Don’t Lie to Me: The Impact of Deception on Vocalic and Linguistic Synchrony

Debra L. Tower, Matthew L. Jensen, Norah E, Dunbar
Center for Applied Social Research
University of Oklahoma
Norman, USA

Aaron C. Elkins
Intelligent Behaviour Understanding Group
Imperial College London
London, UK

Abstract—Most efforts at improving deception detection involve either the examination of a suspect’s behavioral and physiological cues or are aimed at improving the ability of an interviewer to distinguish between truth and deception. The research presented here employs a dyadic approach to deception detection. This is a relatively novel method which utilizes the complex interplay and mutual influence between the deceiver and the receiver by examining the relationship between interactional synchrony and deception. This field experiment uses criminal interviews of both guilty (deceptive) and innocent (truthful) suspects to explore the impact of deception on different measures of vocalic and linguistic synchrony. Preliminary results indicate that deceivers may strategically synchronize to the interviewer in an attempt to allay suspicion.

Keywords—interactional synchrony; deception; linguistic style matching; vocalic synchrony

I. INTRODUCTION

In the field of deception detection, much research has been devoted to the search for, or disputing the existence of, the functional equivalent of Pinocchio’s nose, a clear-cut behavioral or physiological cue that is diagnostic of deception across situations and subjects. Most experts agree that no such cue exists [1, 2]; research shows that many of the proposed cues to deception, such as fidgeting and gaze aversion, are no more likely to be exhibited by liars than truth-tellers [2]. In a meta-analysis of 158 cues to deception, DePaulo et al. [1] found very few significant links between behaviors and deception.

A second approach to deception detection focuses on the receiver’s ability to accurately distinguish between deception and truth. Although many people believe they are able to detect when someone is lying to them, a meta-analysis by Bond & DePaulo [3] calculated that participants in deception detection were, on average, only 54% accurate in their ability to distinguish between deception and truth. Research indicates that most professionals who are faced with deception detection as part of their job are no more accurate than the general public, indicating that experience does not necessarily lead to greater competence [2]. Most programs aimed at training individuals in deception detection appear to be of limited effectiveness, resulting in, on average, only a 4% increase in accuracy [4].

These two traditional approaches of deception detection, investigating the cues of the deceiver or assessing and attempting to improve the judgment accuracy of the receiver, adopt a relatively static view and fail to fully realize the interactive process inherent in any interpersonal interaction. The research presented here employs a relatively novel method: a dyadic approach to deception detection [5, 6], which recognizes and utilizes the complex interplay and mutual influence between the deceiver and the receiver.

Conversations may seem effortless, but, in fact, interpersonal interactions involve an intricate and dynamic exchange of information across many channels. The dyadic partners, each with their own unique personality and communicative style, must establish a basic common understanding for communication to take place [7]. Even in a simple conversation, interactants will tend to coordinate their behaviors, such as adopting the same posture, matching a partner’s speech rate, or using similar vocabulary. This process of mutual adaptation in nonverbal, linguistic, and vocalic behaviors is known as interactional synchrony [8]. By meshing with a conversational partner, one conveys politeness [8], improves mutual understanding [9], and enhances the flow of the interaction [10]. Along with mutual attention and positivity, interactional synchrony is a component of rapport [11].

Rapport building techniques are widespread in the field of law enforcement. [12]. Interactional synchrony and rapport are utilized by intelligence agents [13], the FBI [14], and crisis negotiators [15] to establish a common understanding, encourage cooperation, and facilitate a successful outcome. In the preceding examples, the interviewer primarily uses rapport and interactional synchrony to elicit information or cooperation from the suspect; in the following study, we examine the relationship between synchrony and deception [5, 6].

II. BACKGROUND

A. What is synchrony?

Interactional synchrony is defined as the “similarity in rhythmic qualities and enmeshing or coordination of the behavioral patterns of both parties” [8] (p. 128) in a dyadic interaction. Interactional synchrony is considered to be the glue of social interaction and relationships [16]. According to Communication Accommodation Theory (CAT) [17],

This research was supported by a grant from the Intelligence Community Postdoctoral Research Fellowship Program. The views and conclusions contained herein are those of the authors and should not be interpreted as necessarily representing the official policies or endorsements, either expressed or implied, the ICPRFP or the U.S. Government.

