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AUTHOR McNinch, George

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ABSTRACT

A study was conducted to determine the relationship between auditory perceptual skills and first-grade reading success when readiness and intelligence measures were used in conjunction with auditory skills assessments. Sex differences were also considered. Six boys and six girls were randomly selected from each of 10 first-grade classrooms. Complete pretest and post-test data were obtained on 111 pupils. The auditory factors were assessed by two specially constructed instruments, the Roswell-Chall Auditory Blending Test, the Wechsler Intelligence Scale for Children Digit Span, and the auditory discrimination subtest of the Harrison-Stroud Reading Readiness Profiles. The readiness test and Lorge-Thorndike Intelligence Tests were also administered at the beginning of first grade, and the SRA Achievement Tests, Primary Battery, were given the following April. Interpretation of the data revealed a generic relationship between the auditory perceptual variables, but it appeared that the instruments were measuring different skills. Sex had no significant effect on test performance, though a positive trend of superiority for girls was noted. Significant relationships were found between the prereading variables and measured reading achievement. However, it was concluded that redundant information was obtained by using the combination of auditory perceptual measures, the reading readiness, and intelligence tests. Tables and a bibliography are included. (CH)

Predictive Values of Selected Auditory Perceptual Factors in Relation to Measured First Grade Reading Achievement

By

George McNinch
Assistant Professor
University of Southern Mississippi Reading Center

Accurate prediction of behavior is a fundamental goal of education (Weintraub, 1967). Prediction of success in an academic area is usually based upon assessment of skills which are considered to be prerequisite to the learning task involved, or inherent in a proposed model or hierarchy of skills representing the disciplin Most of the academic areas have developed behavioral models or learnings necessary for mastery of the discipline involved. To the researcher, these models are a simplified, readily understood and studied version of complex interactions.

Prediction of reading success in the first grade, when conducted through the exploration of a model can fulfill the recommendations proposed by MacGintie (1969) as being fundamental to sound readiness research: "Research on reading readiness has two purposes: 1) to understand better the nature of the process of learning to read, and 2) to learn how to make helpful predictions (p. 399)." A further recommendation advanced by MacGintie argued for the use of "basic prediction tasks" that did not resemble the criterion measure. Prediction measures of this type would, in MacGintie's estimation, be measures of auditory-visual integration or visual-motor coordination.

Flower (1968) proposed a systematic hierarchy of auditory perceptual skills that were, according to his theory, necessarily mastered prior to reading instruction. This auditory model stressed an appraisal of auditory processes that "... might be involved in learning to read (p. 21)." Thus, predictive estimates or evaluation connected with initial reading experiences should be sought in the following areas:

> Auditory discrimination, including both the ability to identify the presence of a given sound in a sequence of sounds and the ability to differentiate among similar sounds.
>
> Auditory memory, including the amount of heard information that can be retained and the ability to retain the elements of a series of stimuli in accurate sequence.
>
> Auditory integration, or the ability to synthesize elemental signals into meaningful oral signs.
>
> Auditory-visual intergration, or the ability to establish relationships between heard signals and graphic representations of these signals (p. 22).

Adaptation of the Flower hierarchy is needed in order to investigate a further perceptual skill possibly involved in language and reading learnings. Insertion of an additional step between auditory integration and auditory-visual integration is necessary if auditory-visual integration is to be investigated as a language process requiring the one-to-one correspondence between the graphic symbol representing a word and the segment of the speech string that forms a word. Discrete word awareness may not have developed in some children when initial reading instruction is begun, nor is word awareness a skill that is acquired automatically. Day, a participant in a conference on the reading process (Kavanagh, 1968), cited an illustrative "breakfast table" analogy supporting the idea that some children possess a reduced lexical code. Day then continued his argument that word segmentation or representation was developmental by stating:

> The hypothesis that word segmentation is something we've got to learn how to do is especially plausible when we examine the speech stream. If you look for discrete boundaries between successive words, say on a spectrogram, there are usually no 'spaces' between successive words. In fact, there are often bigger 'spaces' within words than between words (p. 129).

Day summarized his arguments for word awareness by noting that "... segmentation of words from the speech stream is a prerequisite for learning to read (p.129)."

The auditory skills proposed in the perceptual hierarchy posited by Flower have independently received an abundance of theoretical comment and a significant amount of empirical study. The available literature concerning the five categories of auditory perceptual skills (auditory-visual integration, oral words representation, auditory integration, auditory memory, and auditory discrimination) chosen for this study evoked a series of unanswered questions, presented some ambiguous findings, and established precedents.

