Automated Linguistic Analysis of Deceptive and Truthful Synchronous Computer-Mediated Communication

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Abstract

The present study investigates changes in both the sender's and the target's linguistic style across truthful and deceptive dyadic communication in a synchronous text-based setting. A computer-based analysis of 242 transcripts revealed that senders produced more words overall, decreased their use of self-oriented pronouns but increased other-oriented pronouns, and used more sense-based descriptions (e.g., seeing, touching) when lying than when telling the truth. In addition, motivated senders avoided causal terms during deception, while unmotivated senders relied more heavily on simple negations. Receivers used more words when being deceived, but they also asked more questions and used shorter sentences when being lied to than when being told the truth, especially when the sender was unmotivated. These findings are discussed in terms of their implications for linguistic style matching and interpersonal deception theory.

1. Introduction

Modern communication technologies have advanced both the speed and quantity of information that is shared among humans and organizations. While these changes have created a number of advantages for society, including faster access to information and inexpensive modes of communication at a distance, they have also created new opportunities for the darker aspects of human communication, such as deception [1]. Deception involves a deliberate attempt to create in another person a belief in which the communicator deems untrue [2], and it does not appear to be uncommon. It has been reported that people tell an average of one to two lies a day, and these lies occur in both FtF and mediated interactions [3, 4]. Indeed, phone conversations tend to involve more lies than FtF interactions, while the rate of deception observed in Instant Messaging appears to approximate FtF rates [4].

The observation that lying occurs across different media has important implications for corporations and other organizations that are increasingly relying on computer-mediated communication (CMC) to support information exchange and communication within and between organizations. In particular, is it possible to detect deception in these new, typically text-based, communication settings?

A number of recent studies have addressed this question by developing automated linguistic analysis techniques, in which computer programs are used to analyze the linguistic properties of texts, to examine the linguistic content and structure of deceptive communication [5, 6, 7, 8]. The objective of the present study is to replicate and extend this initial research by examining the linguistic profiles of deceptive and truthful senders and targets engaged in a text-based, synchronous CMC interaction. Unlike previous research, in the present study the motivation of senders to succeed in their deceptions was manipulated so that some senders were highly motivated to deceive their partners while others were not.

1.1. Automated analysis of linguistic cues

As Pennebaker and his colleagues [9] note, words used in daily interactions reveal both psychological and social aspects of peoples' worlds. Certain words and parts of speech can be markers of emotional, psychological, and cognitive states. Given that deceiving others likely involves changes in emotional or psychological states, linguistic cues detected using automated techniques may indicate lying in conversation. A review of the relatively small literature concerned with automated linguistic analyses of deception indicates that, to date, four main types of linguistic cues have been associated with deception: 1) word counts 2) pronoun usage, 3) words pertaining to feelings, and 4) exclusive terms [10, 1, 7, 8].

Consider first the overall production of words across deceptive and truthful communication. Some studies have found that liars offer fewer details because, not only do they have less familiarity with what they are discussing, but they also attempt to avoid the opportunity to be disproved [11, 1, 2]. Empirical investigations of CMC-based lying, however, have revealed that deceptive senders actually produce more words than non-deceptive senders [e.g. 7]. Two possible reasons have been suggested for this increase. The first is that the CMC environment may provide the deceiver with more time and control to embed deceptive messages within truthful messages. The second explanation is concerned with

properties of the task. Deceivers appear to use fewer words in interrogative contexts, in which it behooves the deceiver to say less in order to avoid contradicting other statements. In contrast, in more conversational contexts, the deceiver may produce more words in order to provide additional evidence to support their deception [e.g. 7].

Consider next patterns of pronoun usage. In a series of studies in which participants either lied or told the truth about a given subject, Newman et al. [8] observed that individuals consistently used first person singular pronouns less frequently when lying than when telling the truth. Using first person pronoun words such as "I," "me," or "my" involves taking ownership of a statement, and deceivers may refrain from using these first person pronouns due to either a lack of personal experience or a desire to dissociate themselves from the lie being told. The data concerned with second person pronouns, such as "you" and "you'll," and third person pronouns, such as "she," "their," "they," and "them," are less consistent. In particular, there are conflicting findings regarding the use of second and third person pronouns. Some studies have found that liars are less likely to use second and third person pronouns [8] while other studies have found that liars are more likely to use second and third person pronouns [11, 7].

