PREDICTIVE AND EXPLANATORY RELATIONSHIPS AMONG PRESCHOOL TEMPERAMENT AND HOME ENVIRONMENT VARIABLES AND SUBSEQUENT READING READINESS AND ACHIEVEMENT

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The purpose of this study was to investigate the relationships among selected behavioral, environmental, and achievement variables for young children. Specifically, preschool measures of socioeconomic status, family intactness, and child temperament characteristics, together with subsequent measures of reading readiness and reading progress were included in a hypothesized causal model. Data from these measures were primarily analyzed according to the principles of path analysis. The hypothesized causal ordering among the variables are graphically portrayed by the path model in Figure 1.

The hypothesized causal orderings were supported both on the basis of temporal sequence and reason. The results of measures which preceded in time must logically represent portions of the cause, rather than the effect, of subsequent variables. The temperament characteristics of a child were more logically viewed as a function of home environment, i.e., socioeconomic status and family intactness, rather than vice versa.

Path analysis permits a determination of the validity of hypothesized causal orderings. In addition, the magnitude of effect that one variable has on another, both directly and indirectly through mediating variables, can be determined. For the model under consideration, it was hypothesized that reading readiness would have the greatest direct contribution to subsequent reading progress due to its temporal proximity and similarity to the criterion variable. Temperament was hypothesized to demonstrate the next largest direct contribution, mediating much of the influence of socioeconomic status and family intactness.

The explanatory value of the temperament measures was of particular interest to the author both for what they might contribute in addition to reading readiness and an alternative, more meaningful predictor of school performance than socioeconomic status and family intactness. The temperament measures were in the form of nine behavior rating scales. The scales purport to measure the *how* of behavior as opposed to *what* the child does, *why* he engages in various behavior or even *how well* he performs. As such, they are concerned with elements of style theoretically rooted in biological factors. Temperament theory is not, however, exclusively constitutional. It is
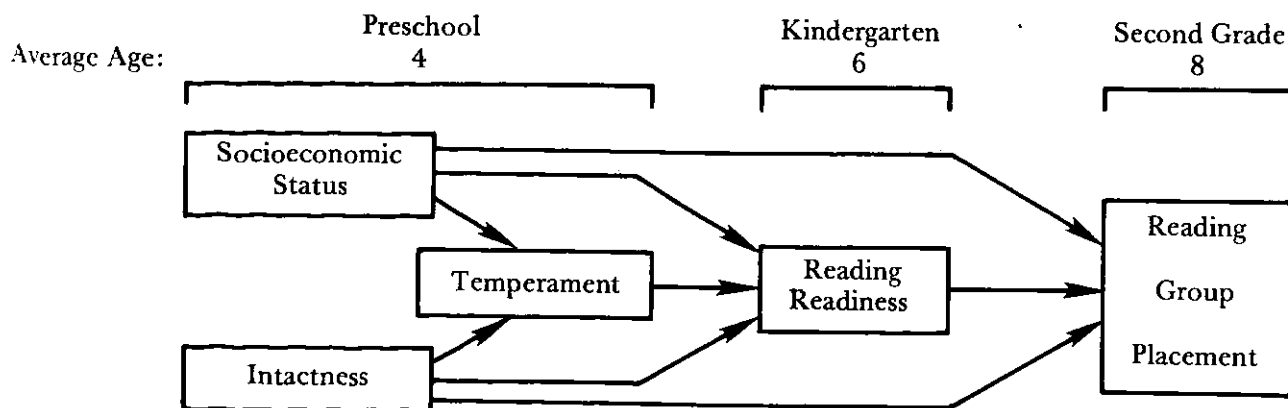

Figure 1. Path Analysis Model Portraying Relationships of Interest and Their Hypothesized Causal Orderings

recognized that behavior is a representation of the dynamic interaction of both biological and environmental influences (Thomas, et al., 1968). Thus, it was reasonable to hypothesize that socioeconomic status, family intactness, and temperament were, to some degree, functionally related as indicated by the model.

