

**SCANNING FOR TRUTH. SCHOLARS' AND PRACTITIONERS' PERCEPTIONS ON THE USE(FULNESS) OF
SCIENTIFIC CONTENT ANALYSIS IN DETECTING DECEPTION DURING POLICE INTERVIEWS**

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ABSTRACT

SCAN (Scientific Content Analysis) is an analytic method that claims to detect deception in written statements. Although the validity of SCAN is contested in literature, various (law enforcement) agencies across the globe are trained in using the technique. To date it remains unknown how the technique is perceived and to what extent it is used in practice. Based on a scoping review and an open- and closed-ended survey, we identified practitioners' and scholars' prevailing perceptions on the use(fulness) of SCAN. Data were collected from 48 participants (35 practitioners and 13 scholars). Key findings illuminate a discrepancy between practitioners and academics. While practitioners position themselves positively towards SCAN, academics urge for a complete disappearance of the technique. Practitioners apply an incomplete, personalized version of SCAN. Since SCAN is not applied in its originally designed form and existing research demonstrates the technique has important shortcomings, we advise practitioners to abandon SCAN altogether.

Keywords:

SCAN, content based credibility assessment, verbal credibility assessment, lie detection, investigative interviewing

INTRODUCTION

Investigative interviewing is an essential part of police work. Investigative interviewers spend up to 80% of their time in the interview room during a judicial investigation (De Greef & De Fruyt, 2006). Obtaining truthful information about the offence and involvement of suspects is an important goal of investigative interviews (Gudjonsson & Pearse, 2011). Based on the assumption that verbal structures of true and false statements significantly differ from each other, verbal credibility assessment (VCA) tools can assist investigative interviewers in detecting lies and/or deception (Meijer et al., 2008; Nicklaus & Stein, 2020; Vrij, 2008). In particular, VCA methods test verbal indicators of statements based on the tool's specific criteria. The presence or absence of certain criteria is considered as an indication of either truthful or misleading/deceitful information (Bogaard et al., 2019; Bogaard et al., 2016a). Examples of VCA tools include Statement Validity Analysis (SVA), Criteria Based Content Analysis (CBCA), Reality Monitoring (RM), and Scientific Content Analysis (SCAN) (Bogaard, 2017; Bogaard, Meijer, & Vrij, 2014; Bogaard, Meijer, et al., 2014b; Bogaard et al., 2016a; Meijer et al., 2008; Smith & Willis, 2001). In this article, we focus on SCAN.¹

SCAN was developed by former polygraph examiner Avinoam Sapir (LSI, n.d.) and claims to detect misleading and hidden information, as well as involvement in a crime by analysing a written statement (Vanderhallen et al., 2016). SCAN thus represents itself as a technique to detect deception (Armistead, 2011; Kang & Lee, 2014; Smith & Willis, 2001; Vanderhallen et al., 2016), not as a lie detection tool. When applying SCAN, practitioners follow six steps (Bockstaele, 2019). First, the 'initial phase' serves

¹ The following overview of the literature was obtained through a scoping review, of which the research protocol can be found in Appendix 1.

as an introduction between the interviewer and interviewee in order to minimize resistance of the interviewee (Bockstaele, 2019). Second, in order to obtain a ‘pure version statement’, the interviewee is asked to write everything down about a certain event without any guidance or influence (Bogaard, 2017; Bogaard, Meijer, & Vrij, 2014; Bogaard, Meijer, et al., 2014b; Bogaard et al., 2016a; Meijer et al., 2008; Smith & Willis, 2001; Vanderhallen et al., 2016; Bockstaele, 2019). Third, this written statement is analysed using SCAN criteria (Bogaard, 2017; Bogaard et al., 2016a; Meijer et al., 2008; Bockstaele, 2019) in order to detect ‘highlights’ or ‘hotspots’ that indicate deception. Table 1 represents SCAN’s criteria following Belgian police superintendent Bockstaele (2019). Fourth, these hotspots are discussed more thoroughly in subsequent interviews (Bockstaele, 2019; Bogaard, 2017; Smith & Willis, 2001). Fifth, as part of the detailed interview, the interviewer asks open questions and aims to build rapport, for example by using the word ‘we’ and smiling at the interviewee. Sixth, debriefing after the detailed interview allows the interviewer to probe for the interviewee’s experienced emotions during the interview (Bockstaele, 2019).

