AFRL-AFOSR-UK-TR-2018-0036

Does Technological Surveillance Change Behavior?

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08/15/2018
Final Report

Air Force Research Laboratory
Air Force Office of Scientific Research
European Office of Aerospace Research and Development
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REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE *(DD-MM-YYYY)*
15-08-2018

2. REPORT TYPE
Final

3. DATES COVERED *(From - To)*
01 Jan 2016 to 31 Dec 2016

4. TITLE AND SUBTITLE
Does Technological Surveillance Change Behavior?

5a. CONTRACT NUMBER

5b. GRANT NUMBER
FA9550-16-1-0090

5c. PROGRAM ELEMENT NUMBER
61102F

6. AUTHOR(S)
Elaine Fox

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
THE UNIVERSITY OF OXFORD
UNIVERSITY OFFICES
OXFORD, OX1 2JD GB

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
EOARD
Unit 4515
APO AE 09421-4515

10. SPONSOR/MONITOR'S ACRONYM(S)
AFRL/AFOSR IOE

11. SPONSOR/MONITOR'S REPORT NUMBER(S)
AFRL-AFOSR-UK-TR-2018-0036

12. DISTRIBUTION/AVAILABILITY STATEMENT
A DISTRIBUTION UNLIMITED: PB Public Release

13. SUPPLEMENTARY NOTES

14. ABSTRACT
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15. SUBJECT TERMS
EOARD, Experimental Psychology, Technical Surveillance

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			IYER, NANDINI
Unclassified	Unclassified	Unclassified	SAR		**19b. TELEPHONE NUMBER** *(Include area code)* 44 1895 616161

Standard Form 298 (Rev. 8/98)
Prescribed by ANSI Std. Z39.18

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Grant No. FA9550-16-1-0090

Abstract

Eye cues have been shown to stimulate rapid, reflexive, unconscious processing and in many experimental settings seem to cue increased prosocial and decreased anti-social behaviour. Eye cues are being widely applied in public policy to reduce crime and antisocial behaviour. Recently, failed replication attempts and two meta-analyses examining the eye cue effect on generosity have raised doubts regarding earlier findings. Much of the wider evidence on eye cues has still not been systematically reviewed, notably that which is most relevant to its practical application: the effect of eye cues on anti-social behaviour. Given the evidence of humans' greater sensitivity to threat and negative information, we hypothesized that the watching eyes effect would be more consistent in studies examining anti-social behaviour. In our meta-analysis of 14 experiments from 11 research papers we report a reduction in the risk (frequency) of anti-social behaviour of 32% when eye cues are present. By contrast, systematic reviews have suggested CCTV cameras reduce crime by only 16%. We conclude that there is sufficient evidence of a watching eyes effect on anti-social behaviour to justify their use in the very low-cost and potentially high-impact real-world interventions that are proliferating in public policy, particularly in the UK.

Key Words: "watching eyes", “eye cues”, "eye images", “surveillance cues”, "eye primes", "implicit social cues".

Public Significance Statement:

"Our meta-analysis of 14 experiments involving 1931 participants shows that photographs and/or stylized images of eyes reduced anti-social behaviour by 32%. Our findings support public policy initiatives employing pictures of ‘watching eyes’ to reduce crime. Furthermore, in an age when we are watched more than at any time in modern history – both online and on the street – our findings highlight an urgent need to fully understand the effect that perceived surveillance – feeling watched - has on our decisions and actions.”

1.1 Introduction

The idea that surveillance can change behaviour is not new. In ancient Egypt the image of the God Horus' eye was worn as a talisman to ward off evil and the 'Evil Eye' has been used as a motif, hung as a charm and worn as an amulet across cultures dating back to Classical antiquity. (Bagli & Ogut, 2009). The ancients seemed to believe that subtle 'eye cues' on everyday objects could act as proxies for watching gods or human gaze.

In contemporary society, rapid advances in surveillance technology mean that people in developed countries will soon be watched as never before (Ball, 2010; Bamford, 2016). This proliferation of surveillance has created a new academic field of Surveillance Studies, which has been described 'as a cross-disciplinary initiative to understand the rapidly increasing ways in which personal details are collected, stored, transmitted, checked, and used as a means of influencing and managing people and populations' (Lyon, 2002, 2007; Lyon, Ball, & Haggerty, 2012). How surveillance changes human behaviour and what effect it may have on individuals, groups and societies are pressing questions. Yet, despite claims that Surveillance Studies is an interdisciplinary approach there remains very limited psychological research on the subject (Ellis, Harper, & Tucker, 2016).

One area of psychological science that has approached this problem is the investigation of the so-called 'watching eyes' effect. This research suggests that the mere presence of pictures of eyes or stylized eye images (hereafter: eye cues) is enough to cause us to adjust our behaviour (Burnham & Hare, 2007). Eye cue research offers a way to study the effect of perceived surveillance on behaviour, independent of deterrence effects or real reputational concerns, as might occur with camera surveillance. The 'watching eyes effect' suggests that just feeling watched may be enough to make us modify our actions independent of deliberative, explicit, conscious, evaluation of the costs and benefits of an action. Perhaps the talismans and charms of the ancients offered more than just superstitious reassurance.

1.2 Why might eye cues work? Before we explore the experimental evidence, it is helpful to consider a theoretical framework within which we can explain and understand why eye cues might have an effect on behaviour. If eye cues do have an effect on our decisions and behaviour, it seems reasonable to assume they are acting as false cues to actual gaze, triggering the normative response to being watched. A reasonable assumption therefore would be that we can utilize evidence and theoretical developments from work that examines real, human-to-human, eye-to-eye gaze. We start this exploration by looking at the cue itself, the structural design of human eyes.

Biologically, our eyes may have evolved to capture attention and communicate. We are the only animal with the pronounced white sclera, and biologists have suggested that this is evidence that the eyes evolved this ‘design’ in order to give us ‘signalling’ eyes as opposed to the camouflaged eyes of all other species (Kobayashi & Kohshima, 1997). Thus our survival and fitness depended in part on our ability to respond to the messages encoded and passed by the eyes of our conspecifics, rather than on hiding our eyes to avoid detection by our predators or our prey. Given that we have evolved to send and receive messages via gaze, eye cues might similarly capture our attention and communicate a message.

