Competing Sentences Test: Adapting it to the Singapore Population Using Diotic Presentation – A Pilot Study

Principal Investigator: Dr Jenny Loo, Principal Audiologist, NUH
Co-Investigator: Maureen Ding, MSc Audiology student, NUS
Introduction
Competing Sentences Test (CST) (Willeford & Burleigh, 1994)

TEST OF BINAURAL SEPARATION:
ABILITY TO SEPARATE DIFFERENT AUDITORY STIMULI PRESENTED SIMULTANEOUSLY TO BOTH EARS (Dichotic Listening)

Target sentence at 35dBHL
In one ear

Ignore competing & repeat target sentence

Competing sentence at 50dBHL
In other ear

In one ear

In 35dBHL

Ignore competing & repeat target sentence

Target sentence at 35dBHL
In one ear

Competing sentence at 50dBHL
In other ear

In 50dBHL

NUS MSc (AUDIOLOGY)
Agenda

1. Aim & Hypothesis
2. Background
3. Methodology
4. Results
5. Discussion & Clinical Implications
6. Future Study
1. Aim & Hypothesis

**Aim:** To record and adapt the Competing Sentences test (CS test) material to the Singapore test population

**Hypothesis:** Singapore children will perform better on the adapted Singapore version of the CS test compared to the US version
2. Background

• Both language background and language-related disorders significantly impact performance for CS test, with its reasonably heavy linguistic as well as memory load (Loo, Bamiou & Rosen, 2013; Hull & Vaid, 2007).

• SCAN and SCAN-C (recorded in General American English) revealed that British school children performed much worse than US norms for most age groups and this resulted in a greater rate of over-diagnosis of listening difficulties (Dawes & Bishop, 2007; Marriage et al., 2001).

• Marriage et al. suggested that the test material be recorded by a UK English speaker, with substitution of high error-rate target words, followed by normative data collection for the revised test material.
2. Background

• Singapore adopted English as first language in 1965. Education system is bilingual since 1985. Each child learns English and his/her own Mother Tongue.

• **Singapore English has developed as independent type of English**, with unique style of pronunciation, grammar, and usage common to all ethnic groups (Deterding, 2007)

• Phonetic and phonological features of Singapore English include distinct consonants and vowels as well as unique suprasegmental features such as rhythm, intonation, and stress placement.

• Supports premise that **CS Test should be adapted to the local population using Singapore English**
Background summary

CS test (AUDiTEC) recorded in General American English and normed based on US population

Inappropriate for Singapore given CS test is a linguistically loaded task

Need to record and adapt CS test to Singapore test population to account for accent differences and word familiarity.
3. Methodology

Record CS test with Singaporean male speaker

Administer US CS test and SG CS test using diotic presentation to normal children to compare performance between 2 tests

Identify any high error-rate target words in SG CS test for re-recording or removal

Diotic presentation: Better delineation of accent and word familiarity effects without binaural separation ability needed in dichotic listening
Record Singapore CS test

Audio recording of CST at Yong Siew Toh CoM with Singaporean male speaker

Edited using Pro Tools: Each dichotic sentence with equal onset and offset times

10 sec interval in between each sentence to serve as response time

Digital data equalized for overall intensity using calibration tone of 1 KHz

Note: Parameters chosen to match that of original US CS test material
21 subjects recruited and met criteria

**Subject Inclusion Criteria**
- Aged 7-12 years old: youngest population tested (Willeford & Burleigh, 1994)
- Normal hearing
- Born and raised in Singapore

**Subject Exclusion Criteria**
- Previous diagnosis of developmental, language or learning disorders

Note: Sample of 10 or fewer may suffice assessing clarity of instructions or item working, acceptability of formatting, or ease of administration (Hertzog, 2008). Yet another study advocated a sample size of 12 as a rule of thumb for pilot study (Julious, 2005)
Screening and Testing

Screening

✔ PTA (500, 1k, 2k and 4kHz)
✔ Tympanometry
✔ TAPS – 3 Memory
✔ TONI – 3 Intelligence
✔ CELF – 4 Core Language

Testing

➔ Listen and repeat CS test sentences at 60dBHL presented diotically
➔ Order of US vs. Spore CS test randomized
➔ Order of CS test version is reversed in follow-up visit

✔ Scoring of test results using Bellis Quadrant method (Bellis, 2003) and
✔ Identification of high error-rate target words based on threshold of errors greater than 20% of subjects in both test and retest. Reliability of SCAN test on British schoolchildren: Specific items greater than 40% errors considered high rate (Marriage et al, 2001)
4. Results

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>25&lt;sup&gt;th&lt;/sup&gt; percentile</th>
<th>50&lt;sup&gt;th&lt;/sup&gt; percentile</th>
<th>75&lt;sup&gt;th&lt;/sup&gt; percentile</th>
</tr>
</thead>
<tbody>
<tr>
<td>SG CS Test</td>
<td>21</td>
<td>583.75</td>
<td>592.50</td>
<td>596.25</td>
</tr>
<tr>
<td>US CS Test</td>
<td>21</td>
<td>560.00</td>
<td>581.25</td>
<td>590.00</td>
</tr>
<tr>
<td>Asymp. Sig. (2 tailed)</td>
<td>0.000</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total score is 600

