DOCUMENT RESUME

ED 052 047 SE 012 007

AUTHOR	Butzow, John W.; Sewell, Leyton E.
TITLE	The Process Learning Components of Introductory Physical Science: A Pilot Study.
INSTITUTION	Maine Univ., Orono.
PUB DATE	Mar 71
NOTE	20p.; Paper presented at the 44th Annual Meeting of the National Association for Research in Science Teaching, Silver Spring, Maryland, March 1971
EDRS PRICE	EDRS Price MF-$0.65 HC-$3.29
DESCRIPTORS	*Classroom Research, *Evaluation, Observation, Research, *Scientific Methodology, *Secondary School Science
IDENTIFIERS	Inference Skills, Introductory Physical Science, Test of Science Processes

ABSTRACT

The Test of Science Processes was administered as a pre- and post-test to 92 eighth grade students studying the first five chapters of the Introductory Physical Science materials to determine if process learning was significantly changed. The students were in four homogeneously grouped classes all taught by the same teacher. There were significant improvements in students' ability to observe, compare, classify, quantify, measure, experiment and infer during the period of the course, but not in the ability predict. It appeared that there was a relationship between intelligence and process skills such that more intelligent groups at the eighth grade level are further down a continuum of difficulty from observing to experimenting at the onset of instruction. Consequently, classes with students having lower ability levels showed the most change in process learning during IPS instruction. (Author/AL)

ED052047

John W. Butzow
Assistant Professor of Education
University of Maine
College of Education
Orono, Maine 04473

The Process Learning Components of Introductory Physical Science: A Pilot Study

Authors:

John W. Butzow — University of Maine
Leyton E. Sewell — Bangor State Hospital

Category:

Junior High School Science: Process Learning

SE 012 007

The Process Learning Components of Introductory Physical Science: Pilot Study

John W. Butzow
Assistant Professor of Education
University of Maine
College of Education
Orono, Maine 04473

Leyton E. Sewell
Inservice Training Director
Bangor State Hospital
Box 926
Bangor, Maine 04401

ABSTRACT

Many science educators have commented about the possible processes learning components of the recently developed project courses. It would appear that junior high school students participating in the type of direct learning activities described by the *IPS* program should increase their abilities to observe, to measure, to infer, to use and collect numerical data, to communicate with graphs, and to design parts of laboratory investigations. The first five chapters of *IPS* seemed especially geared to the development of such process skills, or at least to their being adequately practiced.

This project was conducted in order to determine if process learning was significantly changed during the period of time that eighth grade students were using the first 5 chapters of *IPS*. The sample consisted of the eighth grade classes that used *IPS* during the fall of 1969 at Union Street Junior High School located in Bangor, Maine. Classes were organized on a homogenious basis. Divisions were labled 81 through 84 from high to low. Ninety-two students participated in this study. Criteria for placement included IQ, teacher recommendations, interviews conducted by guidance personnel, and student records of achievement in English and mathematics. These classes were taught by one of the authors who served as an interclass control. At the time he had taught IPS for two years and had completed training at an *IPS* sponsored workshop.

The experimental data gathering procedures consisted in administration of *The Test of Science Processes* which was developed and field tested for the junior high school by Tannenbaum. This test was administered prior to any *IPS* instruction and also after all classes had completed chapter 5 of *IPS*. In addition, three process practical examinations developed by the authors were administered following chapter 2, 3, and 5. Additional achievement and intelligent data were collected.

The basic statical hypothesis was that there would be no statistically significant changes in process learning skills during the time period selected. Scores on the process test were analyzed by comparing pre with post test scores. Students t was employed at the 0.05 level of confidence. The null hypothesis was rejected.

The classes were compared on their scores on the author developed practical process measures to determine if certain *IPS* chpaters facilitated the development of specific skills. In general, the scores indicated a positive correlation between placement into homogenious groups and process scores. One notable exception was skill in using the balance beam in which all groups produced like scores.

The data trends available from this study were interesting particularly because significant positive changes in measured process skills were observed. Classes showed different changes in process development. Intelligence level seemed to be a factor in determining which processes would be learned. Classes with lower intelligence levels showed the most change in process learning. The authors recommend that programs such as *IPS* may be better utilized in lower ability groups.

