Computational Analysis of Lexical and Cohesion Differences in Deceptive Language: The Role of Accordance

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Abstract

In this study, two advanced computational text analysis tools were used to catalogue *lexical* and *cohesive* features of deceptive language and language accordance (i.e., agreement/disagreement on topic of conversation) in a corpus of dyadic conversations. The study specifically focused on how the variable of *accordance* conditions the process of deception in terms of lexical and cohesive features. The results indicated that there is no interaction between deception and accordance in deceptive conversations in terms of cohesive or lexical sophistication indices. The results also did not show main effect for indices of cohesion and lexical sophistication for deceptive versus non-deceptive conversations. However, main effects were observed for indices of cohesion and lexical sophistication in distinguishing conversations characterized by agreement or disagreement. The linguistic differences related to the cohesive and lexical sophistication aspects of agreement versus disagreement conversations are discussed.

Introduction

Deception is a common breach of social conventions in human interactions (Hancock, Curry, Goorha & Woodworth, 2007; McCarthy, Duran & Booker, 2012). Deception occurs with varying degrees of stakes and it is, at times, successfully practiced without being detected. But due to its frequency and high rate of occurrence in conversational interactions, deception is not a totally untraceable phenomenon. For instance, Duran, Dale, Kello, Street and Richardson (2013) found that deceivers leave behind, in their linguistic and body dynamics, subtle linguistic and behavioral traces that can indicate the truth value of their language. Duran et al. (2013) contend that deception rests on an assumption of "hidden cognitive states" (p.1) that deceivers strive to keep hidden. How deception changes mental states and their associated observable linguistic correlates (Hancock et al., 2007) has led researchers in psychology, linguistics, cognitive and forensic sciences to focus on regularities of the language of deception in an attempt to extract and catalogue linguistic features that are predictive of deceptive language. However, the endeavor up to now has not provided a reliable set of linguistic cues of deception. This is not surprising given the nature of deception as premeditated to evade detection. In addition to the challenges involved in classification of distinctive linguistic features, there is also a need to consider the deception phenomenon within its own ecologically valid context (i.e., that deception should be studied within a conversational, interactive framework). Relevant variables within an interactive framework include *accordance* (i.e., whether participants are in agreement or not; DePaulo, Stone & Lassiter, 1985), *participation* (i.e., degree of engagement in conversation; Burgoon & Buller, 2008), *alignment* (i.e., reciprocal behavior and physiological mimicry; Fusaroli, Raczaszek-Leonardi & Tylen, 2014), *interpersonal synergy* (i.e., structural organization of the interaction; Fusaroli & Tylen, 2016) and *involvement of interlocutors* (i.e., active participation in the conversation; Hartwig, Granhag, Stromwall & Vrij, 2002).

Deception

Depending on their focus, researchers have defined deception in different ways. DePaulo et al. (2003), in their meta-analysis of linguistic cues of deception, defined deception as a general phenomenon including "deliberate attempt to mislead others" (p.74). Likewise, Hancock, Toma and Ellison (2007) defined deception as "intentional misrepresentation of information" (p.449) in form of explicit deception or hyperbole. Defined in these terms, deception includes both avoidance and utterance, which means that deception

works in both directions where information content is either hidden from the interlocutor(s) or it is uttered in a way that camouflages the factual side of a given proposition. However, the common thread running through almost all the definitions of deception is intentionality and commitment on part of the deceiver to use language to create a cognitive state which differs from a given factual proposition. Overall, deception is multifaceted, context-dependent, and a complex cognitive phenomenon (DePaulo, Lindsay, Malone & Muhlenbruck, Charlton & Cooper, 2003) that can be studied from various perspectives and in interaction with different factors.

