DOCUMENT RESUME

ED 109 629 CS 002 031

AUTHOR Rudegeair, Robert E.
TITLE Confusability of Consonant Phonemes in Sound Discrimination Tasks.
INSTITUTION Southwest Regional Laboratory for Educational Research and Development, Los Alamitos, Calif.
SPONS AGENCY Office of Education (DHEW), Washington, D.C.
REPORT NO SWRL-TN-2-70-50
PUB DATE Dec 70
NOTE 10p.

EDRS PRICE MF-$0.76 HC-$1.58 PLUS POSTAGE
DESCRIPTORS *Auditory Discrimination; *Consonants; Educational Research; *Phonemes; Primary Education; *Reading Research

ABSTRACT

The findings of Marsh and Sherman's investigation, in 1970, of the speech sound discrimination ability of kindergarten subjects, are discussed in this paper. In the study a comparison was made between performance when speech sounds were presented in isolation and when speech sounds were presented in a word context, using minimal sound contrasts. The findings of the Marsh and Sherman study are compared to results from similar studies, and it is concluded that the Marsh and Sherman data base is substantially supported. The implications of sound discrimination data for phonics-based reading programs are then discussed, and it is recommended that teachers and program planners be cautious in introducing sounds with a high probability of confusion. (TS)

ED109629

SWRL

SOUTHWEST REGIONAL LABORATORY TECHNICAL NOTE

DATE December 14, 1970

NO TN-2-70-50

CONFUSABILITY OF CONSONANT PHONEMES IN SOUND DISCRIMINATION TASKS

Robert E. Rudegeair

ABSTRACT

Marsh and Sherman (1970) investigated the speech sound discrimination ability of kindergarten subjects. Minimal sound contrasts were presented under two conditions. Performance when speech sounds were presented in isolation was compared with performance when speech sounds were presented in a word context. Findings from the Marsh and Sherman studies are discussed and compared to results from similar studies. In general, the Marsh and Sherman data base is substantially supported. The implications of sound discrimination data for phonics-based reading programs are discussed.

CS 002 031

CONFUSABILITY OF CONSONANT PHONEMES IN SOUND DISCRIMINATION TASKS

Objectives of Sound Discrimination Testing

Until recently, studies related to the speech sound discrimination ability of young children were not concerned with specific error types in any systematic fashion. Yet this information is the essence of any data base that must underlie a phonics-based reading program as well as articulatory and auditory training programs for young children. Speech sound discrimination testing has been conducted for some time now, but the major interest has been in assessing some sort of global discrimination skill. The tests of Templin (1943, 1957) and Wepman (1958, 1960) are well known in this regard.

Marsh and Sherman (1970) reviewed recent data on the relative discriminability of specific speech sounds for children who are about to assume the task of learning to read. In addition, their own study provided "a data base for program developers and teachers indicating which phonemes kindergarten children may have difficulty discriminating and producing" (p. 26). Marsh and Sherman studies 35 minimal consonant contrasts consisting of contrasts between stops, fricatives, nasals, semi-vowels, as well as a few contrasts in manner of articulation (e.g., stop vs. fricative). This represents a rather large proportion of possible minimal contrasts.

Rudegeair (1970) studied the ability of first-grade children to discriminate minimal stop and fricative contrasts across the dimensions of voicing and place of articulation. The resulting 18 contrast pairs are presented in Table 1. These contrasts represent a subset of the

TABLE 1

CONTRAST PAIRS STUDIED BY RUDEGEAIR (1970)

	Stops	Fricatives
Voiceless place contrasts	/p/ - /t/	/f/ - /θ/
	/p/ - /k/	/f/ - /s/
	/t/ - /k/	/θ/ - /s/
Voiced place contrasts	/b/ - /d/	/v/ - /ð/
	/b/ - /g/	/v/ - /z/
	/d/ - /g/	/ð/ - /z/
Voicing contrasts	/p/ - /b/	/f/ - /v/
	/t/ - /d/	/θ/ - /ð/
	/k/ - /g/	/s/ - /z/

Marsh and Sherman stimulus items (Marsh and Sherman did not test /v/ vs. /z/ or /ð/ vs. /z/) and provide an opportunity to make some comparisons.