Direct evidence can be found from studies investigating automatic responses to the gaze of others. Extensive evidence shows that the processing of facial images is fast, preconscious, shows evidence of automaticity and cannot be switched off (Palermo & Rhodes, 2007). The eyes are the most important part of the face for conveying non-verbal messages and they are the first part of the face we look at, the most fixated part within the face and the most emotionally informative (Haxby, Hoffman, & Gobbini, 2002; Yarbus, 1967). We follow the direction of their gaze whether we want to or not, even when we are told it will be disadvantageous to the completion of a task to do so (Driver et al., 1999; Friesen & Kingstone, 2003; Kuhn & Kingstone, 2009; Posner, Snyder, & Davidson, 1980). This attentional responsiveness to gaze begins from very early in pre-verbal infancy, again suggesting it is unconscious and automatic, and it remains a critical social cue throughout our lives (Johnson et al 2005) enabling the passing of important social signals which are automatically and effortlessly encoded (Kawai, 2011; Senju & Hasegawa, 2006; von Grünau & Anston, 1995). Eyes are also fixated on even when located outside of the face area. A study by Levy, Foulsham, and Kingstone (2013) showed that it is the eyes to which we saccade and on which we fixate even when those eyes are located on the body or hands of a 'monster', outside of the face. Therefore the eyes are more important than the face in grabbing our attention and are the most important area within the face for communicating information. Eye cues in a poster then would likely also attract our attention, at the very least causing a physical response as our eyes saccade to look at them.

Cognitively, when one of us picks up the direction of another's gaze and automatically follows it we do so to understand quickly what it is that has captured the other's attention: threat, opportunity or curiosity (George & Conty, 2008). From this 'joint attention' follows a further automatic cognitive process: perspective taking. Perspective taking enables us to see the world from the perspective of others. Kampis, Parise, Csibra, and Kovács (2015) showed that while preverbal infants are unable to sustain object representations when that object is occluded from their own view, they are reflexively able to sustain the object representation if it remains within the gaze of another person that the infant can still see. Thereby, they can reflexively 'perspective take', seeing the world from the viewpoint of another and sustain an object representation where they would otherwise be unable to. Both joint attention and perspective taking then are reflexive, automatic and unconscious responses to the gaze of others. It seems likely that these automatic processes might be triggered by false cues, such as pictures of faces or eyes, too.

Gaze and gaze direction have also been shown to influence our categorization and judgement of others. We are faster to pick out a person's gender if they look directly at us, and we judge their degree of anger, happiness and attractiveness to be greater if they look at us (Adams & Kleck, 2003, 2005; Kampe, Frith, Dolan, & Frith, 2001; Macrae, Hood, Milne, Rowe, & Mason, 2002; Mason, Tatkow, & Macrae, 2005; Mathews, Fox, Yiend, & Calder, 2003; Sander, Grandjean, Kaiser, Wehrle, & Scherer, 2007; Sato, Yoshikawa, Kochiyama, & Matsumura, 2004; Vuilleumier, George, Lister, Armony, & Driver, 2005). Thus, gaze affects our cognitive processing of information, suggesting eye cues too might influence our categorization and judgement of a situation. It is noteworthy that in many of cognitive psychological experiments described, photographs of human eyes – eye cues -substituted for human gaze. Taken together, our physical and cognitive response to the presence of someone else's gaze is to look at their eyes and then look where they are looking, to process their eyes' social signal, and then to cause us to see things from their perspective and changing our perception and judgement of what we see.

Our neural response to being watched is also fast and automatic. Despite what would seem the obvious evolutionary advantage of following the gaze of another to see where they are looking – to detect predators, prey, opportunity or threat – and despite that fact that we do follow gaze automatically, unconsciously and rapidly, looking where others are looking, we nevertheless prioritize the processing of the emotional content of the gaze of others ahead of looking where they look (Conty, N'Diaye, Tijus, & George, 2007). Within 150-170ms of detecting gaze our brains have already begun to form an impression of the intentionality behind it (Conty et al., 2007) and recruited elements of the 'social brain network' to begin to form impressions and subconsciously shape our reactions (George & Conty, 2008; Johnson et al. 2005; Senju & Johnson, 2009).

In contrast, we don't begin processing of gaze direction until after 190ms. This is surprising – to have evolved to first process the emotional content of gaze, to 'read the mind in the eyes' of others (Baron-Cohen, 1997; Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001) ahead of following gaze direction suggests that knowing and responding to the emotional content of the gaze of others, rapidly and automatically, has been more important for our survival than looking at where others are looking – more important than seeing predators or prey.

This neural sensitivity to gaze and rapid response to it comes from the >30 regions of the brain dedicated to visual processing (Emery, 2000). The neural response to eyes is routed via a subcortical face detection pathway including the superior colliculus, pulvinar and amygdala (Senju & Johnson, 2009). This circuit appears to attach emotional significance to the eyes (i.e. threat or embarrassment) and then sends signals to the brainstem to initiate an emotional response, such as an increased GSR or blushing (Emery, 2000). Emery (2002) suggests that this could be achieved 'via a direct projection from the central nucleus of the amygdala to the brainstem'. Thus, the effect of being watched would not only be rapid, but automatic and below conscious awareness.

This automatic, rapid 150-170ms response enables us to infer emotional states, to 'read the mind' in the eyes of another (Baron-Cohen, 1997; Baron-Cohen et al., 2001), and it seems to do so in order to inform action (Baron-Cohen, 1997; Conty, Dezecache, Hugueville, & Grezes, 2012; Leonard Schilbach, 2015). This is shown by the way in which our perception, and ultimately the neural processes responsible for action, are affected by being watched.

We perceive objects differently when they are located in the direction of another's gaze. Bayliss, Paul, Cannon, and Tipper (2006) showed how our affective judgement of objects can be modulated by gaze cues. When Bayliss and colleagues presented participants with objects in the presence of a face image looking towards that object, participants rated the object as more likeable than in a presentation when the face was looking away from the object. When arrows were used to point at or away from an object, directional cueing of the participants' gaze did occur, but there was no modulation in affective response. This suggests that the presence of an observers' gaze changes how we perceive and respond affectively to an object (Bayliss et al., 2006; Hartendorp et al., 2013; Manera, Elena, Bayliss, & Becchio, 2014). Similarly, ERP studies have shown that objects that are gazed at by another are processed by infants as familiar, whereas objects that are not observed by another are processed as unfamiliar and novel. In infants then, being watched changes the neural circuitry used to perceive and process objects (Becchio, Bertone, & Castiello, 2008; Nelson, 1997). In one example, Becchio et al demonstrated this in an experiment where infants watched a video of an adult gazing towards one of two objects. Then a paired-preference test phase began. The same objects were presented but without an adult gazing at them. It was found that infants looked reliably less at the previously 'gazed' object, suggesting that the object cued by the adult's gaze was perceived as less novel than the non-cued object and the object was processed via different neural networks. Similar results have been obtained in an event-related potential (ERP) study using a similar paradigm (Reid, Striano, Kaufman, & Johnson, 2004). Thus, gaze changes how familiar an object seems to infants.