The Process Learning Components of Introductory Physical Science: A Pilot Study

Introduction

Many science educators have commented about the possible process learning components of the recently developed project courses. The bulk of the opinion suggests that from the content of courses such as *IPS*, *BSCS*, and *Science A Process Approach* the major expected learning outcomes will be the development of specific mental skills rather than the learning of concepts as such. Direct observation of student behavior in the *IPS* program has shown that major learnings might be associated with students' abilities to observe, to measure, to infer, to use and collect numerical data, to communicate data trends graphically, and to design laboratory investigations. Inspection of the first five chapters of *Introductory Physical Science* (*IPS*) pointed out that those chapters might be especially geared to development and use of process skills.

This investigation was conducted to determine if process learning was significantly changed during the period of time that eighth grade students were using the first five chapters of *IPS*. The study focused on changes in process learning abilities, descriptions of student's measured mental abilities, and their performance on author constructed process practical examinations.

Problem and Hypotheses

This study used a treatment group only design. Comparisons of process learning were made on a pretest and posttest basis. Students were all enrolled in the *IPS* course under the same teacher during the same school term. Students were placed into each of the four sections which were reported to feature homogeniety of ability. The following null hypotheses were tested:

1. There are no differences within each *IPS* class on test measured process learning components and on a composite process learning total score when process

scores are compared on a pre-post test arrangement.

2. Process learning will not differ between homogeneous divisions of the course.

3. Significant correlations will not be observed when measures of academic achievement, reading level, and intelligence are compared with process measures.

In addition, a series of process practical examinations were administered to determine if the same kinds of results would be observed with object based tests as with a pencil and paper test of science processes.

Population and Sample

The sample in the study was the eighth grade science students at Union Street Junior High School, one of three junior high schools in Bangor, Maine. The school has approximately 330 students enrolled in grades seven, eight, and nine. The curriculum of the school was fairly typical of modern junior high schools with the possible exceptions of modern math for all divisions in grades seven and eight, and oral French for ninth grade French classes.

The seventh and eighth grade are both divided into five groups ranging in size from 18 to 35 students. The groups were composed of students of similar ability with 81 having highest general ability to 85 with lowest general ability. Many criteria were used in determining placement in the various groups while in the seventh grade. The criteria were I.Q. level, teacher recommendations in English and mathematics, general performance in seventh grade classes, and interview with students new to the area who brought with them either incomplete records or no records at all.

The classroom was a standard sized classroom. Flat-topped tables were arranged in island fashion with one team of students per table and two tables facing each other. The teams were chosen by the instructor and for the most part were comprised of two students, but in larger classes a few teams were three in size. All of the *IPS* equipment and supplies were available for student and instructor use

There was only one sink. There were 35 texts available and, hence, were not asigned to any particular class, but were retained in the room at the various tables.

In early November the instructor stopped utilizing the *IPS* course with the 85 division. Reading was a problem and an extreme amount of time was taken in pre and post lab activities. This, plus student desire to study material more relevant to their interests, prompted the instructor to drop *IPS* in favor of a series of individualized science projects.

The sample included in this study consisted of those students in classes 81 through 84 who had taken *The Test of Science Processes* both as a pretest and posttest. The total sample size was 92 students. Approximately 40 students were lost because of absences during either of the two test administrations, or withdrawal from the school system.

Mr. Sewell, the instructor, holds a Baccalaureate Degree in Botany and a Masters Degree in Education from the University of Maine, Orono. He had four years previous science teaching prior to the research project year. Three years had been in eighth grade general science programs and the year previous had taught general science and *IPS*. This project took place during first half of fifth year teaching. Mr. Sewell had participated in an *IPS* sponsored workshop taught in Pittsfield, Maine by a qualified *IPS* workshop Instructor. The Instructor had been a participant in a six-week summer program conducted by Uri Haber-Schaim. Mr. Sewell had also met and discussed the *IPS* program with one of the authors, Judson B. Cross, prior to implementing it in the Old Town School System.