Previous research studies on linguistic cues of deception have shown that deceptive texts use fewer self-reference pronouns (Hancock et al., 2007), more negative words (Bond & Lee, 2005), fewer words indicative of cognitive complexity (Hancock et al., 2007), more modal verbs but more modifiers (Ali & Levine, 2008), less new information (Duran, Crossley, Hall, McCarthy & McNamara, 2009) but more sense-based words (Hancock et al. 2007), and fewer exclusive words (e.g., only and just), but more motion words (Bond & Lee, 2005). In comparison, cohesion, which is a function of discourse, is less studied in deception. Previous studies on cohesive cues of deception have shown that deceptive texts tend to be less coherent and contain more redundancy (Duran et al., 2010) show less referential cohesion (Bedwell, Gallagher, Whitten & Fiore, 2011), and use fewer connective devices (Van Swol, Braun & Malhotra, 2012) but show higher overall textual cohesion (Schober & Glick, 2011).

Accordance

Accordance is defined as "a show of support from one speaker for a belief or proposition expressed by another" (Johnson, 2006, p. 42) which is implicated in casual conversation in the *Maxim of Agreement* (Leech, 1983). The maxim refers to the normative expectation that speakers provide a reasonable level of agreement but a minimal degree of disagreement. Lower disagreement in conversation has been attributed to the pragmatic concept of *face* defined as "the public self-image that every member wants to claim for himself" (Brown & Levinson, 1987, p.61). Likewise, Kreutel (2007) argues that disagreement "is most likely to constitute a threat to the hearer's (or recipient's) positive face, as the stance usually questions the recipient's competence or even truthfulness and thus damages his or her self-image" (p. 4). Furthermore, relevant to the nature of the conversation is the expectation that interlocutors are truthful in their statements (*Maxim of Quality*, Grice, 1989). The maxim ensures that interlocutors "subscribe to the social contract (to) create statements that are reflective of reality" (Burgoon, Buller, Floyd & Grandpre, 2001, p.724).

Accordance has been examined in combination with deception in a few previous studies. For instance, De Paulo, Stone and Lassiter (1985) looked at verbal differences of deception when in agreement (labeled as ingratiating deception) and disagreement (non-ingratiating deception). The results of the study indicated that deception during agreement was easier to detect than deception during disagreement. In a follow-up study, De Paulo, Kirkendol, Tang and O'Brien (1988) examined the relationship between high motivation, competence (i.e., self-reported competence), gender, attractiveness, and accordance in deception performance. Their results showed that highly motivated/highly competent and more attractive deceivers in an agreement context were more successful. The results also showed that women with high motivation participating in agreement conversations were more likely to be perceived as deceivers than male deceivers. Lastly, Johnson, Barnhardt and Zhu (2005) used behavioral and Event Related Potential (ERP) activity to study truth and deception in situations in which participants either agreed or disagreed with the presented stimuli statements. The results showed that their behavioral and ERP activity changed as a function of agreement versus disagreement attributed to the statements presented to the participants.

Current Study

Only a limited number of studies have examined accordance in terms of deceptive behavior. However, in the limited number of studies in which agreement was included as a factor of deception, none examined differences in accordance in terms of linguistic structures. More specifically, no studies to our knowledge have examined links between accordance, deception, and linguistic features related to text cohesion and lexical sophistication.

In the present study we address this gap by performing computational text analyses of linguistic features in a conversational corpus split on two levels: *deception* (i.e. deceptive versus non-deceptive) and *accordance* (i.e. agreement versus disagreement). We focused on the question of what linguistic differences (i.e., lexical sophistication and cohesion differences) are observed as a function of deception and accordance and whether these differences were statistically significant in distinguishing between deceptive versus non-deceptive and agreement versus disagreement language encounters.

Method

Corpus

The deception language corpus used in the present study was collected in a laboratory setting. Participants in the experiment had two eight-minute conversations, either

agreeing or disagreeing with each other (as assigned). To manipulate accordance, participants were provided with several controversial topics (e.g., abortion, legalization of marijuana, etc.), and their true opinions were recorded. Topics were selected based on a systematic procedure using a questionnaire and a follow-up explanation of how strongly participants felt about each topic. For the experiment, the participants' stated opinions were aligned (agreement condition) or misaligned (disagreement condition). Moreover, for one of the two conversations, one participant was randomly assigned the role of deceiver (devil's advocate). To manipulate veracity, prior to the initial or second conversation (thus counterbalanced across participants), deceivers were covertly asked by researchers to take an opinion opposite of what they actually believed, i.e., to introduce deception into their language, whereas non-deceivers were always asked to discuss their true opinion.

