

THE UNIVERSITY OF MANITOBA
MATERNAL RESPONSE AND ARITHMETIC ACHIEVEMENT LEVELS
OF ELEMENTARY SCHOOL BOYS

by

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ABSTRACT

An intervention method was used to study the contribution of parental interest to variability in the level of school performance. The subjects were 40 eight- and nine-year-old boys attending normal Year Three classes in a suburban elementary school. They were randomly assigned to four groups with two age levels and two values of parental interest. The level of performance on arithmetic worksheets completed in school was the dependent variable and the response of the mothers to correct answers on the marked worksheets that had been taken home was the independent variable. Data were represented by a 2 x 2 factorial model and examined with a two-way analysis of variance. The study demonstrated the feasibility of an intervention approach for studying sources of variability and the results indicated with an 0.025 level of significance that a significant part of the difference in level of school achievement can be attributed to parental interest in academic performance.

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INTRODUCTION

Although level of performance in school may vary among students at any one time and within the same student from one time to another, a good deal of research still must be done if there is to be an understanding of school performance that would permit the appropriate arrangement of conditions so that each student could realize his maximum potential. Undoubtedly, there are numerous historical and cultural factors that have contributed to the relatively slow progress made in the acquisition of useful knowledge regarding school behaviour. Among these is the tendency for many psychologists to account for school performance almost entirely on the basis of fixed states, such as ability or intelligence, that are regarded as constant within the individual learner. In addition, progress has been further retarded due to the fact that the research has tended to be of the covariation rather than the intervention type. Correlation coefficients produced by this type of research reveal the extent to which two variables covary but indicate very little about how the values of one variable could be changed by manipulating a second variable. As Bloom (1972) has said in an examination of the present state of knowledge in education:

Our innocence in education may, in part, be attributed to our addiction to correlation and association in our research. In contrast are those research procedures which seek to establish a causal chain, that links one set of events to a relatively remote set of results or consequences. As long as we only know the correlation between two variables, we are not likely to be much affected. Our innocence is threatened when

evidence accumulates under a wide variety of conditions that the relationships have a causal rather than only an associational basis. And our innocence is really challenged when some of the links between the phenomena are established.

One of the striking things about the loss of innocence is that a single clear presentation of a causal chain is sufficient to change almost everyone who understands and accepts the evidence (pp.3-4).

In keeping with Bloom's suggestion, it was felt that a preferred method of research would be directly to change the value of some variable thought to be related to performance in school and to assess the results in terms of the original conjecture. Although it was recognized that such an intervention approach would undoubtedly be fraught with many practical difficulties, a successful demonstration of its feasibility would be a valuable contribution to research methodology.

While some efforts have been made to consider the school learning of bright students who readily cope with the formal school situation, underachievement, because of its cost in terms of wasted human potential and its damaging effect on personality (Bloom, 1972), has been a prime stimulus in generating research into the bases of achievement variability. Numerous facets of the question have been studied, including neurological functioning, psychoanalytic theory, teaching methods and environmental influence, but none have yet yielded completely satisfactory explanations.

Although minimal brain damage is the diagnosis placed on some underachievers, this is an elusive syndrome. Zimet and

Fishman (1970) point out that:

...instead of a diagnosis made on "hard" neurological signs, this syndrome is usually diagnosed on the existence of one or several psychological behavioral factors. These include abnormal activity level of a hypokinetic or hyperkinetic nature, perceptual-motor deficits, specific learning disabilities, short attention span, impulsivity and lability, and a generalized developmental lag. In spite of the term "brain dysfunction", the question of whether or not damage has been sustained at all remains (p.141).

It is also noted that Money (1966), in a study of dyslexia, was unable to find satisfactory evidence of neurological dysfunction in children whose poor achievement had been attributed to perceptual difficulties.

Clear-cut evidence for a psychoanalytic theory of achievement is also difficult to find. However interesting its explanation of the etiology of learning difficulties, there has been no effective use of psychoanalytic theory to account for observable behaviour change in research studies.