Electromyography (EMG) shows that direct gaze stimulates emotional arousal in the brain (Conty et al., 2010), while positron emission tomography (PET) scanning shows direct gaze activates specific areas of the brain such as the right amygdala that averted gaze does not

(Kawashima et al., 1999). In their review of direct gaze effects, Becchio et al (2008) show how the properties we perceive in an object are dependent in part on the gaze of another concluding that "under the gaze of others the object is enriched with motor, emotive and status components that it would not display if not looked at". Under direct gaze we process information via different neural pathways and perceive and respond to objects differently.

Most significantly, a separate line of research suggests that the neural circuitry used to control our actions differs when we are watched. A series of fMRI studies examining differences in performance in simple stimulus-response compatibility (SRC) tasks show that when we are watched performing simple tasks (e.g. button pressing) neural activity occurs principally in the inferotemporal cortex, the amygdala and medial prefrontal cortex, whereas tasks performed when we are not watched leads to principal activation of extrastriate visual and posterior parietal cortices. Therefore the neural circuitry responsible for social perception plays a greater role in the generation of motor-control when we are watched (Schilbach et al. 2011). Indeed, Shilbach et al conclude that being watched 'significantly changes the neural underpinnings of action control and recruits brain regions previously implicated in action monitoring, the reorienting of attention and social cognition' (Schilbach et al 2011). fMRI studies of mimicry when watched and not watched suggest that gaze causes activation in an area of the brain on the boundary between the posterior and anterior of the mPFC. The posterior region of the mPFC is associated with response inhibition, while the anterior is associated with mentalising and social cognition, thus our neural response to gaze seems to inform motor action by aiding us in inhibiting responses and in understanding the emotions of others (Yin Wang & Hamilton, 2014; Y Wang, Ramsey, & Hamilton, 2011). Similarly, Schilbach's review (2015) of gaze effects on neural processing suggests social presence triggers the recruitment of unconscious sub-cortical processes, while trying to ignore the social presence correlates with activation of reward-related neurocircuitry.

Taken together, the neural evidence suggests that our response to gaze is fast; at least partly automatic and unconscious; focused on emotional content; causes us to perceive objects differently; process information differently; elicits emotional arousal in the brain and causes the brain to control our actions via different neural pathways when observed than when not. All of which suggests that gaze should change behaviour.

1.2 Eye-Images as Eye-Cues

So, might we be so sensitive to gaze that eye cues alone can trigger such responses? There is evidence that we might. Eye cues may function as a gestalt, a still image prompting the brain to consider the independent existence of the whole object via pattern recognition. In this case, eyes cue consideration of the ‘whole person’ or a social presence (Kandel, 2012). Tsao, Freiwald, Tootell, and Livingstone (2006) and Tsao, Moeller, and Freiwald (2008) showed how the brain processes face images along 6 main patches, about 3mm in diameter arranged along an axis from the back of the inferior temporal lobe to the front. Examining each ‘patch’ under fMRI shows that they each respond to a different dimension or aspect of a face or face image, and activation of any one causes the others to activate, suggesting that we unconsciously create an overall picture of the face and person/animal rapidly even when we only have part of the face ‘pattern’ (Freiwald & Tsao, 2010; Kandel, 2012; Tsao et al., 2006; Tsao et al., 2008). The majority of the cells in the middle patches are specifically responsive to large irises (Freiwald & Tsao, 2010; Kandel, 2012; Tsao et al., 2006; Tsao et al., 2008), while electrophysiological studies have shown that eyes presented in isolation elicit a significantly greater neural (ERP) response than whole faces or any other feature of the face alone (Bentin, Allison, Puce, Perez, & McCarthy, 1996). This may explain why the eyes can be such a powerful cue: their mere presence cues us to construct a ‘whole’ social presence of another person (Freiwald & Tsao, 2010; Kandel, 2012; Tsao et al., 2006; Tsao et al., 2008), rapidly, and unconsciously, causing the changes in neural processing previously described.

Further evidence for our ability to identify and adapt to social presence comes from studies of human infants. Empirical evidence shows that infants are able to identify a three-spot pattern (two dots for eyes, one for mouth) immediately upon birth and suggests that this pattern recognition is programmed and developed pre-natally during REM sleep in the womb, thereby facilitating facial recognition and orientation to the eyes of adults from the moment of birth (Morton & Johnson, 1991). This proposition has received support from neuro-computational modelling that again suggests the response even to simple 3-dot eye cues is unconscious, automatic, innate, subcortical and present from the moment we first open our eyes to the world (Bednar & Miikkulainen, 2003).

Thus, our fixation on the eyes, our physical response to them, our cognitive ability to see things from the perspective of another’s gaze, our fast, automatic, unconscious neural processing, our altered perceptions and motor-control mechanism and our unconscious consideration of reward might all be activated by eye cues as they trigger a gestalt representation of the watching ‘other’ in the brain.

Much of psychology has, of course, long relied on photographs of eyes to cause physical, neural and cognitive reaction, accepting them as a substitute for human-to-human gaze cueing [for a review see Axelrod, Bar, and Rees (2015)]. The science of the ‘watching eyes effect’ then, examines whether these well-established unconscious, automatic, physical, cognitive and neural responses to the eyes of others have a behavioural manifestation when triggered by a false ‘eye cue’.

1.3 Eye Cues and Prosocial Behaviour

Much of the research on the influence of eye cues on behaviour has focused on prosocial behaviour. For instance, a picture of human eyes added to charity donation buckets in supermarkets increased donations by 48% (Powell, Roberts & Nettle 2012). In addition to field experiments similar to Powell, Roberts & Nettle's study, laboratory studies have also addressed the question of whether eye cues might increase generosity utilizing tasks such as Dictator Games (Nettle, Bateson, et al., 2012). In these games a person is given an allocation of, say, $10 on a computer screen or in an envelope and then has to allocate an amount (or nothing) to another player, keeping the rest for himself. Both allocator and receiver are paid anonymously. In the first experiment of this type that tested the effect of the presence of subtle eye cues there was an increase in the mean allocation by 31.4%. When the eye images were clearer, allocations rose by an average of 55% (Haley & Fessler 2005). A similar experiment showed the presence of eyes increased altruistic contributions in an economic simulation by 29% (Burnham & Hare 2007).

