Legal and Criminological Psychology (2017), 22, 378–399

The British Psychological Society

www.wileyonlinelibrary.com

Telling friend from foe: Environmental cues improve detection accuracy of individuals with hostile intentions

Remco Wijn[1]*, Rick van der Kleij[1], Victor Kallen[1], Michael Stekkinger[2] and Peter de Vries[2]

[1]TNO, Soesterberg, The Netherlands
[2]University of Twente, Enschede, The Netherlands

Purpose. Detecting deviant behaviours that precede and are related to crimes can help prevent these crimes. Research suggests that the psychological mindset of wrongdoers may differ from others, such that they are more anxious, self-focussed, and vigilant. As a result, their responses to environmental cues, specifically those that signal risk of exposure, may differ.

Method. In two randomized controlled trials, participants with high (vs. low) cognitive load walked a pre-defined route to carry out a hostile or non-hostile task. En route, participants were exposed to a strong (vs. mild) cue from a security officer (Study 1), or a cue (vs. no cue) resembling police walkie-talkie static noise (Study 2). Participants filled out a questionnaire measuring psychological constructs. Reactions during the task were recorded and presented to independent observers to determine the participants' intent.

Results. Participants with high (vs. low) cognitive load who were exposed to a strong (vs. mild or no) cue while carrying out their task were more often correctly identified by observers as either innocent or hostile based on their behaviour. Analysis of the questionnaire revealed that the experience of hostile intentions is related to anxiety, inhibitory control of anxiety, activation control of normal behaviour, and to other relevant constructs which may explain why cues that signal risk of exposure can improve the detection accuracy of individuals with hostile intentions.

Conclusion. These studies show that cues that signal risk of exposure can improve the detection of wrongdoers and the role of self-regulation in the suppression of anxiety and deviant behaviours.

Supported by a motivation to avoid, contain, or mitigate societal risks (Adam, Beck, & Van Loon, 2000), the use of behavioural analysis methodologies to identify hostile intentions before any criminal acts are committed in public places seems trending (e.g., Elias, 2009). The basic premise that underlies these methodologies is that hidden hostile intentions (vs. non-hostile intentions) may be deduced from overt behaviours. However, security programmes based on these methodologies have recently received criticism for their lack of a convincing psychological basis or empirical support (Ormerod & Dando, 2015; U.S. Government Accountability Office [GOA], 2013; Weinberger, 2010). This criticism

*Correspondence should be addressed to Remco Wijn, TNO, Kampweg 5, PO Box 23, 3769 ZG Soesterberg, The Netherlands (email: Remco.wijn@tno.nl).

DOI:10.1111/lcrp.12107

suggests that hostile intentions are in fact not at all easily deductible from behaviours. Although this may generally be true, we argue there is a psychological basis for deviant behaviours and present two studies that show that some conditions may render the identification of hostile intentions more accurate than others.

The conclusions in the GOA report about the ability to detect deceiving intentions are in line with research findings that suggest that people are not so good at detecting other forms of deceit, specifically lying. For example, a meta-analysis of 206 studies showed that on average people detect deception slightly above chance level (i.e., 54%; Bond & DePaulo, 2006). Other meta-analyses and reviews come to similar conclusions (DePaulo *et al.*, 2003; Vrij, 2008). Two reasons offered for these findings are that either people rely on invalid cues when judging deception, or that valid cues of deceit are lacking in studies on deceit (Vrij, 2008). A series of meta-analyses carried out to test which of these explanations is most supported by the available data shows that subjective perceptions of cues to deception are quite accurate and that limitations in lie detection accuracy are mainly attributable to weaknesses of available behavioural cues to deception (Hartwig & Bond, 2011). In other words, experimental situations generally contain weak cues, offering too little diagnostic information for judges.

To achieve better detection results, Hartwig and Bond (2011) suggest to increase cues to deception. Although this suggestion may seem trivial, research studies have shown to increase deviant behaviour, and subsequently improve detection accuracy, by imposing cognitive load on the part of the deceiver (Vrij, Fisher, Mann, & Leal, 2008). This idea to influence potential deceivers so as to increase cues to deception has not yet been applied to deception other than lying. Yet, much deceit in criminal context concerns not lying but rather to remain undetected, and to prevent getting caught. The present research aims to fill this void. To this end, we will first suggest a psychological basis for deviant behaviours of individuals with hostile intentions. We define hostile intentions as an individual's intent to act in ways that imply or aim to inflict harm onto others. Critically, individuals with hostile intentions will try to hide these intentions if they assume that others are motivated to frustrate their goals (i.e., preventing their hostile actions from taking place; DePaulo *et al.*, 2003; Ekman, Friesen, & O'Sullivan, 1988; Koller, Wetter, & Hofer, 2015).

Deviant behaviour

Individuals use their own experience as an anchor to determine how they appear to others. This often results in an overestimation of the salience of their own behaviour or appearance (i.e., the spotlight effect; Gilovich, Medvec, & Savitsky, 2000), or even the salience of their inner states (i.e., the illusion of transparency; Gilovich, Savitsky, & Medvec, 1998; Savitsky & Gilovich, 2003). A pivotal element in these effects is self-focus (Brown & Stopa, 2007). Self-focus increases individuals' perceptions that they caused, or are the target of hypothetical events (Fenigstein, 1984; Fenigstein & Levine, 1984). Apparently, peoples' states and traits are more salient in their own perceptions than in others', particularly when they are doing things that they would rather keep to themselves (such as the truth when telling a lie; Gilovich *et al.*, 1998), or of which they think may catch the eye (e.g., Gilovich *et al.*, 2000), and this can lead to egoistic interpretations of situational cues (Fenigstein, 1984; Fenigstein & Levine, 1984).

A range of cognitive and behavioural consequences of self-assumed salience of one's own states and traits have been found in relation to stigmata. Individuals with a stigma and individuals with hostile intentions share that they both assume that their social environment holds negative views of their states or traits, and this will lead to negative

or harmful treatment once exposed (e.g., Jones *et al.*, 1984). As a result, individuals experiencing and trying to hide a stigma are more suspicious and vigilant to their surroundings, more anxious, socially avoidant, and concerned with their impression management (Mendoza-Denton, Downey, Purdie, Davis, & Pietrzak, 2002; Pachankis, 2007; Riggio & Kwong, 2009). Even experimentally induced concealable stigma (viz. participants pretending and concealing to be lesbian in a conversation) resulted in greater paranoid social cognition such as self-conscious concern, sinister attributions, and negative attitudinal metaperceptions (Santuzzi & Ruscher, 2002).

These cognitive consequences seem functional in that they enable individuals to quickly determine whether they, or their hidden states or traits, have been noticed so that they can take the right actions to thwart the threat that stems from potential discovery (Pachankis, 2007). When the costs of discovery are regarded very high such as when an individual is planning or executing criminal or aggressive acts that one believes others will try to prevent or avoid, the cognitive appraisal of threat of discovery can be translated, at least to some extent, into anxiety-related response patterns (i.e., fight, flight, freeze, or faint) to increase short-term chances for survival (Benarroch, 1993; Cunningham, Arbuckle, Jahn, Mowrer, & Abduljalil, 2011; Hermans, Henckens, Joëls, & Fernandez, 2014; Mendelsohn, Pine & Schiller, 2014). However, although anxiety-related response patterns may be fundamentally adaptive, these and related processes may also be maladaptive in the long run and frustrate one's longer-term goals. For instance, when a person is extremely anxious about giving a presentation, a flight-or-fight response would directly interfere with the goal to inform one's audience (Aldao, 2013). In the case of hostile intentions, initial anxiety-related responses to external cues may reveal an individual's hidden, potentially malicious intentions, and thereby warn or inform bystanders.