Quality of teaching, although an obvious candidate as a culprit in underachievement, has not proved as important as might have been expected. Baker (Gilmore, 1971), after a study of methods for the remediation of learning difficulties, suggested that teachers are an "insignificant factor (p.80)." Arthur Jenson (1968) said that, "the large educational differences between individuals, social classes and racial groups cannot be explained to any appreciable degree in terms of what goes on in the schools (p.31)." In support of his statement, he referred to the Coleman

study on Equality of Educational Opportunity (1966) which concluded that only 10 - 30 percent of the variability in school achievement was attributable to differences in school facilities and other educational variables in the school system and found the largest sources of variability associated with family background, socioeconomic status and race. Nevertheless, there is evidence that achievement can be influenced by what happens in the classroom and a great deal of energy is being devoted to finding ways of improving teaching methods. For example, Bloom (1968) reported success in raising levels of achievement through using a teaching strategy for mastery learning. There is also evidence that behaviour modification techniques have been used with considerable success (Abidin, 1971; Andrews, 1970; Greiger & Mordock, 1970; Hall, Lund and Jackson, 1968; Madson, Becker and Thomas, 1968; Thomas, Becker and Armstrong, 1968). However, a problem exists in training teachers to apply behavioural principles in the classroom. Although the methods may be effective, they often require a number of relatively sophisticated procedures and extra staff. Andrews (1970) said of these procedures that, "Most school-oriented practitioners do not have the time, facilities or personnel to employ them (p.37)." Abidin (1971) estimated that a school psychologist can expect to spend 150 hours of professional time in a school year to assist a teacher in setting up a token economy; there are practical problems in regard to

initiating behaviour modification programs in the schools. In fact, none of the teaching methods have been able to eliminate completely the problem of underachievement. The plethora of methods, in itself, is an attestation to that.

Research into the influence of the child's environment has attracted a great deal of attention, subsuming many variables that might account for some of the variability in achievement. In recognition of the role of the environment, an attempt was made to combat negative influences among the disadvantaged with the Head Start Programs in the United States with a success that was somewhat short of what was hoped for. For example, a Winnipeg study (Bell and Switzer, 1971) looked at a Nursery School Program in a low socioeconomic area and reported:

The results collected over two years in this study, however, fail to substantiate the claim that a Nursery School year should more adequately prepare for academic work, the children who may have suffered environmental deprivation (p.5).

The home is one aspect of the environment that has attracted attention in this search for factors relevant to the differences in achievement that exist among pupils. The Board of Education for the City of Toronto undertook a longitudinal study of achievement in which various measures were correlated with achievement. In the conclusions of the report on the relationship of the home to under- or over-achievement (Schroder, Crawford and Wright, 1971) it was stated that:

Although this study has succeeded in identifying a number

of factors in pupils' home backgrounds that are associated with different levels of school achievement, in many instances the strength of the association has been weak. It appears that this study did not directly tap all the factors in the home that influence pupils' school achievements. At this stage one can only guess at possible factors: such unmeasured home characteristics as the nature of the parent-child interactions might be important (p.57).

Alan S. Gurman (1970) explored these interactions within the family in a group counselling situation with underachieving students and their parents. He said:

While extra-familial forces undoubtedly operate in the life of the underachiever, as in the lives of all adolescents, the family system nevertheless appears to be of crucial significance in attempting to understand the meaning of underachievement beyond actuarial considerations (p.52).

Heilbrun and Waters (1968) in another correlational-type study found that achievement motivation as a personality attribute of the achiever or underachiever was a function of perceived maternal control and nurturance during development. High control - low nurturance subjects were underachievers at college, whereas, high control - high nurturance subjects were higher achievers.

In this ongoing effort to identify those factors in the home that influence school achievement, it is probably safe to say that the covariation type of research has predominated. This has meant that the role of the family in school achievement has been studied by examining the correlations between the level of performance in school and the many correlational type variables that differentiate homes.

There is, however, another type of research that has

approached the question of school performance utilizing an operant paradigm. It has attempted to change the level of school performance by reorganizing facets of the learning situation so that the reinforcement of emitted school behaviours could be readily controlled. For example, insofar as it was thought that aspects of the home situation might be changed to provide a new social interaction situation which might better facilitate school performance, the interaction patterns have been changed. Home-based reinforcement techniques have been used to bring changes in the level of academic behaviour at school (Bailey, Wolf and Phillips, 1970; McKenzie, Clark, Wolf, Kothera and Benson, 1968; Sluyter and Hawkins, 1972).