[Insert Table 1 here]

Extant research consistently dissuades the further use of SCAN for several reasons. Most importantly, SCAN criteria differ from study to study (Meijer et al., 2008; Oberlader et al., 2020). Besides the unclear content of these criteria, the number of criteria to be used ranges from ten to sixteen in different studies (see Bockstaele, 2019; Bogaard, Meijer, & Vrij, 2014; Bogaard, Meijer, et al., 2014a, 2014b; Kang & Lee, 2014; Smith & Willis, 2001). Because of this discrepancy in interpretation and number of criteria, analysts apply SCAN differently and obtain different results after analysing the same statement. As a consequence, SCAN is found to have low (interrater) reliability (Bogaard, 2017; Bogaard, Meijer, & Vrij, 2014; Bogaard, Meijer, et al., 2014a, 2014b; Kang & Lee, 2014; Kleinberg et al., 2019; Smith & Willis, 2001; Vanderhallen et al., 2016), caused by the lack of well-defined criteria and personal interpretations of the analysts (Bogaard, Meijer, & Vrij, 2014; Bogaard, Meijer, et al., 2014b; Bogaard et al., 2016b; Meijer et al., 2008; Vanderhallen et al., 2016). Furthermore, the technique has only a limited ability to differentiate between truthful and dubious or fabricated statements, making the validity of SCAN questionable (Bogaard, 2017; Bogaard, Meijer, & Vrij, 2014; Bogaard, Meijer, et al., 2014a, 2014b; Kleinberg et al., 2019; Vanderhallen et al., 2016). What is more, SCAN does not contain a criterion that allows to distinguish between true and false statements (Bogaard, 2017; Bogaard, Meijer, & Vrij, 2014; Bogaard et al., 2016a), and would hence fail to detect the truth (Bogaard, 2017; Nahari et al., 2011; Vanderhallen et al., 2016). Moreover, SCAN tends to increase the risk of tunnel vision and judicial errors (Komel et al., 2020; Vanderhallen et al., 2016). In addition, when compared to the academically well-established VCA tool ‘Criteria Based Content Analysis’ (CBCA), SCAN includes the criteria ‘lack of memory of the event’ and ‘spontaneous corrections’ as indicators of deception, whereas CBCA considers these criteria as truthful (Bogaard, 2017; Bogaard, Meijer, et al., 2014b; Oberlader et al., 2020).

In sum, despite SCAN being represented as “*the key to unlocking the truth*” (LSI, n.d.), academic substantiation for its use is absent (Armistead, 2011; Bogaard, 2017; Bogaard, Meijer, et al., 2014a; Meijer et al., 2008; Oberlader et al., 2020; Vrij & Nahari, 2017). SCAN is based on nearly no theoretical assumptions or empirical evidence and thus poses a risk to use in practice (Heydon, 2008; Oberlader et al., 2020). Nevertheless, a wide range of practitioners including police forces, intelligence services, and private actors, in a number of countries apply SCAN in their daily practice (Bogaard, 2017; Bogaard, Meijer, & Vrij, 2014; Bogaard, Meijer, et al., 2014a, 2014b; Bogaard et al., 2016a, 2016b; Meijer et al., 2008; Smith & Willis, 2001). In other words, there seems to be a major discrepancy between academics and practice on the prevailing use and perceived usefulness of SCAN. In order to confirm or refute this discrepancy, it is essential to survey both practitioners and academics on their perceptions of SCAN.

Furthermore, given the lack of academic substantiation, it is pivotal to gain insight into how and why SCAN practitioners continue to use this technique. Extant research – of which the majority experimental designs using students as participants – has not taken into account the use and perceptions of SCAN practitioners and academics. In this study, we fill this gap by assessing the use of SCAN among practitioners who followed a SCAN training in Belgium, as well as practitioners' and academics' attitudes towards the usefulness and validity of SCAN. The following research questions are answered by an online questionnaire with open- and closed-ended questions:

- (1) To what extent do practitioners trained in using SCAN in Belgium use the technique in practice?; and
- (2) What are the prevailing attitudes towards SCAN (and its future use) among practitioners trained in SCAN and academic experts specialized in SCAN, investigative interviewing, or lie/deception detection?

This article is structured as follows. The method section describes participant selection of both practitioners and academics, as well as the content of both the practice- and academics-oriented online questionnaire. The results dig deeper into the use of SCAN by practitioners, as well as the perceived usefulness and future of the technique by academics and practitioners. The article concludes with a general discussion, including limitations of the study and recommendations for future practice and research.

METHODS

Participants and procedure

Practitioners completed a practice-oriented version of the questionnaire (see Appendix 2), whereas academics completed an academic version of the questionnaire (see Appendix 3). Practitioners were recruited by attendance lists from previous SCAN trainings organized by the Belgian *Centre for Policing and Security* (CPS).² CPS organizes a yearly three day basic SCAN training, followed by a two day more in-depth specialized training, taught by SCAN's founder Avinoam Sapir. All 103 Dutch-speaking participants from 2012 to 2018 of the basic and specialized SCAN trainings were invited to participate in the study. The questionnaire was filled out by 44 practitioners, of which 9 only answered the first couple questions. A sample of 35 practitioners filled out the entire questionnaire, implying a 34% response rate. We used a non-random homogeneous purposive sampling method (Sharma, 2017) to select academics, based on two inclusion criteria: (1) active in the field of criminology and/or legal psychology, and (2) minimum one published article on investigative interviewing, lie/deception detection, or specifically SCAN. In total, 35 academics were contacted to take part in the study. The questionnaire was filled out by 13 academics, implying a 37% response rate. The full sample thus included 48 academics and practitioners.