Self-regulative processes (e.g., Vohs & Baumeister, 2011) ensure that maladaptive responses are inhibited and longer-term goals will be reached. They are instigated by the same cognitions that form the basis for the anxiety-related responses, but are meant to keep these dominant responses under control (i.e., inhibitory control) while activating subdominant behaviours (i.e., activation control; Rothbart & Bates, 2006). Self-regulative actions thus include suppressing undesirable behaviours, including some of the reflexes that the autonomic nervous system may initiate, trying not to act out of the ordinary, and planning goal-directed actions. As self-regulation processes are effortful, they require energy and cognitive capacity (Baumeister & Heatherton, 1996). When people are tired and their physiological energy levels are low, when they are under stress or distracted, or when cognitive capacity is otherwise overexerted, self-regulation, and hence, behavioural control, will decrease (Hermans *et al.*, 2014; Hofmann, Schmeichel, & Baddeley, 2012; Thayer, 2006). As a result, reflexes and affective reactions will become more dominant and potentially prominently visible (Wegner, 2009).

As an illustration of hampered self-regulative processes, a study on lie detection showed that participants who were instructed to tell a lie showed increased behavioural rigidity (i.e., less body movement) compared to participants who were instructed to tell the truth. Even when participants were told that this behavioural rigidity would give them away to observers, they seemed unable to correct for it. The researchers concluded that the cognitive pressure when telling a lie prevented successful regulation of other behaviours such as a natural way of moving (Vrij, Semin, & Bull, 1996). Wegner (2009) describes how mental control over behaviours often has ironic effects. Mental control prevents many errors of thought, speech, and action, but they can increase the likelihood of such errors when people attempt to exert control while under mental load. In line with

these findings, other studies showed that signs of deception were stronger when people had a stronger motivation to deceive their communication partner. The pressure to perform increased the participants' cognitive load, thereby exhausting self-regulation resources, paradoxically leading to poorer performance (DePaulo *et al.*, 2003; Vohs, Baumeister, & Ciarocco, 2005; see also, Wegner, 2009 on ironic processes of mental control).

In conclusion, research shows that fear of discovery leads to a stronger self-focus, and perception that one's states and traits (e.g., hostile intentions) are salient to others. This can lead to anxiety-related response patterns which can be inhibited by self-regulation processes. At the same time, activation control processes of self-regulation activate deceptive behaviours. These self-regulatory processes require cognitive effort, and when effort cannot be allocated to these processes, the dominant anxiety-related response patterns are likely to expressed.

Present research

Building on these findings, the present research aims to examine whether deception detection accuracy can be improved by confronting participants with cues from the environment that harbour the risk of exposure, and we investigate the psychological processes that may mediate this relation. We reason that hostile intentions lead to increased experience of threat from the environment, heightened self-focus, and perception that one's states and traits (e.g., intentions) are salient to others. This reasoning leads to our first hypothesis:

Hypothesis 1: Individuals with hostile (vs. non-hostile) intentions experience higher levels of threat from the environment, anxiety, self-focus, and perception that one's states and traits (e.g., intentions) are salient to others.

Moreover, because these cognitions follow from each other, we expect that

Hypothesis 2: The experience of threat, anxiety, heightened self-focus, and perception that one's states and traits are salient to others are interrelated and mutually dependent.

These cognitive processes instigate impulsive or reflexive, anxiety-related response patterns (e.g., fight or flight reactions) and can be triggered by cues from the environment that harbour the risk of exposure. At the same time, they can be suppressed by self-regulatory processes when cognitive and energetic resources are available. This leads to our third and fourth hypotheses:

Hypothesis 3: Environmental cues signalling risk of exposure lead to perceptible reactions of individuals with hostile (vs. non-hostile) intentions and therefore to a better ability to distinguish individuals with hostile intentions from individuals with non-hostile intentions.

Hypothesis 4: Chances of detection of individuals with hostile intentions will only be higher when these individual's cognitive capacity is constrained, so that and inhibitory control of impulsive or reflexive behaviours, and activation control of desirable behaviours is hampered.

This article presents two research studies to test these hypotheses. In both studies, we first created stimulus materials consisting of video recordings of participants with experimentally induced hostile or non-hostile intent. Second, independent judges assessed the intent of participants in the stimulus materials based on their behaviours. Hostile intent was induced by asking participants to transfer a package with illegal content past a security officer or a security checkpoint without being stopped. We offered a reward when they successfully managed to do so, and a punishment when stopped by security officials.

STUDY 1

Method

Participants and design

A heterogeneous set of 51 individuals (31 men and 20 women; age: $M = 27.12$, $SD = 7.97$) participated as judges in Study 1 and were submitted to a repeated-measures design. These judges watched and judged our stimulus materials consisting of video footage of participants with experimentally induced hostile (vs. non-hostile) intentions, and to whom we administered a cue (vs. no cue) while they walked a pre-defined route. Judges were unknowing to the conditions and set-up of our stimulus materials.

Apparatus and materials

Stimulus materials

Our stimulus materials consisted of nine video clips of groups of participants who were instructed to carry a package from one point to another on the university campus.[1] Videos showed a part of the route where participants passed a confederate in police uniform. Recordings were made using a high-definition camera from a high vantage point.

For the creation of the video clips that our judges watched and judged, 26 students of a university in the Netherlands (12 men and 14 women; age: $M = 20.15$, $SD = 1.67$) were asked to carry a package from one point on the university campus to another and fill out a questionnaire in exchange for one credit (as part of fulfilment for their bachelor degree) and a chance to win an Apple iPod Nano. Participants were randomly assigned to one of four conditions of a 2 (Intent: hostile vs. non-hostile) $\times$ 2 (Cue: strong vs. mild) between-subjects design.

Upon arrival, we directed participants to individual workstations equipped with a laptop. On this laptop, they viewed a pre-recorded 5-min video briefing. The briefing explained that they would have to carry a package from one point on the campus to another, passing a police cadet who was instructed to detect deviant behaviour and intercept illegal packages. We asked one half of the participants to imagine that the content of their package (viz., a sealed box in a plastic bag) was illegal. Although in reality packages contained no illegal content, we informed them that getting caught by the police cadet nevertheless had very real, negative consequences. Specifically, this would cause them to be apprehended and detained for questioning and paperwork that would take

[1] *Three of twelve video clips showing a total of nine participants were excluded for use in Study 1. One video clip was excluded because of bad visibility due to darkness, one because of severe interruption by an individual unrelated to the research study, and one because of recording problems. This resulted in the use of nine video clips in Study 1.*

some time and would be very tedious. They would not receive extra money or credits for this and lose their chance at winning an iPod. However, if they were not apprehended, they would win an extra ticket, doubling their chances at winning an iPod. We asked the other half of the participants to imagine that their package had normal, legal contents. If they were stopped, they would not be detained and would receive the lottery ticket at the end of the task. Note that in accord with real-life illegal conduct, our hostile intent manipulation contained both a potential gain (i.e., an extra lottery ticket) and a potential loss (i.e., a tedious and time-consuming questioning, and losing the chance at winning an iPod). None of the participants objected to this procedure.

After receiving instructions, the experiment leader led the individuals in groups of minimally two and maximally four, depending on the number of subscriptions per time slot, to the starting point from where the participants would walk to a pre-defined end point. This procedure aimed to induce ambiguity as to whom the cue that would be administered on their way was directed. We instructed participants not to communicate with each other during the course of the experiment, and they were unknowing to each other's intentions or contents of their bags. Before they left, participants received additional instructions to memorize a locker number consisting of one letter and two digits and a code consisting of six digits and correctly reproduce later on. This instruction was designed to increase cognitive load (cf. Gilbert & Hixon, 1991). Note that as part of our theorizing, cognitive load impedes self-regulation and inhibitory control of impulsive reactions. Giving participants high cognitive load thus increases the chances that reflexes and affective behaviours become visible to our judges in the detection task (Hofmann *et al.*, 2012).

Along the route, a confederate was positioned in a police uniform. For participants, this confederate would come into view upon turning a corner half way the route at a distance of approximately 15 m. A few metres before passing the officer, participants would cross a predetermined marker, upon which the police officer produced the cue by saying: 'Code red noted'. In half of the trials, the confederate said this while facing the approaching participants (i.e., the strong cue condition), while in the other half of the trials, this was said while facing the opposite direction (i.e., the mild cue condition). None of the participants was in fact stopped or apprehended. We videotaped several seconds before participants turned the corner until approximately 20 m along the path after passing the police officer.