Overall, the design yielded 42 dyads consisting of deceptive and non-deceptive conversations involving agreement or disagreement. Each dyad was transcribed verbatim and split by interlocutor leading to 84 text files including 42 texts for the agreement condition (21 texts for deceptive agreement and 21 texts for non-deceptive agreement) and 42 texts for the disagreement condition (21 texts for deceptive disagreement and 21 texts for non-deceptive disagreement). The texts were checked for misspellings and typos before submission of the text files to the computational text analysis tools.

Natural Language Processing (NLP) Tools

To realize the objective of the current study, we utilized two recently developed NLP tools to investigate lexical sophistication and cohesion indices. These include the Tool for Automatic Analysis of Lexical Sophistication (TAALES; Kyle & Crossley, 2015) and Tool for Automatic Analysis of Cohesion (TAACO; Crossley, Kyle & McNamara, 2015). A brief description of each tool is provided below.

TAALES

To investigate differences in lexical sophistication as a function of deception and accordance, we used TAALES. The tool calculates frequency properties of words based on data from multi-million word corpora (e.g., British National Corpus) and word property values from psycholinguistic databases (e.g., Medical Research Council psycholinguistic database, Coltheart, 1981). The indices reported by TAALES include corpus-based frequency counts (Crossley & McNamara, 2013), measure of range (i.e., the number of texts containing a given lexical item; Crossley, Subtirelu & Salsbury, 2013), and bigram/trigram frequency (Crossley et al., 2012). In addition to the frequency indices, TAALES reports psycholinguistic indices including *concreteness,* in terms of degree of abstractness and ease of description (Brysbaert et al., 2014), *familiarity,* based on how familiar the words are for adult language users (e.g., *meticulous* is less familiar than *mailbox*), *imageability* (e.g., the imageability of the word *seat* is higher compared to the imageability of *ergonomics*), *meaningfulness* (i.e., what is the relationship between a given word and other words), and also *age of acquisition*, which measures at what age a particular word is acquired. For the present study, the data for all the indices related to frequency and range of words, n-gram frequency, and psycholinguistic indices of lexical sophistication were selected for analysis.

TAACO

We used TAACO to investigate if cohesion was indicative of differences between deception and accordance. TAACO reports on text characteristics such as basic text features (e.g., number of content and function words, type-token ratio, and pronoun-noun ratios). In addition, TAACO reports on lexical overlap (i.e., noun, verb, adverb, adjective, and preposition overlap) and synonym overlap derived from WordNet synsets (Miller, Beckwith, Fellbaum, Gross & Miller, 1990) at the sentence and paragraph level. Lastly, TAACO calculates the incidence of different connectives such as sentence linking (e.g. therefore, although, nonetheless), opposition (e.g., but, however, nevertheless), additive connectives (e.g., and, besides, also), and demonstrative pronouns (e.g., this, that, those). For the present study, all the indices related to basic features of cohesion, such as type-token ratio, measures of overlap, and cohesive connectives (e.g., addition, opposition, and logical connectives) were selected for further analysis.

Statistical Analysis

The data analysis included pre-processing all the indices for normality of distribution, multicollinearity ($r > .900$), and equality of variance. The remaining indices were used as input in 2x2 repeated measure factorial ANOVAs using Bonferroni corrections for multiple comparisons. The factorial ANOVA was used to account for the differences between the two levels within the variable of accordance (agreement vs. disagreement) and two within the variable of deception (deceptive vs. truthful). Also evaluated were possible interactions between the levels of the variables.

Results

Cohesion

The results of the 2x2 repeated measure factorial ANOVAs indicated that there was no significant interaction between accordance and deception for the indices of cohesion. However, several cohesion indices showed statistical main effects for the accordance condition. These included *negative logical connectives,* $F(1, 20) = 19.731$, $p < .001$, $\eta 2 = .49$, *addition cohesive devices,* $F(1, 20) = 40.74$, $p < .001$, $\eta 2 = .20$ and *overlapping function words*, $F(1, 20) = 14.22$, $p < .001$, $\eta 2 = .41$. None of the indices of cohesion

showed a significant main effect for the deception condition. The direction of difference in terms of agreement versus disagreement for the accordance condition is shown in Table 1.

