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Deception detection from written accounts

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Most research into deception detection in written accounts has been conducted on transcripts instead of written messages, and has focused on identifying valid verbal deception correlates instead of also examining untrained readers' spontaneous lie-detection attempts (accuracy rates, the cues they use, and so on). Also, the question of whether good liars are also good detectors has not been examined using written accounts. In Study 1, 78 participants handwrote a story and then judged the veracity of another participant's story. Accuracy was at chance level. Good liars were not better detectors than poor liars, but participants who thought they were good liars also thought they were good detectors. The higher the participants' fluidity scores on a standardized test, the poorer liars they were and the better liars they thought they were. The cues participants said they used were related to their judgments but unrelated to actual veracity. In Study 2, some Linguistic Inquiry and Word Count (LIWC) categories (with the Spanish-language dictionary) permitted a 68% classification rate of the written accounts of Study 1.

Key words: deception cues, deception detection, lie detection, LIWC, verbal skills.

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INTRODUCTION

Research on deception detection has been mostly non-verbal in focus. As a result, a number of topics that have received much attention from the non-verbal approach – such as the accuracy of untrained observers judging veracity or the cues they say they use in making their judgments – remain largely unexplored when it comes to detecting deception from written accounts. The present research aims at filling this gap by exploring lay readers' accuracy and self-reported use of cues in judging veracity from handwritten messages. The relationship between these cues and actual and perceived veracity of the messages was also examined, along with the unexplored issue of the relation between lying ability and deception ability. This research complements knowledge derived from non-verbal studies and helps draw a more complete, detailed and accurate picture of humans' ability to detect deception.

Background

Deception detection studies have shown that accuracy rates are greater when observers have access to the audio-only channel or to the audiovisual channel (both of which contain verbal information) than when they have access only to the nonverbal channel (Bond & DePaulo, 2006; Zuckerman, DePaulo & Rosenthal, 1981). However, in absolute terms detection accuracy based on channels containing verbal content is still poor (54% on average, hardly above 50% chance accuracy; see Bond & DePaulo, 2006). In any case, the verbal channel *par excellence* is the textual one; however, this channel has been examined only rarely, and the focus has been different from that adopted in non-verbal deception research. First, whereas non-verbal research has often examined the *spontaneous* detection of deception by lay observers (i.e., how untrained observers try to detect deception without the help of specific lie detection protocols or technologies), verbal deception detection research has focused on testing the usefulness of systematic credibility assessment procedures (Masip, Sporer, Garrido & Herrero, 2005; Sporer, 2004; Vrij, 2008). Thus, in many non-verbal studies the accuracy of lay observers in judging veracity has been examined, as well as the cues observers say they use (e.g., Ekman & O'Sullivan, 1991; Granhag & Strömwall, 2001; Masip, Garrido, Herrero, Antón & Alonso, 2006); however, almost no study has examined the accuracy of untrained observers in judging veracity from written texts (for an exception, see Hancock, Woodworth & Goorha, 2010, who used typed computer-mediated messages), and to our knowledge no peer-reviewed report has been published on the cues that readers say they use in order to assess veracity from written accounts. The present study examined lay readers' accuracy and self-reported use of cues in judging deceit from written messages.

Second, generally, when the textual channel has been examined, transcripts of spoken accounts have been used instead of original written accounts (e.g., DePaulo, Blank, Swaim & Hairfield, 1992; Landry & Brigham, 1992; Miller *et al*., 1981; Tye, Amato, Honts, Devitt & Peters, 1999). However, the results derived from transcripts may not be replicated with written accounts. For example, Hancock *et al*. (2010) suggested that the latter permit more planning and editing than spoken language. This would result in fewer deception cues and lower accuracy rates among judges, particularly among the most motivated ones (Hancock *et al*., 2010).[1]

In the present studies, written accounts were used instead of transcripts to examine people's spontaneous attempts to detect deception. In view of the dearth of research with written accounts, we focused on a variety of interrelated issues that have been examined in non-verbal – but not in verbal – research. We first examined the *accuracy rates* of untrained readers trying to detect deception from written accounts, and one of the main goals

of the present research was to examine *whether good liars are also good detectors* (and, if so, whether there is any characteristic, such as verbal skill, that makes a good detector or a good liar). As explained below, the examination of this issue led us to also examine the relationships between the *cues that readers said they used* spontaneously to make their judgments and the actual and perceived veracity of the accounts. Although the issues that we explored may seem unrelated at first glance, in reality they are tightly interconnected. For example, the participants' verbal skills and the reported cues had to be examined to elucidate the possible relation between lying ability and detection ability. Unlike researchers interested in computer-mediated communication, we did not ask our participants to type their accounts, but to handwrite them (and also to detect deception from handwritten texts).

STUDY 1

In Study 1, we asked participants to handwrite a truthful or a deceptive story and then to judge the veracity of one of their peers' stories. They also had to write down what cues they had used for their judgment. In addition, the participants also had to assess their judgmental confidence, how good they were at detecting deception and how good they were at lying. Finally, the participants were asked to complete standardized tests measuring verbal understanding, verbal fluidity and verbal reasoning. Our predictions were as follows.

