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ABSTRACT

The ability of social, economic, and educational variables to predict screening outcomes among 398 school districts in a statewide preschool screening program was examined. First, salient demographic and educational variables were identified and reduced to five global factors using principal components factor analysis. Then, five factor scores and one additional variable (percentage of handicapped students) for each school district were evaluated as predictors of screening outcomes. In Study 1 the screening outcome was membership in groups of screening programs with the lowest versus highest referral rates. In Study 2 the screening outcome was referral rates among the screening programs. Results from both studies indicated that screening outcomes were not related to broad social, economic, and educational factors in any simple way. Alternative explanations are discussed, as well as implications for research on both intra- and inter-program factors that may influence the screening of preschoolers. (Author)

University of Minnesota

RESEARCH REPORT #5

PREDICTING OUTCOMES IN A STATEWIDE PRESCHOOL SCREENING PROGRAM USING DEMOGRAPHIC DATA

James E. Ysseldyke and Patrick J. O'Sullivan

EARLY CHILDHOOD ASSESSMENT PROJECT

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Abstract

The ability of social, economic, and educational variables to predict screening outcomes among 398 school districts in a statewide preschool screening program was examined. First, salient demographic and educational variables were identified and reduced to five global factors using principal components factor analysis. Then, five factor scores and one additional variable (percentage of handicapped students) for each school district were evaluated as predictors of screening outcomes. In Study 1 the screening outcome was membership in groups of screening programs with the lowest versus highest referral rates. In Study 2 the screening outcome was referral rates among the screening programs. Results from both studies indicated that screening outcomes were not related to broad social, economic, and educational factors in any simple way. Alternative explanations are discussed, as well as implications for research on factors that may influence the screening of preschoolers.

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Predicting Outcomes in a Statewide Preschool Screening Program Using Demographic Factors

James E. Ysseldyke and Patrick J. O'Sullivan

Many local and state education agencies have implemented preschool screening programs to expedite the early identification of handicapped children, and satisfy the child find mandate of P.L. 94-142. Preschool screening has been defined as a brief, relatively inexpensive assessment procedure that can be conducted by nonprofessionals and that aims, "to identify those children in the general population who may be at-risk for a specific disability, or who may otherwise need special services or programs in order to develop to their maximum potential" (Barnes, 1982, p. 11). Children found to be at-risk during screening are referred for more extensive diagnostic assessment by a professional, which often leads to assignment of a diagnostic label and placement in special education programs. Since preschool screening is often the family's first contact with the school system and the first opportunity for children to enter special education programs, its impact can lead to enduring, far-reaching changes in the lives of children and their families.

Consider Minnesota's statewide health and developmental preschool screening program, where tremendous variability in referral rates exists. Among the state's more than 400 school districts in 1980-81, screening referral rates ranged from .56% to 71.4% of the children screened, and the percentage of referred children who received preschool services ranged from 0% to about 30% (Lombard, 1983). The striking variability in referral rates occurred even though districts

referring the lowest and highest percentages of children screened similar proportions of the preschool population, and used similar screening instruments and personnel (Lombard, 1983). We suspect the picture is similar in other states. Thus, whether a child is referred for further evaluation during preschool screening may have little to do with who conducts the screening or what instrument was used. The key question is: What factors determine the extent to which children screened by a school district are referred?

Much of the research on preschool screening has focused on the predictive accuracy of specific screening instruments and programs (e.g., de Hirsch, Jansky, & Langford, 1966; Gallerani, O'Regan, & Reinherz, 1982; Lichtenstein, 1981). Virtually no research has investigated the myriad of more global social, economic, and educational variables that may influence preschool screening referrals from one school district to the next. Such factors could play an important role in screening outcomes. For example, it has been observed that children from low socioeconomic status (SES) families tend to be referred more often than high-SES children (Lichtenstein & Ireton, 1984). Also, in several studies broad demographic and early environmental factors, such as SES, race, prenatal care, maternal education level, and educational stimulation, correlated significantly with later school performance (Ramey, Stedman, Borders-Patterson, & Mengel, 1978; Werner, Bierman, & French, 1971). Perhaps general social, educational, and economic factors also contribute to variability in screening referral rates among different communities.

