Articles Section

EXPERIMENTAL DICHOTIC TESTS IN FRENCH MODELED ON SSW TEST DESIGN

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Currently there are no central auditory speech tests suitable for the French speaking populations of Canada. The design of the Staggered Spondaic Word (SSW) Test has clinical characteristics and cross-linguistic adaptability that recommend it for development in French. This study reports on the development of a set of French SSW word lists and tapes. Nine word lists were prepared, each based on a different linguistic cohesion between the competing and the non-competing words presented to each ear. Three of these used a semantic linkage, four used a syntactic linkage, and two used a non-linkage. For each of the nine lists, two dichotic alignment conditions were taped. These are word center alignment and word onset alignment. These French SSW tapes are now available for trial clinical use and experimental research.

Il n'existe actuellement aucun test d'orthophonie auditive centrale qui convienne à la population de langue française du Canada. La conception du Test du mot spondaique décalé (Staggered Spondaic Word-SSW) presenté des caractéristiques cliniques et une adaptabilité interlinguistique qui favorisent son adaptation en français. Cette étude fait part de la mise au pointe d'un ensemble de bandes et de listes de mots SSW français. Neuf listes de mots ont été préparées, basées chacune sur une cohésion linguistique différente entre les mots simultanés et non-simultanés présentés à chaque oreille. Trois de ces listes utilisaient une relation sémantique, quatre une relation syntactique et deux utilisaient une non-relation. Pour chaque liste on a enregistré deux situations d'alignement dichotique. Il s'agit d'alignements de milieu de mot et de début de mot. Ces bandes SSW en français sont maintenant disponibles pour essais cliniques et recherche expérimentale.

Central auditory testing encompasses all audiological procedures used to evaluate the central auditory nervous system (CANS). A wide variety of procedures are available, including both behavioral and physiological tests, using both speech and non-speech stimuli. Dichotic tests form a sub-class of the behavioral speech tests. They entail the simultaneous presentation of different messages to each ear. Dichotic tasks may require the subject to repeat the messages presented to both ears, or to only repeat the message presented to the target ear while ignoring the contra-lateral message. In either case, the messages should compete for the subject's processing capacities.

The dichotic paradigm was first used in experimental psychology by Cherry (1953) and Broadbent (1954). Feldmann (1960) made the first dichotic speech test (in German) designed explicitely for central auditory testing. In the Feldmann Test, numbers such as twenty-six and forty-seven are presented to different ears simultaneously. Kimura (1961) made an audiologic dichotic test in English in which three digits are presented simultaneously to each ear. In 1962, Katz described the Staggered Spondaic Word (SSW) Test, designed for central auditory testing in a clinical setting. A number of other dichotic speech tests are also available for clinical use. These include the

Synthetic Sentence Index with a contra-lateral competing message (SSI-CCM) (Speaks & Jerger, 1965), the Competing Sentences Test (Willeford, 1968), and Berlin's simultaneous and time-staggered CV syllables tasks (Berlin et al., 1968; Lowe et al., 1970).

Of these tests, the SSW is currently the most widely used in clinical audiology (Martin & Forbes, 1978). The clinical usefulness of the SSW has been substantiated by numerous reports in the journal literature (Katz, 1962; Katz et al., 1963; Katz, 1968; Balas, 1971; Lynn et al., 1972; Gilroy & Lynn, 1974; Jerger & Jerger, 1975; Stubblefield & Young, 1975; Lynn & Gilroy, 1976; Winkelaar & Lewis, 1977; Lucker, 1980; Musiek & Sachs, 1980; Johnson et al., 1981; Musiek & Morgan, 1981; Musiek et al., 1982). In the most recent review of the SSW (Brunt, 1978), a number of characteristics of the SSW are identified which are clinically advantageous:

1. It is an easy task for a wide range of normals, yet challenging for those with CANS disorders.

2. The raw SSW score can be corrected for errors due to peripheral hearing loss.

3. Since the SSW alone yields 9 scores, both quantitative assessments of the amount of error and qualitiative assessments of the error patterns are possible.

