



Saccadic eye movement rate as a cue to deceit



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ABSTRACT

In the present experiment we considered a cue that has not been examined in nonverbal deception research before, non-visual saccadic eye movement rate. The psychological process as to why saccadic eye movements could be related to deception is also new for nonverbal deception research: memory retrieval. Non-visual saccadic eye movement rate has been shown to be related to memory search, with searching information in long-term memory generating increased saccadic activity (Ehrlichman & Micic, 2012). According to fMRI research lying is associated with more long-term memory search than truth telling (Ganis et al., 2003), which leads to our hypothesis that liars display more saccadic eye movements than truth tellers. Thirty participants expressed a true opinion and lied about another opinion (within-subjects design) and the number of saccades per second of speech was measured. As predicted, participants displayed fewer saccades when they told the truth than when they told a spontaneous lie. The implications for this finding are discussed.

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1. Non-visual saccadic eye movement rate as a cue to deceit

People often pay a lot of attention to nonverbal behaviors when attempting to detect deceit (Vrij, 2008a). Nonverbal behaviors stand a better chance to become diagnostic cues to deceit when there is a sound theoretical underpinning as to why such behaviors should be related to deception. In the present experiment we considered a cue that has not been previously examined in nonverbal deception research and that has a strong theoretical underpinning: frequency of spontaneous non-visual saccadic eye movements. Non-visual saccades are correlated with search for information in long-term memory, with a more intensive search resulting in more saccades (Ehrlichman & Micic, 2012). In the current paper we argue that lying involves more intensive long-term memory search than truth telling and that, consequently, liars would display more saccades than truth tellers.

Non-visual saccades differ from the eye movements typically examined in deception research. Deception researchers have examined *visual* saccadic eye movements related to deception, which are eye movements that change the direction of people's visual attention (from an interviewer to an object; from one picture to another, from one visually presented word to another, etc.).

None of the deception studies have involved spontaneous saccadic eye movements that occur when people are not examining a visual stimulus array.

Virtually all research on saccadic eye movements is related to their role in vision. However, saccadic eye movements also occur when people are not inspecting a visual scene, and often without the person being aware of making such movements. These movements occur when people are engaged in tasks that require search through long-term memory. The evidence for this, and the rationale for labeling such eye movements "non-visual," comes from numerous studies in which eye movements have been recorded as people carry out various cognitive tasks that do not involve any visual stimuli in face-to-face situations, when people are alone in a physically barren environment, when they are in complete darkness and when their eyes are closed. There is extensive research demonstrating that saccades are highly related to the efficiency of searching for information in long-term memory (LTM). Tasks that involve more difficult retrieval of information from either semantic (e.g., "say as many words as you can that begin with the letter A") or episodic memory (e.g., recalling words from a previously learned list) typically produce about twice as many saccades per unit time (eye movement rate, EMR) as tasks that involve easier retrieval of highly over-learned material (e.g., the alphabet, someone's name or address) or tasks that involve working memory (e.g., keeping track of a series of letters and reporting how many have a long E sound) (Bergstrom & Hiscock, 1988; Ehrlichman & Micic, 2012; Ehrlichman, Micic, Sousa, & Zhu, 2007; Micic, Ehrlichman, & Chen, 2010).

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When people answer questions that do not involve highly over-learned material they need to engage in a search for material in LTM. The difficulty of such a search, at least in part, reflects the number and integration of potential retrieval cues that are available. Therefore, we would expect that lying ought to be more difficult than telling the truth because lies are constructed from less readily accessible semantic and episodic information stored in memory, whereas truthful information is more readily accessible in LTM, as fMRI research has shown (Ganis, Kosslyn, Stose, Thompson, & Yurgelun-Todd, 2003). People sometimes prepare their lies. One could argue that prepared lies should be readily available and all that liars need to do is to tell a rehearsed story. However, the degree to which search is required would hinge on how well-prepared or rehearsed the lie is. If the person simply thought about some things to say but did not actually commit a complete script to memory, there should still be a need for some search through LTM, and some accompanying eye movements. On the other hand, if the lie is a completely over-learned word for word script, little LTM search would be required and we would expect an eye movement rate similar to the low-retrieval tasks of previous studies. Yet, fMRI research has demonstrated that, in terms of brain activity, telling a planned lie shows some overlap with telling a spontaneous lie, and differs from telling the truth in that a planned lie is more difficult to retrieve from LTM than the truth (Ganis et al., 2003). To explain this, Ganis et al. (2003) argued that truths, more than lies, are based on extensive and frequent interactions with the real world, and therefore truths are more readily accessible from LTM than planned lies. Based on Ganis et al. (2003) fMRI findings and given the relationship between EMR activity and high-retrieval tasks we thus predicted that truths would result in the lowest EMR activity and spontaneous lies in the highest EMR activity (Hypothesis 1). We did not predict EMR activity in planned lies as EMR activity would depend on how well-prepared or rehearsed the lie is.

