Speech Prosody 2016
31 May - 3 Jun 2106, Boston, USA

Lying, in a manner of speaking

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Abstract

We investigated the production and perception of paralinguistic cues to deception in a two-person, interactive game. Speakers tried to mislead their partner by lying some of the time, while listeners tried to catch speakers out by guessing when they were lying. Our results show that listeners were more likely to associate disfluencies with deception, despite the fact that speakers were in fact more disfluent when telling the truth. We interpret this pattern of behavior within the attempted control approach to deception, whereby liars manipulate their language to conceal the fact that they are lying.

Index Terms: disfluency, deception, dialogue

1. Introduction

A listener's interpretation of a speaker's utterance depends not only on its lexical content, but on the way in which it is delivered. Among the many prosodic features which can affect an utterance's interpretation, disfluencies—interruptions to the ongoing linguistic content—have been shown to affect listeners' confidence in the speaker's knowledge [1], and ultimately, their judgment on whether the speaker is telling the truth [2, 3, 4]. These observed interpretation effects raise the question of whether listeners' judgments are well-founded: Are speakers more disfluent when they are lying, and if so, what is the underlying cause of this disfluency?

Research on deception identifies three hypotheses by which a speaker's choice to deceive may affect the utterance they produce. The emotional approach focuses on various emotional states that liars may experience and the behaviors associated with each [5]. The cognitive approach emphasizes that liars experience increased mental load, resulting in a change in speech pattern or body language [6, 7]. The attempted control approach proposes that liars are aware that their behavior may contain signs that would reveal their deception and therefore they attempt to counteract such exposure by controlling their behavior [8].

Each of the three theories has been used to explain observed differences in the paralinguistic behavior of liars and truth tellers. For example, Vrij [9] noted that liars may experience emotional arousal, contributing to a higher pitched voice (cf. [10]). Cognitive load also has been implicated as a factor, based on evidence that speech hesitations and speech errors increase with the complexity of the lie in question [6]. The cognitive approach receives further support from non-deception paradigms, which show that people engaged in cognitively complex tasks tend to speak slower and pause more than those engaged in simpler tasks [11, 12]. Finally, the attempted control approach has been cited as a reason for why researchers have failed to consistently identify reliable indicators of deception [9]. This approach is reinforced by evidence that people hold strong, stereotypical beliefs about cues to deception [2], and that speakers are able to regulate several aspects of their behavior when lying [13].

From the perspective of the listener, disfluencies are frequently implicated as a cue to deception [2, 3, 4]. Yet lie production studies have failed to converge on a consistent pattern exhibited by speakers. Some studies report an increase in filled pauses (*um, uh*) during deception [2, 9], others report a decrease [14, 15], and yet others report no difference between liars and truth-tellers [16].

One reason for the inconsistency in findings may be that speakers' paralinguistic behavior during deception can be modulated by external factors. As well as the effects of lie complexity [6], filled pauses are shown to vary with other factors related to the speaker and listener. Bond et al. [17] report cultural differences in the link between deception and disfluency: Jordanian speakers produced more filled pauses when lying than telling the truth, while American speakers showed no differences. Properties of the listener matter as well: Anolli & Ciceri [18] considered silent and filled pauses as a single category, and found that, compared to truthful utterances, they were produced more frequently when speakers lied to a trusting interlocutor, but not when speakers lied to a suspicious interlocutor.

Although filled pauses are generally analyzed as a distinct category, many authors have analyzed other forms of disfluency collectively (e.g. [2, 4, 9, 14]). However, given evidence (from non-deception studies) to suggest that different forms of disfluency may arise from separate processes [19, 20, 21], it seems plausible to consider that each form may pattern differently with deception as well. Hence, this study aims to analyze how individual disfluency types vary with deception, as well as how individual types are perceived by listeners judging deception.

