

How much in advance can listeners perceive upcoming speech targets? Insights from children and adults

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Coarticulation characterizes the temporal overlap of articulatory gestures for neighboring segments, hence contributing to make speech fast and continuous [1]. In adults, many studies have shown that coarticulation isn't (solely) a by-product of production but is used by listeners to anticipate upcoming speech material ahead of their acoustic onset [2, 3, 4]. In children, the question remains whether coarticulatory information is used in the same way and to the same extent as in adults. While the literature is replete with studies showing infants' sensitivity to transitional information (e.g., [5, 6]), the maturational trajectory of speech processing as children transition into more phonologically-driven processing is not well understood.

Previous research investigating vocalic anticipation in speech production revealed that children exhibit greater vocalic prominence over time which results in an earlier initiation of the vowel within syllable and greater temporal overlap of their lingual gestures as compared to adults [7, 8, 9]. Interestingly, this translates into a facilitative vowel identification effect when adults are exposed to child speech (3, 4, 5 and 7 years) as compared to adult's speech [3]. To the authors' knowledge, only a few studies have examined this phenomenon further [10, 11] while no study so far investigated vowel anticipation in children.

The present study expands on previous research by examining adults' as well as children's anticipatory perception using not only speech samples from adults but also from children of different age groups. The two main hypotheses we tested are that 1) both adults and children would identify upcoming vowel targets earlier in child's speech as compared to adult's speech; 2) this effect should be sensitive to gestural compatibility between consecutive segments, resulting into different degrees of perceptual salience of coarticulatory information. More specifically, listeners should anticipate vowels earlier when gestures of adjacent segments recruit different organs and can overlap in time without impeding intelligibility (e.g., /bu/) as compared to cases where the same organ is recruited for both segments (e.g., /du/). However, we expected consonantal effects to be reduced with child stimuli who globally show greater vocalic coarticulation than adults.

To test these hypotheses, we used stimuli previously recorded in a large cross-sectional investigation of coarticulatory patterns in children and adults [7]. We first investigated the ability of 94 adults to detect a target vowel ($V_3 = /i:, y:, u:, a:/$) ahead of its acoustic onset in short utterances of the form article + nonword ($V_1C_1V_2 + C_2V_3C_3V_4$ with $C_2 = /b, d/$; $C_3 = /g/$; $V_{2\&4} =$ schwa, noted @ from here). A multiple forced choice gating paradigm [12] was designed using the speech of 3-, 5-, and 7-year-olds and adults with 5 temporal gates corresponding to the temporal windows ($G1 = @$ midpoint; $G2 = @$ offset; $G3 = C_2$ midpoint; $G4 = C_2$ offset; $G5 = V_3$ midpoint). Stimuli were presented in OpenSesame [13] using headphones.

Preliminary results show that accuracy increases as the portion of the signal gets longer (i.e. later gate). Furthermore, performances differ as a function of C_2V_3 pair identity suggesting that perceptual patterns are not uniform across the whole set of vowels for a given consonant. Instead, patterns seem to vary as a function of the gestural specifics for both segments that are coproduced with one another, as found in previous investigations of the coarticulatory patterns themselves [14]. Surprisingly, although listeners showed sensitivity towards coarticulatory differences between CV pairs, a clear age effect was absent. To address these observations in more detail, in-depth analyses are currently being conducted.

In order to investigate effect of listener's age, perception data for 7-year-olds are currently collected. While the procedure is the same as the one used for the adults, the set of child stimuli only includes 3-year-olds, 7-year-olds (as peer group) and adults.

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