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Smiling synchronicity and gaze patterns in dyadic humorous conversations

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Abstract: This present article is part of a larger study on speaker-hearer allocation of attentional resources in face-to-face interactions. The goal of the paper is twofold: first, we present results concerning the degree of correlation, in computer-mediated conversation, between speaker's timing and intensity of smiling when humor is either present or absent in the conversation. The results were obtained from the analysis of five dyadic interactions between English speakers that were video and audio recorded, transcribed, and analyzed to establish a baseline of synchronicity of smiling among participants. From the study it emerged that conversational partners engaged in humorous conversations not only reciprocate each other's smiling, but also match each other's smiling intensity. Our data led to the identification of different smiling and non-smiling synchronic behaviors that point to the existence of a synchronous multimodal relationship between humorous events and smiling intensity for conversational partners. Second, in the last part of the paper, we argue for the need of a multimodal conversational corpus in humor studies and present the corpus that is being collected, annotated, and analyzed at Texas A&M University–Commerce. The corpus consists of humorous interactions among dyads of native speakers of English, Spanish, and Chinese for which video, audio, and eye-tracking data have been recorded. As part of this section of the paper, we also present some preliminary results based on the analysis of one English conversation, and some exploratory analysis of Chinese data, that show that greater attention is paid to facial areas involved in smiling when humor is present. This study sheds light on the role of smiling as a discourse marker (Attardo, S., L. Pickering, F. Lomotey & S. Menjo. 2013. Multimodality in Conversational Humor.

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Keywords: smiling, gaze, humorous conversations, eye-tracking

1 Introduction

Stemming from the recognition of different smiling patterns occurring in face-to-face conversations (Gironzetti and Menjo 2014), the analysis of smiling synchronicity and gaze patterns investigates whether conversational partners attend to each other smiling behavior and how they communicate through smiling. This paper reports on a small exploratory study that is testing new methodologies and contributes to the ongoing discussion about the relationship between smiling and humor – intended as a cognitive rather than emotional phenomenon – by providing insights on how smiling and humor interact in a computer-mediated conversational setting. Taking into account that shared construction tasks have been shown to require specific dynamics of cooperation (Dale et al. 2013; Fusaroli et al. 2014), and that humor in conversation involves some degree of coordination, we hypothesize that synchronized smiling behaviors and an increased attention to facial regions involved in smiling (eyes and mouth, Ekman and Friesen 1978) will characterize humorous exchanges.

2 Behavioral synchrony

Behavioral synchrony has received a lot of attention within different subfields of psychology, and several studies have demonstrated that the behavior of interacting people synchronizes and may even align across modalities (Fusaroli and Tylén 2012), "from physiology to syntax" (Dale et al. 2013: 79). The degree of behavioral alignment has also been shown to depend on a number of social factors, such as pro-social or pro-self orientation of individuals (Lumsden et al. 2012) or contextual influences (Miles et al. 2010). On the other hand, behavioral alignment may also have an impact on social perception by eliciting feelings of rapport, attraction, positive affect, and connectedness towards people who mimic our actions or display behavioral synchrony (Chartrand and Bargh 1999; Lakin and Chartrand 2003; Miles et al. 2009; Tschacher et al. 2014), as well as enhancing memory (Macrae et al. 2008), cooperative ability (Valdesolo et al. 2010), or increasing attention towards the partner in the interaction (Macrae et al. 2008).

Within the behavioral synchrony paradigm, some attention has also been paid to the role of smiling. Previous research on smiling has shown that conversational partners reciprocate each other smiles (Capella 1997; Hess and Bourgeois 2010; Wild et al. 2003) and expect others to do the same, otherwise perceiving the partner as aversive and not willing to communicate (Capella 1997; Heerey and Kring 2007; Heerey and Crossley 2013). Moreover, research in interpersonal alignment showed that speakers tend to "change their affect, behavior, and cognition as a direct result of their interaction with another individual" (Paxton and Dale 2013: 1). However, the issue regarding the relationship between synchronic smiling behaviors and the presence of humor in a conversational setting has not been addressed. Our study contributes to the ongoing research in interaction and smiling by investigating if and how conversational partners coordinate their smiling behavior, and if there are any differences in smiling synchronicity across humorous and non-humorous segments of conversation.

3 Smiling and humor in conversation

The relationship between humor and smiling has been studied mostly within the field of humor in interaction, though not extensively. The most common approaches to humor in interaction studies have been Conversation Analysis and other branches of Discourse Analysis. In part due to the historical technological and methodological limitations of these approaches, laughter has received most of the attention in the study of humor in interaction.