Certainly. before we can claim to understand what specific factors affect screening outcomes, such as the instrument used or the people who do the screening, the contribution of more global contextual factors must be delineated.

The two studies described here are part of a research program investigating factors that influence early identification and the social, economic and political implications of alternative screening practices. Both studies examined the contribution of global demographic and educational factors in predicting the range of outcomes among preschool screening programs in Minnesota. In Study 1, salient demographic and educational constructs first were identified, along with school districts referring extremely high and low percentages of children screened. Then, the global demographic and educational variables were used to predict whether school districts belonged to high or low-referral rate groups. In Study 2, we assessed quantitatively the relation between the broad demographic and educational constructs, and the statewide distribution of screening program referral rates. Together, these studies addressed three research questions: (a) Can membership in groups of screening programs with high versus low referral rates be predicted accurately using demographic and educational characteristics of the school districts? (b) How strong is the relationship between preschool screening referral rates and the demographic/educational characteristics of the districts? (c) Are some predictor variables better than others in their ability to predict preschool screening

outcomes? Answers to these questions should help place the results of previous and future research on preschool screening in a broader social, economic, and educational context.

Study 1

Method

Subjects. In 1982-83 the Minnesota Preschool Screening Program screened 46,986 (81%) of the estimated 58,202 children eligible for screening. Our sample included 45,457 children, 96.9% of the children screened from 398 of Minnesota's 432 school districts. The average age of these children was 51.5 months (SD = 6.7 mos), and included 49.0% females and 51.0% males. For the 398 school districts, an average of 113.9 children (SD = 195.0) per district was screened.

From the pool of 398 school districts, the 50 districts with the lowest referral rates, and 50 districts with the highest referral rates were selected. During selection, some small-sized districts were not considered in order to avoid including screening programs with spuriously high or low referral rates. Districts screening less than 25 children were excluded, as well as those that screened less than 100 children and referred none.

Procedure. On forms submitted to the state education department, each screening program provided information on each child's sex, birthdate, and results of screening in nine areas: height, weight, vision, hearing, fine motor development, gross motor development, speech/language development, social-emotional development, and cognitive development. The referral rate for each school district was

calculated by dividing the number of children referred in one or more of the nine areas by the total number of children screened.

Social, economic, and educational variables used to predict high versus low-referral rate school districts were selected from three data sources describing Minnesota's 432 school districts: 1980 U.S. Census tract data (Bureau of the Census, 1982) School District Profiles (Minnesota Department of Education, 1984a), and the 1983 Child Count of handicapped children in Minnesota (Minnesota Department of Education, 1984b). A total of 24 Child Count variables, 38 School District Profile variables, and 134 Census variables and tables were available for consideration.

The large number of predictor variables was reduced in two stages. First, the theoretical relevance of variables for identification and treatment of handicapped children was considered. Selection criteria were purposely lenient, to encourage consideration of a broad spectrum of potentially meaningful predictors. Sixty-two predictor variables were selected because of their potential theoretical relevance.

Next, factor analysis was used to reduce the 62 variables to a few factors reflecting the broad underlying constructs that accounted for a relatively large proportion of predictor variance. Exploratory factor analyses were conducted several times, after which variables contributing little information to the solution were eliminated based on examination of intercorrelations among variables, communalities (sums of squared factor loadings), and patterns of factor loadings.

Variables with intercorrelations exceeding .9 or communalities less than .1 were excluded from further analyses. Judgment was used in eliminating several variables which approached, but did not meet these stringent criteria.

