1. REFLEXES: Ask questions about coughing, swallowing, drooling, and observe. Ask the patient to drink a glass of water as fast as possible (not suitable for all patients, especially if swallowing problems are suspected)! Observe lip seal during drinking. Besides the areas covered in the Frenchay test, assess separately:

- Strength of tongue and mandible, reflexes of pharynx and soft palate, sensory function of the articulators (equipment: spatula, flashlight, cotton sticks).

2. BREATHING: Observe the breathing pattern of the patient during rest and speech. Additional tasks: Ask the patient to inhale strongly and then release the air in a prolonged and even manner (≥5 seconds is normal). Ask the patient to count from 1-20 as fast as possible. Ask the patient to count from 1-20 as fast as possible and observe. Ask the patient to drink a glass of water as fast as possible.
FRENCHAY DYSARTHRIA

MUSCLES RELEVANT FOR BREATHING:

**FUNCTIONING OF THE DIAPHRAGM**

**INHALATION**

**EXHALATION**

FRENCHAY DYSARTHRIA ASSESSMENT
FRENCHAY DYSARTHRIA ASSESSMENT

MUSCLES RELEVANT FOR BREATHING:

3. LIPS: Observe the lips during rest and speech.

Additional tasks: Ask the patient to produce an exaggerated smile or grin. Ask the patient to repeat /pa/ 10 times as clearly as possible and exaggerating lip closure (observe the strength of the closure). Ask the patient to repeat /uu - ii/ 10 times as fast as possible by exaggerating lip movements (observe symmetry of spread and puckering, measure time).
4. MANDIBLE: Observe the position of mandible in rest and during speech. Note deviations to either side, and the ability of the patient to control jaw movements.

5. SOFT PALATE: Observe the functioning of the nasopharynx during drinking (any liquid coming out of the nose). Test several times and close the nostrils occasionally: does nasality increase? Additional task: Ask the patient to open mouth and repeat /a/ several times with a short pause between productions. Observe whether soft palate raises symmetrically, and whether the pharyngeal arches are symmetrically and whether the soft palate rises symmetrically. Ask the patient to repeat "aa-ii" test several times and close the nostrils occasionally: does nasality increase? Ask the patient to repeat 'aa-ii-' test several times and close the nostrils occasionally: does nasality increase? Ask the patient to repeat "aa-ii-" test several times and close the nostrils occasionally: does nasality increase? Ask the patient to repeat "aa-ii-"
6. LARYNX: Observe voice quality during speech.

Additional tasks:
- Ask the patient to produce “ka-la” as long as possible.
- Ask the patient to sing at least six notes with different pitch.
- Ask the patient to count 1-5 with increasing loudness starting with a whispering voice.

7. TONGUE: Observe tongue movements during speech.

Additional tasks:
- Ask the patient to protrude and pull back the tongue five times as fast as possible.
- Ask the patient to raise and lower the tip of the tongue five times.
- Ask the patient to produce “ka-la” 10 times as fast as possible (measure time for all these tasks).
- Ask the patient to produce /a/ as long as possible.
FRENCHAY DYSARTHRIA ASSESSMENT

ARTICULATORY PARAMETERS OF THE TONGUE

1. Horizontal (anterior-posterior) movement of the tongue
2. Vertical movement of the tongue
3. Horizontal movement of the tip and dorsum of the tongue
4. Moving the shape of the tip and dorsum of the tongue (formation of the groove) (sibilants)
5. Convex or concave formation of the tongue (in relation to the palate) (liquid sounds)
6. Changing the shape of the tip and dorsum of the tongue (formation of the groove) (sibilants)
7. Narrow/broad tongue shape

FRENCHAY DYSARTHRIA ASSESSMENT
Lesion in the upper or lower motor neuron.
15. FRENCHAY DYSARTHRIA

8. SPEECH INTELLIGIBILITY: Estimate speech intelligibility using the set of words and sentences (which is actually a word intelligibility test in a fixed sentence frame). Estimate also the intelligibility of spontaneous speech.

16. PERCEPTUAL EVALUATION OF INTELLIGIBILITY OF SPEECH

1. PERCEPTUAL TESTS OF INTELLIGIBILITY
2. SOME LIMITS OF AUDITORY PERCEPTUAL ASSESSMENT OF SPEECH DISORDERS
3. PHONETIC INTELLIGIBILITY TEST OF DYSARTHRIC SPEECH
4. ASSESSING INTELLIGIBILITY WITH PRAT

KEY READINGS:


PERCEPTUAL EVALUATION OF
INTELLIGIBILITY OF SPEECH

Setting the Scene:
Speech subsystems related to intelligibility involve consonantal and vowel contrasts, prosody, nasality (but strangely, not voice; cf. Parkinson’s disease), D2K and rate analytics, information analytics, Vowel analytics, Consonant analytics, Nasal resonance analytics, Voice Quality, Voice analytics, Rate and Prosody, Intelligibility.