Laughter was identified by Sacks (1974) as one of the possible responses to humor, which lead to many researchers focusing on the role of laughter in conversation as the preferred marker for humor. For example, Schegloff et al. (1977) focused on multi-party laughter. They observed that laughter was an indexical expression or token of understanding that occurred in reference to something else, which was sought by the participants in the conversation as the source of laughter. Laughter could be used to refer forward or backwards to previous segments of the conversation, for example, to "appreciate a joke which just occurred" (p. 12). Jefferson (1979) studied laughter in conversation as an indication of the speaker's intention. She recognized the role of laughter as a technique used by the speaker to invite more laughter from the hearer, thus validating laughter as a possible response to an utterance as well as cueing the humorous intention of the speaker. O'Donnell-Trujillo and Adams (1983) also noted that laughter could be used to cue the humorous intention of the speaker and the humorous interpretation of the utterance. Norrick (1993) considered humor and laughter as forming an adjacency pair, thus suggesting that laughter

may be the sole necessary marker to indicate the presence of humor in conversation. Hay (2001) included laughter and the production of more humor among the strategies used by conversational partners to acknowledge the presence of humor. In a more recent collection of studies on laughter, Holt and Glenn (2013) referred to laughter as "the most common, overt indicator of the presence of humor" (p. 2), while also clarifying that laughter is not the most frequently used means to indicate the presence of humor. Despite all the research on the topic, using laughter as a marker for humor in conversation remains problematic because laughter is not a product of humor, but a social emotion (Scott et al. 2014) and as such it can occur with and without humor. Conversely, humor in conversation can occur with and without laughter. In fact, while people report laughing at jokes and humor, studies show that laughter is more frequently associated with statements and comments rather than jokes (Provine 2004; Scott et al. 2014).

More recently, research on the markers of humor has also focused on prosody, exploring the possibility that humor in conversation may be delivered "with bells and whistles" (Chafe, 1994: 131). However, empirical studies by Attardo, Pickering, and associates (Attardo et al. 2011 and 2013) found that humor in conversation is not marked by significant changes in pitch, volume, speech rate or pauses, and is not reliably marked by the presence of laughter either. On the other hand, having observed that humor and smiling tend to co-occur, they hypothesized that "a manifestation on the smile-laughter continuum was used to "frame" a segment of the discourse as humorous" (Attardo et al. 2013: 411), with smiling being used to provide "clues that lead to the framing of segments of the exchange as humorous" and indicate "agreement with the humor" (Attardo et al. 2013: 408).

Finally, the relationship between smiling and laughter is not straightforward either. On the one hand, it has been suggested that smiling may be the visual signal of joy (Ekman et al. 1969; Elfenbein and Ambady 2002) and laughter the auditory signal of enjoyment of physical play (Sauter et al. 2010). Thus smiling may be the visual equivalent of laughter, as both communicate a state of enjoyment. On the other hand, smiling may also be a signal of generally positive social intent, whereas laughter may be a more specific emotional signal, originating in play (van Hoof 1972). However, it has been suggested that conversational laughter, which is different from reactive, involuntary laughter, is used in conversation as an intentional communicative act (Gervais and Wilson 2005). Taking into account these conflicting hypotheses, for the purpose of this study, smiling is intended as a continuum encompassing "laughing smile", a jaw-dropping type of smiling behavior that is normally accompanied by laughter (see Appendix A) as its most intense manifestation. In line with previous work

on markers of humor, the present study follows Attardo et al. (2013) hypothesis that humor markers may be multimodal, and explores the role of smiling in dyadic face-to-face conversations where canned and spontaneous humor is present.

4 Smiling synchronicity study

The results that will be presented and discussed in the following sections represent the preliminary findings of the analysis of five dyadic interactions. This small-scale study is part of a larger project investigating the allocation of attentional resources in face-to-face interactions involving humor.

The study followed a mixed method approach combining the collection of quantitative and qualitative data that were analyzed and coded separately, and finally combined in order to explore the relationship between the presence of humor in conversation and synchronic smiling behavior of dyads. Qualitative data comprise transcriptions of interactions, and humor identification and coding (Attardo 2001, 2012). Quantitative data used include time measurements of different synchronic smiling behaviors. Based on the analysis of these data, some descriptive and inferential statistics are presented.

4.1 Participants

Participants were recruited among university students and received no course credits or any other compensation. All participants agreed to participate in the study and signed a written consent form. The data presented here refer to five dyadic interactions involving ten native speakers of American English. Pseudonyms are used to protect participants' identity.

4.2 Data collection

Five conversations among dyads were audio and video recorded. Participants were interacting using video-chat software, therefore two audio and video recording (one per participant) were made per conversation. Each conversation lasted approximately five minutes. Participants were instructed to start the interaction by telling each other a canned joke, provided by the research team in their native language, and then continue talking about any topic they liked for approximately five minutes. This allowed the researcher to collect a sample of canned humor for each conversation, and any other spontaneous instance of conversational humor that might have been produced by the participants.

4.3 Corpus alignment and annotation

Individual audio and video files belonging to the same conversation were aligned using ELAN, a professional tool for the creation of complex annotations developed at the Max Planck Institute for Psycholinguistics. First, the two videos from each participant's webcam were synchronized; then, one audio file was selected and synchronized with both videos. An ELAN file was created for each conversation, allowing researchers to create different tiers and annotate different types of information across modalities. Thus, a typical ELAN file used in this study would contain video files, audio files, transcription of the conversation, information about different prosodic features (pitch, volume, speech rate, prominent syllables, and pauses), smiling intensity coding, smiling synchronicity coding, and humor coding.