4. Although the SSW is primarily a test for Heschl's gyrus lesions, it is also sensitive to disorders of other cortical and subcortical areas.

5. The SSW is essentially free of laterality effects caused by hemispheric dominance for speech.

These characteristics are due in large part to the design of the SSW Test. First of all, the test uses spondaic words, which have a steep articulation function (Hirsh et al., 1952). The words were recorded with a brief pause between the two monosyllables of each spondee. For each SSW item, a spondaic word to one ear is matched with a spondaic word to the other ear in a time staggered manner. Thus, the last half of the first spondee is over-lapped with the first half of the second spondee. This is illustrated in Figure 1. Note also that the two spondees for each item are selected to allow a foil

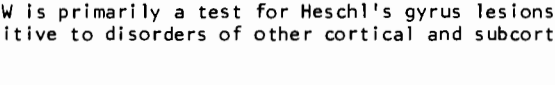

Figure 1: This is item 5 from the SSW EC list. Corn-bread begins in this right ear (RE) in channel 1. Then oat-meal begins in the left ear (LE) in channel 2. Bread and oat are presented dichotically, one to each ear. Note that the two non-competing monosyllables can be combined to make the foil item, corn-meal.

combination of the first and the last monosyllables. The subject is presented a relatively short list of 40 of these items, alternating half starting in the right ear and half in the left. Finally, a carrier phrase precedes each item in the lead channel and the presentation level is reasonably loud at 50 dB SL, re: SRT (Brunt, 1978).

The SSW has been modeled in a number of English dialects and foreign languages. These are listed in Table 1, along with example items. Notice that there is a certain flexibility in accommodating the phonological characteristics of the language to the SSW design. The invariant element is that each item is composed of two meaningful expressions (i.e. corn-bread and oat-meal), which in turn are composed of two meaningful words (i.e. corn and bread, and oat and meal). Finally, the first and last words of each item must be combinable to form a third meaningful expression (i.e. corn-meal). This is the foil item to encourage errors by those who are disrupted by the dichotic competition, further driving normal and abnormal scores apart.

Table 1.

A list of SSW versions in English dialects and foreign languages. The ranking is by chronological order of development, with the ~~Origina~~' EC on top. From Rudmin, 1980.

SSW Versions	Example Items
American English	up-stairs/down-town
Indian English	(not available)
English English	cream-bun/high-tea
Turkish	kara-kedi/mavi-deniz
Hebrew	erav-shabat/yeled-tov
Japanese	kata-kana/migi-ashi
Portuguese	porta-mala/uma-luva
Danish	land-skab/vogn-mand
Spanish	cafe-negro/nino-blanco

Currently, there are no central auditory speech tests designed specifically for the French speaking populations of Canada. According to the 1981 census, over 6 million, or 26% of the Canadian population are francophone, approximately 90% of whom live in Quebec (Census of Canada, 1981: Population: Mother Tongue, 1982). Speech-in-noise socres and PB-PI functions can be obtained using existing speech discrimination lists, and a French version of the SSI is under development (Normandin & Lynch, in preparation). However, because of the clinical strengths of the SSW already discussed, and because of its apparent adaptability to different languages, it may be clinically useful to develop a French version of the SSW Test.

The purpose of this study was to create a number of experimental SSW word lists in French and to record and align these to produce tapes for trial clinical use and experimental research. A subsequent paper (Normandin & Rudmin, in preparation) will describe some initial test results with these tapes. Ultimately, the viability of a French version of the SSW and the selection of a best French SSW word list and tape will depend on clinical findings.

Method

The first task was to prepare SSW word lists that would be linguistically suitable for the Quebec French population. Since French has no direct equivalent to the English spondaic word (Picard, in press), a number of possibly viable message units were considered. One 40-item list and eight 10-item lists were devised. Examples of these are shown in Table 2, and full word lists appear in the appendices. List A, the 40-item list, was modeled most directly on the English SSW. Lists B through I were considered to be more experimental, in that they used special types of linkage between the competing and non-competing portions of the words in each channel.

Table 2.