The results of these operant studies, combined with the correlational findings, suggested that it would be reasonable to assume that at least some of the factors influencing achievement level are, in fact, to be found in the home. This does not, of course, preclude part of the variability being accounted for by such variables as genetic factors, neurological dysfunction, personality differences, teaching methods or other aspects of the child's environment. Although the possible contribution of these other variables is recognized, if some control can be gained over the level of achievement by manipulating a variable that is, or could be, a part of normal family interaction, knowledge regarding the level of school achievement would be expanded and manipulation

of the conditions to improve academic performance would be possible. One such variable is parental attitude to the child's performance in school. Parents approve, ignore or disapprove behaviour and the presence, absence or differential application of these parental responses plays an important role in parent-child interaction.

Positive parental response is one kind of social reinforcer and operant studies have demonstrated that social reinforcement can be effective in changing behaviour. Harris, Wolf and Baer (1964) described five studies where social reinforcement was used. In one instance, a 3.4 year-old girl who had regressed to crawling about 80 per cent of the time while at nursery school was the subject. The teacher stopped attending to her when she was crawling and gave her continuous warm attention as long as she remained upright. Within a week, she had a close-to-normal pattern of on-feet behaviour. Differential attention was also used in another study to decrease crying and whining. Solitary play behaviour was markedly reduced in favour of social play in two instances and active climbing behaviour replaced excessive passivity in the final study cited. Hall and Broden (1967) reported the successful use of systematic social reinforcement in modifying behaviours of children diagnosed as brain-injured. Patterson (1965), who has done work on the natural sources of social reinforcement, demonstrated the effectiveness of rein-

forcement by both the peer and the parent in changing the preferences of children in a marble-dropping experiment. In examining the interactions between children and their parents and peers, he suggested that social reinforcement and responsiveness to it have a role in the development of personality trait behaviours, as well. Chadwick and Day (1971) used both tangible and social reinforcers to improve the academic performance level of underachieving minority children. Of their three indicators of performance (work time, rate of output and accuracy), the last two were maintained at the higher level when the use of the tangible reinforcers was terminated and only social reinforcement was continued. In a discussion of behaviour modification programs in the public school, Greiger, Mordock and Breyer (1970) reported that Hewett suggested token reinforcers for the younger child, but, "For the older child and the child whose educational needs are to learn classroom social and achievement skills, he suggested social approval and task success as reinforcement agents (p.263)." Anderson (1967), in a review of educational psychology, stated that social reinforcement is all that is required by way of reinforcement to teach normal, middle-class children.

Anderson (1967) also pointed out that, "Educators generally have been reluctant to employ tangible reinforcement, preferring instead to use 'intrinsic reinforcement', whatever that may be (p.145)." Nolen, Kunzelmann and Haring (1967) stressed the

importance of using reinforcers that are acceptable in a traditionally organized classroom (see also McKenzie et al, 1968). This would preclude the use of money, candy or trinkets in favour of "natural consequences." Social reinforcement by parents, however, according to these criteria, should be admissible as a natural consequence. Moreover, as Hall, Cristler, Cranston and Tucker (1970) pointed out, procedures that use parents and teachers are more likely to be used than those using outside personnel.

Although the social reinforcers used in the above studies occurred during or immediately following the desired responses, there is evidence that success can be achieved with a delay of reinforcement. Brackbill and Kappy (1962) have suggested that:

In any experimental study of delay of reinforcement, if the Ss under investigation are capable of producing and making use of distinctive response-produced cues and if the experimental task and procedure are such as to allow the Ss to make use of these cues, then (a) the potentially deleterious effects of delay on learning efficiency will be reduced by virtue of a bridging or mediating effect from criterional response to reinforcement, and (b) retention, or resistance to extinction, will be enhanced in proportion to the extent that distinctive response-produced cues have been utilized during acquisition (p.17).