The first reviews in the field suggested there was a reliable influence of eye cues on prosocial behaviour. Nettle, Bateson, Harper, Kidson, Stone, & Penton-Voak (2012) reviewed 7 studies and found no effect on mean donations (n=887, Cohen's d=0.04,) but an increase in the probability of donating something vs nothing in 5 of the 7 studies analysed (n=887, odds ratio 1.39, 95% CI 1.02–1.91). Sparks and Barclay (2013) reviewed 25 eye cue effect studies and annotated as to whether they found an eye cues effect or not, and whether the eye cue exposure in each experiment was prolonged, short or ambiguous. Of the 16 studies classified as providing a short exposure to the cue, all but one found an effect, similarly 3 of 5 that had "ambiguous" exposures found an effect. In contrast none of the four experiments with "prolonged" exposures found any effect. Sparks and Barclay concluded that people might habituate to eye cues if they were exposed to them for extensive periods, so that an eye cue effect would only occur if exposure was short.

More recent research has seriously challenged whether there is a watching eyes effect at all. A series of failed replications and new experiments have failed to find any consistent evidence for an eye-cue effect (Beyfus et al., 2016; Brudermann, Bartel, Fenzl, & Seebauer, 2015; Bush, Erlich, Prather, & Zeira, 2016; Cai, Huang, Wu, & Kou, 2015; Carbon & Hesslinger, 2011; Fehr & Schneider, 2010; Fujii, Takagishi, Koizumi, & Okada, 2015; Gaiani, Rose, & Roberts, 2014; Golja, 2013; Huang, Liu, Zheng, Tan, & Zhao, 2015; Jackson, 2015; Jolij & de Haan, 2014; Kuliga, Tanja-Dijkstra, & Verhoeven, 2011; Lamba & Mace, 2010; Matland & Murray, 2015; Matsugasaki, Tsukamoto, & Ohtsubo, 2015; Northover, 2014; Northover, Pedersen, Cohen, & Andrews, 2017; Palomäki, Modic, & Yan, 2015; Raihani & Bshary, 2012; Rose, Gaiani, & Roberts, 2014; Sparks, 2010; Sparks & Barclay, 2015; Stella et al., 2013; Tane & Takezawa, 2011; Vogt, Efferson, Berger, & Fehr, 2015; Waktare & Roberts, 2014; White, 2015).

In a recent meta-analysis and review Northover and colleagues (2017) reported no effect of eye cues on the 'proportion who gave' in generosity tasks across 27 experiments, challenging Nettle et al (2012) conclusion that the presence of eye cues increased not the mean donation but the probability of donating something rather than nothing. Furthermore, Northover and colleagues also found that the effect size was extremely small when comparing the difference between mean donations in the eyes/no eyes conditions across 26 dictator games and charitable giving experiments, (ES = .03, SE .05; 95% Confidence Interval crossing zero -.08 to .13) (Northover et al, 2017).

However, some of the experiments which have found their way into recent meta-analyses and reviews were conducted in conditions such that no effect should have been expected. Tane and Takezawa (2011) conducted their dictator game study with participants in darkness, which perhaps confounds any cue to surveillance by conveying anonymity even with the presence of watching eyes. Bourrat, Baumard, and McKay (2011), testing moral judgements under watching eyes, and Northover (2014), in some of her replication attempts, tested participants in the library, where social cues would have already abounded. Lamba and Mace (2010), were perhaps wrongly included in Spark and Barclay's (2013) meta-analysis. They were not testing the eye images effect but rather the actual presence of others.

Carbon and Hesslinger (2011) report their experiment as a failed replication of Bateson et al's coffee bar honesty box experiment (2006), finding no significant difference between eyes and no eyes conditions in their study. Yet Carbon and Heslinger's experiment was not a replication of Bateson et al's field experiment. Rather theirs was a lab-based task inviting participants to respond to given scenarios in a questionnaire, far removed from someone contributing to an honesty box at an office coffee bar (2006). Additionally, Carbon and Hesslinger's control image was designed to mimic stylised eyes schema (see Figure 1), despite the fact that (Rigdon, Ishii, Watabe, & Kitayama, 2009) had already shown that unnatural stylised eye schema, such as three dots in an eyes and mouth configuration, could affect behaviour. Such methodological issues and potentially unreliable results are a concern because the four existing meta-analyses of the eyes effect (Nettle, Bateson, et al., 2012; Northover, 2014; Northover et al., 2017; Sparks & Barclay, 2013) include Tane and Takezawa (2011). Sparks & Barclay (2013) also include Lamba and Mace (2010) and Carbon and Hesslinger (2011).

Figure 1. Carbon & Heslinger (2011)

Despite some potential problems with the selection criteria used in the existing meta-analyses (Northover, 2014; Northover et al., 2017; Sparks & Barclay, 2013) the current research indicates that eye cues may have little effect on prosocial behaviour, which Northover et al (2017) suggest may be attributed to publication bias. We argue that the complexity of the concept of generosity may provide an alternative explanation for the variability in the results. How one's generosity should differ when watched is unclear. While in many cases the presence of another may make us wish to appear less miserly, in other situations, one may fear being seen either, on the one hand, as ostentatiously generous or, on the other, as naïve and vulnerable to exploitation. There is evidence, for instance, that generosity is complex, and that while being seen to be fair rather than selfish enhances reputation, being more generous brings no further reputational enhancement and may be damaging. In contrast, being seen to be unfair or antisocial is simple, damaging, and may bring punishment. Thus, if eye cues provoke subconscious reputational concerns, they ought to reduce selfish and anti-social behaviour, but might not increase generosity and pro-social behaviour.