Example itsm from experimental French SSW lists.

French SSW Lists	Example Items
A. Bisyllables	grande-vente/quelle-joie
B. Numbers	trente-deux/dix-sept
C. Subject Pronoun-Verb	on-lit/elle-trouve
D. Imperative-Object Pronoun	mange-la/pige-les
E. Unrelated Monosyllables	bague-ciel/page-fleur
F. Vowels	in-eu/un-o
G. Names	Jean-Pierre/Anne-Marie
H. Adjective-Noun	ta-lampe/sotte-mere
I. Indirect Object Pronoun-Verb	lui-donne/la-roule

The selected words were not sampled in any empirical manner, since for each item, the first half of the first word and last half of the last word must be able to be combined to form a meaningful foil word. However, efforts were made to select expressions common to the greater Quebec population. These expressions utilized words from current French speech discrimination lists (Benfante et al., 1968), from a children's dictionary (Fonteneau & Poiré, 1956), and from Quebec newspaper idiom. Preliminary items were prepared by a francophone audiologist familiar with the SSW test and the constraints imposed on item selection by word familiarity, phonological homogeneity, age appropriateness of words for children and the need for a meaningful foil option. No efforts were made to make lists phonetically balanced and representative of common oral French. The preliminary items were then examined by several native speakers, including a person over age 60 and a child. Unfamiliar or questionable items were changed. Also, items with possible emotional overtones, such as "chien fou" were discarded. Finally, the expression, "Ecoutez bien," was chosen as the carrier phrase.

The word lists were recorded one channel at a time by an educated female francophone speaker, native to Montreal. Equipment consisted of a Revox A77 Dolby recorder with a condenser microphone. To allow common acoustic reverberation, recording was done in a laboratory room during quiet hours, rather than in an audiological soundroom.

Alignment was done by a method recommended by Rubino (1972) and utilized by Rudmin (1978) in the preparation of a Japanese SSW tape. In brief, the initial recording was threaded on a reel-to-reel tape player so as to bypass the capstan. The tape was then manipulated by hand while the output was monitored via earphones. For the competing monosyllables on each item, word onsets and word offsets were identified auditorily and marked directly on the tape. The word durations were measured, and a third mark was made to locate the word centers, i.e. the duration mid-points.

A master copy tape was prepared for the alignment process by dubbing the carrier phrase "Ecoutez bien," at regular intervals in alternating channels. This was threaded on a SONY TC-330 stereo recorder with input connections from two monophonic Revox A77 Dolby players. A tape for each channel, marked as described above, was loaded on the monophonic players. The alignment reference mark on each monophonic player was set at a common distance from the playback head. The carrier phrase on the master copy tape was similarly set to a fixed distance from the record head. Then, simultaneously, the master copy tape recorder was started in "record" and the two monophonic systems were started in "play". Care was taken that the lead channel alternated to follow the carrier phrase.

This process was repeated twice for each item, since two tapes with different dichotic alignments were prepared. One dichotic alignment was to be based on simultaneous word centers. This means that the mid-points of the competing monosyllables were aligned. This is the dichotic alignment pattern most common on the commercially available SSW EC tape (Rudmin & Katz, 1982). However, Beasley & Rintelmann (1979) have suggested that the SSW would be more effective with word onset alignments. To cover that possibility, a second alignment was made on the criterion of simultaneous word onsets for the competing monosyllables.

Final tapes for each alignment condition were made on SONY TC-K81 Stereo Cassette Decks. Intensity in each channel was maintained for a peak value of 0 dB VU + 3 dB. The tapes were arranged to have a 1k Hz calibration tone and instructions recorded in both channels. Then list A and the experimental lists B through I were added. Note that each list was preceeded by four practice items, presenting a monophonic and a binaural non-dichotic item to each ear.