Since 1964, with the publication of the Birch and Belmont (1964) study, auditory-visual integration and its connection to the reading process has been a subject of numerous research studies. Several of these studies have demonstrated the relationship between A-V equivalence tasks and first grade reading achievement or kindergarten readiness levels. Birch and Belmont (1965) found that A-V performance was more closely related to readiness success than was intelligence. Also noted was a significant correlation between first-grade reading success and the A-V tasks. A series of modality tasks devised by Muehl and Kremenak (1966) were used to augment the predictive quality of the Harrison-Stroud Reading Readiness Profiles. When extreme reading groups were matched on I.Q. at the end of the year, it was found that first of year A-V performance was a predictor of reading success. Other studies show the utility of A-V performance as a discriminator of reading achievement in the middle elementary grades (Kahn, 1965, and Sterritt and Rudnick, 1966); however, the results of these studies are not conclusive. The relationship between A-V transfer and I.Q., or A-V transfer and reading ability have not been adequately explained.

Huttenlocher (1964) demonstrated that young children are not aware of word boundaries, nor are they able to separate single words from multi-word utterances. Syntactic units were not divided into separate words by the children in the sample. Karpova (1966) found that young children could not isolate words of spoken language nor count the number of words spoken to them. Chappell (1968), after a study of 40 children, concluded that lexical units are difficult to discriminate from syntactic constructions. Word identity or awareness is seemingly a learned or developmental task affected by sex, age, and cultural status.

Auditory integration (blending) has been shown by Chall, Roswell, and Blumenthal (1963), Alshan 965 and Kass (1966) to be a predictor of reading achievement for restricted populations. Auditory blending also seems to be a discriminator of good from poor readers in the elementary grades (Reynolds, 1953, Mulder and Curtin, 1965, and Monroe, 193). However, imprecise testing, restricted populations, and unreliable instruments inhibit the conclusions drawn from these studies.

Rizzo (1963), Cabrini (1963) and Morency (1968) found that auditory memory span discriminated between good and poor readers or predicted first-grade achievement to a significant degree within normal populations. When clinic populations were studied, Poling (1953), Rose (1958), Ellehammer (1966), and Sandstedt (1964) demonstrated that auditory memory span did significantly divide normal from retarded readers. Only limited propositions can be drawn from these studies since they used different achievement measures, different labels for normal and retarded, different measures of memory, and no controls for intelligence.

Dykstra (1966) concluded after a review of the research literature concerning auditory discrimination that comparisons of good and poor readers seem to indicate that these groups differ significantly in this skill. He further concluded that small positive correlations usually appeared in reading prediction studies of first-grade reading achievement when auditory discrimination was used as a pretest measure.

The available literature suggests that the auditory perceptual skills involved in Flower's adapted hierarchy are possible determinants of first-grade reading success. However, remaining generally unanswered is the relationship between the combined auditory perceptual skills and reading achievement. Few multivariate studies have been conducted. No studies were found that investigated the prediction of reading achievement at the end of the year by assessment of an auditory skill hierarchy when given in conjunction with readiness and intelligence measures. A study of this type would fulfill the criteria of model evaluation and the proposed tenets of sound readiness research as proposed by MacGintie.

To answer the questions raised, the following null hypotheses were generated and tested.

1. There are no significant correlations among the various auditory perceptual prereading measures.

2. There are no significant differences noted on prereading measures between boys and girls.

3. There are no significant relationships between the prereading measures and measured reading achievement at the end of the school year.

4. There are no significant differences noted on mean reading achievement between boys and girls as measured by the instrument.

Procedures

Ten first grade classrooms (N=285) at Monroe Primary School, Monroe, Georgia, each randomly contributed six boys and six girls to the initial pretest sample of 120 pupils. Complete pretest data were obtained on 117 pupils. Posttest sample size, due to attrition, was 111 pupils.

The following instruments were designed or selected to evaluate each skill in the adapted hierarchy: Auditory-visual Rhythm Perception Test, Aural Word Representation Test, Roswell-Chall Auditory Blending Test, WISC Digit Span, and subtest four of the Harrison-Stroud Reading Readiness Profiles, Making Auditory Discriminations.

