Towards an Awkward Silence-Adaptive Virtual Meeting System

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Abstract

In times of worldwide confinements and global crisis, virtual meetings are increasingly an alternative to in-person meetings. Within virtual meetings, moments of silence can occur due to several reasons like connection issues, several persons starting to speak or none starts to speak (see e.g. [1]). As participants in meetings follow the obligation to avoid interaction gaps, silent moments might cause a state of anxiety referred to “awkward silence” and lead to unconscious behavior such as laughing or being embarrassed [2]–[6]. This so-called state anxiety differs from anxiety disorders and is a short-term emotional state [7]. According to [8], people tend to feel awkward after a certain duration of silence. However, this does not necessarily mean that everyone feels awkward at the same time as individual and contextual factors play an important role. Existing approaches to encounter this awkward silence have created conversational agents or topic proposals that aim to break the silence (see e.g. [9]–[12]). However, recent literature suggests that silence itself is not necessarily bad as it helps to increase creative solutions and can ultimately lead to better meeting outcomes [13]. To incorporate the idea of embracing the silence, we aim to build an adaptive system that can detect and respond to moments of awkward silence by reducing the feeling of state anxiety. In this work-in-progress paper, we report on a first design prototype and a pre-tested experimental design to create silent moments while collecting and analyzing participants’ physiological data.

For our proposed neuroadaptive system, three stages exist based on the biocybernetics loop: Collection of data, state recognition and system adaptation [14]. In stage 1, we continuously monitor the user’s electrocardiogram (ECG) and electrodermal activity (EDA) data. These signals were chosen, because symptoms associated with state anxiety such as alterations in heart rate (HR), HR variability (HRV), as well as sweating and skin conductance response (SCR) can be detected with this data (see e.g. [15], [16]). Further, the meetings audio output is collected. In stage 2, we aim to recognize silence and state anxiety. The detection of silence, defined as none of the meeting participants is speaking, is done via the audio output of the virtual meeting. To recognize state anxiety, the collected ECG and EDA signals are filtered, windowed and features for HR and HRV as well as SCR are calculated based on similar approaches that aim to detect changes in ultra-short time windows (see e.g. [17], [18]). We aim to train a two-class classifier (state anxiety/no state anxiety) on the derived EDA and ECG features similar to existing classifiers detecting arousal by using algorithms such as random forest, decision trees, LDA or k-nearest neighbors (see e.g. area of arousal/stress detection [19], [20]). Stage 3 covers the adaptation logic and visualization. The designed mechanism works as follows: When the state of silence is recognized, the classifier is consulted to identify if state anxiety exists. If so, an adaptation is triggered. To retrieve different initial proposals for the adaptation visualization, we followed an iterative design approach including two workshops with participants from different disciplinary backgrounds. Based on the first workshop, we decided to implement a deep breathing support and reviewed existing applications in literature and practice. Deep breathing exercises supporting a slow breathe in, hold breath and breathe out rhythm, can embrace the silence in meetings and at the same time mitigate state anxiety and anxious feelings (see e.g. [21]). We identified the application "headspace" [22] as an inspiration for our deep breathing animation and created different visualizations and placement options in a group of three researchers. After the two workshops, we voted and chose the design shown in Figure 1.

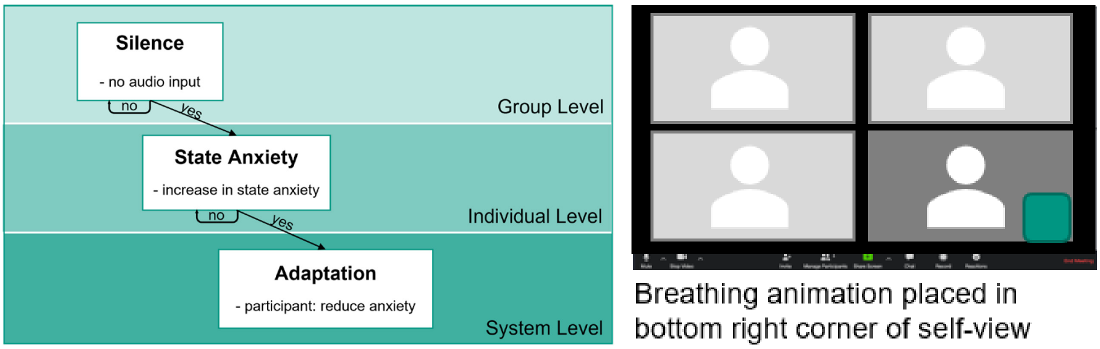

Figure 1. Adaptive system logic and design prototype

To ensure that the recognition will be successful, we need to collect data to better understand the relationship between silence and the occurrence of state anxiety. We designed an experiment that artificially creates silent moments while collecting participants ECG and EDA data using Plux devices in a virtual meeting [23], [24]. During the experiment, a trained experimenter asks randomized questions taken from the International English Testing System [25] for participants to discuss. The participants are instructed to contribute an answer to the questions or comment on other participant's contributions. If no participant contributes to the discussion for more than 20 seconds, the experimenter moves on to the next question. Thus, besides natural silence between contributions of individual participants, we expect moments of awkward silence to occur. To distinguish between these two types of silence, participants are asked to self-report moments of awkward silence during the experiment by writing down the time and rating the intensity on a five-point scale (none to severe).

Results from a first pre-test with six persons (one experimenter, five participants) showed differences in the individual reported intensity of awkwardness for each silent pause which provides first evidence for our stated difference in individual perceptions of silence. We collected ECG data from three participants and EDA data from four participants and are currently analyzing the data. First results hint to differences between awkward silence moments and the collected baseline. Still, the collected data needs to be further analyzed to ensure that the patterns are actually due to silence-induced state anxiety. After having collected enough data, the proposed classifiers will be trained and evaluated.

In this project, we present work-in-progress on a proposed awkward-silence adaptive virtual meeting system. As the evaluation of adaptive systems is manifold [26], several next steps are planned: First, targeting the recognition stage, the proposed experiment needs to be conducted on a larger scale and a more fine-grained analysis of the collected ECG and EDA data is needed. Second, the proposed classifiers need to be trained and evaluated. Finally, targeting the adaptation stage, the selected classifier will be integrated in the prototype to evaluate the users' perception of the proposed adaptive system. We plan to evaluate the system against a baseline non-adaptive system and an alternative rule-based adaptation mechanism using the duration of silence as a threshold to trigger the adaptation when it is longer than the mean duration to perceive silence as awkward (see e.g. [8]). We aim to contribute with design knowledge for system that supports more pleasurable experiences in virtual meetings in silent pauses. Besides, we may provide further insights into the design of adaptive video meeting systems that support users in emotional situations, for example, when experiencing nervousness due to public speaking anxiety.

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