Time reference processing in a grammatical tone language speakers with agrammatic aphasia.

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Introduction
The concept of time is encoded differently across languages in the world. Many languages such as those in the Indo-European group express time reference through tense, whereas Asian languages such as Chinese express time reference through aspeckual adverbs. Interestingly, Akan does so through grammatical tone. Previous studies have found that time reference, particularly reference to the past, is more impaired than non-past time reference in agrammatic aphasic speakers (Bastiaanse, 2013). The PAst DIscourse LInking Hypothesis (PADILIH: Bastiaanse et al., 2011) posits that past time reference is difficult because it requires discourse linking, whereas the non-past (present and future) are not discourse-linked, and hence, not difficult. However, many of the investigations (if not all) on time reference have come from the Indo-European languages which use morphological inflections to make reference to time. Therefore, it remains unclear whether findings from such studies could be extended to languages that use grammatical tone to encode time reference.

Akan is a tonal language spoken in Ghana. In Akan, tense and aspects are expressed by the use of tones (Dolphyne, 1988). For example;

1. Habitual Aspect
   Peter gyiná hɔ
   Peter stand_habitual there

2. Simple Past Tense
   Peter gyinà hɔ
   Peter stand_past there

3. Future Tense
   Peter bégyná hɔ
   Peter future stand there

Methods
Ten (10) agrammatic aphasic speakers of Akan, and ten (10) non-brain damaged (NBDs) Akan speakers, participated in this study. Three (3) of the 10 agrammatic speakers withdrew from the production task. The Akan adapted version of the Test for Assessing Reference of Time (African TART: Abuom & Bastiaanse, 2010), consisting of both production and comprehension tasks, a sentence completion and a sentence-picture matching task, respectively, was used for this experiment. Additionally, five of the agrammatic speakers were tested with a Tonal Screening Test (TST: Kayser, 2010), in which a pair of non-linguistic tones are judged either to be the same or different.
Results
An overall generalized linear mixed-effects regression model showed that the accuracy scores of the individuals with agrammatic aphasia was significantly lower than that of the NBDs ($\beta = -3.30, SE = 0.28, z = -11.63, p = 0.001$). In production, the errors they made affected the past time reference more than both the habitual and the future ($\beta = -1.33, SE = 0.44, z = -3.03$ and $\beta = -2.05, SE = 0.48, z = -4.28$, respectively). There was no significant difference between the habitual and the future. However, the comprehension data showed a significant difference between the habitual and the future ($\beta = 1.91, SE = -0.46, z = 4.16$). Overall, when the agrammatic speakers made errors, these affected past time reference more than present and the future time references. Nonetheless, the five agrammatic speakers who did the TST were relatively better in discriminating the non-linguistic tonal test, with an average score of 90%.

Discussion
The conclusion is that when time reference is expressed by grammatical tone, past time reference is difficult for Akan agrammatic speakers, in both production and comprehension tasks, as predicted by the PADILIH. Surprisingly, the comprehension data showed that the Akan future was relatively difficult than the present habitual. Moreover, the fact that the agrammatic speakers could perceive the non-linguistic tonal differences demonstrates that it is not tone per se that is disrupted, but rather time reference, particularly reference to the past. This suggests that difficulties in non-linguistic prosody such as pitch discrimination may not be attributed to individuals with lesion sites that only result in agrammatic aphasia (Zatorre, Belin, Penhune, 2002; Friederici & Alter, 2004).

References