In Figure 1, it is possible to see, in the upper part of the image, the two videos of participants interacting through video-chat, and the pause-based unit transcription of one of the participants' speech. Below the video, from top to bottom, different tiers include the following information:

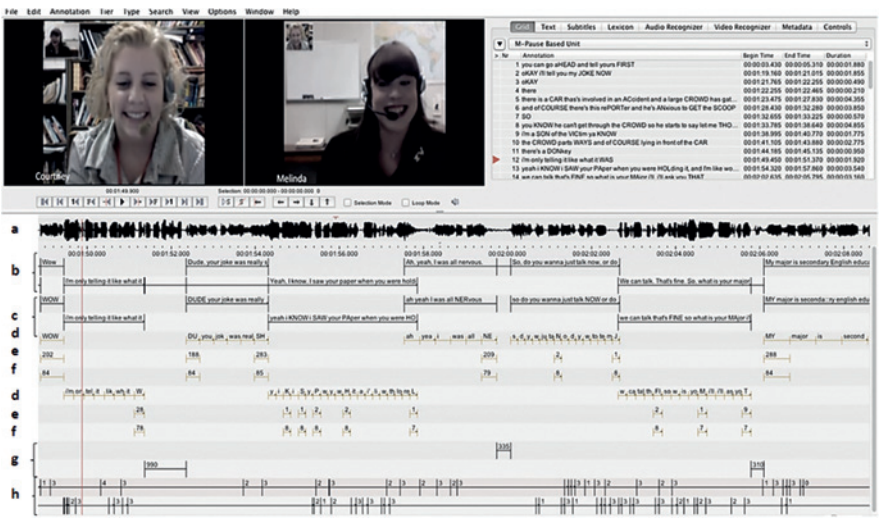

Figure 1: ELAN interface for corpus alignment and annotation.

(a) audio waveform of the conversation (both participants' speech is combined in one wave, since just one audio file was used);
(b) transcription of each participant's speech, aligned with

(c) pause-based unit transcriptions;
(d) word by word transcription for each pause-based unit for each participant;
(e) pitch values for each participant;
(f) volume values for each participant;
(g) length of significant pauses for each participant, and
(h) smiling intensity for each participant.

Each conversation was transcribed according to pause-based units (see Pickering et al. 2009 and Attardo et al. 2011 for a more detailed explanation of the prosodic coding and analysis). Prosodic features of conversations were measured using CSL (Computerized Speech Lab) and included pitch, pauses, volume, speech rate, and prominent syllables (Pickering et al. 2009, Attardo et al. 2011).

In order to measure smiling synchronicity during conversation, smiling behavior was coded across conversational partners using the Smiling Intensity Scale (see Appendix A). The individual data were then combined to obtain a time series reflecting the smiling behavior of both participants at each frame of the video recording (a frame lasts approximately 40 milliseconds).

Smiling synchronicity of conversational partners was then coded into four different categories. The value –1 was used to indicate non-smiling synchronic behavior, when both participants displayed a smiling behavior of intensity 0 on the Smiling Intensity Scale. The value 0 was used to indicate smiling asynchronic behavior, when one of the participants displayed a smiling behavior of intensity 0 on the Smiling Intensity Scale (was not smiling) and the other displayed any other smiling behavior. The value 1 was used to indicate smiling synchronic behavior without intensity matching, when both participants displayed different smiling behaviors other than 0 on the Smiling Intensity Scale. Finally, the value 2 was used to indicate smiling synchronic behavior with intensity matching, when both participants displayed the same smiling behavior on the Smiling Intensity Scale. Figure 2 below is a sample line graph showing the synchronicity in the smiling behavior of two conversational partners (Miranda and Paul) as the conversation unfolds. The vertical axis indicates the four different smiling synchronicity behaviors, and the horizontal axis indicates time. The data were sampled every second, for a total of roughly 638 data points per conversation.

After coding smiling behavior of each participant, and smiling synchronicity for each pair of conversational partners, humorous events were coded using the triangulation method outlined in Attardo (2012). Following this method, humorous events were coded as such based on the presence of metalinguistic comments, speaker's intentions, and a semantic-pragmatic analysis of the text revealing a

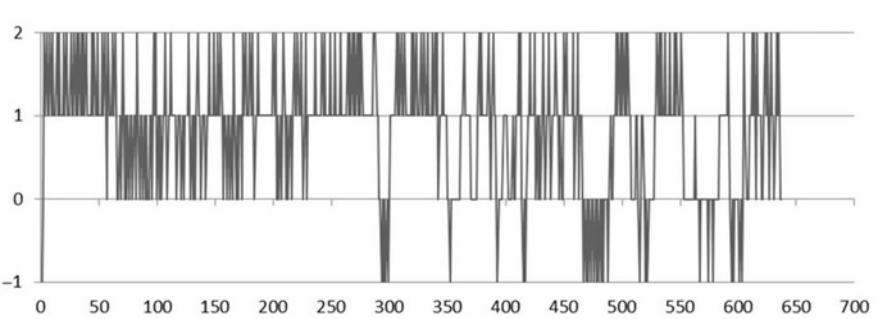

Figure 2: Smiling synchronicity for Miranda and Paul.

script opposition (Raskin 1985). Humorous events were marked as a point in time matching the end of the last word in the humorous phrase. An example of how humorous events were marked can be seen in Table 1 below, which shows a fragment of the transcription of the conversation with the punch line – the humorous noun phrase *a donkey* – marked in bold.