2. Experiment

The present experiment was based on a two-person, competitive treasure-collecting game. Players were assigned one of two roles—'Speaker' (the liar) or 'Guesser' (the lie detector). Speakers were instructed to describe the location of some treasure, with the objective of misleading their partner into looking for the treasure in the wrong location. They were free to lie (or tell the truth) about the treasure's location as they wished. Because motivation level has been implicated as a moderator of paralinguistic behavior in meta-analyses of studies on deception [22], we also attempted to vary Speakers' motivation to lie by presenting either gold or silver coins, with different point values, as the treasure.

Guessers were instructed to click on the location where they believed the treasure was hidden, with the knowledge that their partner might be lying to them about it. We were interested in Speakers' disfluencies, conditioned on whether they chose to

 doi: 10.21437/SpeechProsody.2016-202

indicate the correct location of the treasure on each turn (truth), or the incorrect location (lie). We were also interested in the object selected by the Guesser on each turn. If disfluency indexes falsehood, and Guessers are sensitive to this variation, we would predict greater disfluency when Speakers indicate the false location, and a greater tendency among Guessers to click on the location which wasn't named when the Speaker is disfluent.

2.1. Method

Twenty-four same-sex, native-British-English-speaking dyads took part in the study. All provided informed consent in accordance with the University of Edinburgh Psychology Research Ethics Committee guidelines (Ref. No.: 214/1415-1). Participants did not know each other prior to the experiment. Roles were assigned at the start by drawing lots, and Speaker and Guesser sat facing each other at diagonally opposite ends of a table during the game.

On each trial, each participant saw a visual display comprising a pair of objects—a target, behind which the treasure was hidden, and a distractor. The objects were visually related (e.g., an alligator with an open mouth and one with a closed mouth), such that Speakers were likely to produce complex NPs when naming an object. The Speaker's display included a pile of coins behind the target to indicate the treasure's location, and a pile of dirt behind the distractor (see Fig. 1). The coins were either gold (worth 20 points) or silver (worth 5 points). Eight lists were created, counterbalancing the role of each image within each pair (target or distractor), positioning of the target (left or right), and the type of treasure associated with the target (gold or silver) across all items. The game consisted of 48 trials, with the order of presentation of image pairs randomized across participants.

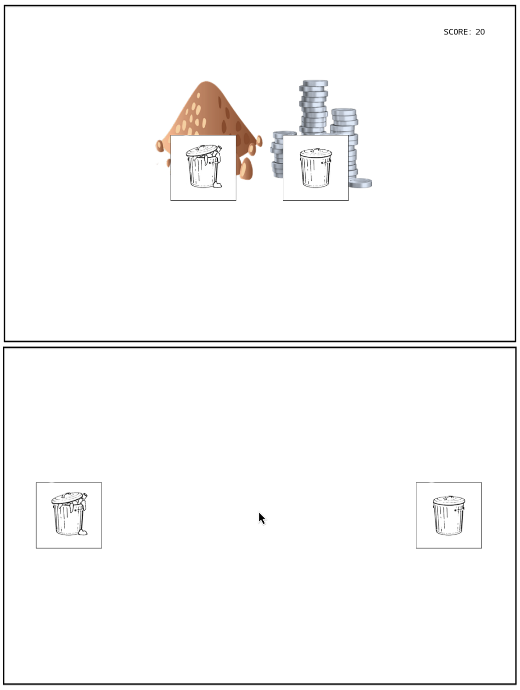

Figure 1: Example trial of the Speaker's display (top) and Guesser's display (bottom). Images on the Speaker's display were set closer together to discourage Guessers from relying on Speakers' gaze location.

On each turn, Speakers had to produce an utterance which named one of the objects presented for the Guesser to click on. They were given no additional guidance, other than that they were free to name the false object if they wished, and could produce any other utterances they wanted to. Players were told the game was interactive, hence Guessers could answer Speakers' utterances if they so wished. Once a click had been detected on an object, both participants saw a message indicating whether or not the Guesser had found the treasure. Guessers were awarded points when they successfully found the treasure; Speakers were awarded points when the Guesser guessed wrong. Participants either received £4 or course credits in exchange for participation. Additionally, the player with the higher score at the end received a £1 cash reward.

Participants' speech was recorded throughout the experiment. We also recorded the Guessers' mouse movements (not reported here) and the location of each mouse click. Participants were also videoed, although we focus here on auditory recordings.