Questionnaire

After reaching the end of the route, participants filled out a questionnaire on laptops. This questionnaire was constructed to test our assumptions regarding the psychological processes related to hostile intentions. We asked participants to report on scales ranging from 1 (completely disagree) to 7 (completely agree) their subjective feelings during the task. Table 1 displays the constructs measured, including internal reliabilities, means, confidence intervals, and statistical tests.

Four items served as a manipulation check: One item assessed whether they had a hostile intent (i.e., my role in the experiment gave me a hostile intent), and three items assessed whether they experienced hostile intentions (e.g., my role in the experiment gave me a feeling of having hostile intentions). Thirty-one items served to measure the various psychological consequences that we expected based on our theorizing: Two items assessed whether they contemplated their hostile intentions (e.g., I contemplated what I had to hide from the officer), four items assessed their anxiety while passing the

Table 1. Means and confidence intervals (95%) of psychological constructs as a function of hostile intention manipulation (hostile vs. non-hostile)

		Hostile intent		Non-hostile intent				
		M	95% CI	*M*	95% CI	*F*(1, 22)	*p*	η^2
1	Hostile role	3.67	2.69, 4.64	3.57	2.67, 4.47	0.02	.89	.00
2	Experience of hostile intentions (α = .90)	3.83	2.84, 4.83	4.52	3.60, 5.44	1.03	.32	.04
3	Contemplation of hostile role (α = .86)	3.79	2.71, 4.88	3.39	2.39, 4.40	0.38	.54	.02
4	Anxiety due to presence of police (α = .89)	4.83	4.07, 5.60	4.71	4.01, 5.42	0.05	.82	.00
5	Inhibitory control of anxiety (α = .91)	4.97	4.20, 5.74	5.48	4.76, 6.19	0.04	.85	.00
6	Activation control of normal behaviour (α = .51)	5.50	4.82, 6.18	5.79	5.16, 6.42	1.09	.31	.05
7	Alertness to being target of police (α = .93)	2.95	2.00, 3.90	3.07	2.19, 3.95	0.47	.50	.02
8	Self-focus (public self-awareness; α = .71)	3.97	3.24, 4.70	3.64	2.97, 4.32	0.53	.48	.02
9	Self-focus (surrounding self-awareness; α = .88)	4.78	3.89, 5.66	3.71	2.90, 4.53	3.15	.09	.13
10	Self-focus (private self-awareness; α = .36)	2.94	2.37, 3.51	2.93	2.40, 3.46	0.00	.96	.00

police cadet (e.g., the presence of the officer made me feel tense), five items measured alertness to threats in their environment (e.g., I generally feel that the police is after me), three items assessed inhibitory control during the task (e.g., I tried to conceal my tension), two items assessed activation control (e.g., I tried to behave normally), nine items assessed self-focus by measuring three facets of situational self-awareness (e.g., private: I was aware of my innermost feelings; public: I was very aware of my appearance; surrounding: I was very aware of my surrounding), three items assessed egoistic interpretation of the cue (e.g., I thought the officer's cue was directed at me), and three items assessed an inverse of the egoistic interpretation (e.g., I thought the officer's cue was directed at someone else).[2]

Procedure

We invited our judges to our facilities and told them that they were going to watch videos of people carrying bags with either legal or illegal contents. Prior to each video, we informed judges how many participants in the upcoming video carried a package with illegal content. This way, we minimized errors as a result of response bias (i.e., marking

[2] *The items measuring activation control and private situational awareness had low Cronbach's alphas. This may be due to the relatively low number of participants in this study, or because of the low number of items measuring these constructs (note that Cronbach's alpha is strongly influenced by the number of items; Cortina, 1993). Regardless of their low alphas, we decided to use these constructs in our exploratory network analysis because they formed a necessary part of our theorizing. One consequence of low reliability is a more conservative statistical test in relation to other constructs. From a statistical viewpoint, this warranted against false interpretations.*

more or fewer participants as having hostile intent than the number of participants in the video actually carrying the illegal packages) and focus on the sensitivity of their responses as a function of cues administered by the confederate. Judges viewed each video once and indicated afterwards on a still image of the video which participants they thought carried a bag with illegal contents (cf., Macmillan & Creelman, 2005). We first showed judges one practice video to become familiar with the procedure. After the practice video, they viewed and rated the remaining eight videos.

We used signal detection statistics to specify how successful our judges were in distinguishing between participants with and without hostile intentions. Signal detection is commonly used for tasks where people have to distinguish between two types of stimuli (such as hostile or non-hostile individuals) and unties sensitivity and response bias based on hit and false alarm rates (Tanner & Swets, 1954). Sensitivity can be estimated by measuring the area under the (ROC) curves. A proper measure of sensitivity for nonparametric data is A. An A of 1 indicates perfect performance, whereas 0.5 indicates performance on chance level (for a discussion on signal detection and the use of A as a measure of sensitivity in nonparametric data, see Zhang & Mueller, 2005).

Results

Questionnaire

We expected that participants in the video clips who had a hostile (vs. non-hostile) intent would experience stronger hostile intentions, leading to contemplation of this experience, anxiety, self-regulative inhibitory and activation control and egoistic interpretation of the strong (vs. mild) cue. To test these hypotheses, we performed two distinct analyses. First, we performed two multivariate analyses of variance (MANOVA) to test the effects of our hostile intent and cue manipulations on the self-reported measures. Second, we tested the relations between the constructs regardless of our manipulations using a network modelling method (Epskamp, Cramer, Waldorp, Schmittmann, & Borsboom, 2012) to explore if the feelings of doing something illegal cause the cascade of hypothesized cognitions, affect, and behaviours.

A 2 (intent: hostile vs. non-hostile) × 2 (cue: present vs. absent) MANOVA did not show a multivariate main effect of intention, $F(10, 13) = 1.03$, p = ns. Nor did it show other statistically significant effects, F's < 2.57, p's > .05. Means and confidence intervals of the psychological constructs as a function of intent (hostile vs. non-hostile), including their univariate tests of significance, are displayed in Table 1. We present these figures as a function of intent because we specifically expected this main effect. None of the measured constructs yield statistically a significant effect of intent. That is, the hostile intention manipulation did not lead to differences in how people responded to the items measuring these constructs. In the discussion paragraph, we will go into this absence of effects.

We also performed a separate 2 (intent: hostile vs. non-hostile) × 2 (cue: present vs. absent) ANOVA to specifically test for the interaction effect of type of intent (hostile vs. non-hostile) and cue type (mild vs. strong cue) on egoistic interpretation of the cue. This analysis yielded a statistically significant interaction effect, $F(1, 22) = 4.65$, $p < .05$. Means and confidence intervals are displayed in Table 2. An examination of this interaction effect showed a statistically significant simple main effect for type of intent in the strong cue condition, $F(1, 22) = 8.60$, $p < .01$. That is, participants in the hostile intent condition showed a stronger egoistic interpretation of the strong cue of the police

Table 2. Means and confidence intervals (95%) of egoistic interpretation of cue as a function of hostile intention (hostile vs. non-hostile) and cue (strong vs. mild) manipulations

			Hostile intent		Non-hostile intent	
			M	95% CI	*M*	95% CI
11	Egoistic interpretation (α = .72)	Strong cue	4.50	3.63, 5.37	2.86	2.05, 3.66
		Mild cue	4.07	3.20, 4.94	4.17	3.36, 4.98
12	Inversed egoistic interpretation (α = .82)	Strong cue	3.50	2.31, 4.69	3.50	2.31, 4.69
		Mild cue	3.43	2.32, 4.53	3.29	2.18, 4.39

cadet than participants in the non-hostile intent condition. We also found a statistically significant simple main effect for type of cue in the non-hostile intent condition, such that participants in the hostile intent condition showed a stronger egoistic interpretation after the mild cue than after the strong cue, $F(1, 22) = 5.70$, $p < .03$.

The inverse of the egoistic interpretation effect did not occur. That is, we found no effects of our hostile intent or cue type manipulations on the extent to which participants thought the cue was directed at other participants, rather than themselves, $F < 1$.