Table 1: Example of humorous event coding.

Mary	//he starts SCREAMing [262] [75] I-I'm a son of the victim I'm the son of the victim so of course the crowd mo:ves and//
	0.5
	//it turns out there's **a DONkey** [163] [66] in front of the car//

The same segment of conversation is also shown in Figure 3, which presents a detail of the ELAN window where the humorous event is marked at the point in time when the noun phrase *a donkey* ends (at time 00:02:07:915). In the ELAN file below are shown, from top to bottom, different tiers containing transcription, pause-based units, word-by-word units, syllables, speech rate, volume, pitch, and smiling intensity coding for each participant. The highlighted gray area corresponds to the fragment of conversation where the punch line "a donkey" occurs, and the end of the punch line is marked by a black vertical line. For each humorous event identified, five-second segments starting two second before and ending three seconds after the humorous event were extracted, in order to allow us to look at smiling behavior immediately before and after the event. The same number of randomly selected non-humorous segments was also

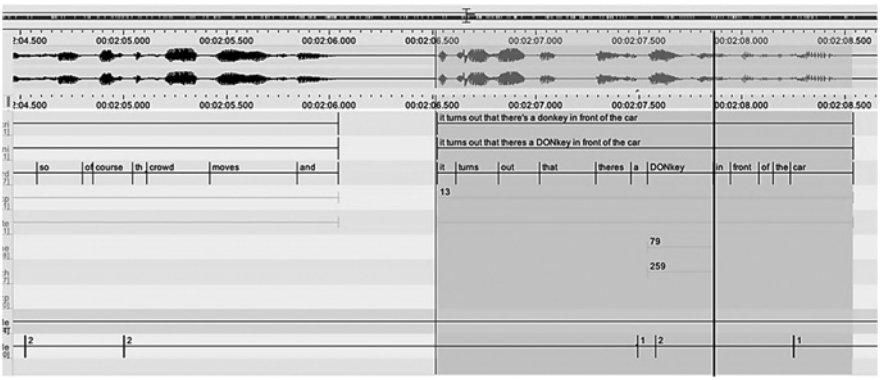

Figure 3: ELAN window and humor coding.

extracted for comparison, for a total of 708,056 milliseconds (11.8 minutes) of recording. Non-humorous segments were selected by randomly marking a non-humorous event in the recording and then extracting the five-second long segment for each one of these events, making sure that none of the non-humorous segments overlapped with any of the humorous segments. Humorous five-second segments that overlapped because the humorous events were less than three seconds apart were collapsed into one single and longer humorous segment so that we always had two seconds before the first humorous event would start, and three seconds after the last humorous event would start. Whenever one of these longer humorous segments was created, we also extracted a non-humorous segment of the same length for comparison. While the use of a computer-mediated conversation may have caused time-lags in the audio files, and these may have affected the marking of the humorous event in time, the impact of this limitation was reduced by using a 5 second-window around the humorous event for the analysis.

4.4 Results

The five couples of conversational partners displayed different levels of smiling synchronicity as shown in Figure 4. These values ranged from a 95% of smiling synchronicity in the conversation of Tamara and Mary, to a 21% overall smiling synchronicity in the conversation of Carmen and Martina.

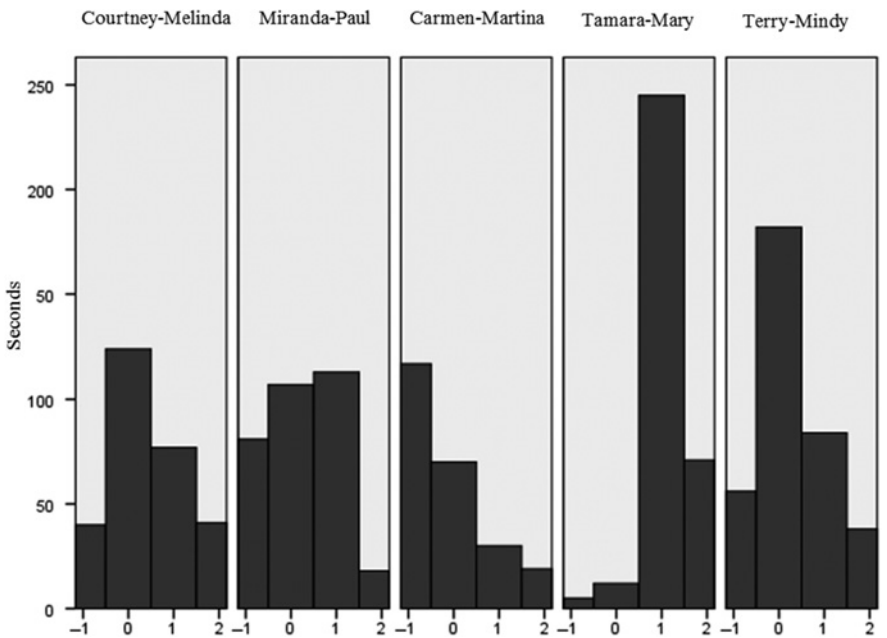

Figure 4: Duration of different smiling synchronic behaviors for five dyads.