In their experiment, the response-produced cues were verbal. Blackwood (1970) used a verbal mediation training technique in a classroom to improve control over misbehaviour beyond that produced by traditional behaviour modification methods and suggested that, "A child's own verbal description of reinforcing consequences of a behaviour can act as a conditioned reinforcer (p.253)."

Schwarz and Hawkins (1970) used delayed reinforcement procedures to modify some classroom behaviours in a sixth-grade child and suggested that the response-produced cues mediating between response and reinforcement were proprioceptive stimuli produced by covert muscular responses. Academic behaviours were modified in a study that used a pay-for-grades token reinforcement system with parents providing the back-up reinforcers (McKenzie et al, 1968). In addition to teacher attention for appropriate working behaviour, Sluyter and Hawkins (1972) avoided immediate feedback from the teacher and made parental reinforcement contingent on a note from the teacher stating that a criterion level of performance had been reached. Reinforcers were determined with the parents for each of the three pupils in the study so that, in addition to praise, they received various privileges and tangible reinforcers. In a study with predelinquents reported by Bailey, Wolf and Phillips (1970), privileges at home were made contingent on having reached an established criterion level of study behaviour and obedience to class rules. In that case, a report card indicating whether or not the criterion level of performance had been satisfied was given to each boy at the end of the school day.

The success of these reinforcement techniques suggested that parental response could well be one of the variables accounting for some of the variability in school achievement. This was compatible with Gurman's (1970) contention that the family system is

of crucial significance and with the Coleman (1966) study finding that much of the difference in performance cannot be attributed to the school. Thus, both operant and covariation approaches suggest that parental response could have a role to play. Unfortunately, neither method of research addresses itself directly to the challenge presented by Bloom (1972). The results of correlational-type studies can in no way imply, even in the probabilistic sense, that systematic changes made in the value of one variable will result in systematic changes in the value of the other variable. Operant studies, on the other hand, do link variables in a more causal manner when they demonstrate changes in behaviour by manipulating reinforcement variables. However, the operant studies are not designed to identify the many kinds of variables which, in fact, influence the child's school performance. With these concerns in mind, a third type of research, one that involved an intervention technique, was proposed for this study.

If the purpose of the study is to be appreciated, it is important that the differences among these three approaches be clearly understood. One way to make these distinctions would be to differentiate between them on the basis of the kind of questions that each can legitimately answer. Correlational studies, for example, allow the researcher to ask whether the variability of one variable can account for the variability of another variable

but not whether a particular value of one variable is the cause (in Bloom's sense) of the value of the other variable.

The operant type of study, on the other hand, attempts to indicate whether the behaviour can be influenced by reinforcement and how the reinforcement contingencies should be arranged. In this kind of study, discriminative stimuli and reinforcers can be identified and behaviours maintained or changed, but this does not necessarily mean that these reinforcing stimuli are those that normally reinforce or maintain the behaviour. In a sense, with the operant approach, an artificial situation is contrived. Furthermore, the facts may even be obscured because of the danger of making unwarranted conclusions when the reinforcer used in the study happens to be a stimulus that is normally found in the subject's environment. It is too easy to conclude, for example, that because the frequency of a behaviour was increased by following it with social reinforcement that therefore social reinforcement was the variable that was usually involved in developing and maintaining that particular behaviour. This may not be the case. An entirely different variable, not yet identified, may actually have been the reinforcer in the real life situation. Even further, there may be nothing in the specific situation to warrant saying that reinforcement was involved at all. Or, again, it may be that reinforcement has to share responsibility with other factors.

The intervention approach is designed to inquire as to

which sources of variability differences in the criterion variable can be attributed. With this method, a variable is manipulated (changed in value) and the concomitant changes in the criterion variable noted. There is no intrusion into the established regimen, nor is there a reorganization of the environment to achieve control. In fact, the environment is changed as little as possible, in the rearrangement sense, so that statements can be made about variables relevant to the empirical situation being studied. With the intervention approach an attempt is made to vary systematically the value of a variable which already characterizes that situation rather than to intrude and thus create a new and different regimen. Indicative of the realization of this intention to intervene rather than to intrude was the remark made by several of the mothers involved in the study that, "It won't be any problem making those comments because I already do that."