We thank Stanley M. Slowik for his contributions to this research.
interactants will continuously, and largely unconsciously, adapt their verbal, paralinguistic, and nonverbal communication in relation to their conversational partner in order to strategically regulate social distance. Convergence or accommodation occurs when the partners synchronize or match behaviors, such as gestures or accent, in order to reduce social differences and facilitate communication. Alternatively, nonaccommodation may take place: an interactant may maintain his or her own style, or, as a way to increase distance, show divergence, such as using formal language when the partner is using a relaxed, conversational style, emphasizing differences with the partner. Although interactional synchrony is generally considered an automatic process, CAT includes the strategic and conscious use of adaptation [18].

Linguistic style matching and vocalic synchrony are of particular interest in the research presented here and will be discussed further.

B. Linguistic Style

An individual’s choice of words is more than a convenient selection; it is an expression of the self. Linguistic Inquiry and Word Count (LIWC) [19] categorizes words across a number of linguistic and psychological dimensions such as affective words (e.g., love, hate) and cognitive processing words (e.g., cause, know). Research indicates that an individual’s linguistic style is reliable across time and is reflective of perceptions and thought processes [20]. Based on this premise, Niederhoffer and Pennebaker [21] proposed that shared linguistic style would be indicative of like-mindedness and affinity. Furthermore, as predicted by CAT [17], as conversational partners synchronize and mutually adapt, their linguistic style should converge. In their analysis of the dyadic interactions in three studies, Niederhoffer and Pennebaker [21] found that dyadic partners tend to coordinate their word use across a number of linguistic, social, and cognitive categories. LIWC has been validated in a variety of contexts [22] and has been also used in deception research [23, 24, 25]. For example, a linguistic analysis by Newman, Pennebaker, Berry, and Richards [24] found that deceptive statements included more negative words, fewer first and third person pronouns, and were less complex than truthful statements.

C. Vocalic Indicators

Vocalic qualities can be assessed along a variety of parameters such as pitch, response latency, intensity, tempo, rhythm, and variation. Pitch, as measured by fundamental frequency (F0) has been demonstrated as a consistent indicator of emotion and attitude [26], and is commonly included in the analysis of vocalic synchrony. Response latency is also of particular interest in this study because it serves as an indicator of thought, doubt, or preoccupation [26]. Pitch, vocal tension, response latency, and talking time have been found to be associated with deception, but the findings are somewhat inconsistent due to moderator variables such as motivation and whether the lie was planned or spontaneous [1].

III. RESEARCH QUESTIONS

Synchrony is a naturally occurring process and takes place in nearly all encounters; it reflects and influences the quality of the interaction. On the other hand, synchrony and rapport are disrupted by emotional or behavioral distance [9, 27]. Deception adds a layer of complexity to an interaction and may attenuate interactional synchrony between an interviewer and a subject. According to Inbau et al. [28], liars will be less cooperative and friendly than truth-tellers. A truth-teller, from this perspective, will gladly offer assistance in terms of ideas and suggestions about the crime. However, an alternative view posits that guilty suspects are likely highly motivated to appear cooperative, while an innocent person may feel indignant and resistant as a result of being unfairly accused [25]. In this case, deceivers, particularly skilled deceivers, should attain more closely than truth-tellers to an interviewer in an attempt to maintain rapport and project an image of credibility.

These competing propositions lead us to ask the following research questions:

RQ1: To what extent do vocalic and linguistic synchrony of the interviewer-interviewee dyad distinguish between truthful and deceptive interviewees?

RQ2: Do the temporal patterns of linguistic and vocalic synchrony differ between truthful and deceptive interviewees?

RQ3: Do the measures of linguistic and vocalic synchrony differ in terms of diagnosticity of deception?

IV. METHODOLOGY

A. Sample

The current paper presents preliminary findings from this work in progress.

We will analyze approximately 40 pre-polygraph interviews from criminal investigations. The interviews were selected from a corpus of 101 interviews according to case outcome on three factors: the legal adjudication of the case, the results of the polygraph test, and the opinion of the interviewer based on the evidence of the case and statements made during the course of the interview. In order to be included for analysis, all three factors needed to be in agreement with respect to guilt or innocence so that, given the inherent difficulties in establishing ground truth in a field study of this nature, a reasonable assumption of guilt or innocence could be made.

The interviews were conducted by one interviewer; a professional white male with extensive polygraph interview experience. The interview style and questions were relatively consistent across the interviews, with some deviation due to case differences.

All of the suspects were adults, ranging in approximate age from 18 to 70. The interviews include both male and female suspects and the cases involved a variety of charges.

B. Measures

1) Vocalic Synchrony: The vocalic features of the utterances of the interviewer and subject are analyzed to
determine the level of prosodic synchrony, including pitch and response latency across time.

2) Linguistic Synchrony: The linguistic analysis examines the degree and direction to which the dyadic partners synchronize their linguistic style in terms of word use, length and complexity of utterances, the relative use of different linguistic and paralinguistic dimensions, as well as categories of words, such as affect and cognition.