Instruments Used

The primary instrument employed in this study was *The Test of Science Processes* developed by Tannenbaum.[1] This test was developed for, and trial tested on students in grades seven, eight, and nine. The science processes considered in the test are observing, comparing, classifying, quantifying, measuring, experimenting, inferring, and predicting. In addition, the test yields a total score on all processes considered. The test is multiple choice formatted, and requires seventy-three minutes of actual testing time. It features item stems which are largely pictoral. The illustrations for the first twelve items are 35mm color slides. The remainder of the 96 items are based on printed black and white illustrations. Tannenbaum reports a Kuder-Richardson formula 20 reliability of 0.91 for total score and reliabilities for the subscores ranging from 0.30 to 0.80. This test was the only one described in the literature at the time the investigation was planned which had available norm data and was developed expressly for junior high school use in the measurement of process learning.

In the interpretation of the process measures of the classes studied it was anticipated that measures of achievement and intelligence would be helpful. For this purpose the *Metropolitan Achievement Tests (form G, Advanced)* were used.[2] The following subtest scores were analyzed: Word Knowledge, Reading, Language, Spelling, Mathematics Computation, Mathematics Concepts, Mathematics Problem Solving, Science, and Social Studies. Intelligence scores were abtained from the *Otis-Lennon Mental Ability Test Intermediate Level Form J.*[3]

Three process practical examinations were developed by the authors. Each was keyed to relevant chapters of the *IPS* program. Students were allowed to use their texts and laboratory notes while taking the quizzes. Following chapter 2 of the *IPS* work the following quiz was administered:

Process Practical Examination I

1. A drop of material will be placed in your hand. Write down all you can observe about the material. Do not taste it. You will be given 5 minutes to complete the work. Place your observations on the lines below. *(Expected responses were one observation with the senses of touch, hearing, smelling, and seeing as well as one described change.)*

2. You will be given two objects. List all the properties that both have in common on the lines below. *(The objects were lead balls and glass marbles of unequal diameters.)*

3. Observe the objects again. List all the differences you can between those objects on the lines below.

4. You will be given an object to work with. Measure the mass of the object in beads. (*The object was a sugar cube.*)

5. You will recall that the volume is obtained by multiplying the lengths of the sides of an object. V = l x w x h. Determine the volume of the object in question number 4 in cubic inches.

Following chapter three of the *IPS* work the following quiz was given:

Process Practical Examination II

1. You will be given a block of wood, determine:

   a) the volume of the wood in $cm.^3$

   b) the mass of the wood in beads.

   C) the density of the wood.

   c) change the density for answer c into $g/cm.^3$

2. You will be given four small bottles containing various substances. You are asked to classify them in four different ways. Your answer should include that property which you are using to group them.

3. The density of some solids, liquids, and gases (*in grams per cubic centimeter*) were presented in a table (*similar to Table 3.1 in the IPS text*).[4]

   a) List any 4 substances that will float in mercury.

   b) List any 4 substances that will sink in water at room temperature.

   C) You would like to fill a baloon with a gas so that it will rise into the air. Put the gases in order from the one that will give the least lift to the one that will give the most lift.

After chapter 5 the following quiz was administered:

Process Practical Examination III

You will be given two chemical substances to examine thoroughly in this class hour. I suggest that you attempt to identify these substances by answering the following questions. Avoid jumping to a guess, but rather develop a series of experiments and then conduct your experiments to determine the characteristic properties of the substances.

a) What properties do you desire to determine?

b) What procedure is used to determine each property?

c) What specific observations did you make?

c) What do you conclude the substances are?

(Note: a table of the physical properties of a number of compounds and elements was included. The unknowns were naphthalene and paradichlorobenzene)

The process practical examination items were developed both with reference to the content of the *IPS* text and Tannenbaum's operational definitions of specific science processes. In Table I the process identification of each practical examination score is listed.

TABLE I

Process Identification of Process Practical Examination Items with Tannenbaum's Operational Definitions

Science Process (Tannenbaum's)	Practical Exam. Items
Observing	I-1
Comparing	I-2, I-3
Classifying	II-2
Quantifying	II-3
Measuring	I-4, I-5, II-1
Experimenting	III
Inferring	III
Predicting	III

Method

The Test of Science Processes was administrated to each class just prior to the start of regular class activities in September 1969 and again following completion of chapter 5 of *IPS* in January 1970. The differences between the means for each class were compared for each process and for total score. The same comparisons were made for all eighth graders enrolled in *IPS* using student t.[5] The *Metropolitan Achievement Test* and the *Otis-Lennon Mental Ability Test* were administered as part of a school wide testing program during early October 1969. Comparisons between process scores (*for post-test*) and achievement and intelligence scores were made using Pearson product moment correlations.[6] Differences in process practical examination scores were done qualitatively because of the descriptive nature of the test responses.