The second analysis of the questionnaire aimed to explore the relative effects between the constructs. We followed the procedure described by Epskamp *et al.* (2012), which was implemented in the Qgraph package for R. Qgraph plots the variables as nodes connected by edges in a network. Edges represent partial correlations between two variables. The partial correlations between each node and all other nodes are directly related to the multiple regression coefficients of one variable when regressed on all other variables in the dataset (Pourahmadi, 2011). Hence, the strength of partial correlations can be interpreted as predictive quality between two nodes. Qgraph uses an adaptive LASSO penalty to estimate a sparse network in which weak relations are eliminated from the model. We adopted Qgraph rather than structural equation modelling (SEM) for this analysis because of the exploratory nature of the present analysis. Whereas SEM is useful for testing strict theories, Qgraph allows for cyclic processes and assumes no directionality of relations. As such, it optimally predicts each node given all others.

Figure 1 displays our variables and their relations plotted in a network. Numbers in nodes correspond to the numbers in Tables 1 and 2. This analysis shows that participants who say they had a hostile role also tend to experience hostile intentions. This experience of having hostile intentions in turn is related to anxiety due to the presence of the police cadet and to an inhibitory control of their anxiety. Further, self-focus measured by public situational self-awareness (i.e., being aware of the impression one makes on others) is positively related to contemplating one's hostile intentions and to inhibitory control of anxiety, but negatively related to the extent to which participants experienced their hostile intentions. Although we should be prudent inferring causality, it may suggest that not the experience of hostile intent *per se* instigates self-focus, but that individuals must first be motivated to control their anxiety.

Detection of intent

Judges were instructed to determine the intent of each participant in the videos. Our main hypothesis stated that judges would be better at distinguishing between participants carrying a bag with or without illegal content after a strong cue than after a mild cue.

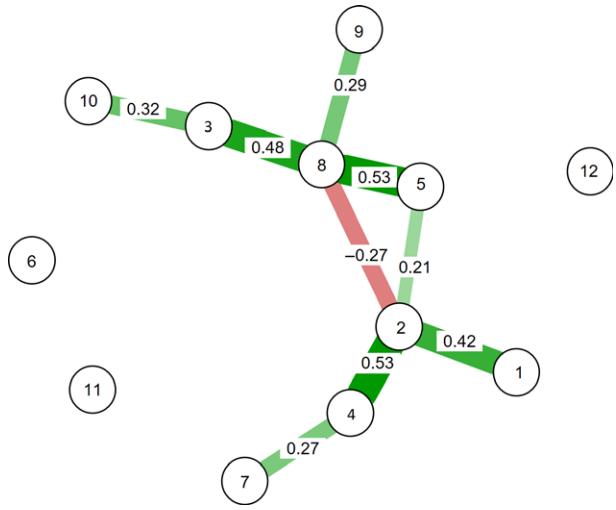

Figure 1. Partial correlations between the psychological constructs (printed between nodes). Numbers in nodes correspond with variable numbers in Tables 1 and 2. [Colour figure can be viewed at wileyonlinelibrary.com]

For each judge, we calculated a sensitivity measure (A) for each of the two cue (mild vs. strong) conditions.[3] A one-way ANOVA showed a main effect of cue type on sensitivity, such that judges were better able to distinguish participants carrying a bag with illegal content from participants carrying a bag with normal content after a strong cue (M = 0.55, 95% CI [0.47, 0.63]) than after a mild cue (M = 0.42, 95% CI [0.33, 0.51]), $F(1, 50) = 4.17, p < .05, \eta^2 = .08$. This shows that the cue influenced the judges' ability to distinguish between hostile and non-hostile intent and thus supports our theorizing that cues signalling risk of exposure provoke behaviours that in turn increase judges' sensitivity.

Discussion

Study 1 lends support for our hypothesis that a strong cue facilitates the detection of individuals with hostile intentions (Hypothesis 3). Our data show that the chance to correctly distinguish participants with a hostile role from participants with a non-hostile role differed significantly between the cue conditions. In the strong cue condition, judges showed increased sensitivity and thus more success in detecting participants carrying a package with illegal content. Note that all participants carried the same plastic bag, and the only difference between the hostile and non-hostile intention conditions was that we told participants in the strong cue condition that being stopped by the officer would yield negative consequences, whereas not being stopped would yield positive consequences.

We reasoned that the effects would be the result of a cascade of psychological processes on the part of participants with hostile intentions which would make their reactions to external cues stand out. Network analysis of the items in the questionnaire lends partial support for this hypothesis (Hypothesis 2). Most notably, we show that the

[3] *Note that sensitivity captures the successfulness with which judges distinguish between participants with hostile and non-hostile intentions in one metric.*

experience of hostile intentions is related to inhibitory control of anxiety, and this inhibitory control is related to self-focus. These processes were unrelated, however, to whether participants thought they or others were addressed by the police cadet. Thus, the measured psychological processes did not lead to an egoistic interpretation of situational cues.

Potentially problematic is that Study 1 did not show a direct effect of our hostile intention manipulations on reported feelings of hostile intentions or any of the other hypothesized cognitions and affective reactions (Hypothesis 1). The manipulation of intent used was based on earlier deception studies (Eachus, Stedmon, & Baillie, 2013; Granhag & Knieps, 2011; Sooniste, Granhag, Knieps, & Vrij, 2013) which did report successful manipulations. Perhaps participants in our study did not experience hostile intentions because they were instructed rather than intrinsically motivated to carry the illegal package. As a result, although knowing their role and the potential consequences, they may not have experienced hostility. Knowing their role and the potential consequences may still have resulted in other aversive experiences which we did not probe which would explain why our judges were able to differentiate those with hostile intent from those with non-hostile intent. In Study 2, we will focus on this issue.

STUDY 2

We aimed to replicate and extend our findings from Study 1 in a second study to examine more closely the role of cognitive load in combination with environmental cues on the sensitivity of judges (i.e., the ability to successfully distinguish participants with a hostile intent from participants with non-hostile intent). When cognitive load is high, inhibitory control of anxiety, and impulsive, or reflexive behaviours is impeded. Cues that may signal exposure may then lead to observable arousal and anxiety-related response patterns. Therefore, in Study 2, we investigate our hypothesis that judges will be more successful differentiating between participants with hostile and non-hostile intentions when these participants experience a high (vs. low) cognitive load and encounter a cue (vs. no cue) that may signal their exposure.

In Study 1, the low number of participants involved in creating the stimulus materials is potentially problematic for the analysis of the questionnaire data because small sample size can lead to unstable networks (Costantini *et al.*, 2015). Therefore, in Study 2, we drastically increased the sample size for the creation of the stimulus materials and reduced the number of judges who judged the stimulus materials so that the total number of observations for the judgement task (i.e., number of participants in the videos multiplied by the number of judges) was comparable to Study 1.

Method

Participants and design

Twenty university students (six men and 14 women; age: $M = 24.22$, $SD = 5.87$) participated as judges in Study 2 and were submitted to a repeated-measures design. These judges watched and judged our stimulus materials consisting of video footage of participants with experimentally induced hostile (vs. non-hostile) intentions, with high (vs. low) cognitive load, and to whom we administered a cue (vs. no cue) while they walked a pre-defined route. Participants were unknowing to the conditions and set-up of our stimulus materials.

Apparatus and materials

Stimulus materials

Our stimulus materials consisted of a new set of video clips of participants carrying a laptop case and walking towards a security checkpoint. Videos showed a part of the route where participants walked towards a checkpoint. Recordings were made using a high-definition camera from a high vantage point.

For the creation of these video clips, a heterogeneous sample of 166 individuals was invited to our office facilities to complete several unrelated tasks in exchange for 30 euros. Thirty-four participants were excluded from analyses: Five participants did not follow our instructions, and for 29 participants, we experienced video recording or logging problems. This resulted in an effective sample of 132 participants (57 men and 75 women; age: $M = 36.56, SD = 12.81$). Participants were randomly assigned to the conditions of a 2 (Intent: hostile vs. non-hostile) $\times$ 2 (Cue: present vs. absent) $\times$ 2 (Cognitive load: high vs. low) between-subjects design.