Overall, when comparing smiling synchronicity across the corpus of five conversations, participants displayed a synchronic smiling behavior (combination of behaviors 1 and 2) for 48% of the time, matching each other smiling intensity (behavior 2 only) for 12% of the time.

However, when examining smiling synchronicity for humorous and non-humorous segments of conversation, a different picture emerges. The graph in Figure 5 combines the values obtained from each pair of conversational partners, and displays values (in milliseconds) of smiling synchronicity for each behavior across humorous and non-humorous segments of conversation. The percentages reported in this graph refer to the amount of time spent displaying each behavior during humorous and non-humorous segments of conversation separately, thus, for example, the percentage value for condition –1 (non-smiling synchronicity) should read as follows: participants spent 8% of the time when humor was present displaying a non-smiling synchronic behavior; participants spent 15% of the time when humor was not present displaying a non-smiling synchronic behavior.

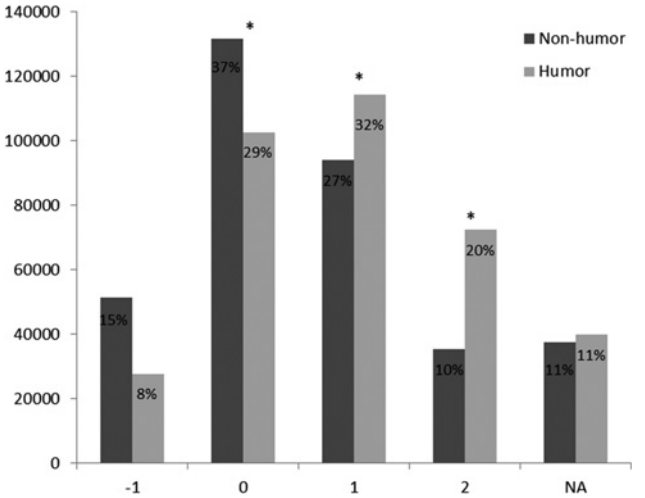

Figure 5: Smiling synchronicity across humorous and non-humorous segments with statistically significant differences ($p < 0.05$) between humor and non-humor flagged (*).

The graph shows that during non-humorous segments of conversation, conversational partners spend more time at 0 (smiling asynchronicity) or at –1 (non-smiling synchronicity) than during humorous segments of conversation, while during humorous segments of conversation they spend more time at 1 (smiling synchronicity without intensity matching) and 2 (smiling synchronicity with intensity matching) than during non-humorous segments of conversation.

From the comparison of the data for humorous and non-humorous segments of conversation (Figure 5) it emerges that there is a general increase of smiling synchronicity and a general decrease of smiling non-synchronicity during humorous segments of conversation. More specifically, the percentage of time for behavior 2 (synchronicity with intensity matching) doubles during humorous segments (Non-humor = 10 %, Humor = 20 %), while the percentage for behavior 1 (smiling synchronicity without intensity matching) increases only slightly (Non-humor = 27 %, Humor = 32 %). On the other hand, the percentage of time for behavior 0 (non-smiling synchronicity) and behavior –1 (asynchronicity) decreases during humorous segments (Behavior -1: Non-humor = 15 %, Humor = 8 %; Behavior 0: Non-humor = 37 %, Humor = 29 %). Overall, synchronic smiling behaviors occur 52 % of the overall time during humorous segments, but only 37 % of the time during non-humorous segments. The percentage of missing data (group NA), which is due to participants covering their face or moving

outside of the area recorded by the cameras, is constant across humorous and non-humorous segments.

The comparison of humorous and non-humorous segments of conversation shows that there is a general increase of smiling synchronicity (conditions 1 and 2) and a general decrease of smiling non-synchronicity (conditions 0 and −1) during humorous segments of conversation.

Given the small sample and the non-normal distribution of data, parametric statistical tests could not be used. Instead, we performed non-parametric Friedman's 2-way ANOVA by ranks with multiple pairwise comparisons. The test revealed that there is a significant difference in the time participants displayed different synchronic behaviors when humor was present or absent, $\chi^2(7) = 14.652$, $p = 0.041$. Pairwise comparisons across synchronic behaviors for each pair of humor behaviors allowed us to examine where the differences actually occur. For synchronicity behavior −1 (non-smiling synchronicity), the test revealed that there was no significant difference between the humorous and non-humorous segments, $\chi^2(1) = 1.8$, $p = 0.18$. For synchronicity behavior 0 (smiling asynchronicity), the test revealed that the difference between the time participants displayed a 0 synchronicity level were significantly lower for humorous events when compared with non-humorous events, $\chi^2(1) = 5$, $p = 0.025$. For synchronicity behavior 1 (smiling synchronicity without intensity matching), the test revealed that participants displayed a type 1 synchronicity for a longer time during humorous events rather than non-humorous events, $\chi^2(1) = 5$, $p = 0.025$. Finally, for synchronicity behavior 2 (smiling synchronicity with intensity matching), the test revealed that participants displayed a type 2 synchronicity for a longer time during humorous events rather than non-humorous events, $\chi^2(1) = 5$, $p = 0.025$.