Research examining verbal cues associated with feelings that occur during deception suggests that there are elevations of negative emotion words (e.g., "hate," "worthless," "enemy") during deception compared with telling the truth [8, 2], which are assumed to reflect the fact that the deceiver feels guilty about the act. These observations are generally consistent with work by Burgoon and colleagues [1, 7], who found that deceivers tend to use more expressiveness, which includes both negative and positive forms of emotion, compared to truth-tellers. Finally, previous research also suggests that liars use fewer exclusive words than truth-tellers [8]. Exclusive words include prepositions and conjunctions such as "but," "except," "without," and "exclude." These words require a deceiver to discuss what is in a category and what is not, and it is a complex task to invent what was done versus what was not done [8]. Thus, it is assumed that only truth-tellers should be able to discuss exactly what did and did not happen because they were actually there to witness the event being discussed. Liars, on the other hand, would be forced to keep track of what they have previously said in order to avoid contradicting themselves later.

Although the literature on automated approaches to linguistic analysis of deception suggests that pronouns, feeling words, and exclusion words may predict deception, the majority of previous research has ignored the impact of deception on the target of the lie (for an exception, see [7]). For example, recall Newman et al.'s [8] examination of only a sender's handwriting, videotapes, and typed transcripts. In no case were the reactions of receivers (i.e., the targets of deceptive messages) studied. However, if senders alter their behavior in systematic ways when lying versus when they are telling the truth, as previous research suggests, then an important question that remains to be addressed is whether receivers will also behave differently when lied to than when they are told the truth. Two theoretical perspectives are relevant to this question, linguistic style matching (LSM) [12] and Interpersonal Deception Theory (IDT) [10].

Linguistic style matching refers to the degree to which two people in conversation adjust their own speaking behavior, or style, to match their partners' behavior. Style matching, in which people vary their words on a turn-by-turn level when in conversations with others, is assumed to reflect the coordination processes inherent in natural conversations [12]. Indeed, participants in conversations have been known to exhibit similar types of concurrent behaviors and word usage [12]. In conversation, Participant 1 will speak to Participant 2 thereby influencing Participant 2 who will, in turn, influence Participant 1.

If, as linguistic style matching suggests, people in conversation adjust their linguistic behavior to that of their partners, then any differences in linguistic behavior by senders across deceptive and truthful communication should also be observed in the receiver's behavior. As such, the linguistic style matching perspective would predict that during deceptive interactions, receivers, like senders, should produce more words, fewer self-oriented but more other-oriented pronouns, more negative emotion terms and more exclusive words.

The second perspective, IDT, also has implications for how receivers will behave linguistically when they are being deceived. Burgoon et al.'s [10] IDT proposes that deceptive communication is interactive, and that both parties make strategic adjustments in order to continuously to relate to one another. However, the relationship between the sender and receiver's behavior is not as straightforward as the linguistic style matching perspective predicts. In one test of IDT, for example, Burgoon, Bonito, Bengtsson, Ramirez, Dunbar, and Miczo [13] observed that the degree to which a conversation was perceived as highly interactive was positively related to the degree to which a participant judged his or her partner as credible. Thus, one would expect that a sender trying to deceive his or her partner would attempt to increase the interactivity of the conversation in an effort to seem more credible. Senders may also attempt to engage the receiver and may, for example, increase turn taking and question asking in an effort to increase interactivity. If this is the case, and the sender is successful in increasing interactivity, then both the sender and the receiver should use more turns and more words during deceitful conversations than during truthful conversations.

A second aspect of IDT is the impact of the cognitive complexity associated with deception. The increased cognitive load of deception has been found to lead to the exhibition of non-strategic nonverbal cues, such as blushing, fidgeting, or gaze aversion [10]. In addition, when lying, senders may become aware that their actions are not consistent with the social expectancies of truthful communication [10]. These feelings can manifest themselves in ways that are detectable to a receiver, who in turn, becomes suspicious [10, 13]. If receivers become skeptical, they should use indirect methods of obtaining more information regarding their partner's truthfulness. Probing and asking questions about the information presented by the sender may be one way skeptical receivers accomplish this [10]. As such, receivers should ask more questions of the sender when they are being lied to than when they are being told the truth.

Considered together, IDT does not posit a one to one relationship between the behavior of the sender and the receiver, as does the linguistic style matching theory. In particular, if linguistic style matching is at work, the receivers will mirror the linguistic behavior of the senders. As such, no differences in the role of the participants (i.e., sender versus receiver) should be observed in conversations that involve deception. In contrast, if IDT is correct, senders will attempt to create greater interactivity with the receiver during deception, and the receivers will then respond to deception by showing signs of skepticism and suspicion. In particular, according to IDT, deceitful senders should use more words per interaction and ask more questions in an attempt to engage receivers. When they are being lied to, receivers should probe their partners by asking more questions.