Participants individually viewed a pre-recorded 3-min video briefing similar to the briefing in Study 1. We explained that participants would have to bring a laptop bag from the instruction room to another location in the building. En route, they would be monitored by security cameras, and at the end, they would pass a checkpoint. Based on psychological assessment, security officers would decide whether participants should be stopped and their bags searched or not. In reality, security officers were not present and all participants were allowed to pass without having their bag searched.

We told participants that for this task, some participants would be requested to carry a dummy explosive device in their laptop bag, whereas others would be requested to carry books of equal weight and size in their bag. On the table next to the computer on which they received their instructions, we placed a dummy explosive device or two books on top of the laptop bag and asked them to put the items in the bag. We emphasized that participants carrying an explosive device would be in trouble, whereas participants carrying books would be allowed to pass if they were stopped and searched. Further, in the hostile intent condition, we told participants that if they were not stopped by the security officers, they would have a chance of winning 100 euros, but if they were stopped, they would lose this chance and have to fill out additional questionnaires which we described as dull and tedious. Finally, as part of the cognitive load manipulation, we asked half of the participants to count their steps on their way to the checkpoint. The other participants were not asked to do this. We reasoned that this task would continuously involve the working memory and would thus hamper behavioural control (cf. Çorlu, Maes, Muller, Kochman, & Leman, 2015). Participants were subsequently asked to take their laptop bag and proceed to the checkpoint. As in Study 1, this hostile intent manipulation contained both a potential gain (i.e., chance of winning 100 euros) and a potential loss (i.e., risk of tedious and time-consuming questionnaires).

The route participants were instructed to walk ended in a 20-m-long corridor. At the end, we positioned the checkpoint. Halfway we hid an infrared device that would be triggered by the passing participant. In the cue present condition, the device produced white noise of 70 dB for 250 milliseconds resembling a police walkie-talkie's static noise; in the no cue condition, no such noise was played. Participants approaching the checkpoint would see the preceding participant waiting at the checkpoint to be let through. This procedure aimed to induce ambiguity as to whom the cue was directed. After proceeding to the end of the corridor and queuing up, the experiment leader called

from behind the checkpoint for the first in line to proceed. This marked the end of the first part of the task.

Questionnaire

After proceeding through the checkpoint, we explained to participants that this part of the task was finished and led them to a computer to fill out a questionnaire. We changed some of the items checking the successfulness of our hostile intent manipulation relative to Study 1. Table 1 displays the constructs measured, including scale reliabilities, means, confidence intervals, and statistical tests. We added a factual check asking 'Did you carry a laptop bag containing a dummy explosive during the experiment?' Second, we combined the item measuring if participants thought they had a hostile role with those measuring hostile feelings and altered it such that it measured whether participants understood they were doing something illegal (e.g., I had an illegal task during the experiment). We further dropped the items measuring the extent to which participants thought the cue was directed at other participants because in the present set-up of the experiment, we thought this would be irrelevant. The remaining items that measured the various psychological consequences that we expected remained the same apart from changed wordings to fit the experimental set-up. After completing the questionnaire, participants were debriefed and thanked for their participation.

Procedure

We invited our judges to our facilities and told them that they were going to watch several videos. In all of these videos, they would see people carrying laptop bags with half of them containing books and the other half dummy explosives. Judges viewed each video once, after which they could indicate whether they thought the individual in the recording was carrying a dummy explosive in his or her bag. Videos were recorded with sound so that the white noise was audible to our judges. In the videos in which the white noise was not originally present, this sound was edited into the video. This way, any effect of the cue would be attributable to behaviour of the participants, and not, for example, to increased attention of judges after hearing the cue in some but not in other videos.[4] We first showed five practice videos in order for judges to become familiar with the procedure. After the practice videos, we showed a summary of the instructions after which we started the experimental trials. As in Study 1, we used signal detection theory for a measure of sensitivity (A) that specifies how successful our judges are in distinguishing between participants with and without hostile intentions (Zhang & Mueller, 2005).

Results

Questionnaire

All participants responded correctly to our factual check if they carried a laptop bag containing a dummy explosive or books during the experiment. Not all participants could recall heaving heard the 70 dB cue on their way to the checkpoint. Of the 69 participants

[4] *Note that muting sound in all videos would make it impossible for judges to determine if a behaviour of a participant was a reaction to a cue or not, and subsequently if these reactions seemed normal to them or not.*

to whom we administered a cue 29 indicated to have heard it afterwards. In the discussion, we will come back to this finding for a possible explanation.

As in Study 1, we used two distinct analyses to test our hypotheses regarding the psychological processes related to hostile intentions. A 2 (Intent: hostile vs. non-hostile) × 2 (Cue: present vs. absent) × 2 (Cognitive load: high vs. low) MANOVA to test the effects of our hostile intent and cue manipulations on the self-reported measures in the questionnaire yielded a statistically significant main effect of hostile intention, $F(9, 116) = 33.26$, $p < .001$, $\eta^2 = .72$. Other main and interaction effects did not reach statistical significance, F's < 1.18, p's > .31.

Means and confidence intervals of the psychological constructs as a function of intention (hostile vs. non-hostile), including their univariate tests of significance are displayed in Table 3. These results indicate that our manipulation of intent was successful. Participants in the hostile intent condition reported greater understanding and contemplation of their hostile role, more anxiety, inhibitory control, activation control to behave normally, and awareness of their surrounding than participants in the non-hostile intent condition.

We also conducted a separate 2 (Intent: hostile vs. non-hostile) × 2 (Cue: present vs. absent) ANOVA on self-focus to specifically test the prediction that participants in the hostile intent (vs. non-hostile intent) condition and who received a cue (vs. no cue) on their way would show a stronger egoistic interpretation of this cue. Means and confidence intervals are displayed in Table 4. This analysis shows an expected main effect of our cue manipulation on egoistic interpretation only, such that participants in the cue present condition report a stronger egoistic interpretation of the cue than participants in the cue absent condition, $F(1, 29) = 5.00$, $p < .04$, $\eta^2 = .15$. Egoistic interpretation of the cue was not influenced by a hostile (vs. non-hostile) intention.

A second analysis of the questionnaire aimed to explore the relative effects between the psychological constructs. Specifically, we aimed to explore if the feeling of doing something illegal causes the cascade of hypothesized cognitions and behaviours. Figure 2 displays the psychological constructs and their relations plotted in a network (Epskamp *et al.*, 2012). Edges represent partial correlations between two variables. Numbers in nodes correspond to the numbers in Tables 3 and 4. This analysis shows that participants who say they had a hostile role also tend to contemplate their hostile intentions. Contemplation of hostile intentions in turn is related to anxiety while approaching the checkpoint, inhibitory control of anxiety, and activation control to behave normally. Further, public situational self-awareness (i.e., being aware of the impression one may make on others) is related to contemplating one's hostile intentions and the inhibitory control of anxiety. These relations between the constructs largely replicate the findings from Study 1.

Detection of intent

After collection of the stimulus materials, judges were instructed to determine the intent of each participant in the videos. We reasoned that our judges would show highest sensitivity to distinguish participants with hostile (vs. non-hostile) intent when these participants had high (vs. low) cognitive load and were (vs. were not) cued on their way towards the checkpoint. In other words, we expect that the ability of the judges to distinguish between participants carrying the bag with dummy explosives and participants carrying the bag with books is strongest when participants were instructed to count (vs. not to count) their steps, and the police walkie-talkie static noise cue was

Table 3. Means and confidence intervals (95%) of psychological constructs as a function of intention (hostile vs. non-hostile). Scale reliabilities are displayed between brackets

		Hostile intent		Non-hostile intent				
		M	95% CI	*M*	95% CI	*F*(1, 130)	*p*	η^2
1	Hostile role (α = .89)	4.89	4.59, 5.19	1.23	0.93, 1.54	284.30	.00	.70
3	Contemplation of hostile role (α = .72)	4.53	4.15, 4.91	3.41	3.02, 3.80	16.70	.00	.12
4	Anxiety due to presence of police (α = .86)	3.20	2.92, 3.49	2.65	2.36, 2.93	7.56	.01	.06
5	Inhibitory control of anxiety (α = .92)	3.61	3.23, 3.99	2.52	2.13, 2.91	15.45	.00	.11
6	Activation control of normal behaviour (α = .88)	4.28	3.90, 4.66	3.73	3.34, 4.12	4.01	.05	.03
7	Alertness to being target of police (α = .90)	2.72	2.41, 3.03	2.66	2.34, 2.98	0.07	.80	.00
8	Self-focus (public self-awareness; α = .77)	4.13	3.78, 4.48	3.86	3.50, 4.22	1.12	.29	.01
9	Self-focus (surrounding self-awareness; α = .70)	4.24	3.95, 4.53	4.75	4.46, 5.05	6.10	.01	.05
10	Self-focus (private self-awareness; α = .69)	4.01	3.67, 4.34	3.94	3.59, 4.28	0.09	.76	.00