Accuracy

We expected low accuracy rates for distinguishing between truths and lies from text. We had three reasons to be skeptical. First, research shows that accuracy rates based on the audio-only or the audiovisual channel is, in absolute terms, poor. Second, accuracy rates in detecting deception from transcripts have been small (see Miller *et al*., 1981; Landry & Brigham, 1992; Tye *et al*., 1999). Third, a recent study examining accuracy at detecting lies and truths from written texts (not transcripts) found a very low accuracy rate (Hancock *et al*., 2010).

Self-reported cues, and actual and perceived ability to lie and detect deception

We also examined whether good liars are also good lie (and truth) detectors. Two alternative hypotheses can be posed. The first is that *actual* lying ability will be significantly and positively related to *actual* detection ability (*actual relation hypothesis*). Alternatively, one could contend that this relation will not be significant and that, instead, a significant positive relationship will be found between *perceived* lying ability and *perceived* detection ability (*perceived relation hypothesis*).

The *actual relation hypothesis* is based on the following two arguments. First, in order to become a good liar, a communicator must be aware of which cues indicate deception. If someone knows cues to deception, then that person should be able to search for these cues in scrutinizing others' messages. Thus, knowledge of valid deception cues would be helpful for both lying and detecting lies.

Second, possessing certain verbal skills may improve one's ability to deceive as well as one's ability to detect deception. In particular, verbal understanding, verbal fluidity and verbal reasoning are relevant skills. Verbal understanding is the ability to understand ideas expressed in words, thus reflecting comprehension skill. Verbal fluidity is the easiness in finding the most appropriate words, and has been found to be related to both writing and reading ability (Cordero, Seisdedos, González & de la Cruz, 1989). Finally, verbal reasoning is the ability to find relations among words (comprehension) and to extrapolate these relations (production). Indeed, it is reasonable to think that verbal understanding, verbal fluidity and verbal reasoning may help liars manipulate their messages to make them credible and may help detectors notice subtle verbal cues of honesty or deceit in the messages of others.

In order to test the actual relation hypothesis, in the present study the senders (writers) also acted as detectors (readers) of the lies and truths of their peers. This would allow us to examine whether successful liars were also accurate detectors. In addition, we asked the participants to report the cues they had used in making their veracity judgments, and we measured the participants' verbal understanding, verbal fluidity and verbal reasoning using standardized psychological tests.

The *perceived relation hypothesis* is based on the empirical evidence showing that people are often unaware of how accurate their veracity judgments are (DePaulo, Charlton, Cooper, Lindsay & Muhlenbruck, 1997), and that people hold very strong (and inaccurate) beliefs about the cues to deception (e.g., Global Deception Research Team, 2006; Strömwall, Granhag & Hartwig, 2004). Thus, some individuals might wrongly believe that they are better lie detectors than others. Also, these individuals may have inaccurate beliefs about the cues to deception. When these individuals lie, they may try to manipulate these wrong cues, and when they judge the veracity of others they may search for these cues. These strategies do not increase either these individuals' actual success when lying or their accuracy in detecting deception, but only rarely do receivers inform the liars that their deception has been uncovered, and only rarely do liars receive feedback indicative that their lie has been uncovered. As a result, these individuals continue believing that they are good at lying because they manipulate ''valid'' cues to deception, and they also continue believing that they are good detectors because they search for ''valid'' deception cues in the senders' communications. Under these circumstances, we would expect (1) a significant positive relationship between self-reported lying ability and self-reported detection ability; (2) strong relationships between the cues mentioned by the readers and their veracity judgments; (3) no significant relationship between these cues and the actual veracity of the accounts; and (4) that if systematic scrutiny of the stories revealed valid cues to deception, these cues would differ from those spontaneously reported by the readers.

Early deception research already examined the relationship between lying ability and detection ability (Bond, Kahler & Paolicelli, 1985; DePaulo & Rosenthal, 1979). However, that research was non-verbal in focus. People have more accurate beliefs about verbal deception cues than about non-verbal deception cues (Strömwall *et al*., 2004). If, as posed when describing the actual relation hypothesis, people's beliefs are behind the relationship

between lying ability and detection ability, the results of non-verbal studies may not generalize to written truths and lies.

METHOD

Participants

The participants were 78 freshman students of criminology (50% females, *M* age = 19.68 years, *SD* = 1.84) at a Spanish university who were taking a psychology of crime course. They participated in exchange for academic incentives. All of them were native Spanish speakers.

Material

The participants had to complete the V (verbal understanding) and F (verbal fluidity) scales of the current standardized Spanish adaptation of Thurstone's (1939) *Primary Mental Abilities* (PMA) tests (Cordero *et al*., 1989). The V factor reflects the ability to understand ideas expressed through words. The scale consists of 50 multiple-choice items asking respondents to indicate which of four words has the same meaning as the stimulus word. The participants have four minutes to answer as many items as possible. The F factor measures the extent to which words come easily to one's mind, and is related to writing and reading ability. The test consists of asking the respondents to write as many words beginning with P as possible during five minutes.

The participants were also asked to complete the VR (verbal reasoning) scale of the Spanish adaptation (Corral & Cordero, 2000) of Bennett, Seashore and Wesman's (1989) DAT-5 (*Differential Aptitude Tests, Fifth Edition*), Level 2, which measures the ability to find out relations among words. It contains 40 verbal analogies. Each analogy consists of one written sentence with two relations, but the space for the first word of the first relation and the space for the last word of the second relation are left blank (e.g., ''…is to hand as sock is to…''). The analogy is followed by five pairs of words, and the respondents have to select the word pair that best fits the sentence (e.g., glove – foot). The test measures the respondents' ability to infer the relation between the first two words (e.g., glove and hand) and to use it with the other two words.

