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ABSTRACT

This study is an attempt tc identify social interactions which fit into a Piagetian mcdel fcr ccgnitive change, and specifically to examine the degree tc which the frequency cf those interactions predicts the rate cf ccgnitive development. The subjects were 74 elementary school children enrclled in 19 K-4 classrooms. These children were in the precperaticnal and transitional stages. In the preoperaticral stage, the child's thinking is centered about himself and his direct experiences and is geared to manipulate the world through acticr. In the transitional stage, the child engages in some problem sclving rather than direct action. The children were administered a number cf tests designed tc examine cognitive and academic abilities. Ccrcurrently, the social interactions of all children were sampled using a classrccm observation instrument. The tests were readministered cne year later. The results suggest that specific ccnflict producing interactions facilitate development from the preoperaticnal and transiticnal levels of thought. Conflict producing interacticns are defined as those in which a conversant infers the gcal guiding the child's behavior and then challenges that gcal by presenting a problem which requires ccncrete operational reasoning. In schccl classrccms, children provide virtually no ccnflict prcducing interacticns fcr other children. This study has two implicatcns: first, extensions of this approach to defining social interactions may allcw fcr definitions of cultural and subcultural envircnments which fit with the Piagetian approach; and second, this approach has hinted as tc what sorts of interactions are missing in classrcoms. Whether these interactions do promote cognitive develcpment needs further examination. (Author/JK)

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The Influence of Social Experience in the Classroom on Cognitive Development

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It would seem to be intuitively obvious that social experience plays an important role in cognitive development. Yet much schooling and cross-cultural research, intended to clarify that role, has failed to define what a social environment and social experience is to the child and by what means it influences him. This oversight is particularly surprising when it occurs in studies done within the Piagetian epistemological framework. Dasen (1972), reviewing previous work on the influence of culture and school, found that conclusions regarding school effects have ranged from no influence, to some influence, to necessary for development. Cultural effects have ranged from none, to causing both permanent and temporary decelerations in development, to regression. His conclusion, like that of deLemos (1966) and Furby (1971) was that the influence of school depends on the cultural context. Exactly how school is an influence or what a "cultural context" is have often been vaguely defined by references to such factors as "under-developed milieus" (Peluffo, 1967; Wei, 1966), exposure to "cluttered" nonfunctional stimuli (Cazden & John, 1971), opportunities to "apply" abstract concepts (Mermelstein & Shulman, 1967), and literacy and opportunities for abstract generalization (Cole, Gay, & Glick, 1971; Cole & Scribner, 1974; Gay & Cole, 1967; Goody & Watt, 1962; Scribner & Cole, 1973).

While such variables as culture or nationality, ethnicity, classroom atmosphere, or specific social interactions certainly have an intuitive appeal as causal influences, few structural analyses have been undertaken in order to theoretically tie environmental social events to cognitive developmental ones. From a Piagetian perspective, a child's environment results from his own active construction of it. The form and products of this construction, in turn, are determined by the cognitive structure the child possesses. By implication, an aspect of "environment" can be defined as having a causal

influence on development from preoperational to concrete operational reasoning only when the environment is defined in terms of preoperational cognitive structures. As independent variables, western vs. non-western cultures, low- vs. non-low-income, school vs. no school, science program A vs. science program B, or various levels of teacher enthusiasm and student freedom can not be used to explain cognitive development until they are translated into variables which correspond to a child's experience, as defined by his cognitive structure.

This study was an attempt, first, to identify social interactions which fit into a Piagetian model for cognitive change, and second, to examine the degree to which the frequency of those interactions actually predicts the rate of cognitive development.

Before proposing how social experience might influence development, we must consider what social experience is to a preoperational child, or indeed whether the preoperational child can have a social experience at all. George Kelly's "commonality corollary" (1963) suggests that definitions of others' cognitive structures are direct derivatives of inferences the observer makes about his own structure. For adults, a social experience involves the attribution of intent to an action other than one's own. This attribution of intent rests on one's ability to infer that the actions of an object are goal-directed and that the particular goal inferred is analogous to a goal one might have himself. From the observer's viewpoint, what is a social interaction among children need not involve social experience on the part of the children. The inference that an invisible mental quality - intent - is a shared invariant connecting one's own behavior with that of another is analogous to the conservation of an invariant physical quality - length, number, weight, etc. A social experience, then, may require the mental operations of

the concrete operational stage of development. While there is some contradictory evidence (Goldstein, 1977), a number of studies of the child's ability to infer the mental states of others suggests that concrete operations are involved (Shantz, 1976). For the preoperational child, social and physical experiences may be only figuratively differentiated.