4.5 Discussion

The main goal of this small-scale study was to investigate how smiling and humor interact in dyadic face-to-face computer-mediated conversations adopting an interactional synchronic perspective (Delaherche and Chetuani 2010), thus treating smiling as a joint behavior of the dyad rather as an individual behavior. Previous findings indicate that when humor is present participants in a conversation display a higher smiling intensity and specific coupled smiling gestures (Gironzetti and Menjo 2014), as well as pay more attention to the facial areas involved in smiling, the mouth and the eyes regions (Gironzetti et al. 2016). Our hypothesis is that an increased smiling synchronicity may also be used by

dyads to co-construct a humorous frame and mark the presence of humor in conversation. While it is true that there are inevitable network lags in computer-mediated communication that may alter the real-time dynamics of face-to-face conversation, this study, for its exploratory nature and innovative methodology, provides a first insight into how people jointly use smiling to mark the presence of humor.

This study is relevant within the field of humor studies as it provides insights on how smiling and humor interact in a conversational setting, and point to the fact that smiling, not as an individual behavior but as a coupled action of two conversational partners, may be used as a humor marker in conversation, framing a given segment of conversation as humorous. Moreover, this study is also in line with recent research in psychology focusing on behavioral alignment during interactions and across modalities (thus involving speech, facial expressions, gestures, etc.), while at the same time exploring the under-investigated area of smiling and humor.

From the data analysis it emerges that conversational partners do not only reciprocate each other smiling, as already described in previous studies (Capella 1997; Hess and Bourgeois 2010; Wild et al. 2003), but they also match each other's smiling intensity. Our data reveal that besides framing humorous events by increasing individual smiling intensity relative to the baseline of the conversation (Gironzetti and Menjo 2014), participants also increase the degree of smiling synchronicity when humor is present. Despite showing very different smiling gestures and levels of smiling synchronicity across conversations, results shows that participants tend to display more synchronized smiling behavior (behaviors 1 and 2) and less non-synchronized smiling behaviors (behavior 0) when humor is present relative to the baseline of the conversation. These results are consistent with previous studies (Dale et al. 2013; Fusaroli et al. 2014), and confirm that the co-constructed nature of humor in conversation requires, as other shared construction tasks, specific dynamics of cooperation.

The picture of the relationship between smiling and humor that emerges is a complex one, and in order to understand how smiling is used by dyads of conversational partners it is necessary to take into consideration the individual participant behavior, as well as the dyad joint behavior. While there is no linear relationship between the presence of smiling and humor, it seems that smiling may be used as a marker for humor in conversation not for its sole presence, since, as laughter, smiling can occur with and without humor, but for its intensity, as preliminary results shows that participants smile with a higher smiling intensity when humor is present (Gironzetti and Menjo 2014). Moreover, smiling synchronicity among participants relative to the conversation baseline also increases when humor is present. Thus, it is possible that

participants having a humorous conversation would smile at the same time and at the same intensity, on average higher than when humor is not present, in order to frame the exchange as humorous.

5 Multimodal conversational corpus analysis

The findings presented in the previous section point to the fact that conversational partners use smiling to communicate during face-to-face interactions involving humor, more specifically, they use smiling intensity and increased smiling synchronicity to frame an utterance or a fragment of conversation as humorous. We assume that this joint activity requires participants to pay attention to each other's facial areas involved in smiling, the eyes' and the mouth's regions (Ekman and Friesen 1978) in order to match or mimic each other's behavior. For the purpose of testing this hypothesis and promoting multimodal research on conversational humor, thus giving a further step forward in untangling the complex relationship between smiling and humor in conversation, more data are needed. In this case, we would need to know what participants are looking at during humorous conversational exchanges and if they pay more attention to the eyes' and mouth's facial areas when humor is present. These questions and initial hypothesis motivated the creation of the multimodal conversational humorous corpus that is now presented. Before introducing the corpus, we will briefly review some relevant (however scarce) literature in the field of social eye-tracking studies, and highlight both the need and the novelty of a multimodal social eye-tracking study of humor in conversation.

5.1 Social eye-tracking

The recent technological development that lead to the creation of portable and non-intrusive eye-tracking devices have allowed researchers to apply eye-tracking methodology to social settings (Broz et al. 2012; Rosegrant, Hearrington, Alvarado, & Keeble 2012; Brône and Oben 2015) to study multiple participants' interactions as they occur naturally. Rosegrant et al. (2012) used wearable eye-tracking glasses to examine students' attention during a classroom lecture, Broz et al. (2012) concentrated on mutual gaze during face-to-face conversations, and Brône and Oben (2015) started creating and analyzing a multimodal dialogue corpus that involves eye-tracking data from participants having a face-to-face conversation.