Procedure

On entering the classroom, each participant was given a card with a number and the message ''Write a TRUTHFUL story'' (*n* = 38 participants) or ''Write a DECEPTIVE story'' (*n* = 40) on it. Unbeknownst to the participants, even numbers always corresponded to deceptive stories, and odd numbers to truthful stories. After the participants were seated, a slide was projected on a screen with a series of questions that the participants had to answer on a sheet of paper. Specifically, they had to indicate their gender, age, and card number. Then they were asked to write a one-page-long truthful or entirely deceptive story about a trip. Finally, the participants had to answer the question ''Am I good at discerning other persons' truths and lies?'' on a 1 (*no*) to 5 (*yes*) scale.

Once all the participants had completed the task, the experimenters collected the sheets of paper, shuffled them and redistributed them among the participants (who were instructed to make sure that they did not receive their own story). A new slide was projected with some additional questions that the participants had to answer on the back of the sheet. Specifically, they had to: (1) write the number of their card; (2) answer the question ''Am I a good liar?'' on a 1 (*no*) to 5 (*yes*) scale; (3) read the story on the sheet of paper and indicate whether it was truthful or deceptive; (4) indicate their judgmental confidence on a 1 (not confident at all) to 5 (absolutely confident) scale; and (5) list up to five cues they had used to make their judgment. After the task, the researchers collected the sheets.

After a rest, the participants completed the V and F scales of Thurstone's PMA, writing the number of their card instead of their name on the answer sheets. Time constraints did not allow us to also administer the VR scale of Bennett *et al.*'s (1989; Corral & Cordero, 2000) DAT-5, Level 2, which was instead completed during the next lecture (unfortunately, only 49 of the participants showed up). One week later the students were debriefed during a regular lecture.

Cue categorization

In all, the 78 readers mentioned 241 cues as a basis for their veracity judgments. Coder 1 (the first author) derived the categories in Table 1 from the cues, assigning each cue to a given category. All categories except the residual ''other'' category were bidirectional. This was also the case for the structure or form of the account category, in which observations with a positive connotation (e.g., ''absence of grammar errors'' or ''there is a thread in the story'') were differentiated from those with a negative connotation (e.g., ''unclear expression'' or ''badly told''). Some observations within this category, however, did not have a clear positive or negative connotation (e.g., ''the story is simple'' or ''the way the story is addressed''), and were coded as undefined.

Coder 2 (the second author) first read brief descriptions of the categories, and then was trained by Coder 1 with 30% of the stories (23 stories; 76 cues). Afterwards, she coded independently the 165 cues found by the readers in the remaining 55 stories. Reliability was then examined taking the cues as the unit of analysis. Across all the cues that Coder 2 had coded independently, Cohen's Kappa was 0.81 when the two directions of the cues were considered (12 categories: plausibility, implausibility, many details, few details, etc.), and 0.79 when the cues were considered without the different directions (six categories: plausibility/implausibility, many details/few details, etc.). Percentage agreement ranged from 63% to 100%, with the exception of structure or form of the account – undefined, with an agreement rate of just 20% (see Table 1). Because of this low reliability, along with the small frequency of this subcategory and the undefined nature of these cues, this subcategory was excluded from the analyses reported below. All the disagreements between the two coders were resolved in a conference.

Statistical analyses

Chi-square analyses were run to examine whether percent accuracy was significantly different from chance and whether successful liars were more accurate than unsuccessful liars. A Student's *t*-test was used to

Table 1. *Reliability (% agreement), frequency, and % of cue categories*

	% agreement[a]	Frequency	%
Plausibility/Implausibility	*91.84*	*133*	*55.19*
Plausibility	86.49	45	18.67
Implausibility	95.08	88	36.51
Many details/Few details	*85.19*	*37*	*15.35*
Many details	75.00	22	9.13
Few details	100.00	15	6.22
Consistency/Contradictions	*85.71*	*12*	*4.98*
Consistency	100.00	2	0.83
Contradictions	80.00	10	4.15
Emotions/Lack of emotions	*100.00*	*7*	*2.90*
Emotions	100.00	5	2.07
Lack of emotions	100.00	2	0.83
Structure or form of the account	*72.73*	*39*	*16.18*
Structure or form of the account: positive	62.50	12	4.98
Structure or form of the account: negative	77.78	20	8.30
Structure or form of the account: undefined	20.00	7	2.90
Other	*77.78*	*13*	*5.39*

Note: [a] % of those cues that Coder 1 had assigned to a given category that were assigned to the same category by Coder 2.

compare confidence scores between accurate and inaccurate judgments. The hypotheses concerning perceived lying ability, perceived detection ability and test scores were tested with Pearson correlation analyses. Finally, Multivariate Analyses of Variance (MANOVAs) and logistic regression analyses were used to examine the relationships between the cues mentioned by the readers and actual and perceived veracity.