1.4 Eye Cues & Anti-Social Behaviour

Evidence for the inconsistent effect of generosity on reputation can be found in a series of 11 experiments conducted by Klein and Epley (2014). These show that generosity is not always good for one's reputation. In fact, while some generosity enhances reputation, greater generosity delivers diminishing reputational returns and extreme generosity can be damaging. In one experiment Klein and Epley placed surveys in the programmes of people attending a 'free' University concert, where entrance was free but charitable donations could be made at the entrance. In the survey, Klein & Epley asked concert goers to read a generic description of 'Tom' a fictional fellow concert-goer, followed by details of how much he donated. There were three versions of the description, differing only in how much Tom was said to have donated: $0, $10, or $20. Klein & Epley then asked the reader to rate Tom's character on the two fundamental dimensions of reputation: warmth and competence (Fiske, Cuddy, & Glick, 2007), each measured across five traits. For warmth these were how tolerant, warm, good-natured, sincere, and caring people judged Tom to be. For competence how competent, confident, independent, competitive, and intelligent they thought Tom was. Each trait was judged on a seven-point scale (1 *not at all*; 7 *very much*). No significant difference was found in ratings of Tom's competence across the 3 levels of donation. This is as we should expect given the description was identical bar the figure for how much he donated. However, Tom's warmth was judged more negatively when he behaved selfishly (donating $0, *Mean reputational judgement* = 3.51, *SD* 1.31) than when he behaved fairly (donating $10, *M* 5.29, *SD* .87; $t(48)$ 5.24, *p* .001, *d* 1.60), but he was not judged more favourably when he behaved generously (donating $20; *M* 5.17, *SD* 1.10) than when he behaved merely fairly ($t(40)$ .39, *p* .70, *d* .12). Thus, greater generosity and prosociality did not bring reputational enhancement.

Klein & Epley conducted additional experiments to further test the relationship between prosociality and reputation via Amazon Mechanical Turk and in laboratory based settings with similar results. Competence ratings varied little, but warmth ratings were telling. For example, one laboratory experiment involved 3 participants, none of whom knew the aim of the experiment. The 3 participants were characterized as the actor, who was to give jelly beans to another the recipient, while the observer, watched. Actors were told in their instructions to give one of three set allocations of jelly beans to the recipient to assist with a 'tasting experiment'. Actors were thereby unwittingly induced to behave either selfishly (giving 1 of 10 jelly beans), fairly (giving 5 of 10) or generously (giving 9 of 10). The recipient and observer did not know the actor had been told how many jelly beans to give. After the actor had given the jellybeans to the recipient and the recipient had eaten the beans, the tasting experiment was said to be over. The observer and recipient were asked to assess independently the character of the actor, while the actor was asked to judge how the others would rate his or her character based on his actions. Actors themselves predicted linearly – imagining that the more generous they were the better their character would be assessed. They were wrong. Observers and recipients gave significantly stronger warmth ratings for those that were 'fair' than those who were 'selfish', but those who were generous were not rated more highly than those who were fair. Results consistently showed that there was little or no enhancement of reputation for generous over fair actions. As the authors put it, 'it pays to be nice, but pays no more to be really nice'. Extending this research across 7 countries and cultures has found similar results (Klein, Grossmann, Uskul, Kraus, & Epley, 2015).

It is interesting to note that participants expected to earn a better reputation by being more generous. This common-sense assumption underpins experiments examining the effect of watching eyes on generosity. The evidence suggests it may be an unsound. It is therefore, unsurprising that cues to surveillance, watching eyes, produce varied responses on people's generosity.

Surveillance cues, if they provoke reputational concerns, should have more consistent effects in reducing anti-social and selfish behaviour, than in promoting prosocial acts, because of our acute sensitivity to negative information (Fiske et al., 2007; Rozin & Royzman, 2001). In an extensive review, instructively titled *Bad is Stronger than Good,* Baumeister, Bratslavsky, Finkenauer, and Vohs (2001) show: how we tend to remember bad events longer – thus anti-social acts will echo longer in the memory of the observer than pro-social behaviours; how negative experiences and negative language in relationships exert more influence on ratings of relationship happiness than positive experiences and positive language – thus we might be keener to avoid providing negative experiences or being talked about in negative language than we are to seek to provide positive experiences and be talked about positively; they demonstrate that negative affect (emotion) and emotional distress have a greater and more enduring influence on us than positive affect and pleasant emotions; how we learn faster from negative experiences than positive; how negative events in childhood have greater power than positive events in predicting success in adulthood; how we prioritise the processing of negative over positive information, allocating greater attention to it, and a greater quantity of cognition; how negative stereotypes are more prevalent, more enduring and more influential than positive; how our self-esteem is more sensitive to criticism than it is to praise; and how we respond more to critical feedback than to praise.