With the exception of these few recent studies, there is a lack of research within a truly social eye-tracking paradigm, as interactions among people have

received limited attention, and have been studied mostly by recording the participants' gaze using a video camera (Kendon 1967; Williams et al. 2009), eye-tracking just one participant in a face-to-face conversation (Vertegaal et al. 2001), or having participants interact through a computer-mediated device, such as video-conferencing (Raidt et al. 2007).

Within this semi-social eye-tracking paradigm, mutual gaze and eye contact have been two of the most extensively studied gaze behaviors. Research shows that these gaze behaviors are used by speakers to signal their willingness to start an interaction (Cary 1978), to regulate turn-taking (Beattie 1978), and to indicate higher levels of attraction, attention and familiarity (Kleinke 1986). In addition, factors such as age, gender, familiarity, conversational role (speaker or listener), type of utterances, and cultural background have been proved to influence participants' gaze behavior (Anolli and Lambiase 1990; Kendon 1967; Knackstedt and Kleinke 1991; Levine and Sutton-Smith 1973). While all these studies provide useful insight into human gaze behaviors, they failed to investigate it in naturalistic social situations where people interact with each other face-to-face.

Smiling, on the other hand, has only been marginally studied using eye-tracking technology, and mostly as part of larger projects dedicated to facial expressions (see, for example, Calvo et al. 2013a, 2013b; Fernández-Martín et al. 2013; Fernández-Martín and Calvo 2012). Moreover, these studies have been carried out in controlled experimental conditions, using static images of faces, often manipulated by the researchers to combine parts of the face expressing different emotions, thus preventing the study of dynamic visual patterns for faces in real-time interactions.

The multimodal conversational corpus that we present here combines the recent technology advances in portable eye-tracking within the new field of social eye-tracking to explore the role of smiling in face-to-face conversations involving humorous events. In particular, the corpus is currently being used to investigate whether conversational partners pay more attention to smiling facial areas (the mouth and the eyes) when humor is present than when there is no humor.

5.2 The multimodal conversational humorous corpus

The following sections will describe in detail the multimodal and multilingual conversational corpus that is being analyzed at Texas A&M University–Commerce. The corpus comprises video, audio, and eye-tracking recordings collected from pairs of conversational partners whose native language was American English, Mexican Spanish, or Mandarin Chinese. In its final form, the corpus will consist of 45 recorded face-to-face interactions of approximately

20 minutes each: 15 interactions among native English speakers, 15 interactions among native Spanish speakers, and 15 interactions among native Chinese speakers. Due to the very purpose and conversational set-up used, participants were allowed to interact as naturally as possible, moving their heads and hands, and this often caused loss of eye-tracking data. To guarantee the validity and integrity of our corpus and subsequent analysis, conversations that allow for the analysis of less than 25% of the data for any of the two participants are discarded, and priority is given to the analysis of conversations for which we were able to collect at least 80% of data from any of the two participants. The corpus has been partially analyzed to date.

5.3 The instrument

Participants' pupil dilation measurements as well as number, order, and length of eye fixations are recorded using Tobii Studio software and two portable Tobii X2-60 eye trackers. Video recording are obtained through two Microsoft LifecamStudio HD cameras, and audio recordings by using one PZM microphone. Two dedicated laptop computers allow for data collection and synchronization of different data sources. The set-up used to collect the data is represented in Figure 6.

As shown in Figure 6, during the recording, the two participants sit across a table, with the two cameras, microphone, and eye-trackers positioned on the table between them, at an optimal height that does not prevent them from interacting naturally and still allows for optimal recording of eye movements. The set-up has a speaker-oriented focus, as our goal is to concentrate on the two participants and obtain video recordings that are detailed enough for a facial expression analysis. Moreover, speakers are facing each other in a naturalistic face-to-face setting optimal for social eye-tracking analysis.

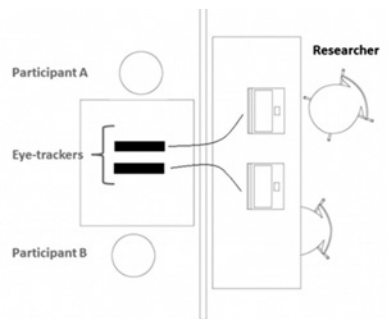

Figure 6: The eye-tracking lab at Texas A&M University–Commerce.

5.4 Data collection

Conversations among dyads of native speakers (university students) of the same language were recorded. Before starting the recording, each participant completed a seven-item closed-response demographic questionnaire. The data collected per conversation comprise one audio track, two video files, and two separate sets of eye-tracking data (number and duration of eye fixations and pupil dilation measurements at a sampling rate of 60Hz). Each conversation lasted approximately 15–20 minutes.