Principal components analysis with iteration (Nie, Hull, Jenkins, Steinbrenner, & Bent, 1975) was conducted to determine the number of factors to rotate using the eigenvalue greater than one criterion. Then, variables were entered into principal components factor analysis (using multiple correlations as communality estimates) with varimax rotation. Varimax rotation aims to enhance the distinctness of factors by finding a solution maximizing the variance accounted for by each factor, a strategy often preferred in applied or clinical use of factor analysis (Reynolds & Paget, 1981).

When the final factor analysis solution was obtained, factor scores for each school district were computed and entered as predictors in a discriminant function analysis. Factor scores were obtained for each district on each of the n-factors of the final n-factor solution. Thus, the products of factor loadings and z-transformed raw scores of predictor variables were summed for each factor in the final solution to obtain a factor score. In addition to n factor scores, for each district, one additional variable (percentage of handicapped students) was entered as a predictor variable in the discriminant function analysis.

About half of the 100 low-referral and high-referral rate districts were randomly selected for inclusion in discriminant

function analysis. To obtain an unbiased assessment of the discriminant function results, the remainder of the sample was used to determine how accurately high-referral and low-referral districts could be classified using the obtained discriminant function.

Results and Discussion

Factor analysis. Of the 62 predictor variables selected for theoretical reasons, 38 were eliminated during exploratory factor analyses. With principal components analysis of the remaining 24 variables, five factors had eigenvalues exceeding one. When these five factors were rotated to a varimax solution, they accounted for 63.9% of the total variance shared by the 24 variables. Factor loadings for the 24 variables in the final rotated solution are presented in Table 1, along with eigenvalues and the proportion of variance accounted for by each factor.

Labeling the factors helps to clarify the theoretical dimensions that might be related to high and low-referral districts. The first factor had high loadings on median family income, median rent, percent of families above the poverty level, and median education level, all of which are clearly related to socioeconomic status (SES). The second factor was labeled school district size, with highest loadings on elementary enrollment, pre-kindergarten handicapped, and percentage of black students. The third factor was the most theoretically ambiguous, with highest loadings on percent minority students, percent federal revenue, and percent attendance (weighted negatively). The factor was named minority/federal revenue for the two highest loading

Table 1

Five-Factor Rotated Solution Showing Factor Loadings on 24 Variables Describing Minnesota School Districts (N = 432)

Variable	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Median Family Income	.95659	.07832	-.11201	.00084	.01624
Median Rent	.83108	.15469	-.12720	-.00923	-.01400
Percent Above Poverty Level	.79478	.08467	-.17000	-.11352	.10050
Median Education Level	.75136	.15848	-.05195	-.01053	.20612
Percent Emotional Disturbed	.47270	.25777	.13231	-.02652	.12512
Median Age	-.42885	-.08848	-.05256	.00020	.38006
Percent Asian	.42222	.37028	.02742	-.06300	.14928
Pupil Support Services	.41806	.16553	.39775	-.06958	.01995
Percent Speech Handicapped	-.29615	-.08831	-.00083	.21118	.08285
Percent Spanish	.26610	.25164	.16605	-.05109	.00079
Elementary Enrollment	.35564	.83481	.13943	-.08139	.00100
Pre-Kindergarten Handicapped	.12424	.81045	.16095	-.03627	.00745
Percent Black	.14993	.76779	.19684	.01815	.09753
Percent Minority	.02607	.17140	.78534	.14500	-.04015
Percent Federal Revenue	-.44088	-.10062	.73683	.09443	-.07954
Percent Attendance	-.09207	-.16745	-.60693	-.08072	.09009
Exceptional Instructional Expenses	-.13120	.22994	.45073	.10583	-.06167
Total Operating Expenses	-.09006	.06977	.36641	.87446	.18650
Regular Instruction Expenses	-.01064	-.08096	.12493	.78732	.21021
Pupil-Staff Ratio	.55241	.11786	-.01631	-.56670	-.20571
1982 EARC Value	-.06993	.03508	-.19624	.41107	.84132
Percent Local/ Other Revenue	.22976	.09249	-.18267	.23619	.81810
EARC Mill Rate	.38883	.14821	.10168	-.13341	-.33947
Community Service Expenses	.15991	.16450	.08591	.01995	.29918
Eigenvalue	5.645	3.226	2.826	1.281	.568
% Variance	41.7	23.8	20.9	9.5	4.2