Results

Differences in process abilities were found for each class using t's significant at or beyond the 0.05 level of confidence (*see Table III*). In order of the ability of the classes, starting with 84, the observed differences are given in Table II.

TABLE II

Process Learning Differences Determined From Pre-Post Administrations of *The Test of Science Processes*

Class Number	Ability Level	Science Processes
84	Lowest	Observing Classifying Total
83	Second Lowest	Classifying Experimenting Total
82	Second Highest	Measuring Inferring Total
81	Highest	No Significant Differences

TABLE III

Comparisons Within Homogeneous Classes of Process Components from *The Test of Science Processes* using Student's t Between Pre-post Administrations

	Class Number	N	Pretest Mean	Post test Mean	t
Observing	81	22	6.00	6.22	0.479
	82	22	5.31	5.77	0.990
	83	25	4.83	5.28	1.027
	84	23	4.17	5.17	2.185 *
	Total	92	5.06	5.59	2.364 *
Comparing	81	22	4.13	3.90	0.774
	82	22	3.40	3.86	1.267
	83	25	3.00	3.63	2.063
	84	23	2.95	3.47	1.664
	Total	92	3.35	3.71	2.227 *
Classifying	81	22	9.81	10.22	0.626
	82	22	8.09	9.27	1.818
	83	25	7.28	8.75	2.181 *
	84	23	6.65	8.00	2.533 *
	Total	92	7.92	9.04	3.561 *
Quantifying	81	22	10.22	10.77	1.867
	82	22	8.40	9.22	1.430
	83	25	8.44	8.48	0.077
	84	23	7.69	8.52	1.563
	Total	92	8.67	9.21	2.213 *
Measuring	81	22	18.09	18.04	0.067
	82	22	13.50	16.13	4.805 *
	83	25	11.96	12.48	0.721
	84	23	10.52	11.34	1.078
	Total	92	13.43	14.40	2.730 *
Experimenting	81	22	5.45	5.72	0.826
	82	22	5.18	5.45	0.709
	83	25	3.36	4.71	3.123 *
	84	23	3.47	3.52	0.094
	Total	92	4.32	4.83	2.440 *
Interferring	81	22	8.13	8.86	1.560
	82	22	5.90	7.09	2.252 *
	83	25	5.32	6.40	1.610
	84	23	4.00	4.91	2.056
	Total	92	5.80	6.78	3.654 *

TABLE III Cont.

Comparisons Within Homogeneous Classes of Process Components from *The Test of Science Processes* using Student's t Between Pre-post Administrations

	Class Number	N	Pretest Mean	Post test Mean	t
Predicting	81	22	4.77	4.68	0.266
	82	22	4.31	4.13	0.445
	83	25	3.44	4.08	1.345
	84	23	2.56	3.30	1.809
	Total	92	3.75	4.04	1.402
Total	81	22	66.63	67.81	0.530
	82	22	53.22	59.81	3.043 *
	83	25	47.64	53.87	2.454 *
	84	23	42.04	48.26	3.339 *
	Total	92	52.11	57.22	4.552 *

*Significant at or beyond 0.05 level of confidence

TABLE IV

Otis-Lennon Mental Ability Test Data for Homogeneous Classes and the Total Group

Class No.	N	Mean IQ	Median IQ	Range of IQ	S.D.
81	22	119.8	118.5	102-138	9.99
82	22	108.5	109.5	87-128	9.84
83	25	102.6	102.0	80-126	10.67
84	23	94.9	95.0	84-111	7.41
Total	92	106.2	105.0	80-138	13.07

In Table IV the intelligence scores for the classes are listed. It appears that there is a relationship between intelligence and process skills such that more intelligent groups at the eighth grade level were further down a continuum of difficulty from observing to experimenting at the onset of instruction. Additionally, the processes learned or processes in which more ability is evident at the close of treatment than before, were dependent upon the prior ability. Classes 84 and 83 were apparently ready to learn observational and classificational skills which may be prerequisite for learning measurement and inference making. Class 82 may then have already passed the threshhold performance in observing, comparing, classifying and quantifying so that they could master measurement and inferring. Class 81 may have already possessed an optimal level of process skill for their age so that no appreciable change could have taken place. This does not, however, rule out possible gains in concept learning for the upper group. No attempt was made in this study to monitor concept development.

