Aviation security by consent using the Controlled Cognitive Engagement (CCE) alternative screening programme

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Abstract

Aviation security measures rely on public acceptance of the trade-off between civil liberties and public protection. Currently, all aviation passengers travelling to the US on an American carrier from non-U.S. locations undergo screening interview based on detection of suspicious signs, an approach which is not supported by psychological research. An alternative, Controlled Cognitive Engagement (CCE) was shown in a series of field trials to be more effective than suspicious signs methods in detecting deception during security interviews. However, CCE asks passengers to satisfy agents that answers to questions are veridical, which raises a concern that CCE might be viewed as too intrusive. Here, 120 genuine air passengers provided anonymous feedback regarding their experience of screening. CCE-screened passengers reported their experience as significantly more enjoyable, no less intrusive nor less acceptable than the current procedure, and were 'promoters' of the technique whereas those in the suspicious signs condition were 'detractors'. Winning and maintaining the respect and approval of the traveling public is an important consideration in the task of securing freedom of movement and public safety.

1. Introduction

Aviation security measures rely on public acceptance of the trade-off between civil liberties and public protection. Passengers traveling by air are familiar with the multiple layers of security at national and international airports. Identifying threats to security of aviation presents significant and evolving challenges. In this context, it is important to establish that security measures have the support of the travelling public.

The U.S. Transport Security Administration (TSA) was established in 2001 following the 9/11 terrorist attacks in New York City and is responsible for day-to-day security operations for passenger air transportation (Aviation & Transport Security Act, 2001). Currently, the U.S. Dept. of Homeland Security Aircraft Operator Standard Security Program (AOSSP) requires aircraft operators to '*adopt and implement a Transportation Security Administration (TSA)- approved security program for all scheduled passenger and public charter passenger operations'* (p.1.1, AOSSP, 2014). Chapter 11 of AOSSP requires *all* passengers travelling to the United States on an American carrier departing from non-U.S. locations be subject to a screening interview while in possession of all accessible property and checked baggage. The TSA mandatory screening interview, which occurs pre-check-in or at the time of check-in, comprises several elements including a documentation check, a series of baggage control questions, and observations of passengers' behaviour.

Billions of dollars have been invested in aviation security procedures (United States Government Accountability Office, 2011), but the cost and effectiveness of these procedures is often questioned (Gillen & Morrison, 2015; Stuart & Mueller, 2014; Weinberger, 2010), particularly when events suggest they may be less than effective, and where procedures have not been empirically validated (United States Government Accountability Office, 2015; 2017). Many aviation security procedures rely on identifying behavioral indicators (e.g., British Security Industry Association, 2008; Reddick, 2004), referred to as 'suspicious signs'.

The AOSSP Chapter 11 screening interview is one such example, where passengers are asked a series of questions that are the same for every passenger, during which screeners look for suspicious indicators. These indicators concern non-verbal behaviours (e.g., agitation and sweating) and appearance (e.g., being appropriately dressed) which are believed to be indicators of threat and deceit.

We and others have previously highlighted a lack of theoretical or empirical support for this type of screening interview (e.g., Bond & DePaulo, 2006; Ormerod & Dando, 2015). In response, we developed Controlled Cognitive Engagement (CCE) as an alternative interview screening method. CCE embodies six theoretically supported and empirically validated features that can discriminate deceivers from truth tellers, a deceptive passenger being viewed as a security threat. Working alongside U.K. and U.S. government organizations, we carried out a series of randomized-control, double-blind field trials of these two aviation security-screening methods across a number of international airports. Both mock and real passengers passed through a security interview for long-haul flights into the US traveling with two large US carriers. Over an 8-month period, 204 passengers were incentivized to attempt to pass through security undetected while giving untruthful answers to security questions. Over the duration of the field trial the base rate of mock passengers to genuine passengers was 1:1000. Security agents trained to use CCE detected 66% of deceptive passengers compared with less than 5% using the mandated behavioral indicator recognition method.

1.2. Security by Consent

CCE may be more effective, but is it acceptable to passengers? If not, there is a risk that airlines may be reluctant to use the method, despite its effectiveness as a security procedure. Although short in duration, typically 3 minutes, the CCE security interview demands more of passengers than the current suspicious signs method. In the case of the

latter, passengers are passive receivers of a series of routine questions, most of which can be quickly and easily answered typically in one word (yes/no). Indeed, in our data collected during the trials (e.g., Ormerod & Dando, 2015), we observed frequent flyers answering questions before they had been asked in entirety. CCE, on the other hand, expects passengers to actively participate in the process of security, conversing with the security screener in an informal manner, yet providing personal information. As the conversation progresses, they are expected to satisfy the screener that their answers to earlier questions are veridical. This raises a concern that, despite its success rates, CCE might be viewed as intrusive and therefore less acceptable than other methods.