If the preoperational child is incapable of social experiences which demand inferences of intent, it is no longer intuitively clear that social interactions can directly influence development. In fact social interaction, as a causal influence on development, plays a relatively minor role in Piaget's thinking, at least with respect to development prior to the concrete operational stage. Piaget maintains that disequilibration is the most fundamental of factors which "explain the development from one set of structures to another" (Piaget, 1966, p.10). A classic illustration of this process is his well-known example of a mathematician who as a child recalls the discovery of invariant number as he arranged and re-arranged pebbles by himself (Piaget, 1972). While Piaget has cited social experience as one influence on development (1966, 1970, 1972), he has also stated that equilibration is "...relatively independent of the social environment" (Piaget, 1966, p. 301). Referring to preoperational thought in The Psychology of Intelligence he said "Oscillating between distorting egocentricity and passive acceptance of intellectual suggestion, the child is therefore, not yet subject to a socialization of intelligence which could profoundly modify its mechanism" (1973, p. 162). Consistent with his work on moral judgment, Eleanor Duckworth quotes Piaget as having stated that "cooperation is indeed co-operation" (in Ripple & Rockastle, 1966, p. 4). The use of the term "operation," of course, implies that social co-operation requires concrete operations.

Nevertheless, there is no a priori reason why certain "proto-social" figurative experiences of the preoperational stage should not facilitate dis-

equilibration and thereby contribute to cognitive development. Disequilibration can be thought of as the identification of a mismatch between one's goal (as determined by his cognitive structure) and a belief or experience (also dependent on cognitive structure). It would seem reasonable to assume that the social interactions most likely to produce disequilibration in the preoperational child would be those in which the "conversant" (the other person) first infers the goal guiding the child's behavior and then challenges that goal by presenting a problem which is likely to require concrete operational reasoning. Neither the problem nor the means by which it is presented need require that the child infer the conversant's intent. With respect to verbal interactions, the conversant's inferences of the child's goals could be made prior to a conversation with the child or following a statement which the child has initiated. The presumed goals could then be challenged by an elaborating statement or a question from the conversant. There are at least three aspects of conversation which are potentially disequilibrating but which do not require inferences of another's intent or psychological state on the part of the child:

1. INITIATION of a conversation by the child, permitting the conversant to infer the child's goals.
2. QUESTIONING of the child by the conversant, providing an opportunity for cognitive conflict.
3. ELABORATION of the child's statement, by the conversant, also providing for cognitive conflict.

It is clear that a preoperational child can initiate conversations, but can he understand conversants' questions and elaborations in a way that promotes disequilibration? As used here, an INITIATION is defined as a child making any statement to a conversant without an immediately preceding statement by that conversant. An ELABORATION by the conversant is a statement following an

initial statement by the child and concerning the same topic. A QUESTION is a conversant's statement which includes a rising intonation and which requires a response. While an adult might interpret an "elaboration" as an extension of a topic beyond earlier limits, and a "question" as a request for more information, it is likely that a preoperational child interprets the two in a radically different way. Piaget (1965) has shown that preoperational children learn rules of behavior in interpersonal situations in which adults would infer intents. These rules are not arrived at by agreement (this would involve comparison of one's own goals with another's); they are assimilated by the child because they are instrumental in attaining certain of his own goals and maintaining certain concepts. Rules simply describe strategies for behavior employed by the child in specific situations involving another person. As with all other invariants, the child constructs them in order to reduce a discrepancy between a desired goal condition and an actual condition.

In this framework, a question is answered not because the child knows that the conversant expects an answer. The child simply understands that to control a desired experience (e.g., continuation of the interaction or cessation of it, approval from the conversant, obedience to a rule that questions should be answered) he must behave in a certain way. An elaboration functions in much the same way, providing predictions, judgments, and conclusions which need not be interpreted as mental states of the speaker. Conflicts created by an inability to answer a question, or by inconsistencies among elaborations or between one's own judgment and that expounded in an elaboration may provide for conditions of cognitive growth.