The same general trends were observed from the qualitative results of the practical process examinations. There were only small differences in achievement in observing. All classes demonstrated adequate abilities on comparing, but class 84 was somewhat lower in ability than the others whose scores clustered closely. All classes performed similarly on the classification item. Classes 81, 82, and 83 mastered the quantifying item while class 84 behaved at a much lower level.

The measurement items did not produce similar results. Item I-4 indicated that all groups could use the balance beam within the required tolerance. None of the groups successfully calculated the volume required in item I-5. Item II-1 indicated that class 81 had mastered the item. Classes 82 and 83 performed at a slightly lower level and class 84 could not respond to the item. On experimenting (*which subsumed inferring and predicting*) only class 81 mastered the item while the other classes were not able to respond.

The large differences observed between the classes in this sample on process skills seemed to indicate a commonality in the kinds of abilities measured by intelligence tests and process tests. Since both types of measures require reading and other linguistic abilities, correlations were calculated between specific ability tests and the post-test process scores for the whole group. In Tables V, VI, and VII the correlation coefficients are listed. Excepting for comparing, all of the process scores seem to be highly related to the other scores with no specific trends emerging.

TABLE V

Product Moment Correlation Coefficients Between *Metropolitan Achievement Test* Reading and Language Arts Scores and Post-test Scores on *The Test of Science Processes*

Process Components	Word Analysis	Reading	Language	Spelling
Observing	0.33	0.23	0.32	0.14
Comparing	0.17	0.09	0.17	0.02
Classifying	0.35	0.28	0.38	0.23
Quantifying	0.47	0.45	0.52	0.31
Measuring	0.65	0.61	0.60	0.46
Experimenting	0.45	0.50	0.48	0.35
Inferring	0.50	0.52	0.51	0.41
Predicting	0.18	0.26	0.31	0.19
Total Score	0.61	0.59	0.63	0.41

N = 92

TABLE VI

Product Moment Correlation Coefficients Between *Metropolitan Achievement Test* Mathematics Scores and Post-test Scores on *The Test of Science Processes*

Process Components	Computation	Concepts	Problem Solving
Observing	0.21	0.25	0.23
Comparing	0.04	0.11	0.02
Classifying	0.30	0.29	0.32
Quantifying	0.54	0.48	0.52
Measuring	0.62	0.59	0.72
Experimenting	0.26	0.41	0.27
Inferring	0.42	0.51	0.51
Predicting	0.22	0.34	0.36
Total Score	0.52	0.58	0.61

N = 92

TABLE VII

Product Moment Correlation Coefficients Between *Metropolitan Achievement Test* Disciplinary Scores, *Otis-Lennon* Raw Scores and Post-test Scores on *The Test of Science Processes*

Process Components	Science	Social Studies	Otis-Lennon
Observing	0.40	0.33	0.35
Comparing	0.11	0.25	0.22
Classifying	0.32	0.39	0.43
Quantifying	0.54	0.53	0.59
Measuring	0.66	0.61	0.73
Experimenting	0.31	0.47	0.42
Inferring	0.44	0.55	0.55
Predicting	0.24	0.34	0.22
Total Test	0.60	0.66	0.70

N = 92

The Test of Science Processes appears to have had approximately equivalent reliability in this study as Tannenbaum indicated. In Table VIII the pre-post test correlations are listed along with Tannenbaum's Kuder-Richardson reliabilities. The largest single difference was that the total score correlated lower than the reported reliability. Some of these differences may have been due to the *IPS* course as a specific treatment.

TABLE VII

Product Moment Correlation Coefficients Between Pre- and Post-Administrations of *The Test of Science Processes* and Kuder-Richardson Reliabilities Reported by Tannenbaum for eighth grade

Process Components	Number of Items	Correlation Coefficient	Kuder-Richardson Reliability
Observing	9	0.32	0.42
Comparing	5	0.17	0.31
Classifying	13	0.32	0.58
Quantifying	12	0.38	0.67
Measuring	25	0.73	0.80
Experimenting	10	0.51	0.47
Inferring	14	0.56	0.63
Predicting	8	0.39	0.56
Total Score	96	0.70	0.90