The two specially constructed instruments were the Auditory-visual Rhythm Perception (AVRP) and the Aural Word Representation Test (AWR). The AVRP is a specially constructed instrument designed to evaluate the ability to make cross-modal equivalence judgements. The instrument is a linguistic modification and extension of the Birch and Belmont (1964, 1965) auditory-visual equivalence test concept, but the AVRP deviates from the Birch and Belmont test by using oral language and not "tapped dot patterns" as the initial stimuli. The AVRP is linguistically grounded in that it requires that a spoken language pattern, composed of varying combinations of juncture, be associated with a visual array representing this language pattern. The examinee must select the correct pattern from a group of three presented choices. The test is composed of three sample and 11 test items.

Two independent estimates of reliability were available for the AVRP. For kindergarten pupils and first-grade pupils the coefficients are .71 and .79 respectively. The Aural Word Representation Test is a specially constructed instrument designed to evaluate the ability to make word boundary discrimination or word segmentations. The AWR is a linguistic test that requires the examinee to represent each spoken word in a stimuli utterance with a single one inch foam rubber cube. The examinee must react to each word individually as it would appear in print, even though it is not separated from other words in a phrase or sentence by open or sustained juncture. Test items ranged from two to six word utterances with various types of syntactic constructions. The AWR test consists of three sample and 15 test items. An independent estimate of reliability for the AWR yielded a coefficient of .71 when beginning first grade children were tested.

The period of initial data collection began approximately one month after the opening of the school session in September 1969, and lasted for five weeks. Posttesting on the achievement battery was done in the first week of April, a lapse of five months. Testing was done primarily by the investigator who was aided intermittently by six advanced graduate students or certified teachers trained in the administration of the instruments.

The group standardized instruments (Harrison-Stroud Reading Readiness Profiles, Lorge-Thorndike Intelligence Tests, and the SRA Achievement Tests, Primary Battery, Form C were administered according to the directions in the manuals accompanying each test. Recommendations concerning the maximum size of the testing groups and the number of subtests to be administered per session were closely followed. The perceptual tests (AVRP and the AWR) were given according to set instructions developed by the investigator. The two other auditory perceptual tests (WISC Digit Span and the Roswell-Chall Test of Auditory Blending) were given according to the specific directions as outlined in their respective manuals.

Group testing was done in the mornings in the school cafeteria (control of extraneous noise and movement was impossible). Each class group was tested separately as an intact unit.

Individual testing conditions were good. Private offices or all-purpose rooms were available to the testers between the hours of 9:00 A.M. and 2:00 P.M. Noise and extraneous movement were at a minimum.

Stimulus items for the three auditory perceptual tests (AVRP, AWR, and the Roswell-Chall Test of Auditory Blending) were recorded by the examiner on cards for the Bell and Howell Language Master. Recording of the stimulus items on tape produced a uniform presentation of test items to each child. A résumé of the testing variables is presented in Table 1.

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Results

The .01 level of significance was used as the criterion for testing all null hypotheses.

The first null hypothesis (there are no significant relationships among the auditory perceptual variables) was tested by construction of an intercorrelation matrix. A matrix reveals all possible relationships by indicating the correlated relations between any two variables taken at once. Table 2 presents the intercorrelations. Nine of the ten possible combinations were

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significant at the .01 level with correlations ranging from .28 to .59. Correlations of this magnitude, though significant, are described by Garrett (1967) in this manner: .20 to .40, low correlation; .40 to .70, substantial or marked correlation. Thus, five of the nine significant correlations are "low." Three other combinations range along the lower border of the upper category and could also be interpreted as "low."

Coefficients of determination were computed for the auditory perceptual tasks (X_1 to X_5) and are shown in Table 3. The highest correlation, .59, between AWR, X_2, and Memory, X_4, produced

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a coefficient of determination of .35 which indicated that only 35% of the variance of X_4 could be accounted for by variance in X_2. The coefficient of determination for the lowest significant correlation, .28, Auditory Discrimination, X_5, with Blending, X_3, accounted for 8% of the common variance. Therefore, though the skills are significantly related and the null hypothesis is rejected, the skills being measured do not appear to be synonymous. Unique properties under the generic category of auditory perceptual skills are perhaps being evaluated by each of the individual perceptual instruments employed.

When comparison of performance by sex was investigated, no statistically significant differences were noted on the prereading variables. Application of *t* test analysis for uncorrelated means, detailed in Table 4, on the raw score data produced

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standard *t* ratios that ranged from .66 to 2.25. A *t* score of 2.326 was required to warrant rejection at the .01 level. Observation of the nonsignificant *t* scores indicated that on all the prereading variables, as well as mental age, the boys were surpassed by the girls. However, null hypothesis two as stated (there are no significant differences noted on prereading measures between boys and girls) was not rejected.