RESULTS

Accuracy and confidence

Only 42.11% of truthful stories and 62.50% of deceptive stories were correctly identified by the readers. Accuracy across truths and lies was 52.56%. Neither of these figures was greater than chance ($ps \geq 0.114$). The participants were more confident when their judgments were accurate ($M = 3.85$, $SD = 0.76$) than when they were inaccurate ($M = 3.46$, $SD = 0.77$), $t\ (76) = 2.28$, $p = 0.026$, $d = 0.51$. People are more likely to act on deception judgments made with high confidence. Nine participants made their judgment with a confidence of 5 on the 1-to-5 scale. Seven (or 78%) of these judgments were accurate. In contrast, only 58% of judgments made with a confidence of 4 were accurate.

Were successful liars successful detectors?

In judging the veracity of the written statements of their peers, successful liars were not significantly more accurate (53.33%) than unsuccessful liars (48.00%), $\chi^2\ (1,\ n = 40) = 0.31$, $p = 0.578$. This does not support the actual relation hypothesis. A correlation analysis revealed that the more a participant believed she or he was a good liar, the more this participant also believed she or he was a good detector,[2] $r\ (n = 75) = 0.33$, $p = 0.004$. This supported the perceived relation hypothesis.

Interestingly, a small but significant correlation revealed that the more the participants believed they were good liars, the more they tended to judge the stories as deceptive, $r\ (n = 75) = 0.24$, $p = 0.042$.

Verbal skills and ability to lie and to detect lies

The actual relation hypothesis was partly based on the rationale that some verbal skills such as verbal understanding, verbal fluidity and verbal reasoning might be related to both the ability to lie and the ability to detect deception. Correlation analyses were performed to examine the relationships between the participants' scores on scales measuring these skills and their performance when lying and telling the truth.[3] Only the PMA F (verbal fluidity) scale scores had a significant correlation with communication success, $r\ (n = 76) = 0.31$, $p = 0.007$, but this was the case only for lies, $r\ (n = 39) = 0.52$, $p = 0.001$, not for truths, $r\ (n = 37) = -0.01$, $p = 0.959$. Specifically, the higher the participants' scores on the PMA F scale, the more transparent their lies were. Apparently, when it comes to getting along with one's written lies, verbal fluidity is more of a hindrance than an advantage. This was at odds with the participants' views because, ironically, the higher the participants' scores on the PMA F scale, the better liars they thought they were, $r\ (n = 73) = 0.38$, $p = 0.001$.

Cues mentioned by the readers

As shown in the third column of Table 1, more than half of the cues listed by the readers pertained to the plausibility or implausibility of the account category. Next in frequency were the structure or form of the account, details, the residual ''other'' category, consistency/contradictions, and emotions/lack of emotions.

Before examining the relationship between the cues and actual or perceived veracity, the variables capturing the frequency of the cues were recoded. First, each instance of plausibility, many details, consistency, emotions, and structure or form of the account – positive was coded as 1, and each instance of implausibility, few details, contradictions, lack of emotions, and structure or form of the account – negative was coded as –1. Then, for each participant, the negative scores for each category were subtracted from the positive ones. For example, if a reader had mentioned two cues that had been coded as plausibility (1 + 1 = 2) and one cue that had been coded as implausibility (–1), the final score on the recoded plausibility/implausibility variable for this reader was 1, because 2 – 1 = 1. The ''structure or form of the account – undefined'' category was not considered in recoding the cue variables, and the ''other'' category remained unchanged because it had no directions.

A MANOVA with actual truthfulness of the stories as the independent variable and the recoded cue variables (as well as the ''other'' variable) as dependent variables revealed that truthful and deceptive stories did not differ in terms of the verbal cues observed by the readers, *Wilks' lambda* = 0.98, $F\ (6, 71) = 0.27$, $p = 0.950$, partial $\eta^2 = 0.02$. A similar MANOVA was run to examine whether the stories judged to be deceptive differed from those judged to be truthful in terms of the cues. The multivariate effect was significant, *Wilks' lambda* = 0.21, $F\ (6,\ 71) = 43.95$, $p < 0.001$, partial $\eta^2 = 0.79$. Univariate analyses (Table 2) revealed that perceiving the accounts as plausible, as containing many details, as consistent, as containing references to emotions, and as stylistically or grammatically rich led readers to judge the accounts as truthful. Conversely, when the stories were perceived as implausible, lacking in detail, inconsistent, lacking in emotion, and stylistically or grammatically poor, they were judged as deceptive.[4]

In summary, the cues that the readers reported had no relationship with the actual veracity of the stories, but were very strong predictors of the readers' veracity judgments.

Table 2. *Differences between stories judged truthful and stories judged deceptive in the cues reported by the readers*

	Mean scores (*SD*s)			
Recoded variables	Stories judged truthful	Stories judged deceptive	$F(1, 76)$	Partial η^2
Plausibility/Implausibility	1.45 (1.34)	−1.87 (1.53)	97.48**	0.56
Many details/Few details	0.48 (0.89)	−0.17 (0.56)	15.82**	0.17
Consistency/Contradictions	0.06 (0.25)	−0.21 (0.46)	9.29*	0.11
Emotions/Lack of emotions	0.16 (0.37)	−0.04 (0.20)	9.66*	0.11
Structure or form of the account	0.39 (0.62)	−0.43 (0.71)	26.90**	0.26
Other	0.26 (0.63)	0.11 (0.38)	1.78	0.02

Note: * $p < 0.01$; ** $p < 0.001$.