Discussion and Conclusions

It was evident that scores on *The Test of Science Processes* changed significantly during the first 5 chapters of the *IPS* course as a treatment. The whole group changed on all the process measures except predicting. Those results appear to be in harmony with the *IPS* program including up to chapter 5. The null hypothesis that process learning would not change during the *IPS* course is rejected. Similarly the hypothesis that all classes would remain at the same relative level on process learning is rejected. There were differential changes observed which indicated that prior ability level on certain processes is required for changes to occur. If the IQ scores can be considered to be an indication of logical maturation then it appears that process skills are developed in a sequence starting with observing and culminating with experimenting. Evidence presented in this study is only sketchy in the order of development of the other processes. It appears that comparing and classifying are roughly equivalent in order of learning. Quantifying and measuring appear to develop next. Processes which require taking mental risks such as inferring and predicting may be the last to emerge. Experimenting appears to be the most complex and subsumes all other processes.

The great similarity of all the achievement and process measures used in this study attested to by the large number of significant correlations between them points out that the kinds of skills measured in all cases were closely related. There are several possible explanations for this. Many test makers believe that all tests which must be read are biased towards the better reader. Even though *The Test of Science Processes* included stems which were largely pictoral, the testee was still required to do considerable reading. There may be, however, an additional reason. Reading ability and ability in science processes both have a basic dependence upon perceptual skills. Diagnostic testing of the development of linguistic abilities usually features decoding of pictoral as well as symbolic information. Tests of linguistic abilities such as the *Illinois Test of Psycholinguistic Abilities*[7] include items which are very similar to the process measures for observing, comparing, and classifying. A basic dependence upon the same prerequisite abilities could be a cause of the observed similarity of measurement.

This study included only information on a group receiving a specific treatment. A commonly stated objection to this type of design is that at its conclusion it is not clear if the observed changes in learning are due to the treatment or maturational factors. In the case of this study a group could have been used which did not have the *IPS* program but another, perhaps non-laboratory oriented one. Comparisons of the two programs may or may not have produced observed differences. In such a design neither program can really serve as a control for the other because of large differences in intended learning objectives. Each program will have different behavioral goals and conceptual emphases. Each program would be expected to produce unique results. A complete control would be obtained in regularly operating public schools. The results reported in this study may be general to *IPS* courses. Replication on a much larger sample would be needed prior to generalization of these findings to the *IPS* program as a whole.

This study has reported many more changes in process learning for lower ability groups. It is our observation that the *IPS* program is often adopted for higher ability groups. School administrators generally tell us that such programs should not be wasted on non-academic students. We recommend that programs such as *IPS* are more likely to enhance the science learning of lower ability students. We think that laboratory learning is more necessary for the lower ability groups because they may still be learning very simple science processes. Once these processes are learned it may be possible for students to work entirely at the level of abstraction. Even then it may not be possible to adequately learn science without direct laboratory experience.

REFERENCES

1. Tannenbaum, Robert S. The Development of The Test of Science Processes. Unpublished Ed.D. Dissertation, Teachers College, Columbia University, 1968.

2. Durost, Walter N.; Bixter, Harold H.; Wrightstone, J. Wayne; Prescott, George A.; and Balow, Irving H. Metropolitan Achievement Tests Advanced Form G. New York: Harcourt, Brace and World, Inc., 1966.

3. Otis, Arthur S., and Lennon, Roger T. Otis-Lennon Mental Ability Test Intermediate Level Form J. New York: Harcourt, Brace and World, Inc., 1966.

4. Ips Group, Educational Development Center. Introductory Physical Science. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1967, p. 32.

5. Student's t was calculated using library program DIFER in the University of Maine, Orono Computing Center. This program was based on formulae given in: Steel, Robert G.D., and Torrie, James H. Principles and Procedures of Statistics. New York: McGraw-Hill Book Co., Inc., 1960, pp. 57-63.

6. Correlation coefficients were calculated using library program CORREG in the University of Maine, Orono Computing Center. This program was based on formulae given in: Steel, Robert G.D., and Torrie, James H. Principles and Procedures of Statistics. New York: McGraw-Hill Book Co., Inc., 1960, pp. 277-303.

7. McCarthy, James J., and Kirk, Samuel A. Illinois Test of Psycholinguistic Abilities. Institute for Research on Exceptional Children, University of Illinois, Urbana, Illinois, 1961.