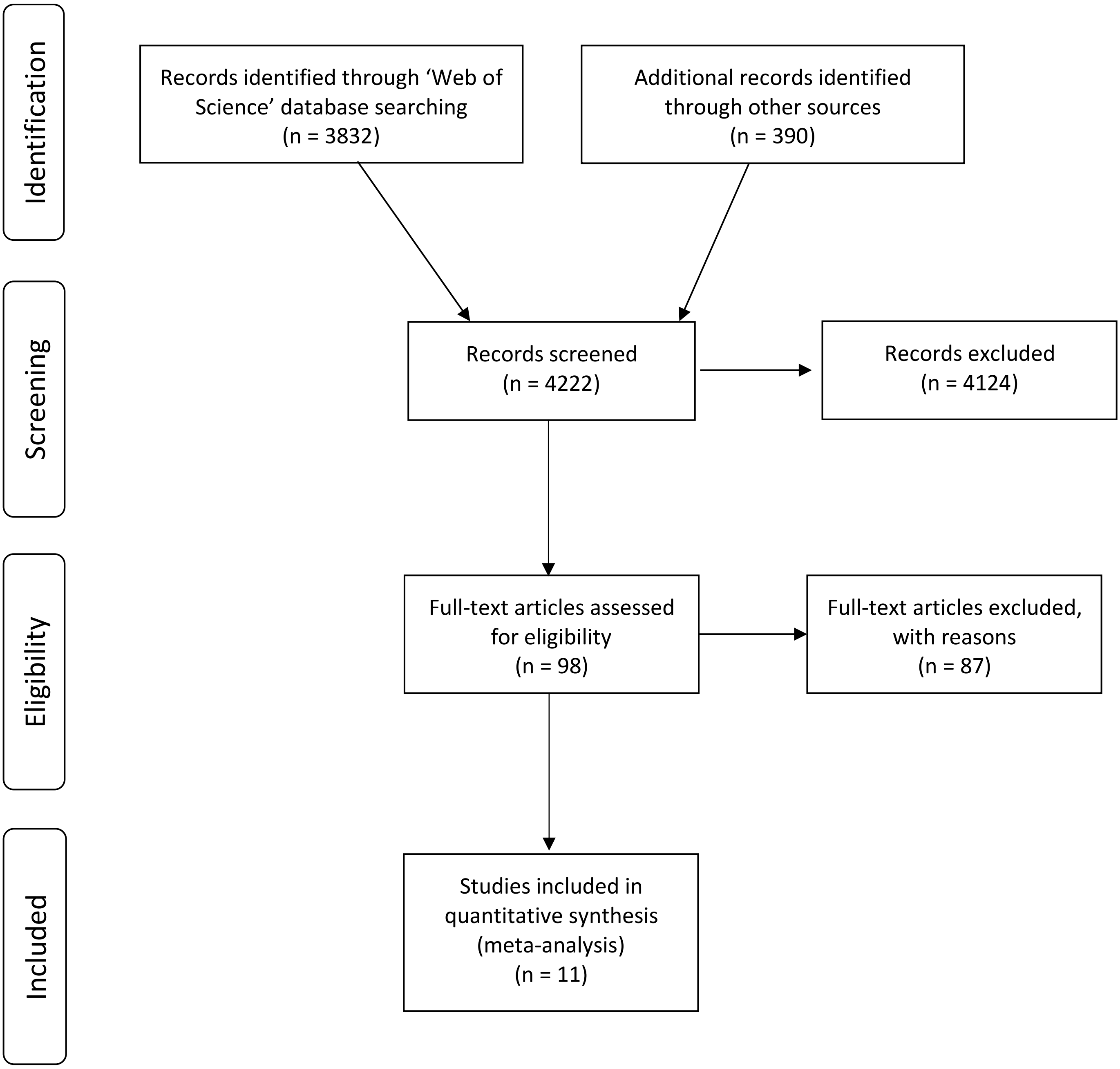
The contention that the reputational threat from displaying anti-social behaviour should be greater and more consistent than that from failing to show generous behaviour is supported by evolutionary psychological evidence too. Punishment in social groups is necessary for group success, preventing free-riding and social infractions, enforcing hierarchy to enable group functioning and ensure group cohesion (Fehr & Gachter, 2002; Gürerk, Irlenbusch, & Rockenbach, 2006). Indeed, an acute fear of being watched may have been essential for social groups to succeed in order to enforce norms without constant combat and punishment, while the difficulty of extending surveillance beyond the small groups of our early evolutionary history may have been responsible for the evolution of all-seeing, punishing supernatural agents – gods – who could ensure we all felt watched even in the absence of others (Johnson, 2016). We should therefore expect stronger, more consistent responses to reputational threat (being seen to behave anti-socially) than ambiguous reputational opportunity (being seen to be generous).

Thus, the impact of eye cues on anti-social behaviour may be more consistent than on pro-social behaviour and therefore more likely to inform real-world interventions.

The eye cue effect on anti-social behaviour is already being put to practical use across Britain. West Midlands Police in 2006 used 100 buses to promote the message 'We're Keeping an Eye on Crime' along with a picture of eyes to reduce cycle and other theft (West Midlands Police, 2006). British Police in the Nottinghamshire town of Hucknall claim posters of eyes reduced crime by 40% (Flanagan, 2013). There has been a proliferation of small-scale interventions across Britain, predicated on the existing research but rarely with an evaluative design. Personal observation by the authors has noted eye cues placed above sinks in several offices to encourage washing up, used to deter crime in sports centre changing rooms, as well as at London's Waterloo, King's Cross, and Paddington rail stations. Press reports indicate that the posters have been used across Britain's rail network to deter crime (BBC News, 2013; Basildon, Canvey & Southend Echo 2013) . Eye cues have been used to reduce dog fouling with a claimed effectiveness of 91% in Harrogate (Parkinson, 2015) and between 4-78% across locations in Cambridge (Cambridge News, 2014; Taylor, 2014). At the time of writing eye cues are appearing at motorway service stations across Britain as Keep Britain Tidy expands an initiative to reduce littering by drivers – reporting preliminary results suggesting eye cues have caused a reduction in littering rates by 23% (Extra Services, 2015; H.M. Government (UK), 2017); they are being added to trees to reduce littering in the Forest of Dean, and being used by Britain's HM Revenue and Customs Service to discourage tax evasion (BBC News, 2015; Knapton, 2016; Nelson, 2013). So well established is the idea in policy circles that the UK Government's 2017 National Anti-Littering Strategy recommends the use of watching eyes interventions to reduce littering (H.M. Government (UK), 2017). Given our hypothesis and its practical implications, we focus our meta-analysis on the watching eyes' effect on anti-social behaviour.

2.1 Methods

PRISMA 2009 Flow Diagram



PRISMA flow diagram after Moher, Liberati, Tetzlaff, Altman, and Group (2009) and Shamseer et al. (2015)

2.2 Types of intervention

We reviewed 98 full-text articles comparing between groups exposed to eye cues and those in a control condition. We examined both laboratory and field experiments. We considered for meta-analysis 16 articles identified as examining the watching eyes effect on anti-social behaviour, excluding a further two due to issues with the experimental design or the unavailability of data as described below.

2.3 Types of outcome measures

The primary outcome measure for the meta-analysis was anti-social behaviour.

2.4 Search strategy

Initially, we conducted a full search without limitation by outcome measure to document all eye-cue relevant research in one place for the first time. In order to take as full a view of the watching eyes field as possible we searched Web of Science by topic using the search terms "Watching Eyes", “eye cues”, "eye cue", "eye spot", "eyespot", "eye-like", "social cues", "eye-images", "watching you", “surveillance cues”, “images of eyes”, “observation cues”, “perception of human face”, “face cues”, “cues of observation”, “gaze cues”, "implicit gaze", “implicit observability” "eye primes", and by title using the terms "implicit social", "watching you", "social eyes OR social-eyes" (See Additional Materials for full details of our search strings). We excluded duplicates as we searched counting only studies not previously identified using earlier search terms. We identified studies in the bibliography of the most recent and thorough review (Northover et al., 2017), and we identified 4 studies by author search when alerted to their interest in the watching eyes effect. Two studies were identified via the abstract booklet of the *Decepticon* conference attended by a colleague (Palomäki et al., 2015; Traver & Cordell, 2014). We searched studies using Google Scholar's 'cited by' function to identify further research in different domains that we might not otherwise have found (generosity in field and lab, voting behaviour, minimal cues), identifying a further 15 studies. Seeking real-world applications of the research we conducted a general web search using Google, finding a further large-scale field experiment (and a number currently underway). All searches are documented in the Excel tabulation in 'Additional Materials' and provide a comprehensive overview of the 48 different outcome measures identified ranging from the watching eyes effect on generosity and hand-washing to their influence on choice justification and poker risk-taking.