Methodology and Results of Two Recent Studies

Marsh and Sherman measured discrimination performance under two conditions--one where the members of a contrast pair were presented in isolation (e.g., /f/ vs. /s/) and another where the members of the contrast pair were presented in a word context (e.g., /fæt/ vs. /sæt/). Rudegeair measured discrimination performance only in the context of a following vowel. Thus, all items in that study were CV (consonant + vowel) syllables. Both studies employed a delayed matching-to-sample forced-choice discrimination (A-B-X) procedure. In presenting the A-B-X paradigm, both studies used stereo speakers and equivalent intervals between item presentations. In both studies all contrasts were consonant contrasts in initial position.

Error rates on contrast pairs common to both studies are presented in Table 2. Absolute error rates between the two studies probably vary because the subject populations used were different. While Ss in the Marsh and Sherman study were kindergarteners not involved in any reading program, the Ss in the Rudegeair study were midway through first-grade and were involved in reading training. Spearman rank order correlations (rho) were computed on the data in Table 2. The Marsh and Sherman isolation data did not correlate significantly with the Rudegeair data (rho = -.02). However, the Marsh and Sherman data with phonemes in a word context did correlate significantly with the data from Rudegeair (rho = .78, $p < .01$).

TABLE 2

ERROR RATES ON CONTRAST PAIRS COMMON TO BOTH STUDIES

Contrasts	Rudegeair	M + S Words	M + S Isolation
/f/ - /θ/	29.0%	39%	46%
/v/ - /ð/	25.0%	43%	53%
/θ/ - /ð/	14.0%	36%	16%
/f/ - /v/	13.0%	26%	24%
/s/ - /z/	12.0%	36%	19%
/k/ - /g/	11.2%	27%	17%
/t/ - /k/	10.9%	28%	22%
/b/ - /d/	9.7%	25%	21%
/p/ - /t/	9.5%	22%	20%
/d/ - /g/	9.3%	23%	26%
/b/ - /g/	9.2%	14%	17%
/p/ - /b/	9.2%	30%	18%
/θ/ - /s/	8.8%	26%	34%
/p/ - /k/	8.6%	13%	21%
/t/ - /d/	8.1%	18%	22%
/f/ - /s/	7.6%	23%	48%

It can be seen in Table 2 that certain types of contrasts are equally difficult to discriminate (e.g., voiceless stop place contrasts). Thus, it may be more appropriate to consider the data in question in terms of certain selected groupings according to articulatory parameters.

Because absolute error rates varied between the two studies it was decided to compute the proportion of errors for each contrast. In this manner, data from one study or condition can be readily compared with those of another study or condition. For each study, then, the probability of an error for each contrast was computed according to the formula: Given an error, what is the probability that it was, for example, a /p/ vs. /t/ error? The mean probabilities of an error for each group of contrasts are presented in Table 3. Means are presented separately for the Rudegeair data, the Marsh and Sherman data for phonemes in isolation, and the Marsh and Sherman data for phonemes in a word context.

The rationale for the particular groupings presented in Table 3 is, in most cases, self-evident. Fricative place contrasts involving /s/ are discussed at length in the report by Rudegeair (1970). The acoustic cues assoicated with the production of /s/ and /ʃ/ are shown to be highly distinctive as compared to the cues assoicated with other fricatives. The contrasts /f/ vs. /θ/ and /v/ vs. /ð/ should be considered separately because these particular items have always exhibited unusually high error rates in sound discrimination testing (Templin, 1943; Miller & Nicely, 1955; Stoudt, 1964; Tikofsky & McInish, 1968; Skeel, Calfee, & Venezky, 1969; Rudegeair & Kamil, 1970). The reasons for this are also discussed by Rudegeair.