Table 4. Means and confidence intervals (95%) of egoistic interpretation of cue as a function of hostile intention (hostile vs. non-hostile) and cue (present vs. absent) manipulations. There were no observations in the combination of hostile intent and no cue condition

			Hostile intent		Non-hostile intent	
			M	95% CI	*M*	95% CI
11	Egoistic interpretation (α = .65)	Cue	2.87	2.34, 3.40	2.93	2.31, 3.56
		No cue	–	–	1.40	0.15, 2.66

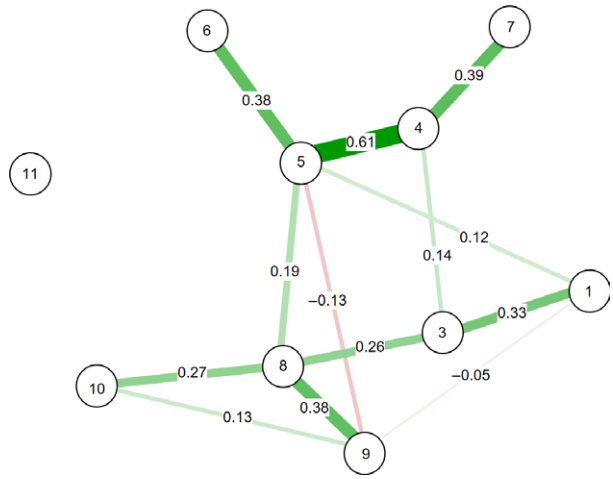

Figure 2. Partial correlations between the psychological constructs (printed between nodes). Numbers in nodes correspond with variable numbers in Tables 3 and 4. [Colour figure can be viewed at wileyonlinelibrary.com]

administered while approaching the checkpoint. Means and confidence intervals (95%) of *A* are displayed in Table 5. The 2 (Cognitive load: high vs. low) × 2 (Cue: present vs. absent) repeated-measures ANOVA shows a statistically significant interaction effect of *A*, $F(1, 19) = 10.95, p < .004, \eta^2 = .37$. Closer examination shows a statistically significant simple main effect of cues (present vs. absent) on *A* in the high cognitive load condition, $F(1, 19) = 10.77, p < .004, \eta^2 = .36$. That is, judges in phase 2 more accurately distinguished participants carrying the bag with dummy explosives from participants carrying the bag with books when these participants received a cue on their way to the checkpoint ($M = 0.54$, 95% CI [0.50, 0.58]) compared to when these participants did not receive a cue on their way to the checkpoint ($M = 0.43$, 95% CI [0.37, 0.50]), provided that participants counted their steps while approaching the checkpoint.

We also found a statistically significant simple main effect of cognitive load (high vs. low) on *A* in the cue present condition, $F(1, 19) = 9.50, p < .006, \eta^2 = .33$. That is, judges more accurately distinguished participants carrying the bag with dummy explosives from participants carrying the bag with books when these participants counted their steps towards the checkpoint ($M = 0.54$, 95% CI [0.50, 0.58]) compared to when these participants did not count their steps towards the checkpoint ($M = 0.43$, 95% CI [0.37, 0.49]), and received a cue while approaching the checkpoint. Other main effects and simple main effects were not significant, F's < 1.80, p's > .19.

Table 5. Means and confidence intervals (95%) of *A* as a function of cognitive load (high vs. low) and cue (present vs. absent)

	Cue			
	Present		Absent	
Cognitive load	*M*	95% CI	*M*	95% CI
High	0.54	0.50, 0.58	0.44	0.37, 0.50
Low	0.43	0.37, 0.49	0.48	0.42, 0.54

Discussion

Study 2 replicates and extends the findings from Study 1. Study 2 shows that independent judges who watched videos showing participants with hostile and non-hostile intentions are more accurate in their judgement of intent when the participant under scrutiny has a high (vs. low) cognitive load and is cued (vs. not cued) on his or her way (Hypothesis 3 and Hypothesis 4). In our experimental set-up, we made sure that our judges were unaware of the conditions our participants were assigned to. Any effect, therefore, can be attributed to the cognitive load on the part of participants and cues they received.

According to our hypotheses, this effect is the result of a cascade of psychological processes on the part of the participant carrying out illegal actions. First, Study 2 shows that these psychological processes are caused by our hostile intent manipulation (Hypothesis 1). Second, a network analysis that largely corresponds with the findings in Study 1 shows the interrelatedness of the experience of hostile intentions, anxiety, inhibitory control of anxiety, activation control of normal behaviour, and to other relevant constructs (Hypothesis 2).

As in Study 1, we did not find a relation between these psychological constructs and egoistic interpretation of the cue we administered. In Study 2, 29 of the 69 to whom we administered a cue memorized this cue. Only when participants had indicated that they had heard a cue while approaching the checkpoint they were prompted for their egoistic interpretation of this cue. Consequently, our sample for items related to egoistic interpretation was relatively low, making analyses less reliable. This may, at least partly, explain the absence of a relation with the other psychological constructs.

Although more than half of the participants report not having heard our cue, we think it likely that they actually failed to memorize it. The sound level of 70 dB of the white noise we used as a cue compares to the sound level of a vacuum cleaner (National Institute on Deafness and Other Communication Disorders, 1990). This sound level should not easily go unnoticed. In line with this reasoning, in the video footage, we observe that some participants who indicated not to have heard a cue actually orient towards the source of the sound. We therefore assume that participants in fact must have heard the cue, but have failed to commit it to memory.

GENERAL DISCUSSION

The two studies presented here show that cues from the environment signalling risk of exposure can aid in the identification of individuals with hostile intentions.

We reasoned that hostile intentions would lead to increased experience of threat from the environment, heightened self-focus, perception that one's states and traits (e.g., intentions) are salient to others, and hence an egoistic interpretation of situational cues. We further reasoned that individuals with hostile intentions will try to suppress their anxiety and to behave normally and that under circumstances of high cognitive load these self-regulative processes are hampered. Under these conditions of diminished cognitive control, cues from the environment that signal risk of exposure may amplify anxiety-related reflexes and behaviours.

In line with this reasoning, in Study 1 participants who received a strong cue from a security officer were more often correctly identified by independent judges as either innocent or hostile based on their behaviour than participants who received a mild cue. All participants in Study 1 were under relatively high cognitive load. Study 2 replicated and extended these findings. In Study 2, we found the same effect of cue strength on detection accuracy, but only for participants who were instructed to count their steps and thus had a high (vs. low) cognitive load, and not for participants who did not count their steps and thus had a low cognitive load. Together, these studies show that cues that may signal exposure can improve the detection of hostile intentions by independent judges, provided that potential wrongdoers have a relatively high cognitive load so that their self-regulatory capacities are diminished and impression management is hampered. These findings support our third and fourth hypotheses.

For the hypothesized psychological processes driving these effects, we find partial support in the studies presented here. In line with our reasoning and our first hypothesis, both studies show that the experience of hostile intentions is directly related to anxiety and inhibitory control of anxiety. Also in line with our reasoning and our second hypothesis is that these processes were further associated with participants' efforts to behave normally (note that although in Study 1 inhibitory control had a poor reliability, in Study 2 its reliability was high) and other relevant constructs. However, participants did not indicate a stronger egoistic interpretation of situational cues as a result of these processes (but in Study 1, we do find an effect of our hostile intent manipulation on egoistic interpretation of the cue). According to our reasoning, this egoistic interpretation stands in direct relation to how individuals react to situational cues. Finding effects on many of the hypothesized psychological processes and detection accuracy on the one hand, we are unsure how to interpret this absence of effects on egoistic interpretation on cues on the other. These findings thus lend partial support for our first and second hypotheses. Future research should further focus on the role of this egoistic interpretation.