From some of the research, it appeared that an interesting and challenging variable to attempt to manipulate using an intervention method was the interest of the parents in the student's work. The object of the study was not to examine social reinforcement, the effectiveness of reinforcement methods, or techniques for bridging the gap between performance and reinforcer, but simply to examine whether a manifestation of parental interest in academic performance could be a variable that would account for

some of the variability in the level of achievement. Although this variable might be variously described as interest, concern, or positive attention on the part of the parent, it was defined in this study as a positive verbal response to items that had been marked as correct, commenting on the quality of the academic response rather than on the goodness of the child.

The study, rather than just randomizing all variables other than the experimental one, was designed to control for two variables reported as relevant by Patterson (1965). In a study of responsiveness to social stimuli in elementary school children, he reported that older children are more responsive than younger children. His data supported his hypothesis that, "in part, responsiveness would be a function of the sheer number of contacts the child has had with people (p.168)." He also said:

There was ... a highly significant interaction between sex of the child and sex of the parent. The child was most responsive to the opposite-sexed parent. Part of this interaction effect was also obtained in an earlier pilot study by Patterson and Ludwig (1961). These findings would suggest that the opposite-sexed parent might be of particular importance in shaping appropriate behaviours in the child (p.168).

It was hoped that while controlling for this interaction between the sex of the parent and the sex of the child, and also for the age of the child would limit the generality of the conclusions, it would increase the chance of detecting any difference in the achievement level that might result from the intervention.

METHOD

The empirical research data were represented by the random 2 x 2 factorial model with two values of parental interest and two age levels. The five percent level of significance was chosen as the value for rejecting the random model.

Subjects

The subjects were 40 eight- and nine-year-old boys who were living at home and attending an elementary school in a middle income, suburban community. They were students in three, normal Year Three classes selected for the study by the school principal. The only criterion used in the selection was that they were in classes that used arithmetic worksheets that could be corrected and then taken home at the end of the school day for examination by their mothers. All of the teachers were female, fully qualified, and each one had several years of teaching experience. Each of them agreed to participate in the study.

Materials

Several days before the study began, the school principal mailed a letter to the mother of each boy that had been selected for the experimental group. This letter introduced the experimenter and requested the participation and cooperation of the parents (see Appendix A).

All classes participating in the study were using the same mathematics textbook (Eicholz & O'Daffer, 1969). The study utilized the arithmetic worksheets that were already being regularly used. Each worksheet was composed of lists of questions based on the work covered in the text. During the period covered by the study, addition with regrouping and subtraction with regrouping were the operations being taught. As well as simple addition and subtraction, the students were asked to solve verbally expressed problems that utilized these operations. The questions were devised by the class teacher and space was left for the students to write in the answers. Each teacher prepared the worksheet that was distributed to the students in her own class and all members of the class received copies of the same worksheet. Time was given in class for the students to answer the questions and then the teacher marked the worksheet indicating which answers were correct and which were incorrect. The teacher returned the worksheets, without comment, to all students to take home at the end of the school day.

Procedure

Experimental and control groups were formed at the eight- and nine-year-old levels by randomly assigning 10 boys from the three classes to each of the four groups. The teachers were not told which of their students had been selected as subjects. They

participated in the study in no way other than to tell all their pupils to take home their marked mathematics worksheet assignments at the end of the school day and to record the number of items answered correctly on each worksheet for five consecutive weeks. The teachers gave these data to the experimenter at weekly intervals.

The experimenter phoned for an appointment and visited the home of each boy in the experimental group during the first two days of the second week in which data were recorded. The letter of introduction had been received by the parents prior to the phone call. Each mother was instructed to go over the marked worksheet with her son whenever he brought one home from school and to make a positive verbal comment about each correctly answered item but to ignore the incorrect items. She was told to make this a comment on the correctness of the academic response and not a comment on the goodness or worth of the child. It was suggested that she use expressions like "good", "well done" and "right", and also that she try to show a genuine interest by her manner and tone of voice. She was asked to change her treatment of the child in relation to his school work in no other way and not to tell him that he was participating as a subject in the study. The parents were not informed about the expected results and the theory involved was not discussed, but they were promised an explanation when the study was finished. All of the mothers expressed a willingness to partic-

ipate and said that they understood the instructions and would follow them. They were asked to begin immediately.