[Insert Table 2 here]

Participants were contacted directly by a personal email and did not receive an email reminder, due to lack of time. To mitigate the risk of non-response, participants were addressed personally and an indication of time to complete the questionnaire was given (McPeake et al., 2014). As depicted in Table 2, slightly more than half of the sample was male. The large majority of practitioners worked at police forces. Most practitioners were very satisfied with the SCAN training they attended and the large

² This research was conducted in collaboration with CPS (<http://www.politiestudies.be/index.cfm?Id=1&Lang=E>).

majority followed the specialized SCAN training at CPS. A small proportion of academics followed training in SCAN.

Questionnaire

The practice- and academics-oriented questionnaire took each approximately 20 minutes to complete. Before distributing, a draft of the questionnaire was reviewed by police, private practitioners, and academics. Respondents received a personal introduction mail containing information about the study, sampling method, and guarantees of confidentiality and anonymity. Before starting the questionnaire, a box regarding informed consent had to be ticked off, stressing guarantees concerning voluntary participation, the right to withdraw, anonymous reporting of the results and the possibility to contact the researcher. The online questionnaire was designed using ThesisTools and consisted of open- and closed-ended questions. Follow-up questions and probing (Bell et al., 2016) were anticipated as much as possible. Given the mixture of open- and closed-ended questions, anticipation of follow-up and online standardized character of the survey, this study followed an open-ended standardized approach, which implied a combination of qualitative and quantitative perspectives (Halcomb & Davidson, 2006).

The practice-oriented questionnaire (see Appendix 2) focused on three sections: SCAN training; use; perception and future perspectives. Multiple choice answers regarding the use of SCAN criteria were based on the work of Belgian police superintendent Bockstaele (2019) as this work possesses the most extensive list of criteria. The academics-oriented questionnaire (see Appendix 3) included three sections: SCAN training; academic research; perception and future perspectives. The sections in the practice- and academics-oriented questionnaire consisted of open questions, as well as closed questions and propositions with a Likert-scale response format. Data were automatically transcribed to Excel by ThesisTools. Open-ended questions were coded by the process of open, axial, and selective coding. Open coding involved the development of a code tree, whereas axial coding organized these codes according to (sub)themes, and selective coding focused on the in depth analysis of data in search for similarities and differences (Decorte & Zaitch, 2016; Williams & Moser, 2019). With regard to the closed-ended questions with designated response options, descriptive univariate statistics were used. The results described below focus on the use, perception and future perspectives of SCAN.

RESULTS

Use

As depicted in Table 3, SCAN is used by the majority of practitioners who followed SCAN training at CPS (65,7%). Of this 65,7%, only a small proportion applies the technique in the majority of interviews (17,4%). When asked why SCAN is not used in most interviews, respondents refer to complexity and loss of knowledge over time. When asked about the reasons why participants do not use SCAN, practitioners indicate the impossibility to obtain a written statement and the lack of support amongst judicial authorities and academics, as well as the lack of clarity on how SCAN should be applied. To overcome the difficulty of obtaining a written statement, some respondents indicate that SCAN could be used verbally, thus applying the criteria to what the interviewee says, not to what he or she writes. Some users stress that SCAN is incorporated into a global interviewing strategy and should be used complementary to other interview techniques. The vast majority of academics (77%) dissuades the use of SCAN in practice, based on the absence of academic support, as already mentioned in the scoping review. They indicate that other techniques should be used instead. Only two academics state that SCAN can be applied cautiously, to acquire additional information from an interviewee.

[Insert Table 3 here]

Only five SCAN users (21,7%) indicate that they use all SCAN criteria. The majority (69,6%) only applies a selection of SCAN criteria. The criteria ‘details in the story’, ‘evasive answers’, and ‘language changes’ are most commonly used, ‘placing of emotions within the statement’ is less commonly used. When asked why not all criteria are utilized, a number of respondents state that it is too labour-intensive and time consuming to apply all criteria, as well as that some criteria, like ‘improper use of pronouns’ and ‘lack of social introduction’, are unreliable as deception indicators. No SCAN user follows all predefined phases. Most respondents use the steps ‘analysis’, ‘detailed interview’ and ‘pure version statement’. Users indicate they apply SCAN to suspects, witnesses, and victims. One respondent who works in insurances indicates he uses SCAN on customers. Police users utilize SCAN in interviews involving sex offences, thefts, violence, drugs, fraud, embezzlement, and manslaughter. Other answers refer to the use of SCAN in interviews where certain elements are written down spontaneously such as farewell letters, when the person involved refuses to make a statement, or to make a selection of a large number of suspects.