Canonical correlation analysis indicated that there was one significant way ($R = .749$, $p < .0001$) in which the 13 prereading and four reading variables were related. The canonical R which suggests significant commonality is reported in Table 5. Vector

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weights indicated that the canonical correlation was best described by the following major loadings: X_{13}, X_4, X_{11}, X_{10} with Y_1 and Y_2 (See Table 6). Mental age as measured by the Lorge-Thorndike, and Auditory Memory as measured by the Digit

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Span were the prime contributors to the prereading set when the reading set was described by major loadings on Verbal-Pictorial Association and L..nguage Perception, two subtests of the SRA reading achievement battery. Therefore, the third null hypothesis (there are no significant relationships between the prereading variables and measured reading achievement at the end of the school year) was rejected.

The mean scores of boys and girls were compared to investigate sex differences on the reading measures. A *t* test for uncorrelated means was used to test the fourth null hypothesis. The *t* values are reported in Table 7. Nonsignificant *t* ratios were noted when the boy versus girl reading comparisons were

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made. In four of the comparisons the girls' group achieved higher mean scores than did the boys' group; however, the differences between the mean scores were not statistically significant. The computed t scores ranged from .31 to 1.77. A t score of 2.326 was required for rejection of the null hypothesis; therefore, the fourth null hypothesis (there are no significant differences noted on mean reading achievement at the end of the school year) was not rejected.

Discussion

The auditory perceptual variables as measured by the selected instruments did seem to be related in a generic relationship. However, it appeared that the instruments were measuring different skills. This conclusion is based on the fact that the computed inter-correlations were significant, but the coefficients of determination were quite small.

Since it is possible to segment and test the separate skill areas, it is possible that instructional materials developed in these areas may be an aid in developing auditory skills usually stressed in initial school experiences. The testing procedures and instruments may be beneficially adapted for use as instructional materials.

Sex had no statistically significant effect on test performance on the prereading or reading variables. However, a positive trend of superiority by girls was noted on all measures. Even though the differences were not significant, the trend does seem to support the generally acknowledged idea that girls mature linguistically and perceptually more rapidly than do boys.

Girls possibly need less training or exposure than boys to the auditory skills or the skills inherent in the reading readiness measure prior to formal reading instruction. Whereas boys would seem to need compensatory training in the linguistic-perceptual areas, reading instruction for the girls could capitalize on their earlier development in these skills, using them as the basis of reading instruction.

Mental Age, Auditory Memory, Letter Names, and Using Context and Auditory Clues comprised the major vector weights in the prereading set of the canonical correlation. This finding indicates that diagnostic evaluations prior to planning an individual curriculum should be sought in these four areas when reading achievement is to be measured in terms of Verbal-Pictorial Association and Language Perception. It should be pointed out, however, that only one area is readily amenable to instruction, Using Context and Auditory Clues. Both measured mental age and auditory memory are possibly functions of innate ability as demonstrated by test performance.

When prediction of reading achievement in grade one is the purpose of preinstruction evaluation, it would appear that redundant information is supplied when combined assessments are sought through the auditory perceptual skill hierarchy, the reading readiness test, and the intelligence measure. More economical prediction or screening could probably be made through selective test administration. There would seem to be some value in measuring mental age, letter names, and using context and auditory clues.

Assessment of an auditory perceptual skill hierarchy in conjunction with a group reading readiness test does not seem to enhance description of the reading process. However, this conclusion is restricted solely to the evaluated first grade sample and the selected measuring instruments. Depressed scores and the associated restricted variance on the prereading and reading measures may well have influenced the results and caused the low correlational relationships. Appropriate selection of predictive and criterion instruments is a vital factor in any study attempting to describe the reading process.