1.2 Hypotheses

The present research examines both the senders and receiver's behavior in conversations in which the sender lies and conversations in which the sender tells the truth. The first hypothesis was derived from previous data suggesting that in asynchronous CMC interactions (e.g, email), deception involved more words than truthful messages [7]. We predicted that this observation would hold in synchronous environments as well.

Hypothesis 1: Both senders and receivers will use more words during deceptive conversations than during truthful conversations.

Recall that IDT assumes that as receivers become skeptical during a deceptive interaction they will attempt to probe for more information from the sender, which may be manifested in increased question asking. Thus, in deceptive interactions, receivers were expected to ask more questions than during truthful interactions:

Hypothesis 2: Receivers will ask more questions during deceptive conversations as compared to truthful conversations.

A second set of hypotheses was derived from previous empirical observations with automated linguistic analysis. First, consistent with the notion that senders attempt to distance themselves from their deception [8, 2] it was expected that senders would use fewer self-oriented but more other-oriented pronouns when they lying compared to when they are telling the truth.

Hypothesis 3: Senders will use fewer first person singular but more second and third person pronouns in deceptive conversations relative to truthful conversations.

Based on the findings pertaining to senders' increased rate of negative emotion words during deceptive conversations [8, 2], the senders in the present study were expected to also produce an increased rate of negative words.

Hypothesis 4: Senders will use more negative emotion words during deceptive conversations than during truthful conversations.

Based on Newman et al.'s [8] findings regarding the senders' decreased use of exclusive word during deceptive conversations, the senders in the present study were expected to also produce a lower rate of exclusive words during deceptive communication in comparison to truthful communication.

Hypothesis 5: Senders will use fewer exclusive words in deceptive conversations as compared to truthful conversations.

Finally, a set of research questions was posed regarding a number of linguistic variables that have not been previously examined. The goal of these research questions was to explore other variables that may have an impact on the prediction of deception. The first variable of interest was negation words (e.g., "no," "never," "not"). One method of lying is to simply negate statements that describe the truth.

RQ1: Will senders use more negation words during deceptive interactions as compared to truthful interactions?

Causation words (e.g., "because," "effect") provide a certain level of concreteness to an explanation, although given that concreteness, causation words can increase the potential of detection. The sender's reasoning may not make sense or might be vague which would lead a receiver to question what the sender is saying.

RQ2: Will senders use fewer causation words during deceptive interactions as compared to truthful interactions?

The present study also explored the use of sense words (e.g., "see," "touch," "listen"). These words were of interest because a deceiver may be likely to attempt to create a detailed story and draw the receiver into that story in order to avoid eliciting skepticism from the deceiver [13].

RQ3: Will senders use more senses words during deceptive interactions as compared to truthful interactions?

A second objective of the present study was to explore the impact of motivation on the linguistic aspects of deception. The observation that highly motivated liars are more likely to be detected has been referred to as the *motivational impairment effect* [14]. However, this effect has been examined primarily with regard to nonverbal cues. Given the importance of motivation in deception, the present study examined how motivation affects the linguistic behavior of unmotivated and highly motivated senders and of their targets.

RQ4: How will motivation to deceive a partner affect the linguistic style of senders and receivers across deceptive and truthful communication?

2. Methods

2.1 Participants

Participants (n = 66) were upper-level students at a northeastern American university, and they participated for credit in various courses. Participants were randomly paired to form 33 same-sex, unacquainted dyads (15 male and 18 female).

2.1 Procedure

The general procedure was adapted from Burgoon et al. [15]. All participants were told that they would be having a conversation with an unknown partner. They were instructed that they would discuss 5 topics, which were then provided to the participants on a sheet of paper. The first topic was always "When I am in a large group, I…" This initial topic was designed to allow the participants to become comfortable interacting with their partner, and was not included in any analyses. After this topic, participants began a discussion of the four experimental topics which included: "Discuss the most significant person in your life", "Talk about a mistake you made recently", "Describe the most unpleasant job you have ever had to do" and "Talk about responsibility." There was no time limit and participants were asked to discuss each topic until they had exhausted it and understood each other's responses.

One of the two participants was randomly assigned to the role of sender, and the other to the role of receiver. Senders were asked to sometimes deceive their partners. In particular, they were instructed "to NOT tell 'the truth, the whole truth, and nothing but the truth'" [15] on two topics, and to be truthful on the other two topics. The two topics in which the whole truth was not to be told were marked with an asterisk on the sheet of paper given to the sender. The sequence in which the topics were discussed, and the order in which the sender lied, was counterbalanced across 16 orders. Receivers were blind to the deception manipulation and were told that they were going to have a conversation with another person and that their role was to keep the conversation going. The same list of topics in the same order was given to the receivers but without any asterisks marking topics.