Most deception research and most police/suspect interviews focus on the ability to distinguish between truth tellers and liars when they describe alleged past activities (Vrij, 2008b). This was not the focus of the present experiment as the relation between past activities and memory retrieval is complex, as we will argue in Section 4. In this experiment we instructed participants to lie about their opinions. Determining the veracity of opinions can be important, for example in security settings, as demonstrated by the loss of seven CIA agents in Afghanistan on 30 December 2009. They were killed via a suicide attack by a man they believed was going to give them information about Taliban and al-Qaeda targets in Pakistan's tribal areas. The CIA was aware that the man had posted extreme anti-American views on the Internet, but believed these to be part of a cover (Leal, Vrij, Mann, & Fisher, 2010). Telling the truth or lying about opinions differs in terms of memory retrieval. People normally think more deeply about, and are more able to generate, reasons that support rather than oppose their beliefs (Ajzen, 2001). Truthful opinions should therefore be more readily available from LTM than deceptive opinions.

Apart from EMR we also measured answer duration and response difficulty. Since participants in the prepared lie condition were given time in advance to generate their answers we predicted that the planned lies would be longer in duration than truths and spontaneous lies (Hypothesis 2). We further predicted that afterwards participants would report that telling a spontaneous lie was more difficult than telling a planned lie or the truth (Hypothesis 3).

2. Method

2.1. Participants

Thirty undergraduate students took part in the experiment, 9 males and 21 females, with an average age of $M = 20.8$ ($SD = 4.4$).

Participants were recruited via posters, leaflets, and online advertisements on the University's staff and student portals. Participants were invited to take part in a study "measuring opinions and attitudes about key issues going on in the world" (they were not told that this was a deception study). The advert provided contact details and offered a goody bag to those who took part.

2.2. Design

The experiment involved a within subjects design with three veracity levels (truth, planned lie and spontaneous lie). The dependent variables were honesty ratings, EMR, answer duration and difficulty ratings.

2.3. Procedure

The experiment consisted of three phases: an opinions questionnaire, an interview and a post-interview questionnaire.

2.3.1. Phase 1

After consenting to the study, each participant completed an opinions questionnaire which asked the extent to which he or she agreed or disagreed (where 1 = agree and 7 = disagree) with the 19 different statements listed in Appendix 1. The final question asked the participant to indicate on a seven-point scale, from [1] dishonest to [7] honest, how truthful s/he was while completing the opinion questionnaire. Twenty-eight participants circled the maximum score '7' and the remaining two participants circled '6'.

The experimenter then selected one attitude that the participant scored 1, 2, 6 or 7 and inverted the score (7 becoming a 1, etc.) – this would become the planned lie. Unknown to the participant, the experimenter also selected two further attitudes (one's score was inverted – this would become the spontaneous lie – and the other score was left untouched). Appendix 1 reveals that 14 different opinions were introduced in the truth condition and 16 different opinions in the planned and spontaneous lie conditions. This indicates a good spread of opinions in all three conditions.

The participant was then introduced to the planned lie. The participant was told which attitude was selected and that the experimenter had inverted their score on this item with a 2 becoming a 6, a 7 becoming a 1, etc. The participant was told that he or she should say in the interview that this inverted score reflected his or her real attitude. The participant was then told that the interviewer would ask the following question "I understand you are in favor of/against (attitude). Is this true?" and that the participant should say YES to this question and thereby tell a lie. The participant was then informed that the interviewer would ask as a second question "Explain with as much detail as you can why you have this opinion". The participant was asked to think about reasons why people could hold this attitude, to write them down, to rehearse them, and to recall them during the interview as being his or her true opinion. To give the participant an opportunity to think about the planned lie, the experimenter left the room. The experimenter returned to the room five minutes later and after the participant said that s/he finished planning the lie, the experimenter said: "Remember your answer because this attitude will be discussed during the interview, and you will have to lie about it, just as we discussed. There will be two other attitudes discussed during the interview but I cannot tell you which ones. You always have to answer YES to the question "I understand you are in favor/against (attitude). Is this true?". For one attitude, this YES answer is your true opinion and you thus can be truthful when answering the second question (Explain with as much detail as you can why you have this opinion). For the other attitude, this YES answer contradicts your true opinion, and you thus have to lie when answering the second question. You should try to ensure that the interviewer believes

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