Because Initiation by the child, and Questioning and Elaboration by the conversant may serve as indices of opportunities for disequilibration at the preoperational level, the frequencies with which children participate in these interactions may influence the rate of development from preoperational to

operational thinking. The following experiment was designed to examine this hypothesis.

METHOD

Subjects

Subjects were 74 preoperational and transitional elementary school children enrolled in 19 grade K-4 classrooms (10, 21, 18, 16, and 9 children, respectively) in three southeastern communities. These children were selected from a larger group of 165 randomly sampled children (41 classrooms) by a screening procedure using a group-administered 15-item conservation battery. Only children making incorrect judgments on at least one-third of all items were included. Seventy-three percent of the children identified were enrolled in classrooms implementing the cognitively-oriented curriculum of the Mathemagenic Activities Program-Follow Through, a federally funded educational intervention program. All others were enrolled in traditional classrooms. By grade level, mean ages were 5.87 (grade K), 6.79 (grade 1), 7.81 (grade 2), 8.89 (grade 3), and 9.95 (grade 4). Thirty-eight percent were male, 68% were black, and 74% were from families identified as low-income using HEW-OE 1974 guidelines.

Procedure

In April, 1975, 165 children were administered a conservation task battery, the Purdue Conservation Film (Wheatley, 1972, 1974), as well as a number of other tests designed to examine cognitive, socio-economical, and academic abilities. Only the results of the conservation battery were used in this study. Concurrently, the social interactions of all children were sampled using the Classroom Observation Instrument developed by the Stanford Research Institute (Stallings & Kaskowitz, 1974). One year later, April, 1976, all chil-

dren were readministered the conservation tasks along with other tests of the original battery. The specific instruments, administration, and scoring procedures are described below.

Purdue Conservation Film. This group-administered conservation test is a thirty-minute 16 mm film consisting of two practice discrimination items followed by twenty three conservation items organized as nine subtests assessing conservation of number, length, discontinuous quantity, mass, continuous quantity, area, weight, discontinuous volume, and continuous volume, in that order. Presentation of the items follows the format of Piaget's original transformations. Following each item, children are required to respond to verbal instructions to mark one of the three pictures on an answer sheet, representing "A has more", "B has more", and "A and B have the same amount". Problems requiring conservation of both equality and inequality are included in order to discourage the occurrence of habitual responses. Children's justifications for answers are not sought. The film was administered by pairs of trained examiners to groups of children ranging in number from six (for younger children) to 30. Because of low alpha reliabilities of individual subtests, scores on subtests composed of less than three items were not used. Consequently only five of the nine subtests, each composed of three items, were used to compute a Conservation Total Score (total possible was 15 points): Conservation of number, length, discontinuous and continuous quantity, and area. Using estimates of expected scores obtainable by guessing alone and frequency distribution break-points, children were classified as follows: preoperational (0-5); transitional (6-10); concrete operational (11-15). Alpha reliabilities for this scale were .85 in 1975 and .82 in 1976 (N=165). A Conservation Change Scale used in subsequent analyses was computed by subtracting each S's 1975 score from his 1976 score. The alpha reliability of this scale was .66.

SRI Classroom Observation Instrument. The Stanford Research Institute Classroom Observation Instrument is composed of a variety of classroom checklists, designed to assess classroom atmosphere and physical characteristics, and a five-minute observation (FMO) section, designed to provide a real-time record of the occurrence of specific social interactions among adults and children. Only data from the FMO were used in this study. Administered by a trained observer, the interpersonal interactions and activities of a preselected focus child are recorded for four to five five-minute observation periods (OPs) over the course of one day. FMO interactions are coded in 76 "frames", approximately one frame every four seconds. A frame is a sentence-like arrangement of four categories of prespecified observation codes which permit the description of a single action in the form "WHO does WHAT to WHOM and HOW". For this study, variables were defined as specific combinations of successive frames, allowing for the identification of sequences of both continuous and briefly interrupted interpersonal interactions. An average five-minute frequency for each variable was computed for each child by summing the total number of occurrences of a particular combination of frames, and dividing this sum by the total number of OPs for that child. While acceptable inter-observer reliabilities have been reported (Stallings, 1975), alpha reliabilities (using OP frequencies as items) for individual variables created for this study were relatively low (Tables 1 and 2).