DISCUSSION

Although much research has been conducted on people's spontaneous attempts to detect deception, this research has been mostly non-verbal in focus. The present study examined people's spontaneous attempts to detect *verbal* deception in *written* accounts (not transcripts).

Accuracy, judgments and confidence

Accuracy rates did not differ from chance, and overall accuracy was very similar to that reported by Hancock *et al.* (2010) with text-based computer-mediated communication.[5] Although accuracy in detecting truths and lies may be greater from verbal content than from non-verbal cues (Bond & DePaulo, 2006; Vrij, 2008), in absolute terms accuracy rates from text alone are still poor and close to chance. However, judgments made with maximum confidence were likely to be correct (78% accuracy), although accuracy decreased sharply (to 58%) for judgments made with a confidence of 4 on the 1-to-5 scale.

Judgmental confidence was greater when the judgments were accurate than when they were inaccurate. This finding is contrary to DePaulo *et al.*'s (1997) meta-analytical conclusion. They found that the average weighted accuracy–confidence correlation was not significantly different from zero. In the present study, the significant relation can be a result of the communication medium. Typically, videotaped segments have been used in deception research. These are so brief and uninformative that reasoned veracity judgments are hard to make. As a result, the participants must resort to making heuristic judgments (see Masip, Garrido & Herrero, 2006, 2009, 2010). In contrast, written texts may favor content-based systematic processing to a larger extent than brief and ambiguous non-verbal displays. It is possible that well-founded, reasoned judgments (even if they are wrong) are more strongly correlated with confidence than intuitive or heuristic judgments based on gut feelings.

Actual and perceived ability to lie and detect deception

No significant relationship emerged between actual lying ability and actual detection ability. However, *perceived* lying ability was significantly related to *perceived* detection ability: the more the respondents believed they were good liars, the more they also believed they were good detectors. Over-reliance on wrong deception cues may explain these results. Valid cues to deceit do not abound, they do not coincide with widespread stereotypes about the behavior of liars, and their validity is influenced by a number of contextual variables (DePaulo *et al.*, 2003; Sporer & Schwandt, 2006, 2007). It is therefore impossible for liars to rely on *valid* deception cues that would allow them to lie proficiently and to detect other people's lies. Also, detection ability does not seem to be a reliable individual-difference variable (Bond & DePaulo, 2008); therefore, it cannot be reliably correlated with anything. For these reasons, the relationship between lying ability and detection ability was not significant. However, some individuals have very strong (but incorrect) beliefs about the cues to deceit. They try to manipulate these cues when lying to others, and search for these cues in others when trying to detect deception. As these individuals normally receive no feedback about their lying success or their detection success, they continue to rely on the wrong cues, believing that most of their lies are opaque to others, and believing that most of the other people's lies are transparent to them. In line with this argument, we found: (1) a significant correlation between perceived lying ability and perceived detection ability; and (2) that the verbal cues mentioned by the readers were strongly related to their judgments but unrelated to the actual truthfulness of the stories – i.e., readers relied on wrong cues.

Perceived lying ability was also positively associated with deception judgments: the more the participants believed that they were good liars, the more likely they were to judge the stories as deceptive. Perhaps deception was simply more salient for these participants. Alternatively, maybe individuals who think they are good liars will lie more frequently than those who think they are poor liars and, owing to the false consensus effect (Ross, Greene & House, 1977), will also think that other people also lie quite often. This would lead them to be inclined to judge other people's accounts as deceptive. Future research should test these speculations.

Verbal skills

Consistent with the lack of a significant correlation between actual lying ability and detection ability, no significant relationships were apparent between verbal understanding or verbal reasoning and communication success or detection success. We only found a *negative* correlation between verbal fluidity and lying ability: the higher the participants' fluidity scores, the more transparent their lies were (no significant effect emerged for truths). Ironically, the participants' fluidity scores were also positively and significantly correlated with perceived lying ability. These two findings together suggest that individuals with higher verbal fluidity scores are overconfident in their ability to tell lies. They may be aware of their verbal fluidity and put little effort into constructing their false statements. As a result, their lies are transparent. It is also possible that words come so quickly to the mind of persons with high fluidity scores that they have no time to create an elaborate story. Alternatively, they may manipulate their deceptive messages in an unusual way, such as by using uncommon or over-elaborate words that might arouse suspicion.

Cues

As a basis for their deception judgments, readers mentioned the plausibility or implausibility of the account more than half the time. Other cue categories referred to style or grammar aspects, amount of details, consistency/contradictions, and emotions/lack of emotions. The perceived relation hypothesis was based on the participants' reliance on wrong cues. Indeed, the cues that the readers mentioned were strongly related with their judgments, but unrelated with actual truthfulness. This might seem surprising because two of the categories (plausibility and details) were found to differ between truths and lies in DePaulo *et al.*'s (2003) meta-analysis, and the readers interpreted these cues correctly (e.g., plausibility as indicating truthfulness and implausibility as indicating deceptiveness). Apparently, the readers had some correct notions about the cues to deception (see Hartwig & Bond, 2011). However, as stated above, the meaning and discrimination power

of verbal and non-verbal cues to deceit often change from one situation to another, and the readers may not have been aware of this. To identify verbal cues useful for separating truths and lies in this study (cues that our readers missed), we used the Linguistic Inquiry and Word Count (LIWC) software (Pennebaker, Francis, & Booth, 2001).

