Als, and Brazelton (1977) data using spectral time series and found that the mutuality conclusions were valid in only one of three cases.

The present data would suggest that infant intentionality is more readily accessed through investigations of rule violations. Investigations of normal interactions provide a far more difficult test of the phenomenon because of their greater variability. However, it may be that infant intentionality is to be found in investigations that distinguish between each class of normal interaction. The Gottman and Ringland (1980) spectral analysis did, in fact, find evidence of mother influencing infant in the least positive of the three interactions studied. Such negative interactions in fact more clearly resemble "stressed" interactions in which the infant has to achieve more actively its own agenda. What may happen in positive interactions is that the mother so smoothly follows the infant that he need not adjust to and follow her.

The present study would suggest several directions for further work. To begin, the sequential analyses employed in the current investigation have implicitly assumed both a first order Markovian process and the homogeneity of experimental and control conditions. While the assumption of a first order process is a reasonable one, significant conditional probabilities at greater lags would be worth pursuing. More important is the need to investigate the assumption of homogeneity of conditions in studies with sufficient numbers of cases (see Castellan, 1979). In particular, sequential analyses intended to separate satisfactory from "stressed" normal interactions would seem especially valuable. Brazelton, Koslowski, and Main (1974), for instance, proposed that mothers must adequately provide for their infants' needs if successful interaction is to be achieved. Sequential analyses could be used both to delineate the meaning of adequate provision of needs and to trace the course of infant behavior over time as a function of maternal behaviors. One would hypothesize that the quality of individual interactions would be related to the phenomena of directionality (whether mother, baby or, alternately, both lead the interaction) and of rule following (what rules are in effect, how consistently are they followed). In addition, one would want to investigate the relation between the sequential structure of interactions and maternal, infant and dyadic variables (past, concurrent and future). For instance, what is the relation between the sequential structure of interactions at 6 months and the quality of later attachment (cf. Ricks, 1980).

Lastly, one would speculate from the present study that infants would dramatically adapt to chronic reductions of maternal affect with a pattern of behavior reflecting both the quality and quantity of that experience. One would speculate further that the resultant adaptation would be maintained for some time. In the present data, a brief 3 minutes of reduced maternal expression produced significant amounts of wariness lasting into the next period of normal interaction. One wonders about the consequences when violations are both more frequent and of greater duration. Not only may the latency of appropriate infant responsiveness to normal maternal interaction increase, but conversely the consequent period of negative feedback a mother must endure before affecting positive change may increase as well.

Summary

Investigations of mother-infant interaction have increasingly indicated that such interactions conform to a hierarchically organized, rule governed model. Such models hypothesize that violations of context (displays whose regulatory function is at variance with the regulatory function of the qualifying contextual markers) produce negative affect and disturbance in the infant. To test this hypothesis, the effect on the infant of simulated maternal depression during face-to-face interaction was investigated.

Subjects were 12 female and 12 male infants and their mothers. Two counterbalanced experimental treatments consisted of 3 minutes of Normal maternal expression and 3 minutes of Simulated Depressed expression. A control treatment consisted of two 3 minute epochs of Normal expression. Interactions were videotaped using split screen techniques and infant behaviors were scored on a 5-second time base that retained the order of occurrence.

Infants in the Simulated Depressed condition structured their behavior differently and were more negative than infants in the Normal condition. Infants in the Simulated Depressed condition produced higher rates of Protest, Wary and Brief Positive. They had higher conditional probabilities for transitions to and from these states and they tended to cycle exclusively among them. In addition, differences in negativity were likely to continue briefly after mothers switched to Normal interaction.

The data indicate that infants have a specific, appropriate and negative reaction to simulated depression in their mothers. These results question discrepancy and stimulus intensity related hypotheses of affect and suggest that the infant has communicative intent in its interactions.

FOOTNOTES

[1]Massie's meaning of attachment is not the same as that of Ainsworth (e.g., Ainsworth, 1969).

[2]See Footnote 3.

[3]Concurrent violations of context entail a lack of parental reciprocity. A counterpart to this phenomenon may be that of extinction trials in instrumental conditioning. Among infants, perceived contingency is related to: onset and increase of instrumental behavior (Watson, 1972; Watson & Ramey, 1972; Rheingold, Gerwitz, & Ross, 1959; Weisberg, 1963; Brackbill, 1958) and the elicitation of vigorous cooing and smiling (Watson, 1972). When contingencies are either suspended or rendered ambiguous, infants respond with initial response bursts and then a decrease in instrumental responding. Exctinction frequently elicits negative emotional responding as well (Watson, 1972; Watson & Ramey, 1972; Etzel & Gerwitz, 1967; Weisberg, 1963; Brackbill, 1958). From a communications perspective, contingency training teaches the infant certain rules that regulate his/her subsequent displays in the presence of a context marker. Violations of context may generalize across a range of social and nonsocial contexts.

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