variables. The fourth factor was labeled school expenses because of high loadings on total operating expenses, regular instruction expenses, and pupil-staff ratio (weighted negatively). The final factor was related to local revenue, having highest loadings on 1982 EARC value (local tax rates) and percent local/other revenue.

The five-factor solution encompassed a variety of broad social, economic, and educational constructs, but included just a few variables with relatively low factor loadings related to special education funding (e.g., exceptional instruction expenses) and handicapped students. Consequently, the percentage of handicapped students in each school district was added as a sixth predictor variable (in addition to factor scores), as a prototypic descriptor of the emphasis on special education services in each district.

Referral rates for the 50 low-referral districts ranged from 0% to 12.1% with an average of 5.3% (SD = 4.3) of children screened. For the 50 high-referral districts, referral rates ranged from 39.0% to 62.5% with the average being 46.5% (SD = 12.8). Low-referral districts tended to screen more children ($\bar{X}$ = 141.0) than high-referral districts ($\bar{X}$ = 109.7), although considerable variability in the number of children screened existed for both low-referral districts (SD = 137.0) and high-referral districts (SD = 95.0).

Table 2 is a summary of results of the stepwise discriminant function analysis using randomly selected districts (25 low-referral, 21 high-referral). Since none of the predictor variables contributed significantly ($p < .05$) to prediction of high versus low referral

Table 2

Stepwise Discriminant Analysis of Low and High-Referral School Districts (N = 46)

Step	Variable Entered	Standardized Discriminant Coefficient	df	Approximate F	Significance
1	Minority-Federal Revenue	.68	1,44	2.35	.132
2	Percent Handicapped	.55	2,43	1.75	.185
3	School District Size	-.13	3,42	1.16	.335
4	School Expenses	.09	4,41	.86	.497
5	SES	-.04	5,40	.67	.648
6	Local Revenue	.02	6,39	.55	.770

group membership, step entry/exit parameters were set so all predictors entered the discriminant function analysis. Together, the six predictor variables did not predict group membership at better than a chance level (F [6,39] = .55, p = .77). Although no variables made significant predictive contributions, the minority/federal revenue variable (F [1,44] = 2.35, p = .13) and percent handicapped variable (F [1,44] = 2.03, p = .16) were the two best single predictors of membership in high and low-referral groups.

The accuracy of the obtained discriminant function in predicting group membership was evaluated using classification analysis of the remaining 54 districts in the sample. Again, all predictor variables were entered in the discriminant function used to classify districts as belonging to high or low-referral groups. Overall, only 54% of the districts were classified correctly (χ^2 [1, N = 54] = .113, p = .74), with 15/25 low-referral and 14/29 high-referral districts being identified correctly.

Results of discriminant function analysis indicate that membership in high and low-referral rate groups was not accurately predicted by broad constructs reflecting general social, economic, and educational characteristics of the school districts. In fact, the independent variables were no better than a toss of a coin in predicting whether districts had extremely high or low screening referral rates.

Before drawing conclusions about the relation between these predictor variables and preschool screening referral rates, a more

direct quantitative analysis is necessary. Perhaps the poor predictive accuracy observed in the present study was related to the selection of a limited number of school districts having extremely high and low referral rates. Or maybe the use of a dichotomous dependent variable in discriminant function analysis significantly restricted the range of screening outcomes so that the predictive power of the independent variables was weakened substantially. In any event, the validity of conclusions and our understanding of factors related to screening outcomes would be enhanced by considering the entire distribution of school district referral rates.