Participants discussed the topics in a text-based, synchronous computer-mediated setting and performed the task at isolated computer terminals. Participants used one of two desktop computer stations while the experimenter monitored and recorded the interaction from a third station. Once participants were seated at their terminals, the experimenter briefly demonstrated the use of the computer interface, Netmeeting, in which participants typed their message in a private composition window and hit enter to send their message to a shared chat window. Message transmission was virtually instantaneous.

2.3 Motivation manipulation

Senders were randomly assigned to one of two motivation conditions: "low motivation to lie" or "high motivation to lie." The motivation manipulation was based on previous research procedures used to manipulate motivational levels of liars [e.g. 16]. In the case of high motivation manipulation, senders were falsely informed "that they had to make sure that they were able to convince their partner on the topics that they were lying about, as it was a very important skill to be able to deceive others in daily interactions." Low motivation senders were only told to try to deceive their partners. Only senders received the motivation manipulation; receivers were blind to the motivation manipulation. During debriefing the senders were informed that, in fact, no relationship between lying ability and future success has actually been documented.

2.4 Automated linguistic analyses

Both sender and receiver transcripts were converted into separate text files separated by topic. Each dyad produced eight different transcript files: two deception discussions and two truthful discussions for each sender, and two deception discussions and two truthful discussions for each receiver, which produced a total of 264 transcripts. Before conducting the linguistic analyses, the transcripts were subject to pre-processing, which involved three aspects. First, given that CMC participants often omit punctuation, periods were placed at the end of all turns. Similarly, if a question mark was omitted after a question, a question mark was inserted, and if multiple question marks ended a question they were reduced to one question mark. Lastly, any misspellings were corrected unless the participant explicitly corrected the spelling error. For example, the phrase "poeple are mean" would be corrected (i.e., "people are mean") unless

the participant corrected their mistake (e.g., "Poeple are mean" followed by "I mean people"). In this case, both the spelling error and the correction were left in the transcript.

All transcripts were analyzed using the Linguistic Inquiry and Word Count (LIWC) program [17]. This text analysis program was used to create empirically derived statistical profiles of deceptive and truthful communications [9], and it has been used in studies to predict outcome measures like social judgments, personality, psychological adjustment, and health. LIWC analyzes transcripts on a word-by-word basis, including punctuation, and compares words against a file of words divided into 74 linguistic dimensions. For the purposes of this study, only variables relevant to the hypotheses or of potential interest to deception were included, which left 11 variables to analyze: word counts, words per sentence, use of question marks, first person singular, second person and third person pronouns, negative emotion words, exclusive words, negations, causation words, and words pertaining to the senses. LIWC produces the percentage of each variable type by dividing the frequency of the observed variable by the total number of words in the sample. Word counts and words per sentence were not reported as percentages, but as frequency totals.

3. Results

The model used to analyze each of the 12 linguistic variables involved both between and within-subjects analysis. In particular, a 2 (discussion type: truthful vs. deceptive) x 2 (role: sender vs. receiver) x 2 (topic: first vs. second) x 2 (motivation: high vs. low) mixed General Linear Model (GLM) procedure was conducted on each dependent variable. The discussion type, role and topic factors were entered as repeated measures, and the motivation factor was entered as a between subjects variable. Table 1 contains the descriptive statistics for each variable.

3. 1 Word count analyses

The first analysis examined the number of words produced during the interaction. A significant main effect of discussion type was observed for the word count data, F (1, 31) = 6.86, p < .05. More words were produced during deceptive discussions (M = 156.53, SE = 13.73) than during truthful discussions (M = 122.32, SE = 10.45). Senders produced significantly more words in deceptive conversation topics (M = 156.63, SE = 11.56) than in truthful ones (M = 125.9, SE = 11.06). Receivers also produced more words in deceptive interactions (M = 157.77, SE = 16.32) than in truthful interactions (M = 121.24, SE = 10.92). The increase in word count for deception was equivalent for both senders and receivers, F (1, 31) < 1, *ns*, suggesting that both senders and receivers used more words when the sender was lying. No role of motivation was observed, nor did any of the factors interact.

An analysis of the number of words used per sentence revealed a significant interaction between discussion type and role, F (1, 31) = 4.07, p < .05. Simple effect analyses, conducted at each level of discussion type, revealed that senders (M = 9.03, SE = .53) and receivers (M = 9.04, SE = .59) produced the same number of words per sentence during truthful discussion, F (1, 32) < 1, *ns.* In contrast, during deceptive conversations, senders used more words per sentence (M = 10.20, SE = .97) while receivers used fewer (M = 8.21, SE = .42), F (1, 32) = 3.81, p = .06.