2.2. Coding and annotation of utterances

Speaker utterances for each trial were coded as truths (participant told the truth) or lies (participant lied about the treasure's location or the type of treasure or both). Guesser judgments were correspondingly coded as truths (participant clicked on the treasure's location indicated by the Speaker) or lies (participant clicked on the other object). Trials on which the Speaker was inconsistent in their description of the treasure's location were excluded (0.26%), since it was impossible to determine on these whether the Speaker intended to lie or tell the truth from the outset.

Table 1: Disfluency types and examples from data.

	Transcript
Filled pause	behind **um** the banana that's not peeled
Silent pause	behind the camel with **(0.32)** two humps
False start	the money is **th-** behind the one with the big tail fin
Repetition	behind the- **the** cut cake
Prolongation	behind **thee** leaf that looks like the ace on a pack of cards
Substitution	behind the necklace which has beads **coming-** falling off it
Insertion	behind the open- **more** open book
Other speech error	behind the squashed **turtoise-** tort- tortoise

Utterances were annotated for disfluencies and each disfluency labeled for type. The categories were identified based on previous studies employing disfluency classification systems [19, 20] and are summarized in table 1. Disfluencies included silent pauses, with a minimum cutoff of 250 ms adopted, based on the claim that intervals of shorter duration would be attributed to articulatory processes rather than cognitive functions [12]. For trials which included additional dialogue before the Guesser clicked on an object, only the Speaker's initial utterance associated with the treasure's location was used for analysis. For example in (1) only the utterance in bold was analyzed:

(1) S : **oh it's the– behind the full bin** (1.28)

Table 2: Mean values of verbal and vocal characteristics for truthful and deceptive utterances produced by Speakers and truthful and deceptive judgments by Guessers. Proportion values were calculated out of the total number of truthful and deceptive utterances and truthful and deceptive judgments by Speakers and Guessers respectively. Standard errors in parentheses. Figures in boldface represent significant differences; figures in italics represent marginally significant differences.

	Speaker		Guesser	
Measure	Truthful	Deceptive	Truthful	Deceptive
Proportion of utterances containing:				
a. Filled pauses	**.28 (.04)**	**.22 (.04)**	*.23 (.04)*	*.28 (.04)*
b. Silent pauses	.54 (.05)	.48 (.05)	**.46 (.05)**	**.57 (.05)**
c. False starts	**.12 (.02**	**.07 (.02)**	.09 (.02)	.11 (.03)
c. Repetitions	.05 (.02)	.05 (.01)	.05 (.01)	.05 (.01)
d. Prolongations	.29 (.04)	.29 (.05)	.27 (.04)	.32 (.05)
e. Substitutions	.03 (.01)	.04 (.01)	.03 (.01)	.04 (.01)
f. Insertions	.01 (.00)	.01 (.00)	.01 (.00)	.01 (.00)
g. Other speech errors	.02 (.01)	.01 (.00)	.01 (.00)	.02 (.00)
Silent pause duration (ms)	685.18 (40.49)	612.49 (50.38)	**566.41 (36.81)**	**759.21 (54.82)**
Onset latency (ms)	2214.54 (58.13)	2124.82 (49.16)	2139.86 (52.94)	2215.17 (56.47)
Utterance duration (ms)	3048.57 (52.66)	2962.61 (58.68)	3488.64 (79.82)	3877.52 (98.99)
No. of words	8.99 (0.14)	9.11 (0.16)	8.84 (0.14)	9.30 (0.16)
Speech rate (syllables/second)	3.71 (0.06)	3.94 (0.06)	3.90 (0.06)	3.72 (0.06)

G : as in the one with like rubbish that you can see

S : like all the rubbish yeah the rubbish in

2.3. Analyses

Statistical analyses were carried out in R version 3.2.2 [23] using the lme4 package [24]. To explore Guessers' sensitivity to the paralinguistic information in Speakers' utterances, we used a series of mixed-effects logit regression models to individually test each of the disfluencies produced by the Speakers as predictors of the Guesser's response judgment (truth/lie), as determined by the object clicked on.