Future research might also focus on the real-life application and ecological validity of the processes and effects described in this article. In the absence of any empirical studies examining the relation between a security officer's behaviours and the chances of detection of individual with hostile intentions, and the role of cognitive load, this article's goal was to investigate and present the evidence of these fundamental processes. Now that we have elucidated an important part of the behavioural and psychological processes a next step could be to work on its real-life application. For example, cues communicated by security officers in a real airport checkpoint and the use of mystery guests as participants with hostile or non-hostile intentions could be evaluated. Real-life means to raise the cognitive load of potential harmdoers might include rerouting travellers in an airport setting. These and other applications of the findings from our studies should now be examined.

A critic may argue that in Study 1, the hostile intent manipulation did not influence the manipulation checks and therefore this manipulation was unsuccessful. Also, the hostile intent manipulation did not influence the measurements of anxiety, inhibitory control of anxiety or of the cognitive and affective processes, except for the egoistic interpretation of the cue which was stronger in the hostile intent (vs. no hostile intent) condition. Yet, as noted earlier, our network analysis in Study 1 suggests that this egoistic interpretation was unrelated to the other constructs measured. In contrast, in Study 2, the manipulation checks and the measurements of the cognitive and affective processes were influenced by the hostile intent manipulations, but did not lead to a stronger egoistic interpretation of the cue. We offer three explanations for these incongruent findings.

First, participants in both studies were instructed rather than intrinsically motivated to carry the illegal package and therefore they may not have experienced hostility. Therefore, in Study 2, we changed the wording of our manipulation check from asking how participants experienced their hostile intention to whether they understood their hostile task. Based on these respective findings, we propose that participants understood their task, but may not have experienced hostile feelings. A second explanation for the incongruent findings is that we reduced the time between the task participants carried out and the questionnaire measuring the effects of this task in order to increase the reliability of the measurements (Petitmengin, Remillieux, Cahour, & Carter-Thomas, 2013). A third reason for finding stronger effects in Study 2 is that we increased the sample size (n = 132) relative to Study 1 (n = 26) in the stimulus acquisition phase, which leads to more statistical power. Taken together, we think results of Study 2 present a more accurate image of participants' cognitions and experiences. For these reasons, we also think that our conclusion that situational cues improve the detection of individuals with hostile intent remains intact.

In Study 2, more than half of the participants had no recollection of the cue we had administered. Although this may seem problematic in terms of the manipulation effectiveness, given that the sound level of the cue resembled that of a vacuum cleaner (70 dB), and given that we observed participants orient towards the source of the sound who later responded not to have heard it, we assume that participants did hear the cue, but failed to remember and subsequently report this. Participants who did not recollect heaving heard the cue could further not report on their egoistic interpretation of the cue. Future research should try to use other means to measure egoistic interpretations of situational cues that do not rely on introspection in order to better determine its importance in relation to reactions to situational cues.

Future research should also focus on actual behaviours portrayed by individuals with hostile or non-hostile intentions. In this study, we did not focus on actual behaviours. We did reason that the psychological processes of individuals with hostile intent differ from those with non-hostile intent and that these differences would result in different behaviour patterns. But our goal was to show how, through understanding this process, chances of detection could be improved. We showed this by relying on the gut feelings, or holistic interpretation of behaviour, of our judges. Adding single or combined sets of behaviours to look out for may further improve security professionals' sensitivity to hostile intentions.

Conclusion

Security programmes based on behaviour detection have lately received criticism for their lack of a strong psychological basis or empirical support (Ormerod & Dando, 2015; U.S.

GOA, 2013; Weinberger, 2010). This article has tried to fill this void by presenting a theoretical foundation for deviant behaviour and by presenting two research studies that show that perceptible reactions to environmental cues can aid in the early detection of individuals with criminal intentions. The findings have practical implications for the way some security tasks are carried out. It offers guidance for both acting on and interpreting behaviours displayed by potential adversaries. Importantly, by increasing cues to deception (cf., Hartwig & Bond, 2011), this method aims to increase sensitivity (that is, improving the ability to tell friend from foe), rather than to adjust the criterion (increasing the likelihood to detect foes while accepting an increased likelihood of incorrect judgements of hostile intent). As such, it tries to protect citizens' right to be left alone and not to be bothered or affected by the same measures that should protect from harm doing (Warren & Brandeis, 1890).

Acknowledgements

We thank Jack Vogels, Dianne van Hemert, Helma van den Berg, and Maaike Lousberg for their suggestions during this research project and their comments on previous versions of this article and Maaike Roelofs for her assistance with data collection. The research reported in this article was funded by the Ministry of Economic Affairs, the Netherlands.

References

Adam, B., Beck, U., & Van Loon, J. (2000). *The risk society and beyond: Critical issues for social theory*. London, UK: Sage.

Aldao, A. (2013). The future of emotion regulation research capturing context. *Perspectives on Psychological Science*, *8*, 155–172. doi:10.1177/1745691612459518

Baumeister, R. F., & Heatherton, T. F. (1996). Self-regulation failure: An overview. *Psychological Inquiry*, *7*, 1–15. doi:10.1207/s15327965pli0701_1

Benarroch, E. E. (1993). The central autonomic network: Functional organization, dysfunction, and perspective. *Mayo Clinic Proceedings*, *68*, 988–1001. doi:10.1016/S0025-6196(12)62272-1

Bond, Jr, C. F., & DePaulo, B. M. (2006). Accuracy of deception judgments. *Personality and Social Psychology Review*, *10*, 214–234. doi:10.1207/s15327957pspr1003_2

Brown, M. A., & Stopa, L. (2007). The spotlight effect and the illusion of transparency in social anxiety. *Journal of Anxiety Disorders*, *21*, 804–819. doi:10.1016/j.janxdis.2006.11.006

Çorlu, M., Maes, P. J., Muller, C., Kochman, K., & Leman, M. (2015). The impact of cognitive load on operatic singers' timing performance. *Frontiers in Psychology*, *6*, 429. doi:10.3389/fpsyg.2015.00429

Cortina, J. M. (1993). What is coefficient alpha? An examination of theory and applications. *Journal of Applied Psychology*, *78*, 98. doi:10.1037/0021-9010.78.1.98

Costantini, G., Epskamp, S., Borsboom, D., Perugini, M., Mõttus, R., Waldorp, L. J., & Cramer, A. O. (2015). State of the aRt personality research: A tutorial on network analysis of personality data in R. *Journal of Research in Personality*, *54*, 13–29. doi:10.1016/j.jrp.2014.07.003

Cunningham, W. A., Arbuckle, N. L., Jahn, A., Mowrer, S. M., & Abduljalil, A. M. (2011). Reprint of: Aspects of neuroticism and the amygdala: Chronic tuning from motivational styles. *Neuropsychologia*, *49*, 657–662. doi:10.1016/j.neuropsychologia.2011.02.027

DePaulo, B. M., Lindsay, J. J., Malone, B. E., Muhlenbruck, L., Charlton, K., & Cooper, H. (2003). Cues to deception. *Psychological Bulletin*, *29*, 74–118. doi:10.1037/0033-2909.129.1.74

Eachus, P., Stedmon, A., & Baillie, L. (2013). Hostile intent in public crowded spaces: A field study. *Applied Ergonomics*, *44*, 703–709. doi:10.1016/j.apergo.2012.05.009

Ekman, P., Friesen, W. V., & O'Sullivan, M. (1988). Smiles when lying. *Journal of Personality and Social Psychology*, *54*, 414–420. doi:10.1037/0022-3514.54.3.414

Elias, B. (2009). *Airport passenger screening: Background and issues for Congress* (No. R40543), Congressional Research Service.