STUDY 2

One way to scrutinize the stories easily, quickly, and systematically searching for valid deception cues (and to see whether these cues coincide with those spontaneously mentioned by the readers) is using LIWC. The program analyzes text comparing each word against a dictionary containing a series of words and the psychologically meaningful categories to which each word is assigned. The program output shows the percentage of words in each category. The LIWC program has been used to examine language use as a function of attention focus, emotionality, social relationships, social hierarchy, thinking styles, and other psychological variables (Tausczik & Pennebaker, 2010). As certain theoretical perspectives (such as the RM approach, see Masip *et al*., 2005; Sporer, 2004) anticipate linguistic markers of deception, LIWC has also been used to uncover verbal deception cues (Ali & Levine, 2008; Bond & Lee, 2005; Fuller, Biros, Burgoon, Adkins & Twitchell, 2006; Hancock, Curry, and Goorha, 2008; Hirschberg *et al*., 2005; Newman, Pennebaker, Berry & Richards, 2003; Vrij, Mann, Kristen & Fisher, 2007). This line of inquiry has shown some promise, as classification rates using logistic regression analyses entering some of the LIWC categories as predictors have been both significantly greater than chance and significantly greater than the accuracy of human observers (Bond & Lee, 2005; Hancock *et al*., 2008; Newman *et al*., 2003). However, not all of the results are positive. First, some categories that have discriminated between truths and lies in some studies (e.g., Bond & Lee, 2005) have not done so in others (e.g., Vrij *et al*., 2007). Second, opposing results have been found for some categories in different studies. Third, some of the findings using the LIWC program (such as Fuller *et al*.'s (2006) and Hancock *et al*.'s (2008) finding that lies contained significantly more words than truths) are contrary to expectations derived from deception detection theories and previous research. These considerations question the usefulness of the LIWC program to detect deception.

Recently, the LIWC 2001 English dictionary was translated into Spanish (Ramírez-Esparza, Pennebaker, García & Suriá, 2007). The Spanish dictionary contains the same 72 categories as the English dictionary. Ramírez-Esparza *et al*. (2007) found that, for most categories, the correlations among the Spanish and English dictionaries were strong and significant (Study 1), and that the same differentiations can be made with the Spanish and English dictionaries (Study 2).

To our knowledge, it has never been examined whether the LIWC categories can differentiate between Spanish-language truths and lies. Thus, our purpose was to examine our writers' stories with the LIWC program. In view of the discrepancies among the results of previous studies, we refrained from posing any specific hypothesis, and conducted some exploratory analyses. We were also interested in comparing the verbal cues identified by LIWC with those mentioned by the Study 1 participants as a basis for their judgments. Lack of coincidence would show the degree to which lay readers' notions about verbal deception cues are inaccurate, and, in concordance with the findings of Study 1, would lend additional support to the perceived relation hypothesis.

METHODS

Participants were the same 78 students who participated in Study 1, as we used the 78 handwritten stories from Study 1. These stories were first typed and saved as individual Microsoft Word files. A researcher checked the accuracy of the transcriptions and made the necessary corrections. Afterwards, the 78 files were analyzed with the LIWC software.[6] Student's *t*-tests were used to examine differences between scores on some LIWC categories, logistic regression analyses were run to regress actual veracity on LIWC categories, chi-square analyses were used to examine whether classification accuracy of the logistic equations was greater than chance, and *Z*-tests were conducted to examine whether the logistic equations attained a greater percentage of correct classifications than humans.

RESULTS

LIWC captured 78.84% ($SD = 3.16$) of the words. This is very similar to the 80% rate reported by Pennebaker *et al.* (2001) for the English-language dictionary across 43 studies. No difference was found between the mean number of words in truthful ($M = 228.21$, $SD = 79.56$) and deceptive ($M = 244.85$, $SD = 75.61$) stories, $t\,(76) = 0.95$, $p = 0.347$.

Several categories were excluded from subsequent analyses. First, only the 68 meaningful categories were considered (i.e., word count, words per sentence, words longer than six letters, and percent of words captured by the dictionary were excluded). Second, following Newman *et al.* (2003), we excluded 16 meaningful categories because they had been used less than 0.2% of the time. When testing differences in the means of the remaining LIWC categories between truthful and deceptive accounts,[7] we found that prepositions, affective processes, positive feelings and achievement differed significantly ($p < 0.05$), and positive emotions differed with $p = 0.070$ (Table 3).

These five variables were entered simultaneously as predictors in a logistic regression analysis using the enter method, with the actual veracity of the stories as the dependent variable. The model was significant, χ^2 (5, $N = 78$) = 14.77, $p = 0.011$, although Nagelkerke's R^2 was small (0.23). Classification rates of this model were all greater than the 50% accuracy rate expected by

Table 3. *Scores for significant or marginal LIWC categories*

LIWC category	Truths	Lies	*t* (76)	*d*
Prepositions	14.90	13.74	2.12**	0.48
Affective processes	2.61	3.29	−2.26**	−0.51
Positive emotions	1.76	2.24	−1.84*	−0.42
Positive feelings	0.40	0.65	−2.10**	−0.48
Achievement	0.54	0.88	−2.46**	−0.56

Note: * $p = 0.07$; ** $p < 0.05$ (two-tailed).

chance (see LRA-5 in Table 4). A two-sample *Z*-test showed that the model attained a somewhat greater percentage of correct classifications ($M = 67.95\%$) than human readers ($M = 52.56\%$), $Z = 1.96$, $p = 0.050$. Separate analyses for truths and lies revealed that the model outperformed humans when judging truths, but not when judging lies (Table 4).