In addition to theoretical interests, there appeared to be important practical implications from the determination of the predictive and explanatory value of the temperament scales. As a significant and early predictor of subsequent readiness and reading performance that can be easily administered and that yields a fairly inclusive and fundamental view of a child's functioning, the scales could provide guidance in the generation of curricula and associated professional training designed to support or favorably alter selected behavior characteristics. An alternative contribution would be guidance in the provision of educational program environments that would favorably accommodate characteristics that are practically unalterable. In either case, the resultant educational program could be considerably more individualized than would be possible through the use of gross social indicators.

In similar regard, it was felt that the extent to which temperament was found to mediate home effects would provide an interpretive contribution to the present controversy of home versus school effects on achievement in terms of behavioral characteristics.

Method
Subjects
Ss were 106 second-grade students of the Sioux Falls Public School District who were participants as preschoolers in the Sioux Falls Early Childhood Project. The goals of the project were to provide developmental enrichment as well as identification and remediation of present or potential developmental deficits. All district families having a firstborn child whose birth date was between November 1, 1967 and October 31, 1968 were invited to participate. The project began in the spring of the second school year prior to kindergarten. Initially, group enrichment sessions were conducted by teaching teams composed of a certified teacher, a college student, a high school student, and a parent. The average group had 16 children. As the project continued, it was possible for many teaching teams to have additional professionals in lieu of students.

Data Collection
Temperament ratings (TEMP) were gathered periodically in the course of the project, utilizing the nine dimensions of the Thomas-Chess-Birch Temperament Scales. These dimensions included: (1) activity level, (2) rhythmicity, (3) distractibility, (4) response to new situations, (5) adaptability, (6) attention span and persistence, (7) threshold of responsiveness, (8) intensity of reaction, and (9) quality of mood. The ratings were made by the professional members of the teaching teams and were averaged when a child was rated by more than one person. The set of ratings considered in the model was gathered when the average age of the children was 4 years, 2 months.

Family interviews were conducted immediately prior to the beginning of the project and for new participants thereafter, i.e., when the children were of average age 3 years, 11 months. Data for determining socioeconomic status (SES) and family intactness (INT) were obtained in the course of these interviews. SES consisted of two measures: (1) the number of years of education of the primary breadwinner in family residence; (2) the occupational level of this same parent as measured by the Hollingshead Index of Social Position. Families having two parents in residence at the time of the interviews were considered intact, with all others considered nonintact.

At the end of kindergarten, Metropolitan Reading Readiness Test scores (MET) were gathered. Reading achievement was indicated by reading group placement (READ) in the last grading period of the 1975-76 school year. The school district had established 14 reading levels for the primary grades. As second graders, Ss were expected to be rather normally distributed over approximately six of these levels, which was subsequently found to be the case.

Procedure
Unfortunately, it was necessary to eliminate INT as a variable in the model. The original group of 256 participants in the preschool project included approximately 15 percent from nonintact families. Four years later the remaining 106, for whom data was available on all variables, included only one child from the former nonintact families, providing insufficient variability to meaningfully evaluate the model.

Data for all remaining variables were standardized. In three separate analyses, READ was regressed against the six MET subscores, the nine TEMP dimensions, and the two SES indices, to determine the predictive capacity for each

variable set. In addition, MET total score was regressed against the TEMP dimensions and against the SES indices.

For the path analysis, it was first necessary to combine the variables within each set to form a composite variable for each. READ was regressed against all of the variables of all of the sets. The resultant beta weights were used to combine subscores, yielding a single MET, TEMP, and SES score for each child. Such a procedure for combining a cluster of variables to form a single variable score is recommended by Coleman (1972). Scores for these derived variables were then standardized, and three regression analyses were performed to obtain path coefficients for the model. Nonsignificant paths ($\alpha = .05$) were deleted from the model and further regression analyses were performed to obtain revised coefficients. To evaluate the adequacy of the model, actual correlation coefficients among the variables were compared with those produced by performing appropriate algorithms with the coefficients of the revised model (Spady and Greenwood, 1970). Since the model was not confirmed, analyses were performed to verify the causal orderings that best reflected the data.

Results

The predictive capabilities of MET, TEMP, and SES are indicated by the squared multiple correlations and beta weights in Table 1.