TABLE 1

Independent and Dependent Variables
of Prereading Measures and
Reading Achievement

	Independent Variables		Dependent Variables
X_1	Auditory-visual Rhythm Perception	Y_1	Verbal-Pictorial
X_2	Aural Word Representation	Y_2	Language Perception
X_3	Auditory Integration	Y_3	Comprehension
X_4	Auditory Memory	Y_4	Vocabulary
X_5	Auditory Discrimination (H-S)	Y_5	Total Reading
X_6	Using Symbols (H-S)		
X_7	Making Visual Discriminations, Paced (H-S)		
X_8	Making Visual Discriminations, Unpaced (H-S)		
X_9	Using the Context (H-S)		
X_{10}	Using the Context and Auditory Clues (H-S)		
X_{11}	Giving the Names of the Letters (H-S)		
X_{12}	Chronological Age		
X_{13}	Mental Age (Lorge-Thorndike)		

TABLE 2

Intercorrelations Among the Independent Variables*

		X_1	X_2	X_3	X_4	X_5
X_1	AVRP	1.00	.38	.20	.36	.35
X_2	AWR		1.00	.42	.59	.44
X_3	Blending			1.00	.32	.28
X_4	Memory				1.00	.45
X_5	Discrimination					1.00

*$\underline{r} > .22$, $p < .01$

TABLE 3

Coefficients of Determination for the
Significant Auditory Perceptual Variables

	Variable	X_1	X_2	X_3	X_4	X_5
X_1	AVRP	1.00	.14	---	.13	.12
X_2	AWR		1.00	.18	.35	.12
X_3	Blending			1.00	.10	.08
X_4	Memory				1.00	.20
X_5	Discrimination					1.00

TABLE 4

Means, Standard Deviations, and t Ratios for the Differences Between Boys and Girls on the Independent Variables (X_1 to X_{13})

Variable	n	$\bar{X}$	s	t
X_1 AVRP	59	4.34	2.08	.85
	58	4.69	2.36	
X_2 AWR	59	4.32	2.75	2.25
	58	5.53	3.04	
X_3 Blending	59	2.83	3.08	.66
	58	3.19	2.74	
X_4 Memory	59	5.47	1.76	.71
	58	5.72	2.02	
X_5 Discrimination	59	11.24	3.69	.73
	58	11.72	3.41	
X_6 Using Symbols	59	13.56	6.56	1.09
	58	14.74	5.12	
X_7 Visual Discrimination	59	8.59	4.38	1.48
	58	9.76	4.14	
X_8 Visual Discrimination	59	10.19	4.83	1.59
	58	11.55	4.46	
X_9 Using Context	59	11.24	3.69	.73
	58	15.00	2.63	
X_{10} Context and Auditory	59	8.90	3.86	1.86
	58	10.22	3.80	
X_{11} Letter Names	59	20.31	14.93	.12
	58	20.64	14.00	
X_{12} CA	59	76.07	3.62	.56
	58	75.67	4.04	
X_{13} MA	59	71.73	11.10	.59
	58	73.00	11.78	

TABLE 5

Chi-Square Tests of Successive Latent Roots
for Canonical Correlation

R	Wilk's Lambda	Chi Square	df	p less than
.749	.303	121.926	52	.0001
.435	.690	37.884	36	.3834
.314	.850	16.527	22	.7889
.238	.944	5.931	10	.8210

TABLE 6

Weights for First Vector Corresponding to Canonical Correlation Between Prereading and Reading Variables

	Variable		Weight
First Set			
	X_1	AVRP	.022
	X_2	AWR	.120
	X_3	Blending	.211
	X_4	Memory	.356
	X_5	Discrimination	-.066
	X_6	Using Symbols	-.086
	X_7	Visual Discrimination	-.211
	X_8	Visual Discrimination	-.103
	X_9	Using Context	.170
	X_{10}	Context and Auditory	.273
	X_{11}	Letter Names	.276
	X_{12}	CA	-.063
	X_{13}	MA	.424
Second Set			
	Y_1	Verbal-Pictorial	.500
	Y_2	Language Perception	.434
	Y_3	Comprehension	.123
	Y_4	Vocabulary	.222

TABLE 7

Means, Standard Deviations, and *t* Ratios
for the Differences Between Boys and Girls on the
Dependent Variables (Y_1 to Y_5)

Variable	n	$\bar{x}$	s	t
Y_1 Verbal-Pictorial	56	8.48	5.65	1.77
	55	10.36	5.57	
Y_2 Language Perception	56	71.25	16.98	-1.49
	55	76.62	20.59	
Y_3 Comprehension	56	10.89	3.62	.31
	55	10.76	3.83	
Y_4 Vocabulary	56	9.30	3.53	-1.48
	55	10.20	2.85	
Y_5 Total	56	100.02	23.50	-1.62
	55	107.95	27.74	

*$t_{2.326}$, $p < .01$

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