We ran an additional logistic regression analysis with the same variables but with the backward conditional method in order to eliminate from the model the poorest predictor variables. The test proceeded three steps and eliminated positive emotions and positive feelings. The chi-square of the final model (LRA-3) was χ^2 $(3, N = 78) = 14.16$, $p = 0.003$, Nagelkerke's $R^2 = 0.22$. The overall classification rate was greater than chance (Table 4), but the separate rates for truths and lies only approached significance (the small sample sizes may have played a role in this lack of significance). The logistic equation overall classification rate was not significantly greater than that of human readers; however, the model did outperform humans when judging truths, but not when judging lies (see Table 4).

DISCUSSION

In this, the first Spanish-language study of truths and lies with the LIWC program, we found that deceptive stories were characterized by fewer prepositions, more affective processes, more positive emotions and positive feelings, and more achievement words than truthful stories. Only one of the cue categories mentioned by the readers (emotions/lack of emotions) was presumably related to these LIWC categories (specifically to affective processes), but only seven participants had mentioned this category, and the way they interpreted it (emotion words as indicators of truthfulness and not mentioning emotions as indicative of deceptiveness) was contrary to the actual direction of the effect. Indeed, the readers used the wrong cues when judging veracity. This finding is in line with the perceived relation hypothesis, and in conjunction with the findings of Study 1 shows that readers are unaware of which are the actual deception cues.

Table 4. *Classification rates of truths and lies with logistic regression analyses, and comparisons with chance accuracy and human lay readers*

	Classification Rates	Comparison with chance accuracy (50%)			Comparison with human readers' accuracy[a]	
		χ^2 (1)	*n*	*p*	*Z*	*p*
LRA-5						
Truths	68.42%	5.16	38	0.023	5.32	0.021
Lies	67.50%	4.90	40	0.029	0.47	0.639
Overall	*67.95%*	*10.05*	*78*	*0.002*	*1.96*	*0.050*
LRA-3						
Truths	65.79%	3.97	38	0.052	2.07	0.038
Lies	65.00%	3.60	40	0.058	0.23	0.816
Overall	*65.38%*	*7.39*	*78*	*0.007*	*1.63*	*0.104*

Notes: LRA-5: Logistic regression analysis with the enter method entering the five significant or marginal LIWC categories as predictors; LRA-3: Logistic regression analysis with the backward conditional method in which two variables were removed during the analysis. See text for details.

[a] Human accuracy was $M = 42.11\%$ for truths, $M = 62.50\%$ for lies, and $M = 52.56\%$ across truths and lies.

Prepositions are markers of cognitive complexity (e.g., Tausczik & Pennebaker, 2010). Lying is often cognitively more taxing than truth telling (e.g., Vrij, Fisher, Mann & Leal, 2008); therefore, the liars' stories should presumably be cognitively less complex (and hence contain fewer prepositions) than the truth tellers' stories. Some verbal indicators of decreased cognitive complexity (fewer exclusive words, and more motion verbs) have already been identified in deceptive accounts in previous LIWC research (Bond & Lee, 2005; Newman *et al*., 2003). Probably, prepositions have not emerged as a deception indicator in earlier LIWC research because that research has been conducted on English-language texts. Phrasal verbs, which consist of a verb plus a preposition, are common in English, but they are non-existent in Spanish. The high frequency of prepositions due to the high frequency of phrasal verbs in English may have blurred the differences in prepositions between truthful and deceptive accounts.

Although previous LIWC research has found lies to contain more negative emotion words than truths (Newman *et al*., 2003; but see Ali & Levine, 2008), the communication topic might make a difference. Unlike Newman *et al*.'s (2003) lies, which could generate guilt or preoccupation, the topic of our participants' stories was a trip. People normally enjoy travel, and, in order to make the story more believable, the writers may have included many positive emotions or feelings in their narrations. In addition, DePaulo, Kashy, Kirkendol, Wyer and Epstein (1996) found that most everyday lies are about feelings, and observed that when people lie about their feelings, they pretend to feel more positively that they do in fact. It is no wonder, then, we found so many *affective processes* (the RM approach also predicts this), *positive feelings* and *positive emotions* among the stories of the liars (see also Hirschberg *et al*., 2005), and no increase in the number of negative emotion words.[8] Finally, *achievement words* may reflect exaggeration or bravado on the part of liars that were absent from the truth tellers' stories. Indeed, people often lie about achievements, as this category of lies was also among the most frequent in DePaulo *et al*.'s (1996) diary studies.

Although the frequency of these cues was significantly different in truths and lies, when they were entered in logistic regression analyses classification rates were moderate. In addition, the present results showed the typical pattern of LIWC deception research: only a few categories were significant, these did not coincide with the significant categories in other studies, and some theoretically-grounded categories (such as many RM-related cues) did not discriminate. Indeed, language differences may have played a role.[9] However, in view of the results we think that some skepticism is warranted regarding the usefulness of the LIWC program to detect deception.[10]

There is, however, a more optimistic interpretation of the evidence. Meta-analyses have revealed that a number of variables moderate the relationship between verbal or non-verbal cues and deception (DePaulo *et al*., 2003; Sporer & Schwandt, 2006, 2007). In other words, deception cues often change from one situation to another. The general context of the statements (topic of the lie, communication medium, sanctioned vs. unsanctioned deception, etc.) has varied from one LIWC study to another.