Most practitioners (75,9%) are not familiar with other VCA tools such as SVA, CBCA, or RM. Of the few practitioners who state to be familiar with other VCA techniques, only one actually applies these. Five respondents (14,3%) indicate they prefer SCAN, since SVA, CBCA, and RM should be applied by either a psychiatrist or psychologist, while SCAN is the only technique to be applied by police independently. The majority of academics (69,2%) calls for a replacement of SCAN by other interviewing techniques such as CBCA, RM, PEACE, Strategic Use of Evidence (SUE), Verifiability Approach, Cognitive Credibility Assessment, Discourse Analysis, memory detection, or Assessment Criteria Indicative of Deception (ACID).

Perception and future perspectives

As seen in Table 4, the overall majority of academics (77%) states that SCAN does not offer an added value during investigations, whereas the majority of practitioners (75,9%) acknowledges the added value of SCAN. With regard to positive aspects of SCAN, practitioners refer to the practical applicability and ability to use SCAN without other techniques. Moreover, they state SCAN provides a different perspective on the statement and allows the interviewer to gather more insight into the written text. The majority of practitioners (72,4%) agrees with the proposition that SCAN contributes to keeping the investigative directions broad and reduces the risk of tunnel vision. One academic states SCAN can contribute to “*ringing alarm bells*”, but should be always weighed up against other information available in a case. Looking into the added value of SCAN during police interviews, some SCAN users argue that the technique allows the interviewer to look at the case differently and dig deeper into certain topics. One respondent mentions the reopening of a case because of SCAN and the discovery of a false statement provided by a victim of sexual violence. On the contrary, one participant refers to a false confession obtained from a suspect with low intelligence as a consequence of using SCAN.

[Insert Table 4 here]

A minority of practitioners (34,29%) indicates that they cannot identify negative aspects of SCAN. Others argue that SCAN is time consuming and complex, as well as that it is perceived as offensive by the defence and does not fit into the usual practice of police interviews. What is more, SCAN does not take into account language barriers or the incapacity of some suspects to write a statement. Furthermore, respondents continuously refer to the lack of academic underpinning. Only a small proportion of practitioners (24,1%) claims to be fully abreast of academic research involving SCAN. According to one academic, SCAN is just a “*jumble*” of items from other methods with no standardization, no interrater reliability, and an increased risk of confirmation bias. One academic illustrates that compared

to SCAN, “*tossing a coin seems to work just as well to detect lies and deception*”. The vast majority of academics urges not to use SCAN in practice “*the sooner, the better*” and to apply other techniques such as CBCA and RM.

Considering the future perspectives on SCAN, the majority of practitioners (86,2%) is rather optimistic. A large proportion of practitioners already using SCAN (82,6%) claims they intend to continue using this technique if possible, either or not complemented with other methods. One respondent specifically mentions other colleagues looking into the statement as well, to counterbalance the low interrater reliability and risk of tunnel vision. A few respondents furthermore suggest the developing of a verbal version, where a written statement does not have to be obtained. Other practitioners (13,8%) are not willing to apply SCAN in the future. Contrary to most practitioners, the majority of academics encourages to ban the use of SCAN, with one academic stating that SCAN “*hopefully disappears as soon as possible*”. According to the majority of academics, an integration of SCAN with other VCA techniques is not desirable. One academic explicitly urges for a “*cross-fertilization*” between practitioners and academics as this would be in the best interest of both, whether or not for a thorough reform of SCAN.

DISCUSSION

SCAN is an analytic method used by various practitioners across the globe that aims to detect deception in written statements. A full SCAN analysis consists of six phases and presumably sixteen criteria to apply to the written text. As the first qualitative research on SCAN, we surveyed both practitioners and academics on prevailing (future) perceptions of the use(fulness) of the technique. The study gains a unique and thus far only insight into how SCAN is used in practice and perceived by academics and practitioners. The study demonstrates that SCAN – insofar that it is used – is applied in a limited and slimmed-down form on suspects, witnesses, and victims in different types of interviews. In particular, the vast majority utilizes a personal selection of SCAN criteria and no SCAN user follows all six phases, mainly because of the complexity, lack of consensus, and difficulty to obtain a written statement. SCAN is thus not used as originally intended and designed, what complements with the lack of clarity on the number and interpretation of SCAN criteria as mentioned in the scoping review. This applied ‘personalized version’ on the one hand further weakens the low interrater reliability of SCAN. On the other hand, it indicates a possible flexibility of SCAN, that allows interviewers to customize the technique to their or the interviewee’s needs. Such downsizing and customization is however not desirable, since extant research already states that SCAN in its full format does not work. Regarding prevailing perceptions towards SCAN, the results clearly reflect a discrepancy between practitioners and academics as assumed in the scoping review. The overall majority of academics consistently dissuades the (further) use of SCAN, while the majority of SCAN users is rather optimistic about the (further) use of the technique. Academics urge for a shift toward other VCA techniques, while the majority of practitioners is not aware of these methods.