The mothers were phoned about two weeks later and asked if they were following the procedure. Their report as to when they actually began was recorded. The instructions were repeated and clarified if there was any confusion. In each case where difficulties seemed to exist, there was a further phone call about one week later. The phone conversations revealed that intervention actually began at different points in the study. Six of the 8-year-old group began in the second week, three began in the third week, and one began in the fourth week. In the nine-year-old group, seven began in the second week, and one began in each of the third, fourth and fifth weeks. In each case where the experimental procedure was introduced later in the program, the mothers reported that the boys had not been bringing their worksheets home to them as requested by their teachers.

RESULTS

The number of worksheets which the students were required to complete varied from week to week; the largest number in one week was 6 and the smallest 3, with a mean of 3.93 assignments a week.

The maximum score which a student might obtain was not the same for all worksheets. It ranged from 5 to 84 with a mean of

30.2. The dependent variable, change in level of performance on arithmetic problems, was expressed as a difference between two percentage scores in order to take into account these differences. This conversion made the measure of change in level of performance comparable from test to test and from class to class.

The difference between the mean of the percentage scores for the three assignments immediately prior to intervention and the mean of the percentage scores for the three assignments immediately following intervention was computed for each individual in the experimental group. The difference scores for the subjects in the control group were determined by calculating the difference between the mean of the percentage scores for the week prior to that in which intervention began with members of the experimental group and the mean of the percentage scores for the week following the one in which intervention was introduced (see Appendix B). The mean change in percentage scores from preintervention to postintervention was an increase of 10.95 for the experimental group and 0.22 for the control group. These difference scores for the subjects in each treatment combination were then examined with a two-way analysis of variance (see Table 1). There was no interaction between age and intervention in accounting for variability in change in school performance ($F = 0.19, p > 0.05$), nor did age difference account for a significant amount of the variability ($F = 1.08, p > 0.05$). Parental interest, however, was related to change in school performance when

TABLE 1

ANALYSIS OF THE DIFFERENCES IN PERCENTAGE SCORES
FOR TWO AGES AND TWO VALUES OF PARENTAL INTEREST

Source	SS	df	MS	F
Age	192.28	1	192.28	1.08
Intervention	1,152.40	1	1,152.40	6.45*
Age X Intervention	33.79	1	33.79	.19
Error (within groups)	6,428.65	36	178.57	
Total	7,807.12	39		

* $p < .025$

measured in terms of percentage score change ($F = 6.45, p \leq 0.025$).

In that the difficulty of the assignments was not controlled in the study, the same raw scores that had been converted to percentage scores were also converted to z-scores to take into account the differences in difficulty among the assignments. These derived scores showed the relative position of each subject in his class and provided a basis for indicating any change in position by means of differences in z-scores (see Appendix C). In fact, these difference scores revealed a mean increase from preintervention to postintervention of 0.61 for the experimental group and 0.06 for the control group.

Following the same procedure that was used with the percentage scores, an analysis of variance was done with the z-scores (see Table 2). Again, no interaction could be demonstrated between age and intervention ($F = 1.93, p > 0.05$), nor did the difference in age have an effect ($F = 1.00, p > 0.05$). The use of z-scores allowed the conclusion to be made that parental interest was related to change in school performance when the measure used was the changed relative position in class ($F = 7.14, p \leq 0.025$).

Although the variable used in the study is only one of many variables that might pertain to school performance, the proportion (ω^2) of the total variability accounted for by the intervention variable was 12 percent for percentage scores and 13 percent for the standard scores.

TABLE 2
 ANALYSIS OF THE DIFFERENCES IN Z-SCORES
 FOR TWO AGES AND TWO VALUES OF PARENTAL INTEREST

Source	SS	df	MS	F
Age	.42	1	.42	1.00
Intervention	3.00	1	3.00	7.14*
Age X Intervention	.83	1	.83	1.93
Error (within groups)	15.16	36	.42	
Total	19.41	39		

* $p < .025$

DISCUSSION

On the basis of this study, it would appear that intervention could provide a feasible methodology for the study of variables contributing to the variability in achievement level.

