Does listeners’ breathing change according to speaker and to loudness?

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Abstract

Breathing has specific kinematics during speech production that changes, for example, according to loudness [1, 2] or to the speakers’ gender [3]. Breathing also shows a specific profile during listening to speech, that is intermediate between the profile of quiet (or rest) breathing and the profile of breathing during speech production [2, 4]. In dialogue speaker’ and listener’ breathing synchronize at the time of turn-taking [4]. This suggests a mutual adaptation of speaker’ and listener’ breathing, which could be a part of the interactive speaker-listener alignment process that occurs in communication [5]. In this framework we evaluated if breathing changes during listening to speech depend on the speaker who produces the speech and/or on the loudness of its speech signal.

We recorded acoustic and breathing from two native speakers of German (a male and a female) while they were reading short texts with either a normal or a loud (≈+10dB) acoustic level. The two readers had different breathing kinematics. The duration of the breathing cycle (inhalation+exhalation) was smaller for the female than for the male. The amplitude of the breathing cycle increased with loudness for both subjects while the frequency decreased for the male speaker but remained unchanged for the female. Then, we monitored breathing for 26 native females speakers of German while they were listening to the readers’ recordings audio played back via loudspeakers. They listened either to the male or to the female speaker, starting either with the normal (5 texts) or with the loud readings (5 texts). After listening to each text, listeners had to briefly summarize it. We analyzed breathing kinematics during listening according to the reader (male vs. female), to the loudness condition (normal vs. loud) and to the order (normal first vs. loud first).

As in previous studies, we found that breathing kinematics during speech was different than during quiet breathing [2]. This shows that breathing was involved or at least affected by the listening process. The comparison between the different listening conditions showed that the duration and the amplitude of the breathing cycles were greater when listening to normal speech than when listening to loud speech. The changes in duration due to changes in loudness were similar for listeners to both readers. In contrast, an increase in amplitude was observed for listeners to the male reader while listeners to the female reader tend to show the reverse effect. Finally, we observed some effects of the presentation order of conditions, especially for the male reader.

Altogether, these preliminary results show that listeners’ breathing is sensitive to the reader and to the loudness of the reader’s speech. This sensitivity could be a physiological reaction, as breathing is closely linked with heartbeats and emotional state. However, the changes in listeners’ breathing could also be due to an adaptation to specific characteristics of the reader’s voice and/or rhythms. It could also result from a speaker-listener's breathing coupling, as it has been observed for body movements in dialogue or for brain activity during listening [6, 7, 8].

References