2.5 Meta-Analysis Study selection

All studies containing the search terms were reviewed by title and abstract. Where their relevance remained unclear the full text was accessed. Studies were eliminated from, or included in the review in this way on the first search. Further refinement for the meta-analysis was undertaken following the recording and categorization of the studies [See Excel spreadsheet in additional materials, tab 2].

With all watching eyes studies documented in Excel format we filtered the table to identify watching eyes studies examining anti-social behaviour, selecting from the column 'outcome measure' the anti-social behaviour categories: 'Amount Taken', 'Anti-Social Behaviour', 'Cheating', 'Corruption', 'Cycle Theft', 'Dishonesty', 'Dog Fouling', 'Honesty' 'Littering', and 'Lying' which returned 16 papers. All others were excluded as they did not examine anti-social behaviour [this process can be replicated via the Excel database in additional materials]. The 16 papers selected all studied behaviours that met the Oxford English

Dictionary definition of anti-social, that is ‘contrary to the laws and customs of society, in a way that causes annoyance and disapproval in others’.

From these 16 papers we excluded five. Bateson, Nettle, & Roberts’ 2006 study of the effect of images of watching eyes on donations to a coffee bar was excluded as it was uncertain whether their experiment examined anti-social behaviour or generosity. Their experiment counted how much was in the honesty box at the end of weeks where eye images were displayed, and compared this with how much was in the box at the end of weeks where flowers were displayed as a control. The experiment did not count or track how much individuals donated, or how many donated and how many did not. We cannot therefore know whether in their experiment eye cues increased the generosity of those who would have donated anyway, or whether their use of eye cues caused people who would have free-loaded, and failed to donate, to contribute, and thus was a test of the eye cue effect on anti-social behaviour (or whether their result was a combination of both the eye cue effect increasing generosity and in reducing anti-social free-riding). Therefore, whether Bateson et al’s (2006) findings show the eye image effect on generosity, on conformity to norms, or on anti-social behaviour is unclear, and led to our decision to exclude the positive findings of their experiment from our meta-analysis. The same criteria resulted in the exclusion of Bruderman et al’s (2015) field experiment examining contributions to newspaper honesty boxes.

We excluded Oda, Kato, and Hiraishi’s (2015) study examining the eyes effect on lying principally because their design aimed to make lying pro-, as opposed to anti-social. Oda et al attempted to separate pro-sociality and norms. In their experiment participants were asked to report the number rolled on dice visible only to the participant, affording them the opportunity to lie. The experimenters promised that they would donate the amount reported to the Japanese Red Cross. The idea was to compare the expected frequencies with the reported frequencies, to see if people lied more or less when eyes were present. Oda et al hypothesized that this would enable them to test whether the eye effect reinforced social norms - which they state would be telling the truth, *not* lying and accurately reporting the number rolled - or whether it encouraged prosocial behaviour as evidenced by participants lying and exaggerating the number rolled to achieve the prosocial outcome of more money being given to charity. However, we suggest that in a situation where no one is harmed and there is an opportunity to give money to charity, that telling 'little white lies' to benefit the charity may well be the social norm. This is true both when one considers the injunctive norm, the objective 'right thing to do' – 'What would other people think I should do in this situation?' - and if one considers the descriptive norm: 'What would most other people do this situation?'. In both cases, lying to give more to charity seems a reasonable conclusion. Thus we argue that Oda et al were unable to demonstrate whether eye cues encourage prosociality or reinforce social norms and exclude their results from our analysis.

Traver and Cordell's paper (2014) was excluded as we could not create a dichotomous variable suitable for our odds ratio-based meta-analysis. They examined the eye cue effect in a coin toss and a dice roll experiment (where flipping a head or rolling a higher number brought a greater reward) reporting the number of outcomes against the expected frequencies to identify how frequently people lied to gain personal advantage. We could not calculate the frequency of lying vs not lying from the proportions as all frequencies lay within one standard deviation of the expected frequencies, and thus could have been down to chance.

Finally one study, (Chowdhury, Jeon, & Saha, 2014) was excluded as the authors were unwilling to share additional data because they are seeking re-publication of their paper. There was insufficient information reported in the current paper to assess dichotomously who did and did not behave anti-socially [data requested and refused in writing on 12/13 October 2016 & 23 August 2017].

The 11 studies remaining reported results for a total of 14 experiments. We transformed all findings into dichotomous variables to test the simple effect of eye cues on anti-social behaviour via a Risk Ratio. This measure is intuitively meaningful because it indicates the relative change in frequency of anti-social behaviour in the experimental condition or area compared with the control condition or area. For example, in the study by Ernest-Jones, Nettle, and Bateson (2011) of littering in a café we transformed the data into 'littered/did not litter' variables from the original data, this comes at the cost of hiding significant interactions – in Ernest-Jones' et al's study for example they did find a significant effect of eye cues, but only when >6 people were present.

The same approach was taken with three other experiments examining the eye cue effect on litter (Bateson, Callow, Holmes, Roche, & Nettle, 2013; Bateson et al., 2015; Zengerink, 2013). However, since we are interested in the main effect of eye cues on behaviour, the exclusion of moderating and mediating variables is justified. Similarly we reinterpreted the data from Cai et al. (2015) examining whether eye cues affected participants' tendency to lie for personal advantage to show the frequency of lying or not lying in the eyes and control condition. Again Palomäki et al. (2015) examined the effect of eye cues on lying, in their case in an online simulated insurance claims process. We re-analysed their data to provide a dichotomous outcome lied/did not lie. We reinterpreted Hoffman et al.'s data from their study of the effect of robot eyes on lying (2015) to provide dichotomous proportions of those that cheated/did not cheat and reinterpreted the proportions as frequencies. Huang et al. (2015) examined whether participants would bribe or not bribe in scenario-based economic games studying corruption. Their experiments 2 & 3 included an eye cue/no eyes condition enabling this data to be translated for meta-analysis. In Baillon et al's *Joy of Destruction* game (2013) participants could pay a small cost to destroy part of a payoff to another participant gaining nothing in the process but the possible satisfaction of damaging the other's interest. We transformed their data to report destroyed/did not destroy in the eyes and control conditions. Finally, in an extended analysis, we included Nettle, Nott et al's (2012) examination of the effect of eyes on cycle crime and Keep Britain's tidy's (2014) eye cue intervention designed to reduce dog fouling in public places.