Discussion

Each of the French SSW word lists embodies a different linguistic linkage between the two monosyllables presented to each ear. Brunt (1978) has hypothesized that the semantic linkage between the two monosyllables of each spondee on the SSW EC list is critical to the ease of the test for normal subjects. In preparing the experimental French SSW word lists, several types of semantic linkage were used (on lists A, B, G), as well as various types of syntactic linkage (on lists C, D, H, I) and non-linkage (on lists E. F). There is no *a priori* certainty which of these linkage conditions will be of clinical value, which of research value, and which of no value. It is conceivable that the different linkage conditions will challenge the CANS differently. Therefore, a best clinical tape might incorporate a melange of items, or a set of SSW sub-tests.

The recording and alignment techniques were constrained to a large extent by the availability of equipment. Efforts were made to get the use of a two channel digital computer speech processor to allow controlled alignment by subjective judgements of dichotic simultaneity. But the Rubino (1972) method seemed a best second choice. Oscilloscopic assessment of alignments was not pursued since Freeman & Beasley's (1976) and Matthies & Garstecki's (1980) experiences with that process seemed to show considerable error in determining the onsets of non-sonorant phonemes (Rudmin & Katz, 1982; Rudmin, 1981a; 1981b). It is not yet known empirically what dichotic alignment criterion is the best for clinical applications of staggered dichotic tests. But pilot studies by Katz (1968) and a recent correlational study of normal as well as clinical subjects by Rudmin (in press) both suggest that word onset alignment is to be avoided since it tends to depress the performance of normal subjects while not affecting that of abnormals.

One apparent characteristic of the tapes resulting from the preparation technique is the presence of 60 cycle noise. The signal-to-noise ratio has been measured at 56 dB using a Real Time Analysis System by General Radio. This is probably due to the absence of a 60 cycle line filter during the recording and alignment of the tapes. Similar 60 cycle noise is present on the commercially available SSW EC tape. Matthies & Garstecki (1980) have hypothesized that such noise may be detrimental to the test's clinical efficiency. But it has yet to be determined empirically whether such noise increases or decreases the clinical efficiency of the SSW.

In conclusion, a set of French SSW tapes has been prepared. Nine different linguistic linkage conditions and two different alignment conditions are available. Research is now needed to determine the clinical value of these. Audiologists interested in collaborating in normative, clinical or research studies may obtain copies of the tapes and scoring forms from Nicole Normindin at the University of Montreal.

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APPENDIX A

Bisyllables

a. bruit-fort/sage-femme

b. mai-trop/ma-lin

c. pou-pont/bout-ton

d. plantes-vertes/ciel-bleu

1. grand-mere/pole-nord	2. porte-cle/mille-feuille
3. belle-soeur/blanche-neige	4. bon-soir/gout-the
5. bois-franc/beurre-mou	6. sou-pire/de-daim
7. bien-tot/par-fait	8. mont-the/drap-blanc
9. cou-leur/faux-taux	10. temps-clair/lait-frais
11. chant-the/chaud-son	12. c'est-bon/tant-mieux
13. sous-vent/bout-sol	14. bien-sur/plus-tard
15. grande-vente/quelle-joie	16. bon-coeur/grille-pain
17. grand-terre/beau-pere	18. casse-nois/serre-tete
19. peau-douce/herbe-seche	20. pomme-verte/joue-rouge
21. par-don/gratte-ciel	22. faux-cils/tout-chez
23. bouche-trou/table-ronde	24. sur-prise/pin-saut
25. de-part/veau-tour	26. cou-pont/bout-chez
27. beau-temps/gout-the	28. pie-lier/seule-ment
29. tout-chez/bon-jour	30. eau-taux/voie-scie
31. cure-dent/bonne-pipe	32. pre-lard/grand-dire
33. bout-fond/sou-daim	34. pou-mont/cou-saint
35. chat-noir/tant-tot	36. roue-lot/de-lit
37. sa-pin/pou-voir	38. Saint-Jean/fee-lin
39. pou-lie/chape-laid	40. gars-taux/port-the

APPENDIX B

Numbers

a. trente-deux/dix-sept

b. vingt-huit/cent-neuf

c. il-parle/tu-sautes

d. bonne-chance/beau-temps

1. trente-deux/dix-sept	2. douze-cent/quatre-mille
3. vingt-huit/cent-neuf	4. cent-onze/vingt-huit
5. vingt-cinq/dix-huit	6. cent-deux/trente-quatre
7. six-mille/cinq-cent	8. trente-six/trois-mille
9. mille-dix/cent-un	10. cent-deux/vingt-huit