Two sets of variables were defined: 12 Disequilibrating Social Interactions, categorized as INITIATIONS by the child, and QUESTIONING or ELABORATION by the conversant (Table 1). Seven of these variables with average frequencies less than .10 (less than seven occurrences expected in a 6-hour day) or with skewness coefficients above 4.00 were discarded. Five variables in the three "disequilibrating" categories were retained for further use.

A comparison set of 8 General Social Interactions was constructed, identifying only the people interacting (adult, focus child, or different child), the direction of the interaction (e.g., adult to focus child, or vice versa), and whether or not the interaction was verbal (Table 2). All of these variables were designed to exclude occurrences of the five Disequilibrating variables. Three of the General variables were discarded, using the criteria described for the previous set, leaving five variables for subsequent analysis. No variables in either set included interactions associated with misbehavior.

RESULTS

Tables 1 and 2 contain the alpha reliabilities for the variables, mean frequencies and standard deviations, and simple correlation matrices for the Disequilibrating and General Social Interaction sets. Seven of the Disequilibrating variables not included in subsequent analyses due to low frequencies or high skewness coefficients were: "Adult extended questioning of focus child," "Adult responding to focus child's question with a question," "Adult asking open-ended question to focus child," "Focus child verbally responding to question from different child," "Different child elaborating focus child's statement," "Adult questioning group then elaborating focus child's response," and "Adult elaborating focus child's answer" (Table 1). Of those retained, "Focus child initiating interaction with adult" was the most frequent, followed by "Adult questioning focus child" and "Focus child verbally responding to adult question." The "elaboration" variable was least frequent.

In the General set (Table 2), the three variables discarded were all nonverbal interactions: "Adult to focus child," "Focus child to different child," and "Different child to focus child." Consistent with the inclusive nature of the definitions of these variables, the five remaining General variables had frequencies higher than those of the Disequilibrating set,

with "Focus child to adult," verbal and nonverbal, interactions most frequent, and "Focus child to different child, verbal" least frequent. Conservation Total Score means were 6.01 (s.d. 2.62) in 1975, and 10.35 (s.d. 4.30) in 1976, with mean Conservation Change equal to 4.34 (s.d. 4.20).

Two analytic approaches were considered: (1) Stepwise multiple regressions of social interaction frequencies onto conservation change scores; (2) Stepwise multiple regressions of social interaction frequencies onto 1976 conservation total scores with 1975 conservation totals parted-out. The first provides for a direct measure of rate of development, but confounds rate of change with scores at the first time point since the two are negatively correlated (Lord, 1958; Cronbach & Furby, 1970). The second avoids the negative correlation problem, but requires a number of additional statistical and logical assumptions. One such assumption is that the legitimate contribution to the second time point scores, made by social interactions, is independent of time point one scores. This is clearly at odds with a Piagetian structural approach in which initial cognitive levels determine which social interactions are causal influences on subsequent change. To determine whether the "independence" assumption was, in fact, inappropriate, a preliminary comparison of social interaction frequencies was made for six groups of children (Tables 3 and 4): Children who were (1) preoperational in 1975 and remained preoperational in 1976 (PP); (2) preoperational in 1975 and transitional in 1976 (PT); (3) preoperational in 1975 and concrete operational in 1976 (PC); (4) TT; (5) TC; and (6) concrete operational in 1975 and 1976 (CC) (not included in the sample of 74 preoperational and transitional children, but selected from those remaining in the original group of 165 randomly sampled children). Table 3 presents the results of five one-way ANOVAs using Disequilibrating Social Interactions. While the wide variation in sample sizes precludes definitive interpretations, results sug-

gest that for the three Disequilibrating Social Interactions which varied significantly among the groups, the PC group obtained the highest mean frequencies, with lower means for the PP and PT groups. Table 4 shows similar results for the two General Social Interaction variables which distinguished among the groups, with relatively high PT and PC means. Although a negative correlation between Conservation Change and 1975 Conservation Total scores was found (-.41, N=74), the results in Tables 3 and 4 suggest that preoperational children who changed most (PC) were more likely to participate in the relevant social interactions than either low-change preoperational children or transitional and concrete operational children. By implication, this negative correlation can be attributed, in part, to the influence of social interactions. Thus, to adjust 1976 conservation scores for the variance contributed by 1975 conservation scores, would also inappropriately reduce variance contributed by social interaction frequencies.