From the grouped data in Table 3, it can be seen that the Marsh and Sherman isolation data are, to some extent, compatible with their data from the word condition and the Rudegeair data. Large discrepencies are only apparent in two groups--the voiceless fricative place contrasts and the voiced-voiceless fricative contrasts. Some possible reasons for these discrepencies will be discussed below.

In their paper, Marsh and Sherman report a significant rank order correlation between their data from the word condition and the data from a study by Rudegeair and Kamil (1970). It is clear that the data base provided by Marsh and Sherman is substantially reinforced by other studies employing a similar methodology. It remains to consider some of the implications of this data for teachers and program developers.

TABLE 3

MEAN PROBABILITIES OF AN ERROR FOR SELECTED GROUPS OF CONTRASTS

		Rudegeair	M + S Words	M + S Isolation
Voiceless stop place contrasts	/p/ - /t/ /p/ - /k/ /t/ - /k/	.049	.049	.049
Voiced stop place contrasts	/b/ - /d/ /b/ - /g/ /d/ - /g/	.048	.047	.050
Voiced-voiceless stop contrasts	/p/ - /b/ /t/ - /d/ /k/ - /g/	.048	.058	.048
Voiced-voiceless fricative contrasts	/f/ - /v/ /θ/ - /ð/ /s/ - /z/	.066	.076	.045
Fricative place contrasts (involving /s/)	/f/ - /s/ /θ/ - /s/	.042	.056	.096
/f/ vs. /θ/ and /v/ vs. /ð/	/f/ - /θ/ /v/ - /ð/	.130	.095	.110

Methodological and Instructional Implications

With regard to items rank ordered by difficulty of discrimination, Marsh and Sherman found no correlation between pairs presented in isolation and pairs presented in a word context. Nor was there a correlation between the pairs presented in isolation and the Rudegeair data. But Table 3 shows that discrepancies are restricted to certain contrast types. In the isolated condition discrimination performance on all stop contrasts as well as on /f/ vs. /θ/ and /v/ vs. /ð/ is in substantial agreement with data from the word condition and with the data from the Rudegeair study. It is not surprising that performance on /f/ - /θ/ and /v/ - /ð/ is the same in Marsh and Sherman's two conditions since Ss were operating at the level of chance on these items in both conditions (see Table 2).

The finding that performance on stop contrasts is equivalent across conditions is more difficult to explain, but it probably results from the inability of any speaker to pronounce a stop in isolation. The moment the closure in the vocal tract associated with a stop sound is released, the stop is "in context"--e.g., strong contextual cues are present in the aspiration normally associated with the release of a stop in English speech patterns. In the case of the Marsh and Sherman items, the stop sounds are followed by a voiceless central vowel sound (Marsh & Sherman, p. 7). Thus, even though the stop is not necessarily in any typically English context, contextual cues are present just as they are in the word condition.

Fricatives, on the other hand, can be produced without a context. Besides the nasals, the fricatives are the only truly isolated sounds in Marsh and Sherman's isolated condition. It is very likely that drastic differences exist in the acoustic spectrum of a fricative in isolation and the same fricative in a word context. Differences in discrimination performance, then, should come as no surprise.

These considerations are related to methodological problems in assessment tasks and do not necessarily bear directly on the question of sequencing speech sounds in a beginning reading program. In general, if these discrimination data are used to predict speech sound confusability for kindergarteners and first graders, only a few items would get a high confusability ranking. In addition to /f/, /θ/, /v/, and /ð/, the nasals /m/, /n/, and /ŋ/ apparently fall into this category. Marsh and Sherman found discrimination performance on nasals to be at chance level when the contrasts were presented in isolation. The same finding was reported by Rudegeair and Kamil (1970) when the contrasts were presented in CV or VC nonsense syllables. The Ss in the latter study were both kindergarteners and first graders.