Listener: Speaker’s intended message is recovered by the degree to which the source of speech, i.e., the speaker, correctly recognized words by the listener in a specified environment.

Intelligibility Measures

What do we mean by speech intelligibility?
AUDITORY-PERCEPTUAL EVALUATION OF INTELLIGIBILITY IS THE CLINICAL STANDARD

WHAT IS REQUIRED FROM A DECENT TEST?

1. The ideal scale should permit reliable discriminations between normal and disordered speech.

2. It should permit reliable detection of intra-speaker changes.

3. Users of the test should have a common understanding of the labels given to perceptual dimensions (parameters) such as hoarse, nasal, monotonous, rough, equal stress, etc.

4. Users should be able to isolate perceptual judgments for normal and disordered speech.

5. Test should have uniform reliability in judging the various dimensions that provide a complete clinical pattern of speech disorders.

6. Listeners should be able to make perceptual judgments for which intra-judge differences are smaller than the differences needed for clinical classification.

7. The test should have explanatory information about the underlying disorder.

SCALING METHODS

DIRECT MAGNITUDE ESTIMATION (DME)

Listener assigns a number to each stimulus that represents a ratio of that stimulus to a standard (or reference) stimulus. The reference can be specified by the experimenter or selected by the listener.

(EQUAL-APPEARING) INTERVAL SCALING

Listener assigns a number that represents a linear partition of a scale. The ideal scale should permit reliable discriminations between normal and disordered speech.

SCALING METHODS AND ITEM IDENTIFICATION ARE THE TWO MAIN METHODS TO MEASURE INTELLIGIBILITY.
INTELLIGIBILITY MEASURES

PROBLEMS WITH INTELLIGIBILITY TASKS (1)

1. Judges do not appear to have equivalent definitions of dimensions to be rated
2. Judges fail to reach consensus on which perceptual dimension should be rated for a given disorder
3. Perceptual ratings of different dimensions are in many cases not independent (i.e., they are inter-correlated)
4. Ratings are not uniformly reliable across perceptual dimensions
5. Differences among expert judges are larger than the differences needed for diagnostic classification (or effects of intervention).
6. Sometimes judges hear something that is not in the signal. Auditory illusions (phonemic restoration, verbal transformations)

PROBLEMS WITH INTELLIGIBILITY TASKS (2)

7. Discriminable differences between stimuli may not be uniform (categorical perception)
8. Judges may have different listening strategies when trying to retrieve the linguistic message; this increase variability (listen to stress/intonation pattern, try to recognize words, pay attention to stressed vowels etc.)
9. Effect of lexical status on phonetic categorization: misperceptions of natural speech (segmental errors, lexical confusions, mislocated word boundaries)
10. Perceptual assimilation (similar to listening to L2) affect phonetic judgments (dysarthric speaker provides atypical speech)

Lexical bias is present which may prevent hearing subtle changes.
INTELLIGIBILITY MEASURES

PROBLEMS WITH INTELLIGIBILITY TASKS (3)

1. Visual information may override or complement auditory information especially when the auditory signal is degraded (McGurk effect).

2. Prosodic variation influences phonetic judgments. 

3. Physical appearance of the patient may affect phonetic judgments - BIASING EFFECTS OF SPEAKER CHARACTERISTICS

SOME GENERAL PROCEDURAL ISSUES (1)

1. MODE OF STIMULUS PRESENTATION

- Reliability is usually better for live than for recorded samples.

- Differences among rating scales:
  - If the perceptual dimension is one that varies in quantity (such as loudness), both equal-appearing scale (EAS) and direct magnitude estimation (DME) are fine.
  - However, if the dimension varies in quality (such as pitch), DME is more reliable. Most speech categories are complex and probably vary in quality.

- Differences in sample size:
  - Reliability is usually better for live than for recorded samples.

INTELLIGIBILITY MEASURES

1. Problems with Intelligibility Tasks (3)

2. Degraded (McGurk effect)

3. Visual information may override or complement auditory information especially when the auditory signal is degraded (McGurk effect).
AUDITORY SALIENCE OF SPEECH CHARACTERISTICS
- Listeners seem to be more sensitive to slowly varying temporal components and less to rapid changes.