3.2 Question frequency analysis

An analysis of the number of questions used by both the senders and receivers combined revealed a main effect of discussion type, F (1, 31) = 4.59, p <.05. More questions were observed during deceptive communication (M = 15.67, SE = 1.29) than during truthful discussions (M = 13.60, SE = 1.41). This effect, however, was moderated by a significant interaction between the discussion type, role, and motivation factors, F (1, 32) = 4.23, p < .05. Simple effects analyses revealed that this interaction reflected the fact that receivers asked more questions when unmotivated senders were lying (M = 17.07, SE = 2.26) than when they were telling the truth (M = 8.78, SE = 1.60), F (1, 15) = 9.58, p < .01. This difference in receiver question-asking behavior across truthful and deceptive conversations was not observed in the high motivation condition, F (1, 16), < 1, *ns*. Furthermore, the number of questions produced by senders did not differ across truthful and deceptive conversations in either of the motivation conditions, suggesting that senders used the same number of questions regardless of their truthfulness or motivation level.

3.3 Pronoun analyses

The next set of analyses examined pronoun usage. H3 predicted that senders would use fewer first person singular pronouns and more second and third person pronouns when they were lying. The first analysis examined the use of first person singular pronouns (i.e. "I"). A marginal effect of discussion type was observed, F(1,31) = 3.78, p = .06. Consistent with H3, participants

Table 1. Means and (Standard Errors) of the linguistic output variables by truth condition, role and motivation level.

	Sender *M (SE)*				Receiver *M (SE)*			
	Low Motivation		High Motivation		Low Motivation		High Motivation	
	Lie	Truth	Lie	Truth	Lie	Truth	Lie	Truth
Word Count	145.41 (17.07)	126.13 (16.34)	166.18 (16.56)	124.09 (15.85)	154.22 (24.16)	117.03 (15.98)	160.32 (23.44)	122.03 (15.50)
Question Marks	16.67 (3.31)	17.2 (3.37)	15.13 (3.21)	15.61 (3.27)	17.07 (2.20)	8.78 (1.89)	13.69 (2.13)	12.78 (1.83)
Words per sentence	10.03 (1.41)	8.59 (0.77)	10.37 (1.37)	9.44 (0.74)	8.34 (0.62)	8.98 (0.86)	8.09 (0.60)	9.10 (0.83)
1st Person Singular (%)	7.03 (0.52)	7.81 (0.54)	7.13 (0.50)	7.89 (0.52)	7.85 (0.61)	8.20 (0.60)	6.88 (0.59)	8.57 (0.58)
2nd Person (%)	2.96 (0.40)	2.44 (0.45)	1.90 (0.39)	3.19 (0.44)	2.78 (0.47)	2.26 (0.32)	2.52 (0.46)	2.24 (0.31)
3rd Person (%)	2.92 (0.47)	2.38 (0.27)	3.67 (0.46)	2.49 (0.25)	2.44 (0.44)	1.97 (0.39)	2.70 (0.43)	2.86 (0.38)
Negations (%)	2.77 (0.27)	1.70 (0.24)	1.65 (0.27)	1.83 (0.24)	2.45 (0.27)	2.10 (0.31)	2.11 (0.27)	2.29 (0.30)
Negative Emotions (%)	1.95 (0.30)	1.82 (0.32)	2.06 (0.29)	1.62 (0.31)	2.23 (0.34)	1.94 (0.31)	2.10 (0.33)	1.41 (0.30)
Causation (%)	1.03 (0.15)	0.94 (.18)	0.86 (0.15)	1.44 (0.17)	0.85 (0.14)	1.18 (0.24)	1.13 (0.14)	1.10 (0.24)
Senses (%)	2.61 (0.23)	2.10 (0.29)	2.34 (0.22)	2.08 (0.28)	2.50 (0.27)	2.19 (0.32)	2.48 (0.26)	2.16 (0.31)
Exclusive Words (%)	3.74 (0.39)	4.06 (0.47)	4.26 (0.38)	4.28 (0.46)	3.80 (0.32)	4.17 (0.45)	3.46 (0.31)	3.57 (0.44)

Note: Word count, words per sentence, and question marks are reported as totals. All other variables are reported as a percentage of the total number of words.

used fewer first person singular pronouns when lying (M = 8.12, SE = .30) than when telling the truth (M = 7.22, SE = .33). No effects were observed for role or motivation, suggesting that both senders and receivers decreased their use of first person singular pronouns to the same degree during deceptive communication, regardless of whether or not the sender was highly motivated.