Two stepwise multiple regression analyses, treating the 10 social interaction frequencies as predictors, were applied to the conservation change scores of the 74 children classified as preoperational or transitional in 1975, the first time point, (minimum acceptable F-ratio to enter was .001; tolerance was .001). The first forced the set of five Disequilibrating Social Interactions to enter before the five General Social Interactions (Table 5). In the second regression, this hierarchical ordering of the two sets of variables was reversed (Table 6).

Table 5 shows that by themselves, the Disequilibrating Social Interactions yielded a multiple correlation (R) of .36, significant for the contribution of four of the five variables. The variable "Focus child verbally responding to adult question" was highly correlated with "Adult questioning focus child" (T[illegible] 1) and thus failed to contribute to R. In the context of the

entire set of variables, those which contributed most to R, as determined by standardized beta weights, were "Focus child initiating interaction with adult", weighted positively, and "Focus child initiating interaction with different child", negatively weighted. With the contributions of all Disequilibrating Social Interactions parted-out, two General Social Interactions contributed to R: "Focus child to adult interactions, nonverbal," positively weighted, and "Adult to focus child interactions, verbal," negatively weighted. On the entry of the latter, a significant R of .43 was obtained. The variable "Focus child to adult interactions, verbal" was not entered since the F-to-enter criterion was not satisfied.

When considered as a set, General Social Interactions produced a significant R of .33 for three of the five variables entered (Table 6). Two variables produced significant Betas: "Focus child to adult interactions, nonverbal" (positively weighted) and "Adult to focus child interactions, verbal" (negatively weighted). Because the variable "Different child to focus child interactions, verbal" was highly correlated to "Focus child to different child interactions, verbal" (Table 2), the contribution of the former was artificially diminished. The two Disequilibrating Social Interaction variables, cited earlier, continued to contribute to R following the entry of all "General" variables.

Comparison of the three significant R's (four Disequilibrating variables [.36] Table 5; three General variables [.33], Table 6; and seven "combined" variables [.43], Table 6), using a distribution of percentage points of the sample multiple correlation coefficient (Lee, 1972) showed no significant differences among them.[1]

DISCUSSION

These results provide tentative evidence that spontaneously occurring disequilibrating social interactions moderately contribute to the development of concrete operational physical concepts. The General Social Interactions also contributed to conservation change with no significant difference between the multiple correlations of the two sets.

Within the set of Disequilibrating Social Interactions (Table 5), while an Initiation to an adult enhanced cognitive development, Initiation to a different child had an opposite effect. Adults' Questioning and Elaborations of the child's statements were ineffectual.

For the set of General Social Interactions (Table 6), adult-to-child verbal interactions, defined so as to exclude Questioning and Elaborations, inhibited cognitive change. Although not strongly weighted, the significant negative first-order correlation produced by the child-to-different child verbal interaction variable suggested that it also inhibited conservation change. Only child-to-adult nonverbal interactions contributed positively to conservation change.

In general, child-different child interactions either inhibited or failed to contribute to conservation change, while child-initiated interactions with adults moderately contributed. The failure of the General variable "Focus child to adult, verbal", to correlate with conservation change also suggests that Initiations, which were excluded from this variable play an important role in child-adult interactions. The positive contribution of nonverbal child-to-adult interactions was unanticipated and deserves further study. Since this variable did not exclude Initiations, it is possible that Initiations played a major role here as well. The positive contribution of one-to-one adult-child interactions, in general, and verbal initiatives by children, in particular,

has also been identified by Stallings (1975), whose study included correlations between the Raven's Coloured Progressive Matrices classroom averages of first and third grade children and a number of classroom characteristics.