The next most confusable items are other fricatives, but a high confusion probability is only evident along the voicing dimension. In other words, the discrimination data indicate that the major source of confusions among fricatives is restricted to the distinction between voiced and voiceless cognates (/f/ and /v/, /θ/ and /ð/, /s/ and /z/). Confusions across the place of articulation dimension are less likely (with the exception, of course, of /f/ - /θ/, /v/ - /ð/).

The least confusable items are the stops. All minimal stop contrasts, whether voicing or place contrasts, have a relatively low probability of error. The remaining consonant phonemes, /r/, /l/, /w/, /y/, and /h/, also have a low probability of being confused. It should be noted that these generalizations apply only to Ss with normal articulation capabilities.

A dilemma involving the selection of speech sounds to be used in the initial stages of a phonics reading program arises from the discrimination data. Preliterate children show a relatively mature facility in discriminating both stop sounds and the continuants /r/, /l/, /w/, /y/, and /h/, but none of these is ideal for teaching isolated letter sounds. Fricatives and nasals, on the other hand, are appropriate for isolated letter-sound teaching, but are inherently difficult to discriminate. No ready solution to this problem is available. It may be more efficient in the long run to adopt an instructional unit of at least the size of the syllable. Indirectly, such a view is also supported by data on consonant production by children. Marsh and Sherman (1970) elicited production data on all English consonants from the Ss who participated in their discrimination task. Productions in isolation were compared to productions in a word context. While 25% of productions in isolation were errors, only 10% of productions in a word context were errors.

Adopting a syllabic unit for instruction would require drastic modifications in instructional packages already in use such as the SWRL FYCSP. Such modifications do not seem justified until such an instructional unit is researched systematically. Short of that, the import of the data discussed for teachers and program planners is simply to be cautious in introducing sounds with a high probability of confusion and perhaps be prepared to administer special discrimination training procedures on these items.

REFERENCES

Marsh, G., & Sherman, Marjorie. Children's discrimination and production of phonemes in isolation and in words. Technical Note No. TN-2-70-43, 1970, Southwest Regional Laboratory, Inglewood, California.

Miller, G. E., & Nicely, P. A. An analysis of perceptual confusions among some English consonants. *Journal of the Acoustical Society of America*, 1955, 27, 338-352.

Rudegeair, R. E. The effect of contextual influence on children's discrimination of initial consonants. Technical Report No. 146, 1970, Wisconsin Research and Development Center for Cognitive Learning, University of Wisconsin, Madison, Wisconsin.

Rudegeair, R. E., & Kamil, M. L. Assessment of phonological discrimination in children. Technical Report No. 118, 1970, Wisconsin Research and Development Center for Cognitive Learning, University of Wisconsin, Madison, Wisconsin.

Skeel, Mary, H., Calfee, R. C., & Venezky, R. L. Perceptual confusions among fricatives in preschool children. Technical Report No. 73, 1969, Wisconsin Research and Development Center for Cognitive Learning, University of Wisconsin, Madison, Wisconsin.

Stoudt, R. J., Jr. *A study of consonant discrimination by Aphasics.* Doctoral dissertation, Ann Arbor, Michigan: University Microfilms, 1964. No. 6003.

Templin, Mildred. A study of sound discrimination ability of elementary school pupils. *Journal of Speech Disorders*, 1943, 8, 127-132.

Templin, Mildred. *Certain language skills in children.* Minneapolis: University of Minnesota Press, 1957.

Tikofsky, R. S., & McInish, J. R. Consonant discrimination by seven year olds: A pilot study. *Psychonomic Science*, 1968, 10, 61-62.

Wepman, J. M. *Auditory discrimination test* (Manual of Directions). Chicago: Language Research Associates, 1958.

Wepman, J. M. Auditory discrimination, speech and reading. *Elementary School Journal*, 1960, 60, 325-333.

DISTRIBUTION

1 - R. Baker

1 - B. Berdiansky

1 - Design Staff

1 - M. Okado

1 - F. Niedermeyer

1 - R. Schutz

1 - G. Stanton

1 - H. Sullivan