Two types of other focused pronouns were analyzed, second (i.e. "you") and third person pronouns (i.e., "he," "she," "they"). No effects were observed for second person pronouns. However, an analysis of third person pronouns revealed a main effect of role, F (1, 31) = 4.68, p < .05. Senders used third person pronouns more frequently overall (M = 2.86, SE = .17) than receivers (M = 2.49, SE = .23). This effect, however, was moderated by a reliable interaction between discussion type and role, F (1, 32) = 4.31, p < .05. Simple effects at analysis for each role type revealed that, consistent with H3, senders were significantly more likely to use third person pronouns when lying (M = 3.26, SE = .032) as compared to when they were telling the truth (M = 2.36, SE = 0.19), F (1, 31) = 4.57, p < .05. In contrast, no effect of discussion type was observed for the receiver F (1, 31) < 1, *n.s.* No other effects were observed.

3.4 Content analyses

The next set of analyses examined use of content words in the conversations. The first analysis examined the use of negation (e.g., "no," "never," "not"). A marginal interaction between discussion type and motivation was observed, F (1, 31) = 3.44, p = .07.

Simple effects analyses revealed that, when senders were highly motivated to deceive their partner, no difference in the frequency of negation words was observed across deceptive (M = 1.88, SE = .18) and truthful discussions (M = 2.06, SE = .19), F (1,16) < 1, *ns.* In contrast, when senders were not motivated, senders produced marginally more negation words during deceptive discussions (M = 2.61, SE = .25) than between truthful discussions (M = 1.90, SE = .21), F (1,15) = 3.45, p = .08.

An analysis of causation words (e.g., "because," "effect," "hence") revealed a significant three way interaction between discussion type, role, and motivation, F (1,15) = 4.03, p < .05. Simple effects analyses conducted at each role type revealed no effects of discussion type or motivation on the receiver's use of causation terms. However, highly motivated senders used reliably more causation terms when they were telling the truth (M = 1.44, SE = .17) than when they were lying (M = .86, SE = .15), F (1,16) = 5.58, p < .05. This difference in the use of causal terms across truthful and deceptive conversations was not observed for unmotivated senders, F (1,15), < 1, *ns*.

The next analysis examined the use of "sense" words (e.g., "see," "touch," "listen"). A main effect of discussion type was observed, F (1, 31) = 5.25, p < .05. Participants were significantly more likely to use words that pertained to the senses when lying (M = 2.47, SE = 0.16) than when they were telling the truth (M = 2.10, SE= 0.19). No other effects for the senses variable were observed.

Finally, the remaining analyses focused on exclusive words (e.g., "but," "except," "without") and the use of negative emotion words (e.g., "hate," "worthless," "enemy"). No effects or interactions on either of these word types were observed, suggesting that deception and levels of motivation to deceive did not affect the sender or receiver's production of exclusive words or negative emotion words.

4. Discussion

The primary objective of the present study was to examine the linguistic behaviors of both senders and receivers during electronic dyadic communication that involved both deceptive and truthful discussions. The first question of interest was determining whether the senders' linguistic behavior changed when the sender was being deceptive relative to when the sender was being truthful. The data suggest that, overall, when senders were lying to their partners, they produced more words, used more "other" pronouns (e.g., "he," "she," "they"), and used more terms that described the senses (e.g., "see," "hear," "feel") than when they were telling the truth.

These observations are consistent with a number of the hypotheses described above. Hypothesis 1 was supported, as senders were significantly more likely to use more words in their deceptive interactions as compared to truthful interactions. This is consistent with the explanation that senders attempt to construct a more cohesive and detailed story in order to seem believable [7], although this is inconsistent with previous literature suggesting that liars produce fewer words and less detail (see Vrij [2]). Why this observation occurred in the present study is discussed below with respect to sense terms.

When lying, senders decreased their use of first person singular pronouns, but increased their use of third person pronouns, or pronouns referring to others (e.g., "he," "she," "they"), which is consistent with hypothesis 3. Newman et al. [8] previously observed that deceptive interactions are characterized by the sender's use of fewer pronouns overall, including first, second, and third person pronouns. This was not exactly the case in the present study. Like several other studies (e.g., [1,7]), our senders tended to talk about people other then themselves more often than when they were lying. It is possible that by discussing others and not themselves, the senders were decreasing their chances of being disproved.