C. Procedure

Synchrony Using Linguistic Features: Synchrony in the linguistic channel will be assessed through a multi-step process. The first step involves extracting linguistic features from verbatim transcripts of interviews. First, transcripts are segmented into individual utterances. Next, language features are extracted from the utterances using Linguistic Inquiry and Word Count (LIWC).

Once linguistic features have been extracted from individual utterances, the features are normalized based on the length of the utterance and summarized across 10 utterances (for smoothing and to capture several question-answer exchanges). The summarized utterances from the interviewer and suspect are then correlated across the length of the interview to determine amount and placement of any synchrony. Additionally, plots of the summarized utterances are reviewed and reconciled with the manual synchrony and interview question coding.

Figure 1 displays an example of cognitive processing words from a single transcript. The percentage of cognitive processing words in each utterance is plotted for both the interviewer (blue) and suspect (red). The moving average across 10 utterances is also plotted for both the interviewer and suspect.

Synchrony Using Vocal Features: To analyze the vocal synchrony between the suspect and interviewer, acoustic features were extracted from the interview recordings using Praat [29]. To prepare the audio for feature extraction the audio recordings were first transcribed and time coded by speaker (i.e., interviewer or suspect). Using the time codes each interview recording was then cut into separate audio files of every utterance by speaker. Each utterance audio file was then submitted to vocal feature extraction to represent the voice for that speaker. An utterance corresponds to a turn in speaking during the interview’s question and answer format. The final step was to temporally aggregate the vocal features for each speaker into two minute overlapping intervals. The aggregation took the average of all the vocal features for every two minutes. If an interview was 60 minutes this would result in 30 time points.

Figure 2 illustrates mean F0 pitch after temporal aggregation from one interview. For every sequential two minute period the average of the vocal features was taken for all utterances in this period.

V. PRELIMINARY VOCAL RESULTS

Nineteen interview recordings were transcribed, preprocessed, temporally aggregated, and submitted to vocal feature extraction. Of the 19 interviews, 12 were later judged innocent and 7 guilty. The average length for each interview analyzed was 41.36 minutes (SD=9.84). For this analysis the primary vocal feature analyzed was median vocal pitch (F0), selected to provide a robust estimate that is less influenced by outliers, which are more likely to occur over longer utterances. The average utterance length was 6.78 seconds (SD=9.48).

A. Correlation

The correlation between the suspect and interviewer provide one measure of the vocal synchrony. Overall, the suspect and interviewer had moderate correlation in their vocal pitch, r=.31 p<.001. Looking at the correlation of guilty and innocent suspects we find that guilty suspects had a greater correlation to the interviewer, r=.40 p<.001, than innocent suspects, r=.21 p<.001.

B. Growth Model

The significant correlations suggest greater synchrony for guilty suspects. To further explore the dynamics of the interaction we conducted a multilevel growth model was specified with suspect median F0 as the response variable (N=412) regressed on time (in two minute intervals), Guilt (1=guilty, 0=innocent), Interviewer median F0, Gender, and Dominance. Dominance and Gender were included to control for the individual variation in speech. Dominance is a measure of observed dominant behavior that was coded in an earlier study [23]. Time and the intercept of median F0
were modeled to vary with Subject (N=19) as random effects.

The results of the regression revealed significant interactions between Guilt and Time, b = -3.39 p = .02 and Guilt, Time, and Interviewer median F0, b = .03 p = .02. The first interaction between Guilt and Time indicate that guilty suspects decreased their median vocal pitch at a rate of -3.39 Hz slower than innocent suspects every two minutes. The second interaction indicates that the median vocal pitch of the interviewer affects and increases guilty suspect’s vocal pitch later in the interaction. This could be because relevant issues to the cause get brought up later in the interview and during this period suspects are attempting to be more synchronized with the interviewer. The next step for this work will be to further code the utterances and phases of the interview to better model this phenomenon. Figure 3 illustrates the interaction of guilt, time, and Median F0.

VI. CONCLUSION/FUTURE WORK

At this time, only preliminary vocalic findings are available so all results should be considered tentative. Further analyses on the complete data set will examine the extent and pattern of linguistic style matching and vocalic synchrony between a criminal interviewer and guilty versus innocent suspects.

The initial vocalic analysis on the partial data set indicates that guilty (deceptive) suspects tend to synchronize with the interviewer more than innocent suspects. If true, this may represent a strategic attempt by guilty suspects to maintain rapport with the interviewer in order to appear credible.

REFERENCES