Epskamp, S., Cramer, A. O., Waldorp, L. J., Schmittmann, V. D., & Borsboom, D. (2012). Qgraph: Network visualizations of relationships in psychometric data. *Journal of Statistical Software*, *48*, 1–18. doi:10.18637/jss.v048.i04

Fenigstein, A. (1984). Self-consciousness and the overperception of self as a target. *Journal of Personality and Social Psychology*, *47*, 860–870. doi:10.1037/0022-3514.47.4.860

Fenigstein, A., & Levine, M. P. (1984). Self-attention, concept activation, and the causal self. *Journal of Experimental Social Psychology*, *20*, 231–245. doi:10.1016/0022-1031(84)90049-0

Gilbert, D. T., & Hixon, J. G. (1991). The trouble of thinking: Activation and application of stereotypic beliefs. *Journal of Personality and Social Psychology*, *60*, 509–517. doi:10.1037/0022-3514.60.4.509

Gilovich, T., Medvec, V. H., & Savitsky, K. (2000). The spotlight effect in social judgment: An egocentric bias in estimates of the salience of one's own actions and appearance. *Journal of Personality and Social Psychology*, *78*, 211–222. doi:10.1037/0022-3514.78.2.211

Gilovich, T., Savitsky, K., & Medvec, V. H. (1998). The illusion of transparency: Biased assessments of others' ability to read one's emotional states. *Journal of Personality and Social Psychology*, *75*, 332–346. doi:10.1037/0022-3514.75.2.332

Granhag, P. A., & Knieps, M. (2011). Episodic future thought: Illuminating the trademarks of forming true and false intentions. *Applied Cognitive Psychology*, *25*, 274–280. doi:10.1002/acp.1674

Hartwig, M., & Bond, Jr, C. F. (2011). Why do lie-catchers fail? A lens model meta-analysis of human lie judgments. *Psychological Bulletin*, *137*, 643. doi:10.1037/a0023589

Hermans, E. J., Henckens, M. J. A. G., Joëls, M., & Fernandez, G. (2014). Dynamic adaptation of large-scale brain networks in response to acute stressors. *Trends in Neurosciences*, *37*, 304–314. doi:10.1016/j.tins.2014.03.006

Hofmann, W., Schmeichel, B. J., & Baddeley, A. D. (2012). Executive functions and self-regulation. *Trends in Cognitive Sciences*, *16*(3), 174–180. doi:10.1016/j.tics.2012.01.006

Jones, E. E., Farina, A., Hastorf, A. H., Markus, H., Miller, D. T., & Scott, R. A. (1984). The dimensions of stigma. In E. E. Jones, *et al.* (Eds.), *Social stigma: The psychology of marked relationships* (pp. 24–79). New York, NY: Freeman.

Koller, C. I., Wetter, O. E., & Hofer, F. (2015). 'Who's the Thief?' The Influence of knowledge and experience on early detection of criminal intentions. *Applied Cognitive Psychology*, *30*, 178–187. doi:10.1002/acp.3175

Macmillan, N. A. & Creelman, C. D. (2005). *Detection theory: A user's guide*. (2nd ed.). Mahwah, NJ: Lawrence Erlbaum.

Mendelsohn, A., Pine, A., & Schiller, D. (2014). Between thoughts and actions: Motivationally salient cues invigorate mental action in the human brain. *Neuron*, *81*(1), 207–217. doi:10.1016/j.neuron.2013.10.019

Mendoza-Denton, R., Downey, G., Purdie, V. J., Davis, A., & Pietrzak, J. (2002). Sensitivity to status-based rejection: Implications for African American students' college experience. *Journal of Personality and Social Psychology*, *83*, 896–918. doi:10.1037/0022-3514.83.4.896

National Institute on Deafness and Other Communication Disorders (1990). *Common sounds*. Retrieved from http://www.nidcd.nih.gov/health/education/teachers/pages/common_sounds.aspx

Ormerod, T. C., & Dando, C. J. (2015). Finding a needle in a haystack: Toward a psychologically informed method for aviation security screening. *Journal of Experimental Psychology: General*, *144*, 76. doi:10.1037/xge0000030

Pachankis, J. E. (2007). The psychological implications of concealing a stigma: A cognitive-affective-behavioural model. *Psychological Bulletin*, *133*, 328–345. doi:10.1037/0033-2909.133.2.328

Petitmengin, C., Remillieux, A., Cahour, B., & Carter-Thomas, S. (2013). A gap in Nisbett and Wilson's findings? A first-person access to our cognitive processes. *Consciousness and Cognition*, *22*, 654–669. doi:10.1016/j.concog.2013.02.004

Pourahmadi, M. (2011). Covariance estimation: The GLM and regularization perspectives. *Statistical Science*, *26*, 369–387. doi:10.1214/11-STS358

Riggio, H. R., & Kwong, W. J. (2009). Social skills, paranoid thinking, and social outcomes among young adults. *Personality and Individual Differences*, *47*, 492–497. doi:10.1016/j.paid.2009.04.026

Rothbart, M. K., & Bates, J. E. (2006). Temperament. In W. Damon, R. Lerner & N. Eisenberg (Eds.), *Handbook of child psychology, Sixth edition: Social, emotional, and personality development* (Vol. 3, pp. 99–106). New York, NY: Wiley.

Santuzzi, A. M., & Ruscher, J. B. (2002). Stigma salience and paranoid social cognition: Understanding variability in metaperceptions among individuals with recently-acquired stigma. *Social Cognition*, *20*, 171–197. doi:10.1521/soco.20.3.171.21105

Savitsky, K., & Gilovich, T. (2003). The illusion of transparency and the alleviation of speech anxiety. *Journal of Experimental Social Psychology*, *39*, 618–625. doi:10.1016/S0022-1031(03)00056-8

Sooniste, T., Granhag, P. A., Knieps, M., & Vrij, A. (2013). True and false intentions: Asking about the past to detect lies about the future. *Psychology, Crime & Law*, *19*, 673–685. doi:10.1080/1068316X.2013.793333

Tanner, W. P. Jr., & Swets, J. A. (1954). A decision-making theory of visual detection. *Psychological Review*, *61*(6), 401. doi:10.1037/h0058700

Thayer, J. F. (2006). On the importance of inhibition: Central and peripheral manifestations of nonlinear inhibitory processes in neural systems. *Dose-Response*, *4*, 2–21. doi:10.2203/dose-response.004.01.002.Thayer

U.S. Government Accountability Office [GOA] (2013). *Aviation security: TSA should limit future funding for behaviour detection activities* (GAO publication No. GOA-14-159). Washington, DC: U.S. Retrieved from http://www.gao.gov/assets/660/658923.pdf

Vohs, K. D., & Baumeister, R. F. (Eds.) (2011). *Handbook of self-regulation: Research, theory and applications* (2nd ed.). New York, NY: Guilford Publications.

Vohs, K. D., Baumeister, R. F., & Ciarocco, N. J. (2005). Self-regulation and self-presentation: Regulatory resource depletion impairs impression management and effortful self-presentation depletes regulatory resources. *Journal of Personality and Social Psychology*, *88*, 632–657. doi:10.1037/0022-3514.88.4.632

Vrij, A. (2008). *Detecting lies and deceit: Pitfalls and opportunities* (2nd ed.). New York, NY: Wiley.

Vrij, A., Fisher, R., Mann, S., & Leal, S. (2008). A cognitive load approach to lie detection. *Journal of Investigative Psychology and Offender Profiling*, *5*(1–2), 39–43. doi:10.1002/jip.82

Vrij, A., Semin, G. R., & Bull, R. (1996). Insight into behaviour during deception. *Human Communication Research*, *22*, 544–562. doi:10.1111/j.1468-2958.1996.tb00378.x

Warren, S., & Brandeis, L. D. (1890). The right to privacy. *Harvard Law Review*, *5*, 193–220. doi:10.2307/1321160

Wegner, D. M. (2009). How to think, say, or do precisely the worst thing for any occasion. *Science*, *325*(5936), 48–50. doi:10.1126/science.1167346

Weinberger, S. (2010). Airport security: Intent to deceive? *Nature*, *465*, 412–415. doi:10.1038/465412a

Zhang, J., & Mueller, S. T. (2005). A note on ROC analysis and non-parametric estimate of sensitivity. *Psychometrika*, *70*, 203–212. doi:10.1007/s11336-003-1119-8

Received 25 November 2015; revised version received 8 February 2017