Considering both the results and prevailing literature on SCAN, we advise practitioners to abandon SCAN altogether. Extant academic research clearly states that SCAN falters in terms of reliability, validity, standardization and purpose. Based on the results of this study, it is clear that SCAN’s applicability in practice also staggers. Besides this new insight, this study furthermore contributes to the state-of-the-art by the claim that the current body of knowledge on SCAN does not reach practice sufficiently. Academic conclusions pointing in the direction of abandonment of SCAN do not seem to be implemented in law enforcement practice. Eager for practice-oriented tools to assess truth or deception in interviews, practitioners have turned to a commercial tool as SCAN instead of academia

(Nahari et al., 2019) and apply a dangerous “cherry picking” of criteria. The current unequivocal academic conclusions on SCAN not reaching practice is thus a reason for concern.

When interpreting the results of this study, two limitations are important to note. First, the predominant qualitative nature and small sample size reduce the external validity of this study. Second, since only Belgian practitioners were surveyed, this study was not able to take into account practitioners’ perceptions from other countries. Despite this small sample size and predominant Belgian focus, the study’s main results seem to reflect an international trend and can be mirrored to other countries as well. First, the majority of practitioners’ motivations why SCAN is not or partially used (e.g. complexity, lack of academic support, lack of clarity on how to use SCAN, time consuming nature, ignoring language barriers, unavailability of written statements), is not country-specific or bound to a specific legal system and may thus also be at stake in law enforcement practice outside of Belgium. Second, the above mentioned discrepancy between academics’ negative and practitioners’ positive perceptions on the usefulness of SCAN reflects an international trend. Amongst others, Vrij (2018) describes the irony that a technique falling short on numerous criteria is most popular among practitioners worldwide. Third, the results clearly indicate that academic conclusions do not reach Belgian practitioners, making it thus pivotal to transfer academic knowledge to the field. This finding is consistent with the international call of Nahari et al. (2019, p 17) to make academic knowledge on verbal lie/deception detection more accessible for practitioners. The translation of academic research to practice and the distribution of academically sound practical alternatives is essential (Nahari et al., 2019; ten Brinke & Porter, 2013). Ideally, since research on other VCA techniques is quite promising (see Oberlader et al., 2020), the leap towards these techniques should be made. As most practitioners are not familiar with other tools, practitioners’ knowledge must be enhanced of existing, academically sound techniques. By looking into why and how practitioners use the academically unsound SCAN, the results of this study provide clear insight into what requirements such practical technique must fulfil and offers future avenues for research. For example, practitioners require a technique that can be applied by practice independently, that can be utilized verbally in different settings or circumstances, with a clear manual to be followed, and which is time-efficient. It is essential to establish a cross-fertilization and dialogue between practice and academics. On the one hand, this cooperation might prevent tunnel vision and miscarriages of justice (ten Brinke & Porter, 2013). On the other hand, it will enhance today’s essential evidence-based policing (Knutsson & Tompson, 2017).

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TABLES

Table 1. Most extensive list of SCAN criteria (Bockstaele, 2019)

1. Change in language use	9. Structure of the statement
2. Lack of memory of the event	10. Not answering the question
3. Unnecessary links	11. Evasive answers
4. Out of sequence information	12. Change in verb tense
5. The place of emotions within the statement	13. Lack of social introduction
6. Sensory perceptions	14. Missing information (text bridges)
7. Spontaneous denials/corrections	15. Details within statement
8. Inappropriate use of pronouns	16. Time

Table 2. Sample Characteristics

	Practitioners: n = 35	Academics: n = 13
	(%)	(%)
Gender		
Male	19 (54,3)	7 (53,8)
Female	9 (25,7)	5 (38,5)
No answer	7 (20)	1 (7,7)
Age		
18-30	1 (2,9)	1 (7,7)
31-45	11 (31,4)	4 (30,8)
46-65	15 (42,9)	4 (30,8)
+ 65	1 (2,9)	1 (7,7)
No answer	7 (20)	3 (23,1)
Field		
Police	20 (57,1)	--
Judicial system		
Court-appointed expert	2 (5,7)	--
Other	1 (2,9)	--
Private sector		
Forensic auditing	3 (8,6)	--
Insurance	1 (2,9)	--
Private detective	1 (2,9)	--
Other	3 (8,6)	--
Inspectorate service	4 (11,4)	--
Academia		
Professor	--	4 (30,8)
Doctor	--	6 (46,2)
(PhD) researcher	--	3 (23,1)
SCAN training (CPS or elsewhere)	35 (100)	4 (30,8)
Specialized SCAN training (CPS)	21 (60)	--
Reason for participation		
Obligated	0 (0)	--
Interest	100 (100)	--
Overall satisfaction SCAN training		
Very satisfied	28 (80)	--
Somewhat satisfied	6 (17,1)	--
Neutral	1 (2,9)	--
Somewhat dissatisfied	0 (0)	--
Very dissatisfied	0 (0)	--