Several factors may have operated to reduce the magnitude of correlations generated by Disequilibrating variables, to increase that generated by General variables, and to attenuate the R's in both sets of variables. First, the definitional specificity of the Disequilibrating variables was rather crude, since no variable determined whether in fact the conversant had used the opportunity to infer and challenge the child's preoperational goals. Because the "Disequilibrating" variables were only potentially disequilibrating, the interpretation of these results as support for the role of disequilibrating social interactions rests on a subjective probability value, assigned to "Disequilibrating" variables, which is higher than that assigned to "General" variables. Future definitions of social interactions might incorporate the intentions of the conversant. Second, a number of potentially disequilibrating social interactions which were defined for inclusion in the study simply did not occur in the classrooms observed (Table 1). The failure of several Questioning and Elaboration interactions to occur suggests that those that did occur frequently enough to be analyzed may not have been adequate indices of interactions intended to be disequilibrating. Long-term experimental manipulations of Questioning and Elaboration strategies could resolve this issue. Third, while the alpha reliabilities of both General and Disequilibrating variables were equally low, a definitional analysis of the General Social Interaction variables suggests that inter-judge reliabilities for these variables, had they been assessed, would have been higher than for the more specifically defined Disequilibrating variables. Fourth, the low reliabilities of social interaction variables and marginal reliability of the

conservation change scale had an attenuating effect on all correlations (Lord, 1958). A statistical correction based on alpha reliability coefficients, however, was judged to be inappropriate. Finally, it is possible that 20-25 minutes of observation of each child in the spring of 1975 was not representative of the child's social interactions through the spring of 1976, the following school year. Because all social interaction variables were child-focused, the assumption that frequencies in one school year were similar to those during the following year would seem reasonable. However, repeated observations and assessment of change over a single school year would provide a test of this assumption.

The finding of moderate correlations despite mitigating qualifications suggests that social experiences, particularly those involving interactions Initiated by the child, may influence cognitive developmental rates. While it was hypothesized that Initiations provide opportunities for inferences of the child's goals which can then be challenged via Questions and Elaborations, the lack of effect of the latter two are problematical in light of the positive effect of Initiation alone. It would appear that either Initiation itself functions as an opportunity for conflict resolution (equilibration) or it functions as an opportunity for conflict production (disequilibration). The finding that Initiations to adults facilitate development while Initiations to other children inhibits it suggests, however, that the social role of the conversant may determine the qualities of Initiations made by the child.

An alternative interpretation is that Questioning and Elaboration by the conversant as defined here, do not represent opportunities for disequilibration, but that other statements or actions by the conversant, as yet unspecified, do promote disequilibration. In this framework, the low or negative contributions of child-different child interactions may underscore

the importance of the role that the conversant plays in inferring goals and presenting conflicts. A number of training studies suggest that cognitive development is most likely to be facilitated when the preoperational or transitional child interacts with a person more developed than himself (Kuhn, 1972; Miller & Brownell, 1975; Murray, 1972; Silverman & Geiringer, 1973; Silverman & Stone, 1972; Turiel, 1955). Most relevant to this research, Miller & Brownell (1975) found that when conservers paired with non-conservers were presented with conservation problems, conservers were more likely to "counter the other" and to "move or suggest moving the stimulus"--both potentially disequilibrating for the preoperational child. To the extent that child-different child interactions reflect encounters between preoperational children who can not infer (and thereby challenge) each other's intents, disequilibration is unlikely to occur. In fact, encounters among preoperational children, unable to mutually adjust viewpoints, may even have served to confirm preoperational concepts. Whether this is the case should be determined experimentally.

Conclusion

The results of this study suggest that specific disequilibrating social interactions, when they occur, facilitate development from the preoperational and transitional levels of thought and that in school classrooms (even those in which "Piagetian" teaching methods are encouraged) children provide virtually no disequilibrating interactions for other children.

Preoperational social interactions, particularly involving spontaneous initiations by children to adults in a classroom environment, do contribute to the development of concrete operational physical experience. Whether one accepts that the causal mechanism is "disequilibration" acting on preopera-

tional experience, and that the effect of social interactions is not limited to the school environment is dependent on the validity of the interpretations just made.