Wilcoxon Signed Rank Test showed a decrease in scores of US_CST sentences compared to SG_CST sentences with a large effect size ($r = 0.59$) at significant confidence level ($p < 0.0005$)
### 4. Results

<table>
<thead>
<tr>
<th>Sentence</th>
<th>Frequency of errors (%)</th>
<th>Type of error</th>
<th>Substituted with</th>
</tr>
</thead>
<tbody>
<tr>
<td>You must <em>write</em> to her more often</td>
<td>19.0</td>
<td>Substitution</td>
<td>“try”, “tried”, “try to talk”</td>
</tr>
<tr>
<td>He’s off for <em>Easter</em> week</td>
<td>14.2</td>
<td>Substitution</td>
<td>“east-a”, “at least a”</td>
</tr>
<tr>
<td>I <em>had</em> a wonderful Christmas</td>
<td>14.2</td>
<td>Substitution</td>
<td>“have”, “got”</td>
</tr>
</tbody>
</table>

Responses to SG_CST sentences did not have any word error made by greater than 20% of subjects in both test and re-test.
5. Discussion

Singaporean children were able to listen to and correctly repeat the new SG_CST significantly better than the US_CST.

Mismatch of US accented input to Singapore listener’s lexical representations lead to greater processing load and higher error rates (Menyuk, 1969).
5. Discussion

SG_CST did not have high error-rate target words

SG_CST deemed appropriate for future use for gathering of normative data on Singapore population and as part of clinical test battery
5. Discussion - Clinical Implications

- CST being a speech based test and influenced by language, **different approaches can be taken to minimize influence of cultural diversity of subjects on administration of tests** (Semel et al, 2006).

1. Study found bulk of errors to be grammatical
   - More liberal approach to scoring in clinical testing. Dialectal variations counted as correct if appropriate given language background (Semel et al, 2006)

2. Study shows benefit of practice trials using diotic or monotic presentation before dichotic testing
   - To ensure adequate sentence recognition and familiarize them with task (Weihing & Samuel, 2014)
5. Discussion - Clinical Implications

- Variations in scoring pose limitations to standardizing CS Test for clinical use (Musiek et al, 2011). Study demonstrates need for **standardized approach by clinicians**.

1. Scores dependent on quadrant separation
   - Use standardized method of separation

<table>
<thead>
<tr>
<th>It was</th>
<th>a long</th>
<th>ride</th>
<th>by car</th>
</tr>
</thead>
<tbody>
<tr>
<td>I thought</td>
<td>we would</td>
<td>never</td>
<td>get there</td>
</tr>
</tbody>
</table>

2. Four sentence pairs had zero errors. Linguistic content of some sentences are easier than others.
   - Use standardized choice of sentences
6. Future Study

- Establish normative data using standardization sample representative of Singapore population (gender, race, ethnicity, socioeconomic status, residence, and parent education level)
- Standardization examiners to be trained in uniform administration and scoring of SG CS Test presented dichotically
Thank you

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Dr Jennifer Martin
Tan Kah Yee
Prof Jeffrey Weihing
Zhou Xiaodong
Conrad Chung
Huang Peh Linde
Participating children & parents
Class of MSc Audiology 2015
References

References

Appendix: Other findings

1. Test-retest reliability of CS Test scores were adequate (SG_CST=0.458; US_CST= 0.751). Affected by wide test-retest interval (range 10 – 99 days) (Amos & Hughes, 1998); children’s more variable performance compared to adults (Allen, Wightman, Kistler & Dolan, 1989); 2 hr screening in test 1; range restriction (Goodwin & Leech, 2006)

2. Variability of scores was largest for subjects aged seven years (n = 7). Possible that language/grammar of CST inappropriate (Hexamer & Bellis, 2000)

3. Highest number of word errors made by subjects aged seven years. Their CELF-4 scores are above the mean of 100. Possible that language/grammar of CST inappropriate. Maybe attention factor (not investigated).

4. Median scores increased with increasing age of subjects. Consistent with age-dependent morphological development within the brain (Yakovlev & Lecours, 1976). Need for age appropriate norms.
Appendix: Study Limitations

1. Subjects do not constitute random sampling of Singapore population. Largely recruited through poster and email to staff of NUH and NUS YLL SOM. Profile of subjects wrt memory, language and intelligence scores are expected to be similar or at higher levels of achievement compared to general population. Ethnicity did not include Malays nor Eurasians.

2. Sample sizes of each age band were not equivalent. No subjects aged eight years could be recruited.

3. 21 subjects not large enough sample size to investigate effects of age, memory, language or intelligence scores with CS Test scores. For 4 variables, need at least 60 subjects (Stevens, 1996).

4. Error rates for the individual words may be different when dichotic presentation mode is used. This could occur if a word recording was less than optimal and hence, difficult to perceive under more taxing conditions (dichotic presentation mode). That being said, the study as designed is an important first step in establishing this version of the competing sentence test.