By manipulating parental interest, it was possible to alter school performance to a certain degree. This is in keeping with Gurman's (1970) conclusion that factors within the family system have an important effect on school achievement, and is consistent with similar suggestions in the Coleman (1966) report that a large amount of the difference in performance in school can be attributed to sources outside the school.

It is encouraging to note that, in spite of the multiplicity of sources of variability, the relatively crude control that the investigator had of both the school and the home conditions, and the small proportion of the total variability accounted for by the intervention variable, it was still possible to detect the effects of the intervention with relatively small groups.

The fact that the results did not support age as a relevant variable may be due to the fact that the children in Patterson's (1965) study ranged in age from seven through ten years and came from the second, third, and fourth grades, while the children in this study were eight and nine years old and were all in the third grade.

Although the relevance of the intervention variable has been demonstrated, the details of the basic mediating mechanisms have

not been made explicit. There are several possibilities, including the fact that some boys who were reluctant to take their worksheets home may have felt that their mothers didn't care, or they may have been accustomed to receiving criticism for mistakes and wanted to avoid that unpleasant experience. The positive attention given to the schoolwork when they did take it home may have been seen as an expression of acceptance, interest, or even affection on the part of their mothers. This could have put an increased value on accurate academic work so that it warranted more effort on their part. One mother reported incredulity on the part of her son when she praised the correct items, but failed to criticize him for his mistakes. This very difference in parental response in the experimental condition may have increased motivation. Clearly, questions remain to be answered about the details of parent-student interactions in relation to the expression of parental interest.

Another question not considered by the study was whether the changed level of performance was a stable state. Unfortunately, the experiment did not extend over a long enough period to investigate this question.

In addition to the need for a more extended study, there are other suggestions that might be considered for future investigations. For example, controlling the number and the difficulty of the items on the arithmetic worksheets should give a measure that would be more sensitive to differences in performance level.

Devising a better method of assuring the compliance of parents in the application of the independent variable should also strengthen the study. In regard to this latter suggestion, it might be feasible to record the verbal responses of the parents on a portable tape recorder. Another possibility would be to have the parents return signed worksheets to the experimenter with the items upon which comments have been made check-marked. In addition to improving the method of measuring the dependent variable and having greater assurance that the independent variable is, in fact, manipulated, information could be sought on other variables that may be contributing to the large within-group variability.

Further studies based on the relatively simple design of this one could appreciably contribute to knowledge in this area. Jencks (1972), who saw the family as having an important effect on cognitive performance, pointed out that "we have rather fuzzy ideas about what aspects of family background influence test scores (p.77)." Clarification as to the variables involved and the possible interactions could well result from controlling such things as parental educational level, socioeconomic status, and cultural background. The age levels and tested levels of intelligence of the students and the parent-child interaction histories could also be taken into account. In fact, within the design used for this study, many different studies should be possible.

Conclusion

Most of the information that is currently available on school achievement is from correlational type studies based on survey data. This study demonstrated that an intervention approach, even when using variables related to the home, could make an important contribution to understanding sources of variability in school performance. An additional advantage was that the research was conducted without an intrusion into the subjects' natural environment. Also, it did not require expensive equipment and did not make large demands on the parents or the teachers. These things made it more acceptable to busy teachers and to concerned school administrators.

In summary, the feasibility of an intervention approach was demonstrated, and the results of this study indicated that a significant part of the difference in level of school achievement can be attributed to parental interest in academic performance. The fact that the family does play a role in school achievement was confirmed.

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APPENDIX A

LETTER TO PARENTS

Dear _____

We at Margaret Underhill School are always trying to add to our knowledge so that we can do an ever better job of teaching. To assist us, you are being asked to participate over the next few weeks in a project designed to help us do just that.

Your part in this project won't be complicated or time-consuming, but it is very important that you, as the parents of one of the children selected to take part, (a number of Year 3 boys have been randomly chosen without any regard to their past performance or abilities) follow the simple instructions that will be given to you. Within the next few days, you will be contacted by Mr. David Heslip who is conducting the program. He will explain what is involved. In the meantime, do not discuss this with your son because that might tend to affect the results of the study.