For Speakers, mixed-effects logit regression models were used to model the probabilities with which Speakers produced each type of disfluency during each utterance, depending on whether the location of the treasure was truthfully indicated (truth) or not (lie). As well as veracity, each model included motivation to lie (high: gold coins; low: silver coins) and the interaction between the two as fixed effects, with predictors mean centered to allow easy interpretation of parameter estimates.

Linear mixed effects models were also used to model the effects of veracity and motivation on Speakers' pause duration, utterance onset latency, utterance duration and speech rate (see table 2 for details of these variables). For Guessers, we correspondingly modeled the effect of these variables on response judgment.

All models included random intercepts and maximal converging slopes for subjects, and random intercepts for items.

3. Results

3.1. Overview

The final dataset contained 1,149 Speaker utterances. Out of these, 53.9% were truthful (SE = 1.9), while 55.8% were judged by Guessers to be truthful (SE = 2.1). These figures are in line with the truth bias observed by previous lie production and lie detection studies, which have noted a global bias toward telling the truth or expecting the truth [25, 26]. The mean truth-lie discrimination accuracy for Guessers was 48.0% (SE =1.4), with a 53.5% accuracy for truthful utterances and a 41.7% accuracy for deceptive utterances. This difference is unsurprising given the overall tendency for Guessers to perceive utterances as truthful, and corresponds with the trend observed by meta-analyses of truth-lie discrimination accuracy across studies [9]. Table 2 provides a descriptive summary of truthful and deceptive utterances produced by Speakers, and utterances judged as truthful and deceptive by Guessers, across the experiment.

3.2. Effect of Speakers' paralinguistic cues on Guessers' judgment

Guessers interpreted Speakers' silent and filled pauses as evidence of deception: Guessers were 0.67 times as likely to click on the target (and therefore more likely to click on the distractor) following an utterance containing a silent pause compared with one that did not, $\beta = -0.40$, SE $= 0.14$, $p < .01$ ($e^{-0.40} = 0.67$). They were also marginally less likely to click on the target following an utterance containing a filled pause, $\beta = -0.26$, SE $= 0.14$, $p = .07$. The latter finding is in line with previous work using a similar, listener-only, paradigm, suggesting that utterances including filled pauses are more likely to be treated as deceptive [27]. There was no effect of any other type of disfluency on Guessers' judgments. Guessers were also less likely to click on the distractor following utterances characterized by longer silent pause durations, $\beta = -0.15$, SE $= 0.05$, $p = .01$. There were no effects of onset latency, utterance duration, or speech rate on Guessers' judgements.

3.3. Effect of utterance and motivation on Speakers' paralinguistic cues

Although listeners were more likely to judge disfluent utterances as deceptive, Speakers were actually more disfluent when they told the truth. This was the case for two forms of disfluency: filled pauses and false starts. Speakers were 1.84 times more likely to produce filled pauses when telling the truth, $\beta = 0.61$, SE $= 0.21$, $p < .01$, and 1.82 times more likely to produce false starts, $\beta = 0.60$, SE $= 0.27$, $p = .04$. There was no main effect of motivation on either of the two forms, nor any interaction between veracity and motivation (all $p > .2$). There was no effect of veracity or motivation on any of the other paralinguistic cues tested.

4. Discussion

Although the gold vs. silver coin motivation manipulation may have been too subtle to result in demonstrable differences in the present paradigm, it is clear from our conversations at debrief that participants were engaged in the game and motivated to outwit each other. Importantly, Speakers had no reason to tell lies other than their own wish to prevent the Guessers from finding coins. This can be contrasted with cued lying paradigms [6, 9, 14, 15, 16, 17], in which participants' motives may not always be clear.

Surprisingly, our predictions were only partially borne out: Although Guessers tended to click on the distractor rather than the target following utterances including disfluency, Speakers did not produce disfluencies more often when lying. Instead, they were more likely to produce disfluent utterances when telling the truth. Taking disfluencies as a category, it appears that Guessers were mistaken in their interpretations of Speakers' disfluencies: They judged as deceptive exactly those utterances which, on the basis of the manner of their delivery, were more likely to be truthful.