Table 1. Descriptive statistics for cohesion indices: Accordance condition

Index	Mean (SD) Agreement	Mean (SD) Disagreement
Negative logical connectives	.011(.001)	.017(.001)
Addition connectives	.037(.002)	.031(.001)
Function word overlap	.462(.270)	.598(.025)

Lexical sophistication

In terms of lexical sophistication indices, no interactions were observed between the deception and accordance conditions. However, statistical main effects were observed for nine lexical sophistication indices for the accordance condition. Main effects were reported for all word frequency, content word frequency, frequency of both spoken and written bigrams and written trigrams, SUBTLEXus index, and content word meaningfulness (see Table 2 for descriptive statistics and Table 3 for ANOVA results). None of the indices of lexical sophistication showed a main effect for the deception condition.

Table 2: Descriptive statistics for lexical sophistication indices: Accordance condition

Index	Mean (SD) Agreement	Mean (SD) Disagreement
TL freq AW	3.87 (.009)	3.92 (.007)
Brown freq AW	2.67 (.009)	2.73 (.010)
TL freq CW	3.36 (.010)	3.45 (.012)
BNC written BIGR freq	2.44 (.007)	2.55 (.012)
BNC spoken BIGR prop	0.55 (.009)	0.50 (.008)
BNC written TRIGR freq	1.69 (.013)	1.75 (.013)
BNC written TRIGR prop	0.14 (.014)	0.17 (.014)
SUBTLEXus freq CW	97363 (1894)	124388 (2894)
MRC meaningful CW	408.60 (1.50)	390.46 (2.45)

Table 3: ANOVA for lexical sophistication indices: Accordance condition

Index	*F*	*P*	η2
TL freq AW	19.16	0.001	0.48
Brown freq AW	15.62	0.001	0.43
TL freq CW	29.25	0.001	0.59
BNC written BIGR freq	66.43	0.001	0.76
BNC spoken BIGR prop	14.55	0.001	0.42
BNC written TRIGR freq	18.40	0.001	0.47
BNC written TRIGR prop	15.05	0.001	0.42
SUBTLEXus freq CW	80.93	0.001	0.80
MRC meaningful CW	34.04	0.001	0.63

Discussion

Whereas previous research has focused on micro- and macro-linguistic features of deception (Bond & Lee, 2005; Hancock et al., 2007; Newman et al., 2003), only a few studies have considered the role of interactional, conversational variables as a condition of deception (De Paulo et al., 1985; De Paulo et al., 1988; Johnson et al., 2005). We addressed this gap by examining deception as a function of accordance. In addition, few if any deception studies have focused on lexical sophistication and cohesion features of deceptive language in terms of accordance. We address this gap by using two advanced NLP tools with a diverse library of classic and more recent lexical sophistication and cohesive indices to examine both deception and accordance. The findings of the present study indicate that there were no interactions between deception and accordance in terms of lexical sophistication and cohesion features. The results also indicated that none of the lexical sophistication and cohesion indices showed a significant main effect in distinguishing between deceptive and non-deceptive conversations. However, main statistical effects were observed for indices of cohesion and lexical sophistication for distinguishing between agreement versus disagreement conditions when speakers were in accordance.

In terms of cohesion, the findings indicated that when in agreement, conversations showed a higher number of *addition cohesive devices* (e.g. *furthermore, in addition to* and *likewise*) and when in disagreement they contained more *negative logical cohesive devices* (e.g. *although, alternatively* and *admittedly*) and a greater number of *overlapping functions words* between a given sentence and the next two adjacent sentences. The greater use of additive cohesive devices can be seen as an indicator of elaboration of propositional content as well as a mark of semantic relationships between clauses and sentences that introduce new information into the discourse (Goldman & Murray, 1992). Thus, people in agreement likely elaborate more on existing topics and likely introduce more new topics than people in the disagreement condition.