Although your participation will be entirely voluntary, it is hoped that you will agree to take part. Your cooperation will be sincerely appreciated.

Yours truly,

Principal

APPENDIX B

PERCENTAGE SCORES FOR GROUPS

DIFFERING IN INTERVENTION AND AGE VARIABLES

	Intervention			Nonintervention		
	Before	After	Difference	Before	After	Difference
Age 8	65.03	98.67	+33.64	72.69	83.00	+10.31
	55.81	91.66	+35.85	95.66	96.48	+ 0.82
	57.11	75.49	+18.38	89.03	84.15	- 4.88
	73.43	88.33	+14.90	87.96	97.33	+ 9.37
	95.42	99.26	+ 3.84	91.03	98.00	+ 6.97
	80.91	86.66	+ 5.75	67.33	70.63	+ 3.30
	93.02	98.52	+ 5.50	86.60	87.42	+ 0.82
	80.54	68.62	-11.92	89.25	90.55	+ 1.30
	77.84	63.80	-11.04	73.21	65.91	- 7.30
	43.55	89.29	+45.73	98.91	93.10	- 5.81
	Group mean +14.06			Group mean +1.49		
Age 9	66.16	99.55	+24.39	77.68	75.78	- 1.90
	84.66	86.47	+ 1.81	90.80	97.33	+ 6.53
	72.76	92.07	+19.31	74.14	95.05	+20.91
	79.24	91.23	+11.99	84.88	82.25	- 2.63
	82.86	85.33	+ 2.47	76.40	89.18	+12.78
	76.73	88.08	+11.35	83.92	87.73	+ 3.81
	88.91	78.69	-10.22	81.03	88.48	+ 7.45
	85.91	97.28	+11.37	80.40	66.23	-14.17
	80.27	92.59	+12.32	92.11	67.53	-24.58
	94.47	88.08	- 6.39	81.88	71.27	-10.61
	Group mean + 7.84			Group mean -1.05		
	Intervention mean +10.95			Nonintervention mean +0.22		

APPENDIX C

Z-SCORES FOR GROUPS

DIFFERING IN INTERVENTION AND AGE VARIABLES

		Intervention			Nonintervention		
		Before	After	Difference	Before	After	Difference
Age 8		-1.31	+0.77	+2.08	-0.89	-0.38	+0.51
		-1.55	-0.59	+0.96	+0.86	+0.59	-0.27
		-1.25	-0.25	+1.00	+0.48	-0.30	-0.78
		-0.02	+0.72	+0.74	+0.26	+0.65	+0.39
		+0.63	+1.47	+0.84	+0.82	+0.92	+0.10
		-0.40	+0.63	+1.03	-1.12	-0.78	+0.34
		+0.09	+1.12	+1.03	+0.55	+0.12	-0.43
		-0.17	-0.68	-0.51	+0.68	+0.25	-0.43
		-0.84	-0.79	-0.05	-0.80	-0.47	+0.33
		-1.35	+0.07	+1.42	+0.93	+1.06	+0.13
			Group mean +0.85			Group mean +0.02	
Age 9		-0.63	-0.14	+0.49	-0.40	-1.13	-0.73
		+0.48	+0.64	+0.16	+0.55	+0.65	+0.10
		+0.21	+1.22	+1.01	-1.42	+0.68	+2.10
		+0.07	+0.98	+0.91	+0.35	-0.26	-0.61
		+0.45	+0.49	+0.04	-0.81	-0.40	+0.41
		-0.36	-0.10	+0.26	+0.05	+0.33	+0.28
		+0.51	+0.17	-0.34	+0.07	+0.12	+0.05
		+0.56	+0.36	-0.20	-0.69	-0.78	-0.09
		-0.24	+1.21	+1.45	+0.36	-0.03	-0.39
		+0.77	+0.58	-0.19	-0.07	-0.17	-0.10
			Group mean +0.36			Group mean +0.10	
		Intervention mean +0.61			Nonintervention mean +0.06		