Furthermore, different kinds of individuals (undergraduates, prisoners, military personnel) have participated in different LIWC experiments, and they can use language differently. For these reasons, we would not expect the same linguistic markers of deception in different studies. Perhaps the LIWC program is an adaptive tool that identifies the reliable deception cues in each situation (as suggested by G.D. Bond, personal communication, 14 April 2010). Research must be conducted to examine whether different studies conducted with similar participants and focusing on similar situations find the same LIWC deception cues. In the meantime, caution is advised regarding the LIWC's ability to detect deception.

CONCLUSIONS

Despite the contention that verbal information permits greater accuracy rates in judging truths and lies than non-verbal cues, accuracy from text alone is poor and close to chance. In addition, contrary to what some might expect, better liars are not better detectors, we did not find any verbal skill to be positively related to both lying ability and detection ability, and readers base their judgments on inaccurate cues even though some valid cues might be present that can be detected by programs such as LIWC. Over-reliance on the wrong cues may explain why those individuals who believe that they are good liars also believe that they are good detectors.

Detecting deception is necessary in many applied settings. However, practitioners will not achieve sufficient accuracy merely by focusing on the deceivers' words. A number of interviewing protocols to detect deception are currently being developed by leading researchers in the deception detection field, and empirical results of studies testing these protocols are encouraging (see, among others, Granhag, Strömwall & Hartwig, 2007; Leins, Fisher, Vrij, Leal & Mann, 2011; Vrij *et al*., 2008; Vrij, Granhag & Porter, 2010). Real-world lie detectors would be well advised to be attentive to these developments.

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NOTES

[1] Indeed, the contemporary upsurge of text-based computer-mediated communication (such as e-mail or instant messaging) has generated growing interest among scholars in written lies and their detection (e.g., Hancock, Curry & Goorha, 2008; Zhou, Burgoon, Nunamaker & Twitchell, 2004). However, most of this research has focused solely on identifying verbal correlates of deception instead of also examining how people spontaneously try to detect deceit from text.

[2] Three participants failed to indicate their lying ability. This correlation (as well as other correlations involving perceived lying ability) was conducted on the other 75 participants.

[3] Two participants left before completing the two PMA scales, and another participant failed to follow the instructions when completing the PMA V scale. Also, as explained in the text, fewer participants completed the DAT-5, Level 2 VR scale than the PMA scales. The analyses reported in the text were conducted on the available participants, which were 75 for the PMA V scale, 76 for the PMA F scale, and 49 for the DAT-5, Level 2 VR scale.

[4] Logistic regression analyses were run to further explore the relationship between the cues and the actual and perceived truthfulness of the stories. The results of these analyses mirrored those of the MANOVAs. For these and some additional analyses, please contact the first author.

[5] Univariate *t*-tests were conducted to compare overall accuracy in this study ($M = 52.56\%$) with overall accuracy in Hancock *et al*.'s (2010) computer-mediated communication condition ($M = 49.1\%$). The difference was not significant, $t\ (77) = 0.61$, $p = 0.544$. The difference was not significant either when considering only judgments made on the texts of poorly motivated liars in Hancock *et al*.'s study ($M = 55.6\%$), $t\ (77) = 0.53$, $p = 0.595$.

[6] As the Spanish LIWC dictionary is still under development, some words were added to the dictionary before running the analyses. Please contact the first author for more information.

[7] We first tested two models that had been examined in the English-language LIWC deception research: Newman *et al*.'s (2003) model (first-person singular pronouns, third-person pronouns, negative emotions, exclusive words and motion verbs) and Bond and Lee's (2005) RM-based model (sensory and perceptual processes, space, time, affective processes, and cognitive mechanisms). We used logistic regression analyses with the enter method, and found that neither model was significant. Please contact the first author for more information.

[8] DePaulo *et al.* (1996) also found that people feel little anxiety or remorse in telling the lies of everyday life; therefore, one would not expect negative emotion words in lies.

[9] Some of the most promising cues examined by the LIWC program may not be useful in Spanish. This is the case for first-person singular pronouns (Newman *et al*., 2003). In the Spanish language, pronouns are not required, and people often write or speak with few pronouns. Also, Newman *et al.* (2003) and Bond and Lee (2005) found liars to use more motion verbs than truth tellers. However, the topic of our stories was travel; therefore, we expected many motion verbs irrespective of veracity. As expected, neither first-person singular pronouns nor motion verbs differed in our stories as a function of veracity.

[10] The risk of having committed type one errors in the present study (only a few of the tests produced significant differences) also questions the LIWC ability to detect deception, but it is unlikely that the present results reflect merely type one errors. As explained by Ali and Levine (2008), who had a similar problem in their study, the 5% error rate (which would advise dismissing some of the significant findings as errors) is conditional on the null being literally true in all cases; however, this is not justified in view of the results of previous research. Also, even if the null were true in every case, as in Ali and Levine's study the confidence level of the significant results was below 0.05, which indicates that the expected error rate would be below 5%.

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