Table 3. The use of SCAN by practitioners

	Practitioners
Use (n = 35) (%)	
Yes	23 (65,7)
No	12 (34,3)
If used (n = 23): frequency of use (%)	
Always	4 (17,4)
More than half of interviews	0 (0)
Half of interviews	5 (21,7)
Less than half of interviews	14 (60,9)
If used (n = 23): criteria (%)	
All criteria	5 (21,7)
Selection of criteria	16 (69,6)
No answer	2 (8,7)
If used (n = 23): phases (%)	
All phases	0 (0)
Selection of phases	23 (100)

Table 4. 'SCAN offers an added value during investigations' (n = 42)

	Academics: n = 13 (%)	Practitioners: n = 29 (%)
Totally agree	2 (15,4)	12 (41,4)
Agree	1 (7,7)	10 (34,5)
Neutral	0 (0)	1 (3,5)
Disagree	4 (30,8)	3 (10,3)
Totally disagree	6 (46,2)	3 (10,3)

APPENDIX

Appendix 1. Research protocol scoping review

This scoping review is based on the steps of Verhage & Boels (2015) and Arksey & O'Malley (2005).

Research question: 'What is known about Scientific Content Analysis (SCAN)?'

Inclusion criteria	1. Primary and secondary research involving SCAN 2. Published 3. From 2000 until 2021 4. In Dutch or English
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Search places	Databases	Web of Science Scopus Hein Online
	Academic search engines	Google scholar
	Search engines	Google
	General catalogues	Lib Ugent
	Journals	Panopticon Criminal justice and behaviour Legal and criminal psychology Frontiers in psychology

Search terms	English	1. "Scientific Content Analysis" OR SCAN 2. "Scientific Content Analysis" OR SCAN AND (Sapir OR scientific research OR Statement Analysis OR Verbal veracity assessment OR Deception detection OR Lie detection)
	Dutch	1. "Scientific Content Analysis" OF SCAN 2. "Scientific Content Analysis" OF SCAN EN (Sapir OF wetenschappelijk onderzoek OF misleidingdetectie OF leugendetectie OF verbale analysemethode)

Longlist: 35 studies

Shortlist: 18 studies

1. Armistead, T. W. (2011). Detecting deception in written statements: The British Home Office study of scientific content analysis (SCAN). *Policing: An International Journal of Police Strategies & Management*, 34(4), 588-605.
2. Bockstaele, M. (2019). SCAN versus experimenteel wetenschappelijk onderzoek. *Panopticon*, 40(2), 120-135.
3. Bogaard, G. (2017). *Catching liars by listening carefully: promises and challenges for verbal credibility assessment*. Universitaire Pers Maastricht.
4. Bogaard, G., Meijer, E., & Vrij, A. (2014). Using an example statement increases information but does not increase accuracy of CBCA, RM, and SCAN. *Journal of Investigative Psychology and Offender Profiling*, 11(2), 151-163.
5. Bogaard, G., Meijer, E. H., Vrij, A., Broers, N. J., & Merckelbach, H. (2014a). Contextual bias in verbal credibility assessment: Criteria-based content analysis, reality monitoring and scientific content analysis. *Applied Cognitive Psychology*, 28(1), 79-90.
6. Bogaard, G., Meijer, E. H., Vrij, A., Broers, N. J., & Merckelbach, H. (2014b). SCAN is largely driven by 12 criteria: results from sexual abuse statements. *Psychology, crime & law*, 20(5), 430-449.