This study has two implications: one chiefly theoretical, the other applied. While the study focused only on a handful of American school children in their classrooms, the analysis is limited neither to teachers nor to western culture. Home-environment and cross-cultural extensions of this approach to defining causal social interactions relevant to preoperational children may allow for definitions of cultural and subcultural environments which fit with the Piagetian structuralist approach.

The implications for schooling are twofold. Possibly one of the most startling findings is that so many potentially disequilibrating interactions either rarely occur (elaborations by adults) or fail to promote cognitive growth despite frequent occurrences (questioning by adults). Related to this observation is the contribution which such research can make in formulating the ways classrooms <u>should</u> look. The theory which generated the set of "disequilibrating" social interactions has the value of proposing that social interactions <u>which did not occur</u> may be positive influences as well. That is, in contrast to the ad hoc generating of a "shopping list" of variables, not uncommon in many schooling studies, this theoretical approach has supplied hints as to what sorts of interactions are <u>missing</u> in classrooms. Whether, in fact, these interactions do promote cognitive development needs further systematic examination.

[1]Although the regression of social interaction frequencies onto 1976 conservation, adjusted for variance shared with 1975 conservation, was deemed inappropriate, two analyses similar to those just reported, were done for the sake of comparison. The correlation between 1975 and 1976 conservation totals was .25 ($p < .05$). The final R for the "Disequilibrating" set was .28, $F(5, 68) = 1.12$, $p > .10$; $R = .31$; $F(5,68) = 1.47$, $p > .10$ for the "General" set. The only significant R's generated were for the first variable to enter the "Disequilibrating" regression "Focus child initiating interaction with different child," (negatively weighted), and for both sets combined, $R = .38$, $F(10, 63) = 1.09$, $p < .10$. In each set significant beta weights were generated by the same variables involved in the change score analyses. Except for reductions in the magnitudes of correlation, no substantive differences were found between analyses incorporating change scores and those involving residuals.

TABLE 1

Disequilibrating Social Interactions

Variable	Alpha	$\bar{X}$	S.D.	Correlation: C init. to A	C init. to DC	A qstn. C	C resp. to A qstn.	A elab. C statement
INITIATION								
Focus child initiating interaction with adult	.67	.90	1.01	.31*		.36*	.37*	.27*
Focus child initiating interaction with different child	.51	.35	.55			.03	-.02	.05
QUESTION								
Adult questioning child	.52	.79	.92				.98*	.30*
Focus child verbally responding to adult question (with possible interruption)	.49	.66	.83					.30*
ELABORATION								
Adult elaborating focus child's statement (with possible interruption)	.47	.12	.24					

N=74

*p<.05

TABLE 1 (cont.)

Variable	$\bar{X}$	S. D.
DISCARDED VARIABLES		
Adult extended questioning of focus child (at least 2 questions in 5 frames)†	.53	.96
Adult responding to focus child's question with a question (with possible intterruption)	.06	.11
Adult asking open-ended question to focus child†	.09	.48
Focus child verbally responding to question from different child (with possible interruption)	.07	.14
Different child elaborating focus child's statement (with possible interruption)	.04	.09
Adult questioning group then elaborating focus child's response (with possible interruption)	.02	.06
Adult elaborating focus child's answer (with possible interruption)	.04	.11

†skewness > 4.0

TABLE 2

General Social Interactions

Variable	Alpha	$\bar{X}$	S.D.	Correlation				
				FC to A, verb.	FC to A, nonverb.	FC to DC, verb.	A to FC, verb.	DC to FC, verb.
Focus child to adult, verbal	.48	1.82	1.74		.26*	.02	.47*	.08
Focus child to adult, nonverbal	.40	2.09	2.77			-.11	.46*	-.05
Focus child to different child, verbal	.12	.96	.96				.10	.82*
Adult to focus child, verbal	.40	1.61	1.27					.08
Different child to focus child, verbal	.45	1.06	1.16					
DISCARDED VARIABLES								
Adult to focus child, nonverbal†		.03	.11					
Focus child to different child, nonverbal†		.32	.96					
Different child to focus child, nonverbal†		.03	.13					