APPENDIX C

Pronoun-Verb

a. trente-deux	b. vingt-huit/cent-neuf
c. il-parle/tu sautes	d. bonne-chance/beau-temps

1. il-coure/tu-joues	2. tu-chantes/je-dis
3. on-lit/elle-trouve	4. elle-saigne/ca-bouge
5. elle-valse/il-berce	6. je-classe/tu-manges
7. tu-suces/elle-pige	8. on-lutte/je-chante
9. il-cause/on-joue	10. je-tape/on-rit

APPENDIX D

Imperative-Object pronoun

a. trente-deux/dix-sept	b. vingt-huit/cent-neuf
c. il-parle/tu-sautes	d. bonne-chance/beau-temps

1. trouve-la/dis-le	2. chante-lui/donne-leur
3. mange-la/pige-les	4. joues-leur/rit-la
5. touche-les/tape-le	6. marque-le/perce-les
7. donne-lui/roule-la	8. change-le/fais-la
9. lis-leur/gage-lui	10. ouvre-leur/porte-le

APPENDIX E

Unrelated Monosyllables

a. trente-deux/dix-sept	b. vingt-huit/cent-neuf
c. il-parle/tu sautes	d. bonne-chance/beau-temps

1. quel-donne/taire-signe	2. bague-ciel/page-fleur
3. pomme-coule/mur-cloche	4. sud-nuque/mur-parc
5. ville-rose/banque-levre	6. jambe-maître/gomme-blesse
7. rare-gage/soif-noce	8. choc-mode/sucre-larme
9. vide-tour/sur-car	10. grec-luxe/pauvre-gaz

APPENDIX F

Vowels

a. trente-deux/dix-sept

b. vingt-huit/cent-neuf

c. il-parle/tu-sautes

d. bonne-chance/beau-temps

1. i-è/ou-é	2. a-eu/on-in
3. eu-i/è-a	4. ou-a/u-on
5. in-u/é-i	6. o-un/é-an
7. a-o/on-un	8. eu-è/é-a
9. in-eu/un-o	10. u-un/o-on

APPENDIX G

Names

a. trente-deux

b. vingt-huit/cent-neuf

c. il-parle

d. bonne-chance/beau-temps

1. Jean-Pierre/Anne-Marie	2. Pierre-Luc/Léo-Paul
3. Marie-Marthe/Eve-Lynne	4. Marie-Paul/Jean-Claude
5. Pierre-Paul/Jean-Yves	6. Jean-Louis/Léo-Paul
7. Marie-Rose/Jean-Paul	8. Marie-France/Jean-Luc
9. Jean-Yves/Marie-Pierre	10. Jean-Jules/Marie-Luc

APPENDIX H

Adjective-Noun

a. trente-deux/dix-neuf

b. vingt-huit/cent-neuf

c. il-parle/tu-sautes

d. bonne-chance/beau-temps

1. ta-lampe/sotte-mère	2. votre-nez/bon-jeu
3. robe-jaune/bas-rouge	4. gros-pieds/beau-chat
5. grande-valse/belle-salle	6. pain-chaud/pâte-noire
7. ta-barbe/notre-fille	8. sa-blouse/ma-bière
9. notre-ville/vos-mains	10. son-chat/tes-chiens

APPENDIX I

Indirect Object Pronoun-Verb

a.	trente-deux/dix-neuf	b.	vingt-huit/cent-neuf
c.	il-parle/tu-sautes	d.	bonne-chance/beau-temps

1.	le-trouve/la-dis	2.	lui-chante/leur-donne
3.	la-mange/les-pige	4.	leur-joues/la-rit
5.	les-touches/le-tape	6.	le-marque/les-perce
7.	lui-donne/la-roule	8.	le-change/la-fais
9.	leur-les/lui-gage	10.	leur-ouvre/le-porte