7. Bogaard, G., Meijer, E. H., Vrij, A., & Merckelbach, H. (2016a). Scientific content analysis (SCAN) cannot distinguish between truthful and fabricated accounts of a negative event. *Frontiers in psychology*, 7, 243-249.
8. Bogaard, G., Meijer, E. H., Vrij, A., & Merckelbach, H. (2016b). Strong, but Wrong: Lay People's and Police Officers' Beliefs about Verbal and Nonverbal Cues to Deception. *PloS one*, 11(6).
9. Heydon, G. (2008). Are police organisations suspending their disbelief in Scientific Content Analysis (SCAN)? *iIRG Bulletin* 1(1), 8-9.
10. Kang, S. M., & Lee, H. (2014). Detecting deception by analyzing written statements in Korean. *Linguistic Evidence in Security, Law and Intelligence*, 2(2), 1-10.
11. Kleinberg, B., Arntz, A., & Verschuere, B. (2019). Being accurate about accuracy in verbal deception detection. *PloS one*, 14(8).
12. Komel, M., Šterk, K., Župan Galunić, A., & Savić, G. (2020). SCAN Revisited Through Linguistic Psychoanalysis. *Criminalistic Theory and Practice*, 7(12), 7-30.
13. Meijer, E., Vrij, A., Merckelbach, H., & Vlek, F. (2008). *SCAN: Scientific? Content analysis*. Maastricht University.
14. Nahari, G., Vrij, A., & Fisher, R. P. (2011). Does the truth come out in the writing? SCAN as a lie detection tool. *Law and Human Behavior*, 36(1), 68-76.
15. Oberlader, V. A., Quinten, L., Banse, R., Volbert, R., Schmidt, A. F., & Schönbrodt, F. D. (2020). Validity of content-based techniques for credibility assessment - How telling is an extended meta-analysis taking research bias into account? *Applied Cognitive Psychology*, 1-18.
16. Smith, N., & Willis, C. F. (2001). *Reading between the lines: An evaluation of the scientific content analysis technique (SCAN)*. Police Research Series - Home Office.
17. Vanderhallen, M., Jaspert, E., & Vervaeke, G. (2016). SCAN as an investigative tool. *Police Practice and Research*, 17(3), 279-293.
18. Vrij, A., & Nahari, G. (2017). Verbal lie detection. In A. Granhag, R. Bull, A. Shaboltas, & E. Dozortseva (Eds.) *Psychology and law in Europe: When West meets East*. (pp. 263-281). CRC Press.

Appendix 2. Practice-oriented questionnaire

Informed consent

- I hereby declare that I have been informed in a clear manner of the nature and method of the study, as set forth in the invitation e-mail for this study.
- I am participating in this study voluntarily and reserve the right to withdraw my consent without giving a reason.
- I realize that the reporting of this research is done anonymously. It will only state which target group I belong to and whether I belong to the practice/academic world.
- I know that I can contact the researcher at any time for questions and/or information about the study.

☐ I understand the text above and agree to participate in the study.

Introduction

1. Which target group do you belong to? (police, judicial system, private sector, inspectorate service, other)
 - a. If police, which unit?
 - b. If other than police, what organization do you work for?
2. What is your position within this organization?

SCAN training

3. In which year did you follow the CPS SCAN training? (2012, 2013, 2014, 2015, 2016, 2017, 2018)
4. How satisfied or dissatisfied are you with this training? (Very satisfied - Somewhat satisfied - Not satisfied and not dissatisfied - Somewhat dissatisfied - Very dissatisfied)
5. How did you experience the teaching style?
6. What did you think of the training materials?
7. How did you experience the interaction with the teacher and other students?
8. Why did you attend this training? (obligatory, out of interest, other reason)
9. Did you participate in the SCAN follow-up training? (Yes, no)
10. Did you start using SCAN as a result of the training?
11. In addition to SCAN training, would you like to receive training in other lie or deception detection techniques? (Yes, no, no opinion)
12. If you have any other comments about the training, you can post them here.

Use

13. Why do you or do you not use SCAN during your professional activity?
14. How frequently do you use SCAN (always - in more than half of interviews - in about half interviews - in less than half of interviews - never)
15. How do you experience the use of SCAN from a practical perspective? This could involve the user (un)friendliness, the time SCAN takes, etc.

16. Do you use all 16 SCAN criteria? (I use all criteria, I do not use all criteria)

a. If not, which do you use?

- change in language use
- lack of memory of the event
- unnecessary links
- out of sequence information
- the place of emotions within the statement
- sensory perceptions
- details within statement
- spontaneous denials/corrections
- inappropriate use of pronouns
- structure of the statement
- not answering the question
- evasive answers
- change in verb tense
- lack of social introduction
- missing information (text bridges)
- time

b. If not, why do you not use certain criteria?

17. With which target group(s) do you use SCAN? (Suspects, witnesses, victims, other)

18. In what type of interviews do you use or do you not use SCAN? Why?

19. Avinoam Sapir, the author of SCAN, distinguishes 6 different steps to be followed: the initial phase, obtaining the pure version, the analysis, subsequent interviews, detailed interview and debriefing. Which steps do you complete? (indicate)

a. If you do not complete all steps, what is a reason for this?

20. What results have you already achieved through the application of SCAN?

21. Did SCAN already provide breakthroughs and/or false leads in certain interviews?

a. If yes, what breakthroughs and/or false leads?

Perception and future perspective

22. What are SCAN's positive points?

23. What are SCAN's negative points?

24. How could these negative points be addressed?

25. Why will you or will you not use SCAN in the future?

26. Are you familiar with other methods of analysing statements, such as Statement Validity Assessment/Criteria Based Content Analysis and/or Reality Monitoring? (Yes, no)
- a. If yes, do you use one or more of these techniques? (Yes, no)
 - b. If you have a choice between SCAN, Statement Validity Assessment/Criteria Based Content Analysis and Reality Monitoring, which technique do you prefer and why?
 - c. If yes, do you think it is possible to integrate SVA, RM and SCAN? (Yes, no, I don't know)

Propositions (totally agree, agree, neutral, disagree, totally disagree)

27. I think SCAN training should be organized.
28. I use the person's writing time as extra preparation time.
29. SCAN can help keep the investigation's directions broad and thus reduce the risk of tunnel vision.
30. SCAN does not offer an added value during investigations.
31. I am aware of scientific studies and conclusions involving SCAN.
32. The application of SCAN takes a lot of time.