N=74

*p <.05

†skewness > 4.0

TABLE 3

Conservation Change Groups Compared on Disequilibrating Social Interactions

Variable	1975 / 1976 P P M	s.d.	P T M	s.d.	P C M	s.d.	T T M	s.d.	T C M	s.d.	C C M	s.d.	F(5,150)
INITIATION													
C initiating to A	.90	(.89)	1.12	(1.17)	1.62	(1.77)	.74	(.73)	.68	(.70)	.48	(.57)	4.61*
C initiating to DC	.30	(.42)	.55	(.58)	.25	(.49)	.50	(.98)	.24	(.33)	.31	(.61)	.68
QUESTIONING													
A questioning C	.67	(.64)	.67	(.66)	1.43	(1.87)	1.03	(.67)	.59	(.61)	.42	(.50)	4.79*
C responding to A question	.51	(.49)	.55	(.49)	1.28	(1.69)	.88	(.68)	.48	(.56)	.35	(.41)	5.19*
ELABORATION													
A elaborating C statement	.03	(.08)	.08	(.14)	.09	(.18)	.07	(.14)	.14	(.28)	.07	(.15)	.86
N	6		10		10		12		32		86		

*$p < .05$

TABLE 4

Conservation Change Groups Compared on General Social Interactions

Variable	1975 / 1976 P P M	s.d.	P T M	s.d.	P C M	s.d.	T T M	s.d.	T C M	s.d.	C C M	s.d.	F(5,150)
C to A, verbal	1.28	(1.71)	3.35	(3.00)	2.27	(1.92)	1.85	(1.40)	1.42	(1.05)	1.20	(1.15)	5.84*
C to A, nonverbal	1.78	(1.42)	1.60	(2.03)	3.67	(4.94)	1.73	(1.94)	2.07	(2.66)	1.78	(1.81)	1.28
C to DC, verbal	.57	(.37)	1.24	(1.17)	.68	(.57)	1.40	(1.40)	.74	(.72)	.87	(1.03)	1.27
A to C, verbal	2.04	(1.52)	1.89	(1.76)	2.30	(1.54)	1.67	(1.19)	1.23	(.93)	1.21	(1.13)	2.53*
DC to C, verbal	.84	(.48)	1.66	(1.86)	.82	(.67)	1.47	(1.40)	.76	(.93)	.92	(1.32)	1.23
N	6		10		10		12		32		86		

*$p < .05$

TABLE 5

Multiple Regression: Prediction of Conservation Change from Disequilibrating Social Interactions

Variable	Simple r	Multiple R	Beta	Beta F-ratio	Multiple R F-ratio
DISEQUILIBRATING					
C initiating to DC	-.23*	.23	-.22	2.28*	3.93*
C initiating to A	.19	.36	.33	5.09*	5.10*
A questioning C	.15	.36	.18	.09	3.47*
A elaborating C statement	.04	.36	-.10	.66	2.59*
C responding to A question	.16	.36	-.08	.02	2.05
GENERAL					
C to A, nonverbal	.24*	.39	.22	2.48*	1.97
A to C, verbal	.04	.43	-.24	2.29*	2.12*
C to DC, verbal	-.24*	.44	-.12	.32	1.94
DC to C, verbal	-.17	.44	.01	.00	1.70
C to A verbal	.09		not entered		
(Y intercept = 4.54)					

N=74

*p <.05

TABLE 6

Multiple Regression: Prediction of Conservation Change from General Social Interactions

Variable	Simple r	Multiple R	Beta	Beta F-ratio	Multiple R F-ratio
GENERAL					
C to A, nonverbal	.24*	.24	.22	2.44*	4.50*
C to DC, verbal	-.24*	.33	-.12	.30	4.18*
A to C, verbal	.04	.33	-.24	2.19*	2.80*
C to A, verbal	.09	.33	.00	.00	2.13
DC to C, verbal	-.17	.33	.01	.00	1.69
DISEQUILIBRATING					
C initiating to A	.19	.39	.33	4.76*	1.99
C initiating to DC	-.23*	.43	-.22	2.24*	2.10*
A elaborating C statement	.04	.43	-.10	.62	1.86
A questioning C	.15	.44	.18	.08	1.69
C responding to A question	.16	.44	-.08	.02	1.50
(Y intercept = 4.53)					

N=74

*p <.05

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