However, when we consider individual types of disfluency, the mapping from Speakers to Guessers was not exact: Speakers were more likely to produce filled pauses and false starts (when telling the truth), but Guessers were more likely to respond to silent or filled pauses as markers of deception, although the latter difference was marginal. This may be indicative evidence that different types of disfluency serve different functions for the speaker, in line with a suggestion by Clark & Fox Tree [28]. Alternatively, in line with previous evidence from comprehension [29, 30], filled and silent pauses may have similar functions; the differences in the present study may reflect differences in power. Crucially, the overall pattern that we observed can be accounted for in a model of deception and disfluency. Based on the verbal and vocal characteristics of Speakers' utterances that were measured (see table 2), there is no evidence to suggest that the effect of veracity on disfluency was mediated by other aspects of the Speakers' performance.

The difference between Speakers and Guessers in the present study aligns with the attempted control approach to deception. Researchers who take this perspective note that some aspects of behavior are harder to control than others. These are the so-called 'leaky channels' which in turn expose deceit [31, 32]. For example, Vrij et al. [9] note that it is easier to control gaze behavior than body movements, undermining the cue potential of gaze aversion as an indicator of deception. Along the same lines, (non-deception) research on disfluencies has shown that filled pause behavior is under a speaker's strategic control, and given the right motivation, speakers can reduce the production of disfluency to near-zero levels [33]. From this viewpoint, it is less surprising that Speakers in this study produced fewer disfluencies when lying, perhaps in an attempt to convey an image of truthfulness to Guessers.

There is less clarity about Speakers' increased production of false starts when telling the truth. One possibility is that false starts may serve a similar function to filled pauses. However, this seems unlikely, given evidence suggesting that false starts and filled pauses function differently with respect to utterance planning (e.g. [34, 35]). A second possibility is that Speakers' control of their disfluency production extended to all types of disfluency, but there were too few observations of the other types for a difference to be observed. Most disfluency types occurred in less than 5% of Speakers' utterances. However, all disfluency types (bar substitutions) occurred numerically more frequently in truthful utterances. Apart from those discussed above, the only other type of disfluency which occurred frequently was prolongations. Here, the majority of occurrences can be attributed to a small number of participants, who appeared to habitually lengthen certain words that recurred in their utterances (e.g., *treasu:re, behi:nd*). This pattern of behavior is reminiscent of Shriberg's [19] observation of individual speaker preferences in disfluency type.

If Speakers are more disfluent when telling the truth, why do Guessers believe that they are lying? The mismatch between Speakers' behavior and Guessers' expectations in our study highlights a key component in the act of deception—the social aspect. With perhaps the exception of self-deceit, lying is very much an act woven into the social fabric of life, serving basic interactional functions such as impression management and social support [36]. Consequently, the ability to lie convincingly necessitates that deceivers be able to model the mind of the deceived, in order to project an image of perceived veracity. The paralinguistic behavior of Speakers in the study then suggests that they took into account the stereotypes of deceit held by their interlocutors, and manipulated their manner accordingly. Guessers' persistent interpretation of these signals as a cue to deception highlights the ingrained nature of these stereotypes [2], further validating Speakers' strategic attempts to control their behavior.

While the present results delineate a general relationship between disfluency and deception, it should be acknowledged that external factors such as the Speaker's emotional state in response to the situation or the interactivity between individual Speakers and Guessers may have played a role. A more in-depth investigation on the moderators of prosodic cues to deception would be needed to take these into account.

5. Conclusions

An important aspect of any spoken communication is not only the content of the message, but the manner in which that message is delivered. Listeners appear to be sensitive to disfluency in a message: Where a truth judgment is afforded, they are more likely to judge disfluently-produced content as being untrue. The present study suggests that speakers are implicitly aware of this judgment, to the extent that they control their utterances to give an impression of truthfulness. This has the consequence that disfluency, perhaps perversely, is less often produced when an utterance is deceitful than when it is truthful.

6. References

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