5.5 Data exploration

Preliminary results obtained from the analysis of one conversation between two native speakers of English (Gironzetti et al. 2016) and initial visual exploration of eye-tracking data of interactions among Chinese speakers point to the fact that participants pay more attention to the eyes' and mouth' facial areas when humor is present than when there is no humor. Attention has been quantified as a factor of the total number and duration of eye fixations across participants and Areas of Interest. The different measurements of gaze behavior collected in this pilot study indicate that participants had more fixations on the eye and mouth areas of the interlocutor's face when humor was present, either considered as two separate areas or in combination, that the total length of fixations was higher when humor was present, and that overall participants spent more time fixating on these two facial areas of the interlocutor's face when humor was present (see Gironzetti et al. 2016 for a detailed discussion of these results). A first exploratory data analysis also suggests that this increase in attention for smiling-involved facial areas tends to correlate with an actual smiling behavior of one of both interlocutors, as exemplified in Figure 7.

In the example shown in Figure 7, the dark-grey dots represent the interlocutor's fixations on the participant's face. These two participants in an English dyadic conversation are looking at each other's eyes and mouth, respectively, while also smiling. It remains to be verified if increased attention to smiling facial areas and actual smiling tend to co-occur across dyads and cultures. However, an exploratory analysis of data from Chinese participants shows the same tendency, as illustrated in Figure 8.

In the example in Figure 8, two Chinese-speaking participants are respectively displaying eye fixations on the mouth and eyes of the interlocutor, while also smiling at the same time.

Figure 7: English participants' attention to smiling facial areas while smiling.

Figure 8: Chinese participants' attention to smiling facial areas while smiling.

6 Conclusions

In this paper, we presented the research program that is currently being pursued at the Applied Linguistics Laboratory at Texas A&M University–Commerce. The exploratory study on smiling synchronic behavior of speakers involved in humorous computer-mediated interactions showed evidence that the presence of humor correlates with the display of smiling synchronic behaviors by both participants (behavior 1, smiling synchronicity with no intensity matching, and

behavior 2, smiling synchronicity with intensity matching), while the absence of humor correlates with the display of more asynchronic smiling behaviors (behavior 0, smiling asynchronicity). This suggests that smiling may in fact be used by conversational partners in computer-mediated interactions as a way to jointly frame a segment of conversation as humorous, thus marking the presence of humor. Speakers would increase their level of smiling synchronicity while also smile more intensively (Gironzetti and Menjo 2014) with respect to the conversation's baseline in order to mark a given portion of text as humorous. It remains to be confirmed, however, whether this is also true for non-computer-mediated face-to-face conversations, and whether the presence of different types of humor (canned humor and spontaneous humor, for example) or other intervening variables (e. g., level of familiarity, age, cultural background) may affect the use of smiling as a marker of humor. Moreover, a further distinction between the display of Duchenne and non-Duchenne smiling behaviors would contribute to the ongoing discussion regarding the use of smiling as a voluntary gesture used to communicate the metalinguistic message "this is humorous" (Attardo 2012), or as the expression of a genuine emotion.

This study (but see also Attardo et al. 2013) also highlighted the need for the collection and analysis of a multicultural, multilingual, and multimodal corpus of naturalistic face-to-face dyadic conversations involving humorous exchanges (both canned and spontaneous humor) to understand humor performance, since participants consistently use verbal as well as non-verbal behaviors to communicate to each other (Dale et al. 2013). This corpus was introduced in the final section of this article with the goal of presenting a new methodology for the multimodal study of humor in conversation that would address some of the limitations of the smiling synchronicity study described in this article. Present efforts are focusing on completing the annotation and analysis of the corpus, which will allow us to investigate whether the synchronic smiling behaviors previously described are also present in face-to-face communication and across cultures, and develop cross-cultural comparisons of results for eye-tracking and smiling synchronicity data.

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Appendix A. Smiling Intensity Scale

The five levels of this Smiling Intensity Scale (SIS) are descriptive of different smiling behaviors:

– Level 0: Neutral. No smile, no flexing of the zygomaticus (no AU12), may show dimpling (AU14) or squinting of the eyes (caused by AU6 or AU7), but no raised side of the mouth (no AU 12), the mouth may be closed or open (AU25 or AU26).

- Level 1: Closed mouth smile. Shows flexing of the zygomaticus (AU12), may show dimpling (AU14) and may show flexing of the orbicularis oculi (caused by AU6 or AU7).
- Level 2: Open mouth smile. Showing upper teeth (AU25), flexing of the zygomaticus (AU12), may show dimpling (AU14), may show flexing of the orbicularis oculi (caused by AU6 or AU7).
- Level 3: Wide open mouth smile. Shows flexing of the zygomaticus (AU12), flexing of the orbicularis oculi (caused by AU6 or AU7), and may show dimpling (AU14). 3A: showing lower and upper teeth (AU25), or 3B: showing a gap between upper and lower teeth (AU25 and AU26).
- Level 4: Laughing smile. The jaw is dropped (AU25 and AU26 or AU27), showing lower and upper teeth, flexing zygomaticus (AU12), flexing of the orbicularis oculi (AU6 or AU7), dimpling (AU14)

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