Research question 3 asked whether senders would use sense words (e.g., "see," "touch," and "listen") to bolster the credibility of their stories, or avoid them in order to avoid being detected. The results suggest that senders increased their use of sense words during deceptive interactions relative to truthful interactions. In particular, sense words may serve as enhanced, or more believable, evidence about what is being discussed. They allude to the fact that the sender was involved with what he or she is discussing and may decrease the chances of generating skepticism on the part of the receiver. It is important to note, however, that this increase in sense terms, and the associated increase in word usage during deception, is inconsistent with the majority of previous research (for review, see Vrij [2]), which suggests that when people are lying they produce fewer details, not more. Additional research will be required to determine whether this finding flows from the fact that interactions took place in a text-based CMC medium, or whether it flows from differences in the task. In particular, in the current study, senders were asked to describe false opinions, which are non-verifiable. In contrast, the majority of previous research that has reported decreased detail during deception has involved participants describing event-based, verifiable narratives (e.g., a mock crime). It may be the case that when it is safe to do so, deceivers will pepper their lies with more detail, but when they are at risk of being discovered, they will be more hesitant to provide details.

Not all senders displayed the same linguistic pattern. The motivation of the sender played an important role in several dimensions of the sender's

linguistic style. In particular, motivated liars tended to produce fewer causal terms (e.g., "because," "hence," "effect") when lying, while the discourse of unmotivated liars did not differ on this linguistic dimension. These data have a number of implications for the hypotheses described above.

First, the data concerned with causation terms (e.g., "because," "effect," and "hence") address research question 2, which asked whether senders would use fewer causal terms when lying. In particular, a lower incidence of causal terms was only found for highly motivated senders. Motivated senders were less specific in terms of the causal words they used when lying than when telling the truth. This change in linguistic behavior for motivated senders may have allowed these senders to avoid some of the traps associated with being specific regarding causal connections during deceptions. Indeed, although additional research is required to confirm whether the difference in the use of causal terms between motivated and unmotivated liars leads to differences in deception detection, the data regarding the receiver's question-asking rates, in which receivers asked unmotivated senders more questions than high motivated senders during deceptive communication, may suggest that in fact receivers were more suspicious of the unmotivated liars.

Second, research question 1 asked whether senders would use more negation words during deceptive communication relative to truthful communication. Only unmotivated senders showed an increased use of negations during deceptive interactions. Senders in the low motivation condition, who were less likely to care whether their partner believed their lies relative to senders in the high motivation condition, may have been more likely to use negations in order to craft simple lies. For example, if the sender actually liked his or her job at the hardware store, he or she may have said, "I did not like my job at the hardware store." Negations, words such as "no," "not," "never," are easily added into statements and require little thought to include in conversation. On the other hand, motivated senders may have been less likely to simply negate what they actually saw or felt; they may have attempted to construct more elaborate stories.

Although hypothesis 4, which was based on previous empirical observations [8], predicted that senders would use more negative emotion words when they were lying than when they were telling the truth, this was not found to be the case. Senders used no more negative emotion words when they were telling the truth as when they were lying. Similarly, no support was found for hypothesis 5, which, based on previous observations [8], predicted that senders would use fewer exclusive words during deceptive interactions than in truthful interactions. No difference was found for the sender's use of exclusive words. These null effects should be interpreted with caution, however, given the relatively small sample size.

Considered together, the observations described above can be used to generate a linguistic profile for online deceptive communication. Overall, liars tended to produce more words, fewer first person singular but more third person pronouns, and more sense words than truth-tellers. Motivated liars tended to avoid causal terms when they were being deceptive, while unmotivated liars used more simple negations. Liars did not differ in their use of questions, exclusive words, or negative emotion words in comparison to truth tellers.

The second question of interest was whether the linguistic style of the receivers changed systematically according to whether or not their partners were lying. The data suggest that, in fact, receivers did behave differently linguistically when they were being lied to. In particular, receivers used more words, in shorter sentences, used more sense terms, and asked more questions when they were being lied to than when they were being told the truth. These data provide some support for hypothesis 1 as receivers were significantly more likely to use a more words during deceptive interactions as compared to truthful interactions.

Hypothesis 2, which predicted that receivers would increase questions-asking during deceptive conversations, was also supported by the data. The receivers asked more questions of the senders during deceptive communication than during truthful communication, which may reflect the fact that receivers were becoming somewhat suspicious of their partners when they were lying. These data are consistent with Knapp and Comadena's [18] observation that senders opened themselves to more probing questions from receivers when they were being deceptive. Presumably, question asking, or probing, allowed for the receiver to get more information from the sender. The fact that receivers used shorter sentences during deception may also support the possibility that receivers were probing the sender's narrative.