The coefficients for the model after the deletion of non-significant paths are provided in Figure 2.
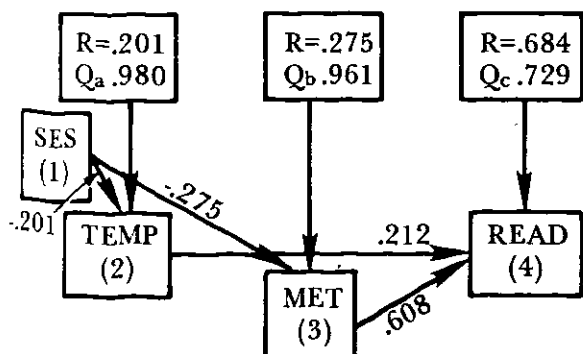

Figure 2. Path Coefficients after Deletion of Nonsignificant Paths

It is evident that MET and TEMP provided direct and significant contributions to READ and that MET did not significantly mediate the contribution of TEMP. The contribution of SES to READ was largely mediated by both MET and TEMP. Three of the six correlations derived from these

TABLE 1
Standardized Beta Weights and Squared Multiple Regression Coefficients for Reading Progress (READ) and Metropolitan Readiness Test Total Score (MET) against the Clustered Variables

Independent Variable	READ Beta	READ R^2	MET[a] Beta	MET[a] R^2
SES		.019		.091*
Education	.143		.278*	
Occupation	.007		-.030	
TEMP		.186*		.324*
Activity Level	-.119		-.154	
Rhythmicity	-.159		-.118	
Distractibility	.221		.315*	
Response to New Situations	-.183		-.072	
Adaptability	.186		-.107	
Attention Span and Persistence	-.229		-.370*	
Intensity of Reaction	-.186		-.300*	
Threshold of Responsiveness	.237		.256	
Quality of Mood	-.160		.134	
MET		.428*		
Word Study	-.018			
Listening	-.009			
Matching	.108			
Alphabet	.289*			
Number	.398*			
Copying	.031			

[a]Total score on Metropolitan Reading Readiness Test

*p < .05

coefficients, however, did not approximate the actual correlations among the variables, as indicated in Table 2. It should be noted that the discrepancy criterion of .05 represents a somewhat subjective judgment of adequate approximation, but has been recommended by Spady and Greenwood (1970).
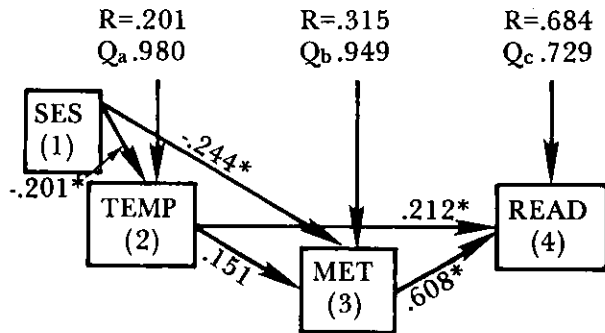
TABLE 2
A Comparison of Actual Correlation Coefficients and Coefficients Derived from the Model with All Nonsignificant Paths Deleted

	SES	TEMP	MET	READ
SES		-.201	-.275	-.138*
TEMP	-.201		.205*	.337*
MET	-.275	.055*		.652
READ	-.210*	.246*	.620	

Note: Actual and derived correlations appear above and below the diagonal respectively.
*Discrepancy > .05

Two of three excessive discrepancies were due to the magnitude of the coefficient for the deleted path from TEMP to MET, which was approaching significance. Had this path been retained, only the correlation between READ and SES would have remained discrepant, and to a slightly lesser extent. The path coefficients for this version of the model are presented in Figure 3 and the comparison of actual and derived correlations appear in Table 3.


*p < .05

Figure 3. Path Coefficients for the Model Retaining One Nonsignificant Path

TABLE 3
A Comparison of Actual and Derived Correlation Coefficients for the Model Retaining One Nonsignificant Path

	SES	TEMP	MET	READ
SES		-.201	-.275	-.138*
TEMP	-.201		.205	.337
MET	-.274	.200		.652
READ	.209*	.334	.652	

To determine if this version of the model represented the orderings that best fit the data, further analyses were required, similar to the approach utilized by Hilgendorf and colleagues (1967). All possible three-variable subsets were examined to determine the most appropriate order for each. The composite variables were reformulated as before for each submodel and the correlations were examined as follows:

