Journal of Applied Research in Memory and Cognition xxx (2017) xxx–xxx

Contents lists available at ScienceDirect

Journal of Applied Research in Memory and Cognition

journal homepage: www.elsevier.com/locate/jarmac

# Association-based Concealed Information Test: A Novel Reaction Time-Based Deception Detection Method☆

Gáspár Lukács*
University of Szeged, Hungary
University of Klagenfurt, Austria

Bartosz Gula
University of Klagenfurt, Austria
Humboldt-Universität zu Berlin, Germany

Emese Szegedi-Hallgató
University of Szeged, Hungary

Gábor Csifcsák
University of Szeged, Hungary
University of Tromsø, Norway

In recent years, numerous studies were published on the reaction time (RT)-based Concealed Information Test (CIT). However, an important limitation of the CIT is the reliance on the recognition of the probe item, and therefore the limited applicability when an innocent person is aware of this item. In the present paper, we introduce an RT-based CIT that is based on item-category associations: the Association-based Concealed Information Test (A-CIT). Using the participants' given names as probe items and self-referring "inducer" items (e.g., "MINE" or "ME") that establish an association between ownership and responses choices, in Experiment 1 (within-subject design; $n = 27$), this method differentiated with high accuracy between guilty and innocent conditions. Experiment 2 ($n = 25$) replicated Experiment 1, except that the participants were informed of the probe item in the innocent condition—nonetheless, the accuracy rate remained high. Implications and future possibilities are discussed.

***General Audience Summary***

In certain scenarios, such as legal cases or counterterrorism, it is of crucial importance to correctly detect deception. One of the potential technological aids under development is the reaction time (RT)-based Concealed Information Test (CIT). The RT-based CIT has very low costs and it is easy to implement: it can be run on any regular personal computer, it takes little time (10–15 min), and its results can be analyzed practically

Author Note

Gáspár Lukács, Department of Cognitive and Neuropsychology, Institute of Psychology, Faculty of Arts, University of Szeged, Egyetem u. 2, 6722 Szeged, Hungary and Department of Psychology, University of Klagenfurt, Universitätsstr. 65-67, 9020 Klagenfurt, Austria; Bartosz Gula, Department of Psychology, University of Klagenfurt, Universitätsstr. 65-67, 9020 Klagenfurt, Austria and Department of Psychology, Humboldt-Universität zu Berlin, Rudower Chaussee 18, 12489 Berlin, Germany; Emese Szegedi-Hallgató, Department of Cognitive and Neuropsychology, Institute of Psychology, Faculty of Arts, University of Szeged, Egyetem u. 2, 6722 Szeged, Hungary; Gábor Csifcsák, Department of Cognitive and Neuropsychology, Institute of Psychology, Faculty of Arts, University of Szeged, Egyetem u. 2, 6722 Szeged, Hungary and Department of Psychology, University of Tromsø, Huginbakken 32, 9037 Tromsø, Norway.

☆ Professor Aldert Vrij, University of Portsmouth, served as Guest Editor for this submission.

* Correspondence concerning this article should be addressed to Gábor Csifcsák, Department of Cognitive and Neuropsychology, Institute of Psychology, Faculty of Arts, University of Szeged, Egyetem u. 2, 6722 Szeged, Hungary. Contact: gaborcsifcsak@yahoo.co.uk

Please cite this article in press as: Lukács, G., et al. Association-based Concealed Information Test: A Novel Reaction Time-Based Deception Detection Method. *Journal of Applied Research in Memory and Cognition* (2017), http://dx.doi.org/10.1016/j.jarmac.2017.06.001

instantaneously. In a CIT, a person is repeatedly presented several items (e.g., personal names), among which one is a probe item (e.g., the name of an accomplice in murder) that only a guilty person will recognize, and consequently his/her responses will generally be slower to this item than to the other items. Consequently, a major limitation of the CIT is that it cannot be applied when an innocent person can be aware of this item—which is the main reason for its very sparse actual application in real life. In the present paper, we introduce an RT-based CIT that is primarily based on associations (and not on recognition): the Association-based Concealed Information Test (A-CIT). In our study, for probe items among the other items, we used the participants' own given names in the guilty condition, and randomly selected names in the innocent condition (as simulation for guilt and innocence in a real life case). The A-CIT included additional "inducer" items: words referring to the participants own given name ("mine," "my name," etc.). These inducer items had to be responded to by a different key press than the given names, thereby inducing incongruity when participants in the guilty condition had to respond to their own names. In Experiment 1, this method differentiated with high accuracy between guilty and innocent conditions. Experiment 2 followed the same procedure as Experiment 1, except that the participants were informed of the probe item in the innocent condition—nonetheless, the accuracy rate of the A-CIT remained high. This implies that this low-cost and easily implementable method could be used, unlike the original RT-based CIT, in scenarios when an innocent person can also be aware of the probe item.