The higher use of negative logical cohesive devices in disagreement conversations follows trends in which interlocutors in disagreement are more likely to use negative logical connectives to provide background to their arguments (e.g., *although, admittedly*) and foreground information to claim their ground and stance on a given proposition or an opinion (e.g., *alternatively;* McClure & Geva, 1983). The other cohesive feature that showed differences in types of accordance was overlap of function words across sentences, which reported higher values for the disagreement condition. This trend might be related to the notion that function word distribution changes based on the psychological state in which one is operating (Chung & Pennebaker, 2007). Therefore, greater overlap of function words may occur in disagreement conversations in which

the interlocutors are cognitively taxed to justify their positions.

In terms of lexical sophistication, nine indices showed statistical effects for differentiating between agreement versus disagreement. Frequency indices including Thorndike & Lorge index of frequency of all words, Brown index of frequency of all words, Thorndike & Lorge frequency of content words, frequency of BNC written bigrams, frequency of BNC written trigrams, and SUBTLEXus frequency were strong predictors of accordance with disagreement discussions, containing more frequent words. In contrast, BNC spoken bigram proportion and MRC meaningfulness of content words scores were greater in the agreement condition. The finding indicates that when in disagreement with one another, interlocutors use more frequent words and use more bi- and tri-grams compared to when in agreement. In addition, interlocutors in the disagreement condition used less meaningful words (i.e., words with fewer associations) and a lower proportion of common n-grams. In general, this indicates that participants in the disagreement condition used words with less complex lexical features, especially in terms of word frequency, and may indicate that, when in disagreement, interlocutors experience higher cognitive load and therefore, rely on more accessible words. The use of more accessible lexical items is argued to result from cognitive processing shortcuts that benefit both speaker and hearer by creating lower processing demands (Wray & Perkins, 2000). We find reverse trends in the use of meaningful words such that words with more associations are produced more frequently in the agreement condition. In addition, we find that agreement leads to the production of a greater proportion of common bigrams.

Thus far, the interpretation of the results strongly suggests that lexical sophistication and cohesive linguistic features can distinguish conversations marked by agreement and disagreement. However, the same cannot be said for discriminating between deception and truth. At one level, this null result is not entirely unexpected given that deception, unlike agreement and disagreement, is a behavior designed to go undetected. But at another level, a null result stands in contrast to previous research that has found a number of linguistic features associated with deception. For example, deceptive language has been shown to contain fewer self-reference pronouns (Hancock et al., 2007), more negative words (Bond & Lee, 2005), fewer words indicative of cognitive complexity (Hancock et al., 2007), more modal verbs and more modifiers (Ali & Levine, 2008), less new information (Duran et al., 2009), more sense-based words (Hancock et al., 2007), fewer exclusive words (e.g. only and just), and more motion words (Bond & Lee, 2005).

Although this range of reported features is impressive, it is important to note that there still remains no universal set of linguistic features that consistently distinguishes deception from truth. This is likely due to the observation that the ease with which deception is deployed and its success greatly depends on contextual and motivational factors. For the current study, the relevant context is unique in that it involves extended face-to-face interactions with a completely naïve conversational partner. As such, deceivers may have a greater sense of control over the interaction, thus mitigating the cognitive demands that have been associated with deception. Recognizing this observation is critical, as many of the linguistic feature that underlie deception are thought to be elicited during increased cognitive load (Ormerod & Dando, 2015). Moreover, deceivers also discussed contentious issues where distinct views exist on either side of the argument. As a further mitigation of cognitive demands, when asked to deceive by taking an opposite view of what was really believed, deceivers could have simply expressed these common counterarguments as if they were their true opinions. Another reason for the failure to distinguish linguistic cues of deception is that the lexical sophistication and cohesive features used in this study might not be sufficiently sensitive or specially designed to capture deception. Replication studies using new corpora will need to investigate the strength of the different lexical and cohesive features in capturing deception. Furthermore, there is a need for future research to study deception in contexts in which deceptive performance requires varying degrees of cognitive demand.

Finally, as it relates to our findings with accordance, future research should examine the reverse trends we found for bigram proportion and meaningfulness scores. It also needs to include other elements of interactional discourse in addition to deception and accordance including engagement, alignment, and involvement variables. This study provides a baseline for these studies and demonstrates how advanced NLP tools can help investigate deception within an interactive framework.

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