Descriptives

33. What is your name? (optional)
34. What is your age? (optional)
35. What is your gender? (optional)
36. What is your email address? (optional)
37. Are you in your current professional activity involved in taking statements/interviewing? (Yes, No)
38. Would you like to be contacted in the future for a follow-up study? (Yes, No)

If you have any further comments, please feel free to submit them here.

Thank you very much for participating in the survey!

Appendix 3. Academics-oriented questionnaire

Informed consent

- I hereby declare that I have been informed in a clear manner of the nature and method of the study, as set forth in the invitation e-mail for this study.
- I am participating in this study voluntarily and reserve the right to withdraw my consent without giving a reason.
- I realize that the reporting of this research is done anonymously. It will only state which target group I belong to and whether I belong to the practice/academic world.
- I know that I can contact the researcher at any time for questions and/or information about the study.

☐ I understand the text above and agree to participate in the study.

Introduction

1. Which target group do you belong to? (professor, doctor, (PhD) researcher, assistant)
2. What organization do you work for?

SCAN training

3. Did you follow a SCAN training? (Yes, no)
 - a. If yes, where did you take this training? (Centre for policing and security, other)
 - b. If CPS
 - i. In which year did you follow the CPS SCAN training? (2012, 2013, 2014, 2015, 2016, 2017, 2018)
 - ii. How satisfied or dissatisfied are you with this training? (Very satisfied - Somewhat satisfied - Not satisfied and not dissatisfied - Somewhat dissatisfied - Very dissatisfied)
 - iii. How did you experience the teaching style?
 - iv. What did you think of the training materials?
 - v. How did you experience the interaction with the teacher and other students?
 - vi. Why did you take this training? (obligatory, out of interest, other reason)
 - vii. Did you participate in the SCAN follow-up training? (Yes, no)
 - viii. Would you set up training in other lie and/or deception techniques? If yes, what techniques?
 - ix. If you have any other comments about the SCAN training, please post them here.
 - c. If no, do you see yourself doing this in the future? (Yes, no, I don't know)

Perception and future perspective

4. To what extent are you familiar with the scientific literature involving SCAN? (I am aware of the studies and conclusions, I have notions of the studies and conclusions, I do not know the scientific literature surrounding SCAN, other)
5. To what extent are you familiar with the content and operation of SCAN? (I know the full content and operation, I have notions of the content and operation, I do not know SCAN, other)

- a. *Academics were presented an introduction text regarding SCAN and its content and operation.*
6. What do you think is the main purpose of SCAN?
7. Did you already apply SCAN yourself in practice? (Yes, no)
8. What are negative points of SCAN?
9. How could these negative points be addressed?
10. What are positive points of SCAN?
11. May SCAN be applied in practice? (Yes, no)
 - a. Why yes/no?
 - b. If yes, how?
 - c. If not, are there certain alternatives that you do support?
12. Are you familiar with other methods of analysing statements, such as Statement Validity Assessment/Criteria Based Content Analysis and/or Reality Monitoring? (I know both, I know Statement Validity Assessment/Criteria Based Content Analysis, I know Reality Monitoring, I know neither)
 - a. Do you see SCAN as an added value, less value, or neither compared to this/these technique(s)? Why?
 - b. To what extent is it possible to integrate SCAN, Statement Validity Assessment/Criteria Based Content Analysis, and/or Reality Monitoring? If these techniques could be integrated, in what way?
13. What is your future outlook on SCAN?

Scientific research regarding SCAN

14. Suppose you had unlimited time and resources, how would you design a new study of SCAN?
15. What do you think is the added value of investigating SCAN in an experimental setting?
16. What do you think is the added value of conducting research in and with practitioners on SCAN?

Propositions (totally agree, agree, neutral, disagree, totally disagree + why?)

17. SCAN encourages false positive errors.
18. A laboratory testing situation is not a reliable reflection of social reality when research is conducted on lie or deception detection.
19. SCAN does not claim to be able to determine whether a person is lying or not. In the scientific studies published so far, SCAN is tested as a lie detection method, which defeats the original purpose of SCAN.
20. SCAN does not offer an added value during investigations.
21. I think SCAN training should be organized.

Descriptives

22. What is your name? (optional)
23. What is your age? (optional)
24. What is your gender? (optional)

25. What is your email address? (optional)

26. Would you like to be contacted in the future for a follow-up study? (Yes, No)

If you have any further comments, please feel free to submit them here.

Thank you very much for participating in the survey!