Winning and maintaining the respect and approval of the traveling public is an important consideration in the task of securing freedom of movement and public safety. In a law enforcement context, it has long been argued that public cooperation for enforcement, compliance and increased anti-terror security measures diminishes proportionately the necessity for use of compulsion and physical force for achieving objectives (see Albrecht, Dow, Plecas, & Das, 2014; Grieve, 2015; Huq, Tyler, & Schulhofer, 2011). In other domains, non-compulsory security measures to protect financial information, personal data and reduce the risk of fraud are improved where users are consulted, and behavior is positively encouraged rather than simply mandated (see Suh, & Han, 2003; Jones, McCarthy, Halawi, Mujtaba, 2010).

Those tasked with ensuring freedom of movement and public safety in aviation security contexts face a series of competing demands. One important consideration is that air passengers have choice. For example, when flying from non-U.S. locations into the U.S.A. passengers are able to choose their carrier. Those who choose to travel with non-U.S. carriers are not subject to the same mandatory screening interview prior to or at the time of check-in. This is a significant difference in passengers' initial security experiences across carriers (e.g.,

U.S. vs. non-U.S. carrier). Were passengers to question the validity and necessity of an alternative security-screening technique or refuse to participate in a security conversation, this would create significant delays. Passenger numbers might reduce if they perceived their experience might be better with another carrier. For service orientated industries such as aviation, perceptions of customer service are fundamental when choosing among rivals (e.g., Shankar, Smith, & Rangaswamy, 2003; Arif, Gupta, & Williams, 2013) and so gauging acceptance of novel participatory security methods is important.

Past research indicates that passenger satisfaction with security screening is not stable over time, and that waiting time is not the most significant determinant of passenger satisfaction (e.g., Clemes et al., 2008; Gkritza, Niemer, & Mannering, 2006; Arif, Gupta & Williams, 2013). Safety and security are reported to be some of the most important service quality dimensions in international air travel (Clemes et al., 2008), with passenger satisfaction apparently influenced most by perceived service fairness and procedural justice (Sindhav et al., 2006). Where fairness perceptions are negative, customer satisfaction reduces significantly and customer responses are intense, immediate and enduring (Seiders & berry, 1998).

1.3. The Current Study

The research reported here concerns genuine air customers' feedback regarding their pre check-in security experience. Using opportunity sampling, these data were collected during the field trial of suspicious signs and CCE methods. Screening using CCE took no longer than the suspicious signs method and all passengers experienced the same procedure in terms of their journey through the pre check-in security process - the only difference was the screening technique (CCE vs. Suspicious Signs). Airline passengers, blind to the field trial, were flying from London Heathrow Airport to the USA and gave verbal responses concerning their experience of pre check-in security screening.

2. Materials and Methods

An opportunity sample of 120 genuine aviation passengers traveling to two major US cities from London Heathrow Airport were approached by a researcher immediately post completion of the pre check-in security procedure. Sixty had been screened using CCE and 60 had been screened using the aforementioned Suspicious Signs method (see Ormerod & Dando, 2015). Passenger pre check-in security screening interactions with the security agent were discretely digitally audio recorded, captured via a non-visible recording device. Signs were posted throughout the airport informing passengers that security interviews may be recorded. Passengers were naïve to the different screening conditions. All agreed to complete the passenger survey prior to passing through central baggage search.

The purpose of the survey was explained using a script. Included in the script was information regarding the ethics of the research, the impartiality of the researcher and that responses were entirely anonymous. Passengers were asked a series of questions by the researcher, who contemporaneously completed a paper-based questionnaire, immediately recording passengers' responses to each question in turn. During this time each respondent was standing immediately next to the researcher. The respondent was then asked to sign and date the paper-based questionnaire before being thanked for their time, and provided with a general information sheet, which included the contact details of the researcher.

Our sample of genuine passengers comprised 73 men and 47 females. One hundred and fifteen passengers (96%) had flown to the US before and all had flown on a US carrier. Five participants (4%) had not flown to the US before. Sixty-six (55%) of our sample were flying with carrier A, the remaining 54 (45%) were flying with carrier B. Opportunity sampling meant that we were unable to control for factors such as gender, age, income and occupation, all of which can impact on perceptions of service and satisfaction (e.g., Clemes et al., 2008).

The questionnaire comprised 10 questions. The first four asked passengers their age range, gender, whether they had flown to the USA before and if so whether they had previously flown with either of the carriers in question. The following 4 question asked passengers to rate their pre check-in security experience using a Likert type scale ranging from 1 to 5 (e.g., 1 = Unhappy/Too long/Unacceptable; 5 = Happy/Ideal/Very acceptable). The ninth question was a ten-point Net Promoter scale, included to understand each passenger's satisfaction level. The final question was an open-ended invitation asking passengers to comment on any aspect of the pre check-in security.