In Study 2 the same six independent variables describing social, economic, and educational characteristics of school districts were entered into a stepwise multiple regression analysis to assess their ability to predict screening referral rates across the entire distribution of referral rates.

Study 2

Method

Subjects. Of the 398 school districts (described in Study 1) that sent screening forms to the state education department, 50 districts had referral rates of 0%, which violates the statistical assumption of a normally distributed dependent variable. These districts were excluded from multiple regression analysis to allow use of statistical tests. The remaining 348 school districts screened 41,403 children ($\bar{X}$ = 119.0, SD = 204.7). Referral rates ranged from .4% to 85.7% of the children screened. The average referral rate was 27.9% (SD = 14.1)

Procedure. Data-gathering and referral rate calculation methods were the same as those used in Study 1. Factor scores obtained in Study 1 were entered into stepwise multiple regresson (Nie et al., 1975) as predictors of referral rates.

Results and Discussion

Results of the stepwise multiple regression analysis are presented in Table 3. Overall, the six predictor variables accounted for only 3.3% of referral rate variance ($F = 1.96$, $p = .07$). The minority/federal revenue variable accounted for the most variance, still a meagre 2.0%, and had the highest simple correlation ($r = .14$, $p = .008$) with preschool screening referral rates. None of the other variables correlated significantly with referral rates, although the percentage of handicapped variable approached significance ($r = .10$, $p = .056$).

Conclusion

Results of Study 1 indicated that membership in a group of screening programs with extremely high or low referral rates was not predicted accurately by global social, economic, and educational characteristics of the school districts. In fact, a coin toss could have predicted group membership with comparable accuracy. In Study 2 the same combination of global demographic/educational variables did not make a significant contribution to prediction of screening referral rates in a statewide program including 348 school districts. Although one (minority/federal revenue) of six predictor variables

Table 3

Stepwise Multiple Regression Results Predicting Screening Referral Rates From Demographic/Educational Variables (N = 348)

Step	Variable Entered	Multiple R	R Squared	F	Significance	Beta
1	Minority-Federal Revenue	.141	.0199	7.02	.008	.141
2	Percent Handicapped	.170	.0288	5.12	.006	.082
3	SES	.177	.0315	3.73	.012	-.053
4	School District Size	.181	.0326	2.89	.022	-.034
5	School Expenses	.182	.0331	2.34	.042	.023
6	Local Revenue	.083	.0333	1.96	.071	-.017

correlated significantly with referral rates, it accounted for only 2.35% of referral rate variance. Overall, only about 3% of the variance in screening referral rates was accounted for by the predictor variables, and even that estimate was inflated by the contribution of variance specific to the present sample. An unbiased estimate of the proportion of population variance accounted for is only .98% (Hays, 1981, p. 480). Both studies clearly indicated that preschool screening outcomes -- referral rates and membership in groups of high versus low referral groups -- were not related to broad social, economic, and educational factors in any simple way.

Frankly, these results surprised us, and run counter to logical extensions of previous research (Lichtenstein & Ireton, 1984; Ramey et al., 1978; Werner et al., 1971), our own beliefs, and the educational lore positing relationships between demographic factors and educational outcomes. But before discussing the implications of the results, alternative explanations need to be addressed.

One explanation is that although linear prediction models were unsuccessful, perhaps a curvilinear relationship existed between screening referral rates and one or more of the educational/demographic predictors. However, inspection of scatterplots depicting relations between referral rates and predictors did not support that hypothesis. Only linear relationships, albeit quite weak ones, existed in the data.

Another explanation for results involves procedures for selecting predictor variables. It could be argued that variables entered into

analyses were the "wrong" ones, and that more powerful predictors exist. Certainly, better predictors may exist, but the chances of other global demographic/educational variables substantially improving predictive accuracy appears unlikely. First, the 196 predictor variables and tables available for consideration covered a wide range of community and school descriptors representing factors of recurrent interest to state and national demographers. The 62 variables selected for factor analysis exhausted the possible variable choices derived from a range of conceivable theoretical rationales. The lack of predictive power also was reflected by only 2 out of 62 significant Pearson correlations between potential predictor variables and referral rates, when three significant correlations can be expected by chance alone. Also, the highest correlation coefficient was only $r = .13$.