Furthermore, the receivers were significantly more likely to ask questions of the senders when the senders were lying in a low motivation condition. In particular, unmotivated senders tended to elicit more questions from receivers when they were lying than when they were telling the truth, while question asking by receivers did not differ across deception and truth in the highly motivated sender condition. This suggests that receivers may have been more suspicious of unmotivated liars, which, if true, is possibly consistent with the motivation impairment effect (MIE). MIE is based on the idea that lying induces psychological, cognitive, and emotional arousal based on feelings of guilt, discomfort, or fear of detection, and this arousal leads to nonverbal leakage cues during deception [19]. According to Burgoon and

Floyd [19], senders who are highly motivated to succeed at deception will suffer negative effects on their nonverbal performance but see positive effects on verbal aspects of the interaction during deception relative to less motivated senders. Therefore, the MIE hypothesis posits a negative relationship between motivation and performance in deception, but only in those instances when receivers can observe senders' nonverbal behaviors [19]. Given that the deceptions in the present study occurred in a text-based communication environment that eliminated nonverbal cues, the highly motivated senders would be expected to be more successful in deception than the unmotivated senders.

With the exception of sense terms, which are discussed below in the context of LSM, no significant differences were found for receivers for the rest of the linguistic variables. Receivers did not differ in their usage of pronouns, negative emotion words, exclusive words, causation words, or negation words.

A third question of interest was whether or not changes in the sender's linguistic behavior across deceptive and truthful communication would also be observed in the receiver's linguistic behavior. Recall that LSM, which assumes that participants match their linguistic styles during conversation [12], predicts that changes in the sender's linguistic profile should be matched by changes in the receiver's linguistic profile. In accordance with linguistic style matching, when the senders used more words, fewer singular first-person pronouns, and more sense terms in deceptive conversations, the receivers responded with more words, fewer first person pronouns and more sense terms as well, suggesting that the receiver was reciprocating the sender's method of communication and characteristics of communication. In addition, senders and receivers did not change their production of exclusion negative affect terms across discussion types. Although convergence between sender and receiver was not observed for causation, negation terms and other-oriented pronouns, the data provide relatively robust support for the linguistic style matching model [12].

The second perspective, IDT, was also successful in predicting some sender and receiver linguistic behavior. Consider first word usage. It is likely that the senders used more words during deceptive communication because they felt a need to construct a more cohesive and detailed story in order to seem believable, especially given the non-verifiable nature of the deceptions. Senders put forth more information for the receivers to comment on. In turn, the receivers discussed more as well. This is in keeping with the interactivity principle of IDT in the sense that a deceitful sender would attempt to engage the receiver in his or her story [10].

Along the same lines, the senders' increased use of sense terms during deceptive interactions can be explained by IDT. Senses words such as "listen," "see," "touch," allude to the notion that the sender actually experienced whatever he or she is discussing. This serves to add detail to the senders' stories and avoid mistrust or skepticism on the part of the receivers, as receivers are more likely to trust senders who seem engaged and develop a rapport with them [13].

Recall that motivated senders used fewer negation words than unmotivated senders. This also corresponds to IDT since the motivated senders appeared to construct more elaborate stories as opposed to simply saying that something did not happen. Senders who were not motivated seemed not to care much whether or not they succeeded at deceiving their partners. They may not have attempted to engage the receiver in an interactive conversation to the same degree as motivated senders.

The probing exhibited by the receivers (i.e., more questions in shorter sentences) also corresponds to the predicted behavior for receivers in Burgoon et al.'s [10] explanation of IDT. IDT states that receivers become suspicious of deception and will use indirect means (such as question-asking) to obtain more information from the senders [10]. The senders, in turn, pick up on the receivers' skepticism and seek to alleviate it, namely, by describing things in more detail [10]. This too, could explain the increased use of words by the senders in deceptive communication. It is difficult to determine definitively, however, whether the senders used more words, which led the receivers to become suspicious and interject with questions, or if receiver suspicion emerged early causing the senders to use more words.

Finally, there are important inherent differences between synchronous, text-based computer mediated interactions and face-to-face interactions. In face-to-face interactions, the participants are in close proximity to one another while in computer-mediated communication participants are physically distributed from one another. Nonverbal cues are also absent in a text-based computer-mediated setting. Also, senders in a text-based environment have more time to construct messages before sending them and they have the ability to edit messages before sending them. This may make deception easier for senders to construct and/or harder for receivers to detect relative to face-to-face interactions. As such, further research should explore if there are any differences in deception styles across computer-mediated communication and face-to-face communication. This type of analysis will tell us whether or not there are inherent differences in the way people communication in a computer mediated setting.

The present research, however, advances our understanding of how linguistic behavior changes in synchronous CMC according to the truthfulness of the discussion and whether the sender is motivated to lie or not. In particular, the findings from the present study

improve our understanding of not only the linguistic profiles of motivated and unmotivated liars, but also the linguistic behavior exhibited by those who are lied to.

5. References

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