LISTENER CHARACTERISTICS
- Listeners can adapt to atypical patterns of speech production, but familiarity and experience to atypical speech sometimes increases reliability.

TOP-DOWN INFORMATION BIASES PHONETIC JUDGMENT
- Previous knowledge of the test items improves accuracy and reliability.

WHAT CAN BE DONE TO IMPROVE RELIABILITY? (1)
1. BE AWARE OF THE DIFFERENT PITFALLS! RECOGNIZE THE SOURCE OF VARIABILITY.
2. SELECT THE TEST ACCORDING TO THE SPEECH MATERIAL AND CLIENT CHARACTERISTICS.
3. USE REFERENCE SAMPLES AND TRAINING IN SCALING STUDIES TO IMPROVE RELIABILITY.
4. THINK ABOUT HOW YOU CODE RESPONSES.

- More is sometimes less in perceptual judgment, especially when listeners are faced with a multidimensional stimulus (such as disordered speech or voice); is 1-10 better than 1-5 scale? How many dimensions to be judged?

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INTELLIGIBILITY MEASURES

WHAT CAN BE DONE TO IMPROVE RELIABILITY? (2)

5. RELIABILITY CAN BE IMPROVED BY USING INSTRUMENTAL METHODS TO SUPPLEMENT AUDITORY-PERCEPTUAL JUDGMENTS
   - Instrumental measurements are presumably more reliable and precise, and can inform about inconsistencies in perceptual judgments (e.g., VOT contrast may be present but due to assimilation, not discriminable).

6. CORRELATION BETWEEN PERCEPTUAL DIMENSIONS AND INSTRUMENTAL MEASUREMENTS CAN BE IMPROVED BY SELECTING THE RIGHT PSYCHOACOUSTIC SCALE (e.g., Hz, Mel, ERB or Bark for “pitch”).

7. USE A PHONETICALLY BALANCED ITEM IDENTIFICATION TEST TO OBTAIN EXPLANATORY INFORMATION ABOUT THE LOCUS OF IMPAIRMENT (Kent et al., 1989).

TWO INTELLIGIBILITY TESTS

INTELLIGIBILITY WITH PRAAT

- Multiple choice test (Kent et al., 1989) and equally-appearing interval scale (rating)

- Two dysarthric speakers, MH & JF (Nemours Database of Dysarthric Speech) plus a healthy control (JP)

- Materials on Internet (http://www.abo.fi/~jtuomain/EMCL)

- Create folder “sounds” on the desktop of your computer

- Download the Praat programs “IntelligibilityRating.txt” and “MCQ-Dysarthria.txt” on the Desktop.

- Start Praat and perform “Intelligibility Rating” first, followed by the “Multiple Choice Test.”

- Download Praat programs “IntelligibilityRating.txt” and “MCQ-Dysarthria.txt” and sound files to the respective folders.

- Two INTELLIGIBILITY TESTS

- Materials on Internet (http://www.abo.fi/~jtuomain/EMCL)

- Dysarthric speech (plus a healthy control (JP))

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INTELLIGIBILITY WITH PRAAT

TWO INTELLIGIBILITY TESTS

- Total of 24 samples, each repeated once

The words provide information on the following phonetic contrasts:

1. Syllable final voicing and place of articulation of stop consonants ("bad/bat/bag/back")
2. Vowel contrast (front vowels: "bait/bet/beat/bite"; back vowels: "boat/butt/boot/bite")
3. Syllable final fricative ("bath/bass/bash/batch")
4. Syllable initial (front vowel context: "thin/sin/shin/chin");
5. Syllable initial (back vowel context: "sue/shoe/who/chew")

When you listen to the samples, use paper and pen to take additional notes on specific issues, such as voice quality, segmental errors, if you are unsure about your decision etc.

FRENCHAY PROFILES FOR MH & JF

Two Intelligibility Tests

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  - Syllable final voicing and place of articulation of stop consonants ("bad/bat/bag/back")
  - Vowel contrast (front vowels: "bait/bet/beat/bite"; back vowels: "boat/butt/boot/bite")
INTELLIGIBILITY WITH PRAAT

Preliminary Analysis

- Use confusion matrix in Praat
- Draw the matrix and inspect your results
- Save the data on the desktop

MULTIPLE CHOICE: JF

Difficult, e.g., “bath” identified twice as “batch”

Inspect the confusion matrix for what contrasts are most difficult.