Speech intelligibility measurement

A latent variable approach on utterances' transcriptions

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Abstract

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1 Introduction

Intelligible speech can be defined as the extent in which the elements in a speaker's acoustic signal, e.g. phonemes or words, can be correctly recovered by a listener [11, 14, 23, 24]. Intelligible spoken language carries an important societal value, as its attainment requires all core components of speech perception, cognitive processing, linguistic knowledge, and articulation to be mastered [11]. In that sense, *speech intelligibility* is considered a milestone in children's language development, and more practically, it is qualified as the ultimate checkpoint for the success of speech therapy, and the 'gold standard' for assessing the benefit of cochlear implantation [4].

Multiple approaches can be taken to quantify *speech intelligibility* [1, 2, 10, 13], but among them, *objective rating* methods on stimuli recovered from spontaneous speech tasks have received recent attention [2, 13]. In objective rating methods, listeners transcribe children's utterances orthographically (or phonetically), and use such information to construct an intelligibility score. The construction of the score can be done in many ways, e.g. counting the number of (un)intelligible syllables or words [10, 15], or calculating the entropy of transcriptions, a measure that expresses the degree of (dis)agreement in the data [2, 21]. In that sense, the method tries to infer intelligibility from the extent in which a set of transcribers, can identify the word contained in an utterance [2].

As the literature suggests, objective rating procedures are thought to produce more valid[1] and reliable[2] scores than any other available procedure [2, 8], as the method does not hinge in the use or production of a *subjective rating scale*, i.e. a scale based on a personal perception of the child's intelligibility. Moreover, the previous advantages are further emphasized by the greater level of ecological validity of the stimuli, which comes from spontaneous speech tasks rather than contextualized utterances or reading at loud tasks [10, 6].

Although the literature is clear on the benefits of the *objective rating* methods to measure *speech intelligibility* [1, 2, 13], we believe the statistical approaches used to model such data still face three important issues, that comes as a detriment to the sophistication of the measurement procedure.

[1] validity is understood as the extent to which scores are appropriate for their intended interpretation and use [16, 22].
[2] reliability is though as the extend to which a measure would give us the same result over and over again [22], i.e. measure something, free from error, in a consistent way.

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