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The eye gaze of 3rd party observers reflects turn-end boundary projection

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Abstract

We show that when observers watch a dialogue, their eye gaze is a viable measure of online turn processing. Third-party listeners not only track the current speaker with their gaze, but they look anticipatorily to the next speaker during question-answer pairs. Eye gaze is a measure of turn-boundary projection that has all the benefits of previous measures, but does not require the participant to make explicit judgments, and so provides a natural alternative for exploring turn-end boundary cues.

1 Introduction

Speakers in conversation take turns with remarkably little delay or overlap (Sacks et al., 1974; Stivers et al, 2009). To accomplish this, potential next speakers must comprehend the present utterance while simultaneously planning a contribution and projecting when the current turn will end. There are a number of candidate cues to turn-completion including pragmatic, prosodic, or lexicosyntactic cues (e.g., Ford and Thompson, 1996; de Ruiter et al., 2006), but little is known about the role of these cues in online turn projection. We attempt to investigate this practice by employing a continuous measure of online processing: gaze tracking.

In a recent study, de Ruiter et al. (2006) addressed turn-end boundary projection experimentally using a non-continuous response measure. They asked Dutch speakers to listen to spontaneous speech fragments and press a button at the moment they anticipated the speaker would finish her utterance. The speech fragments were phonetically manipulated to investigate projection cues such as intonation, lexicosyntax, and rhythm. Their results suggest that speakers rely primarily on lexicosyntax to identify upcoming turn-end boundaries.

But the speech signal is continuously unfolding so listeners' use of particular types of cues may change over the course of an utterance. Eye gaze provides a continuous measure of projection that could detect these potential changes. Since the stimuli for gaze measures can be manipulated in the same ways as the stimuli used by de Ruiter et al. (2006), tracking observer gaze may provide a natural, passive, and continuous method for exploring how interlocutors manage the timing of turns.

To establish observer gaze as a measure of turn-end projection, we show that observers (1) track current speakers with their gaze, and (2) look anticipatorily to next speakers.

2 Methods

Thirty-two volunteers (*females* = 17) watched two short "split-screen" dialogues from a recent motion picture (*Mean Girls*, Paramount Pictures, 2004) while we recorded their eye movements[1].

Participants watched the clips *with* or *without* sound (N=16 each). Participants in the *without* sound condition were warned that they would not hear sound while the clips were playing.

We report data from the first film clip. The dialogue's five question-answer (Q-A) pairs were selected for analysis because Q-A pairs are reliable as adjacency pairs and provide a linguistically diverse sample of turns. Each participant's gaze was coded for gaze direction (right, left, center, blink) every 50ms by two coders: one of the authors and one trained coder naïve to our hypotheses (96% agreement).

3 Results

Observers in the sound condition consistently tracked the current speaker with their gaze: over 70% of looks were directed at the current speaker (Speaker 1=72.6%, Speaker 2=77.5%). Without sound, under 50% of looks were to the current speaker (Speaker 1 = 42.2%, Speaker 2=

[1]Two-thirds of participants in each condition reported having seen the film. These participants were less likely to look at the main character overall, but reliably tracked the current speaker.

41.9%). This was confirmed using generalized linear mixed effects models of gaze direction (looking at Speaker 1/not looking at Speaker 1) with current speaker, condition, and their interaction as fixed effects, and subject and turn as crossed random effects. For Speaker 1, there was a significant interaction such that the likelihood of looking at her during her turn differed across conditions (β=2.75, Z=2.5 p=.01). Looks to Speaker 1 increased during her turns in the condition with sound (β= 2.55, Z=5.5, p<.001), but not without sound (p=.9). Results for Speaker 2 were similar: there was a marginal speaker by condition interaction (β=2.49, Z=1.84, p=.06), and a significant effect of current speaker with sound (β = 2.5, Z=3.47, p <.001), but not without sound (p =.9).

Observers tended to shift their gaze from current to next speaker during the inter-turn gap. Figure 1 shows the average gaze trajectories from current to next speaker for each condition.

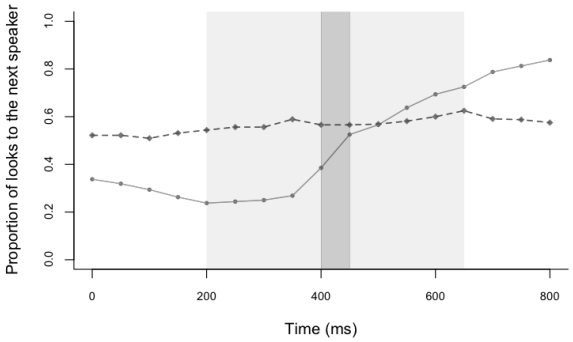

Figure 1: Average gaze trajectory across Q-A pairs with (solid) and without (dashed) sound. The dark shaded region represents the average inter-turn gap and the light shaded regions represent the 200ms before and after the gap.

To assess whether observers anticipate turn-transitions, we compared the proportion of looks to the next speaker in the 200ms surrounding the inter-turn gap. Since eye movements must be planned at least 200ms in advance, an increase in looks to the next speaker during this time would indicate that observers are looking to the next speaker *before* she speaks.

We used linear mixed models to predict gaze direction (current/next speaker), with position (pre-gap/post gap) and condition as fixed effects, and subject and Q-A pair as crossed random effects. There was a significant interaction between position and condition such that the increase in looks to the next speaker across the inter-turn gap was greater for the sound than the without sound condition (β=1.83, Z=3.49, p<.001). This increase in looks was significant only for the sound condition, showing anticipation (β = 2.7, Z = 2.76, p = .006).

4 Discussion

Previous methods for measuring anticipatory turn behavior were unable to track continuous changes in boundary projection and required explicit judgments that are not a part of typical turn-taking. Observer gaze has all the benefits of these methods, but is a passive task that collects continuous, online data.

Here we show that observers not only gaze at the current speaker, but they often look anticipatorily to the next speaker, especially when sound is available. This suggests that gaze in our task is primarily driven by linguistic information.

We are now extending this method to dialogues where the audio is phonetically manipulated to control the linguistic cues that are available (similar to de Ruiter et al., 2006) using spontaneous dialogues from the Meet a Friend corpus (Tice & Henetz, 2011). We are also replicating the current study with still images accompanying the dialogue instead of film. In the future, this method will lend itself well to examining turn processing in an understudied population: children. We expect that observer gaze will provide opportunities for many studies of turn processing that would otherwise not be possible without this natural, continuous measure.

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