*Keywords:* Memory detection, Deception, Concealed Information Test, Reaction time, Association, Recognition

Technological deception detection methods are widely needed, because without such aid, it is extremely difficult—if not impossible—to tell whether a person is telling the truth or not (Bond & DePaulo, 2006, 2008; Hartwig & Bond, 2011; Kraut, 1980). One frequently researched method is the Concealed Information Test (CIT; Lykken, 1959; Verschuere & Meijer, 2014). The CIT allows one to disclose whether an examinee recognizes certain relevant items such as a weapon used in a recent robbery among a set of other objects when he/she actually tries to conceal any knowledge about the criminal case. The recognition of a relevant item can be detected by various means, for instance from increased stress reactions as measured with a polygraph, or from relatively slower responding to relevant items as assessed with a reaction time-based CIT (RT-CIT). However, the applicability of this test is limited in real life settings, since it cannot be used when an innocent person would also recognize the incriminating item, for example due to information leakage and the consequential increased familiarity with the critical item (Bradley, Barefoot, & Arsenault, 2011). In the present paper, we introduce the Association-based Concealed Information Test (A-CIT), a new RT-based paradigm that aims at identifying concealed knowledge linked to words (e.g., nouns or verbs associated with the crime) just like the RT-CIT (Seymour, Seifert, Shafto, & Mosmann, 2000). However, rather than relying on the recognition of unique items, the A-CIT is based on item-category associations and shares many common features with the Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998). Before we describe the new method in detail, we shortly present the two approaches that inspired the A-CIT.

The RT-CIT consists of a fast, two-alternative forced choice task, where participants classify the presented stimuli as targets or non-targets by pressing one of two keys. Several (e.g., 6–7) items are presented, among which one is the *probe* item (the item that the guilty person would recognize, e.g., the murder weapon) and the rest are *irrelevant* items (items that are similar to the probe and thus indistinguishable from the probe for an innocent person). These items are repeatedly shown in a random sequence, and all of them have to be responded to with the same response keys, except the one *target* (irrelevant) item—a randomly selected irrelevant item that has to be answered with the other response key (serving as an "oddball" in this task). In case of guilty examinees, the answer to the probe will be generally slower (and somewhat more often incorrect) in comparison to the irrelevant items because by recognizing the probe as personally relevant, it will become unique (another "oddball") and in this respect, more similar to the rarely occurring target item (Varga, Visu-Petra, Miclea, & Buş, 2014; Verschuere & Meijer, 2014; Verschuere, Suchotzki, & Debey, 2015).

The main advantages of the RT-CIT are its low costs and its easy implementation: it can be run using any regular personal computer and takes little time (10–15 min). Since the method does not require special equipment, it can very easily be standardized in order to run it in the same manner on any computer, including an immediate automatic analysis of the results (see Verschuere & Kleinberg, 2015).

However, a major limitation of the CIT in connection with any measure (RT, polygraph, EEG, fMRI) is that it uses the recognition of the concealed information as the evidence to classify someone as guilty or not. This makes the test unviable if the suspect has a way to know the information (i.e., the probe), for example, in the case of leaked crime details (Bradley et al., 2011; Verschuere & Meijer, 2014). Unfortunately, in the majority of real life scenarios, the probe is indeed known to the suspects—which is the primary reason for the very limited actual field application of the CIT (Ben-Shakhar, 2012; Podlesny, 2003).

The IAT, on the other hand, is not based on recognition, but on item-category associations. There has been a series of studies with IAT-based lie detection, using the IAT basically in its standard format (autobiographical IAT, or aIAT; for review, see Agosta & Sartori, 2013). As critical items presented during the task, the aIAT uses sentences that each refer to one of two opposing claims about a past event (e.g., having or not having used cocaine; Sartori, Agosta, Zogmaister, Ferrara, & Castiello, 2008,

Please cite this article in press as: Lukács, G., et al. Association-based Concealed Information Test: A Novel Reaction Time-Based Deception Detection Method. *Journal of Applied Research in Memory and Cognition* (2017), http://dx.doi.org/10.1016/j.jarmac.2017.06.001