3. Analysis

We employed a mixed methods approach. First, digital recordings of the passenger screening interactions (collected using covert voice activated recording devoices worn by security personnel) were transcribed, verbatim. Two independent coders then coded all 120 transcripts for number of questions asked by screeners, passenger words, and unique information items revealed by each passenger in response to screener questions. Inter-coder reliability for was high: r (120) = .910, $p < .001$; r (120) = .897, $p < .001$; r (120) = .908, $p <$ .00, respectively. Univariate analyses of variance (ANOVA) was used to calculate and compare the number of questions asked, passenger words and unique information items revealed, and to analyse passenger responses to each of the post screening questions across the two screening groups (CCE Vs. Suspicious Signs). Content analyses was used to convert qualitative responses to the open-ended invitation to comment on any aspect of pre check-in security into quantitative data.

4. Results

Examination of the number of questions asked by screeners, the number of words spoken by passengers, and the number of unique information items reveled by passengers revealed significant differences between CCE and suspicious signs interviews. CCE trained

agents asked fewer questions, M_{CCE} = 10.12, CI 95% [9.32; 10.92], than suspicious signs agents, M_{SS} = 27.22, CI 95% [23.50; 27.50], F (1, 118) = 302.461, $p < .001$, $\eta 2 = .87$. Genuine passengers screened using CCE uttered more words M_{CCE} = 202.78, CI 95% [193.85; 211.72], than those screened using suspicious signs, M_{SS} = 25.65, CI 95% [23.64; 27.66], F (1, 118) = 1489.220, $p < .001$, $\eta 2 = .80$. Passengers screened using CCE also revealed more information items, M_{CCE} = 18.45, CI 95% [17.23; 19.67], than passengers screened using suspicious signs, M_{SS} = 1.03, CI 95% [0.51; 1.56], F (1, 118) = 688.004, $p < .001$, $\eta 2 = .79$. Interview duration did not significantly differ across conditions, F (1, 118) = 108.300, $p = .849$ (M_{CCE} = 3.12 minutes, M_{SS} = 2.45 minutes).

Analyses of the four pre check-in security experience questions (applying Bonferroni's correction) revealed one significant main effect of screening method (see Table 1 for means and SDs). Participants in the CCE condition found the pre check-in security experience more enjoyable than those screened using the suspicious signs method, F (1, 116) = 13.323, $p < .001$, $\eta 2 = .10$. All other main effects of Carrier and the Procedure X Carrier interactions for the remaining three Likert questions (duration of the procedure; how acceptable did you find the procedure; were you happy to reveal information about yourself and your plans) were non-significant, all Fs < 5.894, all ps, > .012. There was a significant main effect of screening condition for responses to the ten-point Net Promoter question. Participants in the CCE condition were 'promoters' whereas those in the suspicious signs condition were 'detractors', F (1, 116) = 24.802, $p < .001$, $\eta 2 = .18$. The main effect of Carrier and the Procedure X Carrier interaction were non-significant, all Fs< 1.398, all ps > .239.

Table 1

Means and standard deviations for passenger (N = 120) feedback to questions 5 to 9 of the post security procedure questionnaire.

	CCE	SS
	Mean (SD)	
How enjoyable did you find the security screening process	4.48 (.78)*	3.06 (1.27)
How happy were you to share personal information with the security staff	4.52 (.77)	4.40 (.92)
How did you feel about the time taken to complete the security procedure	4.32 (1.11)	4.36 (1.09)
How acceptable did you find the security screening procedure	4.62 (.76)	4.18 (1.28)
Based solely on the security procedure, on a scale of 0-10 how likely is it that you would recommend travelling with this airline	8.63 (2.02)*	6.23 (2.54)

* $p < .001$

Content analyses of the final open-ended invitation to comment on any aspect the pre check in security procedure resulted in the emergence of three primary themes, which we have labeled i) agent conduct (all comments regarding the conduct of screening agents), ii) procedure (general comments concerning the screening procedure, but excluding efficacy comments) and iii) effectiveness. (comments directly related to perceived effectiveness of the screening procedure, only). Overall, 80 passengers (67% of the sample) answered this final question (52: 87% had been screened using CCE and 28: 47% had been screened using Suspicious Signs). Exemplar quotes are shown in Table 2. Of the 52 CCE passengers who answered this question 75% made general comments regarding the procedure, 69% commented on the conduct of the agent, and 71% on the effectiveness of the procedure. Of the SS screened passengers, 44% commented on the procedure, 20% on conduct of the agent, and 56% on the effectiveness of the procedure.

Table 2.

Exemplar quotes from each of the primary themes that emerged from responses to Q 11 of the post-screening questionnaire.