One could argue that the present results might be due to variability in the proportion of children in the district populations that were screened, leading to random error in referral rates caused by different types of children attending screening programs. In some districts virtually all eligible children may be screened, while in others only underprivileged children or those already identified as handicapped may attend screening programs. Consistently high participation rates among districts offering preschool screening do not support this notion, however. For the year the present data were gathered, the average participation rate was 81%, and most of the school districts screened more than 90% of the eligible children (Minnesota Department of Education, 1984c).

A fourth explanation for our results relates to possible errors in the recording of information on the screening forms. These were suggested by coordinators of high-referral screening programs (Ysseldyke, Thurlow, Weiss, Lehr, & Bursaw, 1985). Specific examples of errors that could have inflated referral rates included: (a) submitting multiple screening forms for a single child referred for multiple problems, (b) referring children twice because of re-screening, and (c) referring a high percentage of children because of their uncooperative or shy behavior. Coordinators of low-referral clinics did not provide specific examples of clerical errors, although failure to mark when a referral was made could have occurred for a variety of reasons. The frequency of such errors and their impact on our results is difficult to assess. It might be hypothesized that the frequency of clerical errors would be higher among clinics with extremely high or low referral rates. This situation, however, would not account for the failure to accurately predict membership in groups of high and low-referral programs, as we found. On the other hand, clerical errors (along with other sources of error variance) undoubtedly weakened somewhat the quantitative relationship between referral rates and predictor variables. Obviously, continued efforts to identify, assess, and minimize potential sources of errors in documenting screening outcomes are needed.

Several incorrect interpretations of results need to be pointed out so that the limits of our knowledge and implications for further research can be understood. Present results do not mean that all

social, economic, and educational factors are unrelated to outcomes of preschool screening. We studied only global demographic constructs derived from data typically gathered for actuarial purposes by government agencies. Careful selection of more specific social, economic, and educational variables could improve predictive accuracy, as others have suggested (e.g., Bradley, Caldwell, & Elardo, 1977). On the other hand, it appears doubtful that variables related to child characteristics and educational outcomes (e.g., educational stimulation, emotional support) can account for the tremendous variability in the outcomes of preschool screening programs. Likewise, the importance researchers and practitioners have placed upon screening instruments, training of screeners, types of information gathered, and so on, needs to be considered in a broader social and political context. For example, we suspect that screening programs differ markedly in their purposes, relations with other service providers, and attitudes about handicapped children, special education, and the responsibilities of public agencies, among other things. One screening program may aim to provide special education services as soon as possible to all potentially handicapped children, another may emphasize health promotion and education, and still another may operate with the belief that screening cannot identify most handicapped children. Screening program administrators also hold differing attitudes about the proportion of children who need further assessment, leading some administrators to adopt lenient referral criteria and others to adopt strict referral criteria. Obviously, the

implications of varied goals, practices, and attitudes surrounding preschool screening carry very different expectations for screening outcomes. This inherent complexity typifying social and educational systems requires a broad, comprehensive focus to untangle interactions between so many potentially relevant factors. The present investigation represents a first step in that direction.

Finally, the present results do not mean that social, economic, and educational characteristics of individual children and families are unimportant in the screening process. Our analyses examined differences among screening programs, and did not address variation in social/educational factors within school districts. In fact, such variation is one factor that has been shown to influence decisions about individual children during screening (Lichtenstein & Ireton, 1984). However, our data do suggest that other factors need to be examined if we are to understand the wide differences in outcomes among screening programs. Both intra- and inter-program characteristics must be studied to clarify the impact of preschool screening on children, and ultimately the implications for policy makers in special education.

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