$r42 = .431$
$r21 = -.133$
$r41 = -.008$
$(r42)(r21) = -.057$
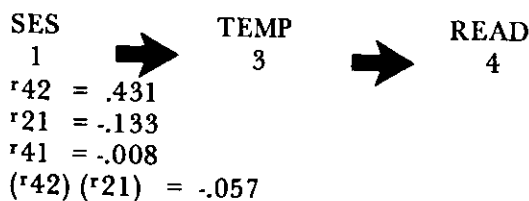
Since -.057 reasonably approximated the actual correlation of -.008 between SES and READ, and since all other orderings provided very poor approximations, the above causal order for these variables was accepted. The following order was also accepted:

None of the possible orderings among SES, TEMP and MET yielded an adequate approximation of the correlation of the first and last variables. The following causal orderings were verified for TEMP, MET and READ:

Since the first two of these were chronologically implausible and inconsistent with the other accepted orderings, the third was accepted. Integration of the accepted submodel orderings yielded the causal structure portrayed in Figure 3. It was therefore concluded that this structure provided the best fit for the data and that the observed distrubances in the model, as indicated by the failure to adequately approximate the correlation between READ and SES, were due to some level of correlation among the residuals of the model. To determine the extent to which this was the case, scores for the residual variables were calculated. The residual of READ, for example, was equal to that portion of READ to which MET and TEMP did not contribute. A residual score for READ was therefore calculated as equal to the READ score minus the sum of the scores for the contributing variables weighted by their respective path coefficients to READ. Correlations among the resultant residual variables were then calculated. The coefficients are provided in Table 4. As shown, the residuals of MET and TEMP were each found to be moderately, but significantly, related to the residual of READ.

TABLE 4
Correlations Among Residuals of the Accepted Model

	MET	READ
TEMP	.130	.268*
MET		.319*

*p < .05

Discussion

The results support the hypotheses that MET and TEMP would each exercise a significant direct effect upon READ, and that these variables would serve to mediate the effect of SES upon READ. These findings serve to substantiate the utility of the temperament scales as a predictor of reading readiness and performance, and as a potential diagnostic tool for prescribing curricula. In terms of prediction, TEMP demonstrated a considerably greater relationship with MET than with READ. With regard to prescribing curricula, confirmation of the submodel that excluded MET provides additional support for use of the scales in this fashion. With regard to implications for temperament theory, the significant relationship between TEMP and SES supports the incorporation of environmental influence.

Generalizability of these findings would be greatly enhanced by similar studies with other groups, due to a number of distinctive characteristics of this sample. First, the relationship of SES with READ was more modest than might be expected with other groups. This was likely due to both restriction of range as a result of attrition of proportionately more low SES children and to the more transient status of parents of firstborn children in terms of attained education and occupational levels. The latter of these influences should probably be considered more important since the resultant SES distribution included sufficient numbers throughout the range, was not highly skewed, and would probably be considered reasonably representative of a general population. However, as younger than average parents, many had not fulfilled their educational aspirations or were at entry-level in their careers. In addition, the community might be viewed as relatively limited in terms of diversity of career opportunity. As a result, underemployment was not uncommon, perhaps accounting in large measure for the substantially greater beta for parent education than for occupation.

Another consideration is the racial and ethnic composition of the sample. The children were primarily of Scandinavian-American descent with less than 2 percent Black or Indian. Perhaps deserving of greatest consideration, however, is that all were firstborn children. Forcer (1976) has provided a summary of the numerous studies identifying correlates of birth order. It has been reasonably well established that firstborn children tend to perform better at all academic levels, and particularly with regard to language skills. With regard to behavior, firstborn children tend to be more conforming than later-borns and less secure in response to anxiety. Unfortunately, the effect of being firstborn on the general pattern of temperament ratings and the resultant path coefficients is, at this time, largely a matter of speculation. However, on the basis of previous research, one could readily hypothesize a group that was representative with respect to birth order to achieve differently and behave differently on such dimensions as adaptability, response to new situations, and quality of mood.

The finding of correlated residuals indicated that the variables involved were in part caused by a common variable or variable set not included in the model. Such a finding does not diminish the value of TEMP and MET for predicting READ, but does serve to qualify the interpretation of the causal relationships among these variables, and suggests the need to expand the model in future research to account for additional relevant variables and further clarify the causal structure.

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