Procedure
I was confused because they didn't ask anything about my luggage like they normally do (CCE)
I thought it was odd because of the personal questions. Not like normal (CCE)
Weird, but very worthwhile. Different from usual (CCE)
Confusing. Was is security? I am not sure (CCE)
Very Quick (SS)
Don't like being asked about my history, its not your business. I like XXXX but not this procedure (CCE)
Effectiveness
Not useful and not thorough enough (SS)
Far superior security to the US procedure where they ask you no questions about nothing (CCE)
More intrusive questioning needed: wouldn't mind opening my bag, wouldn't mind getting here earlier to be better screened (SS)
I am not sure how useful that was, he didn't even ask to look in my bag. I could have been lying and how would he know (SS)
Agent conduct
Really nice person, enjoyable (CCE)
Polite (SS)
Very friendly (CCE)
Polite, worthwhile (CCE)

5. Discussion and Conclusion

The results of the passenger experience study reveal three important outcomes. First, analyses of passenger and screening agent verbalisations during the security screening interview confirm that CCE does engage passengers in considerably more dialogue than the suspicious signs approach, and might therefore be predicted to seem more effortful and invasive from the passenger perspective. Second, despite the higher levels of engagement required of passengers, CCE yielded greater enjoyment and higher recommender scores than

the suspicious signs method. Third, notwithstanding significant differences between the two methods, overall passengers seemed to accept and recognise the value of both methods. The latter result is the first we are aware of in which passengers' willingness to submit to security screening procedures has been assessed, with encouraging results.

Taken together, the results suggest that it is possible to design an effective behaviour-based security screening procedure without sacrificing customer experience. Indeed, we have anecdotal evidence, supported by the qualitative results of this study, that many passengers had their travelling experience enhanced by going through the CCE channel. A CCE interview with a legitimate passenger feels like an informal conversation: the passenger talks about themselves, their experience, skills and knowledge (see Ormerod & Dando, 2015; Dando & Ormerod, 2019). An effective CCE interviewer will put the passenger at their ease and hence enhance their travelling experience. The contrast between the informal approach of CCE and the much more formal, indeed almost adversarial, approach of most other screening methods is stark. We contend that the informal basis of CCE is an important part of the method's effectiveness. To deliver an effective veracity test, which in CCE is the use of unexpected tests of expected knowledge (see Parkhouse & Ormerod, 2018), requires that the screening agent can observe a change in behaviour, but this has to be screener initiated and controlled. This change is from a baseline where the deceptive passenger is not under challenge to a to a heightened behavioural state in which the passenger is challenged by being required to answer an unexpected question to which they know they should be able to provide an answer. The conditions for effective questioning coincide with those that deliver a more enjoyable customer experience for genuine travellers.

Aviation security is costly, and so it seems sensible to consider whether a CCE interview at check-in might offer an effective risk-based method for triaging all passengers - treating all passengers equally, rather than profiling. Lower risk passengers are those who

satisfy CCE screeners on all six aspects of the method that can discriminate deceivers from truth tellers. Lower risk, truth tellers could then undergo less invasive and less time consuming security procedures as they move through the airport. Deceptive passengers are immediately viewed as a security threat and so are higher risk and subjected to more stringent security thereby targeting limited resources.

This research surveyed genuine passengers, but the sample was not large, which is a limitation. However, our findings do concur with those of other researchers who used a larger sample of homogenous respondents who were asked to provide feedback on past experiences (Alards-Tomalin et al., 2014). Further, we were significantly constrained by time and a number of environmental factors associated with surveying genuine passengers and so were unable to distinguish between different sub-groups of passengers, and our survey questions were fairly brief and generally worded so as to be understood by the majority of passengers. However, the survey did tap into passenger's first-hand, recent experiences, which is a strength. Future research in this evolving domain should seek to develop in-depth methods for quickly collecting data regarding first-hand, recent experiences from larger numbers of genuine passengers, including controlling for sub-groups (culture; experience; business; age).

Post the 9/11 terrorist attacks, billions of dollars have been invested in aviation security procedures (United States Government Accountability Office, 2017). However, the effectiveness of these procedures has long been questioned (Weinberger, 2010) and continues to be questioned particularly in light of the lack of empirical evaluation and theoretical support (United States Government Accountability Office, 2015; 2017). Agile security agencies that proactively engage in high quality research and development and who interact with the traveling public as co-creators when doing so are those most likely to outmatch a dynamic threat. Aviation security relies on the mitigation of risk through rule compliance, but passengers have choice as to which carrier they choose to use when flying into the USA, and

so if security procedures are not acceptable, at best passengers may chose alternative carriers. More importantly, they may begin to consider bending and breaking the rules, and so passengers should be treated as active participants in security. Indeed, recent research has indicated that where aviation security is perceived as negative it becomes less effective (e.g., Hasisi & Weisburd, 2011; Alards-Tomalin et al., 2014).

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