2.6 Risk of bias in individual studies

Summary Measures. For the first of our two analyses we identified studies comparing the number of participants behaving antisocially or not in an eyes and a control condition in order to enable the calculation of the log odds ratio as a measure of effect size. The odds ratio as used in one of the landmark watching eyes/anti-social behaviour experiments by Nettle, Nott, et al. (2012), was selected as the measure of effect size as recommended by Welsh and Farrington (2009) for meta-analysis of location-based crime interventions, and by Lipsey and Wilson (2001) for meta-analysis of inherently dichotomous variables. Odds ratios are centred around 1 rather than zero (where 1 indicates no relationship, values 0-1 a negative relationship and values greater than 1 a positive relationship). This distribution makes meta-analysis interpretation complex. However, the log odds ratio is distributed approximately normally with a mean of zero and a standard deviation of 1.83. This allows us to show a negative effect (a reduction in anti-social behaviour when eyes are present) with a negative value (or a positive effect with a positive value) simplifying interpretation and calculation. Thus we selected the log of the odds ratio as our effect size, later transforming it to a risk ratio to enable easier communication of our findings to a lay audience.

	Anti-Social Behaviour (ASB)_YES	*ASB_NO*
Eyes Condition (Group 1)	(a)	(b)
Control (Group 2)	(c)	(d)

The log odds ratio effect size is calculated after Lipsey and Wilson (2001):

$$OR = \frac{(a * d)}{(b * c)}$$

Equation 1

$$OR_{log} = log_e(OR)$$

Equation 2

The logs odds ratio standard error and inverse variance weight are calculated as:

$$SE_{LOR} = \sqrt{\frac{1}{a} + \frac{1}{b} + \frac{1}{c} + \frac{1}{d}}$$

Equation 3

$$W_{LOR} = \frac{1}{SE_{LOR}^2}$$

Equation 4

We applied Cochran's Q test to estimate whether the individual effect sizes were representative of the population values:

$$Q = \left(\sum W_i\, ES_i^2\right) - \frac{(\sum W_i\, ES_i)^2}{\sum W_i}$$

Equation 5

Finding a statistically significant Q indicates a heterogeneous distribution, greater than that to be expected from subject level sampling error alone. A significant Q value therefore suggests it may be appropriate to apply a random effects model to account for variance from random effects, such as differences in experimental design and other sources. We first calculated the random effects variance (V_θ).

$$V_\theta = \frac{Q - (k - 1)}{\sum W_i - (\sum W_i^2 / \sum W_i)}$$

Equation 6

where k is the number of effect sizes, and W_i is the inverse variance weight for each effect size. The random variance was then added to the sampling error and the inverse variants weights recalculated as $\frac{1}{(V_\theta + SE_{LOR}^2)}$

Equation 7

The log odds ratio was then recalculated using the new weights.

Finally, we calculated and report the risk ratio which may be more easily and intuitively interpreted for translational research than the log odds ratio, since it can be reported either as a proportion or a percentage difference between conditions (Chen, Cohen, & Chen, 2010; Davies, Tavakoli, & Crombie, 1998; Higgins & Green, 2008; Zhang & Yu, 1998).

	Anti-Social Behaviour (ASB) ASB_YES	*ASB_NO*	*N = Number of Participants*
Eyes Condition (Group 1)	(a)	(b)	N_{EYES}
Control (Group 2)	(c)	(d)	$N_{CONTROL}$

$$Risk\ Ratio = \frac{a\ /\ N_{EYES}}{c\ /\ N_{CONTROL}}$$

Equation 8

The RR was then transformed via a random effects model calculated by the same procedure as outlined for the log odds ratio, providing our final value.

However, Nettle, Nott and Bateson's field study examining the eyes effect on cycle theft could not report how frequently people did not behave anti-socially (i.e. how many were 'exposed' to the experimental and control conditions and chose *not* to steal bikes). Instead, they report only the frequency of anti-social behaviour across experimental and control locations. We selected the incidence ratio (sometimes called the rate ratio) as the appropriate measure of effect size. Such a rate ratio is calculated by controlling for any change in behaviour in both experimental and control locations before and after the intervention (CTSPedia, 2009). Similarly, the experiment run by Keep Britain Tidy (2014) examined the number of dog poos found in areas around signs with eyes, compared with control areas (or displacement areas, as they characterized them), counting only totals of dog poos for a minimum of 3 weeks before and 3 weeks after at 240 sites. Keep Britain Tidy had 4 types of poster, all with eyes, but with differing text to examine whether this increased or decreased the effectiveness of the intervention. These four poster designs all had pictures of eyes and the text ‘Thoughtless Dog Owners, We’re Watching You’, the first type had no further text, the three others added different messages to try to select the most effective wording. Because in this meta-analysis, we are interested only in the main effect of eyes, we collapsed the data for the four eyes posters into one experimental condition. Furthermore, we reinterpreted Keep Britain Tidy’s ‘displacement areas’ as controls. Their displacement areas were described as spaces without signs where dog fouling was monitored and measured concurrently with the monitoring and measurement of dog fouling at experimental locations before and after the signs were put up. They were selected because Keep Britain tidy expected that dog owners would not allow their dogs to foul where the eyes signs were, but would allow them to in adjacent areas, as soon as the signs were out of sight. This was based on the findings of Nettle, Nott and Bateson’s cycle crime experiment, where cycle crime went up at control cycle sheds at the same rate it went down at the sheds with eyes signs. Since Nettle, Nott and Bateson used adjacent sites as controls, we treated Keep Britain Tidy’s displacement sites as controls to ensure equivalence and enable comparison.

	Before (ASB = Cycles stolen / dog poos in area)	After (ASB = Cycles stolen / dog poos in area)
Experimental Locations (sheds / areas where eyes signs were introduced in the ‘after’ time period)	(a)	(b)
Control Locations (sheds / areas where no eyes signs were introduced in the ‘after’ time period)	(c)	(d)

$$Incidence\ Rate\ Ratio = \frac{a/b}{c/d}$$

Equation 9

Analyses were performed in R 3.1 using the METAFOR package's random effects model function. R Script is provided in Additional Material to aid with replication of our analysis (R Development Core Team, 2016).

3.1 Results

Table 1 ***Studies in the Anti-Social Behaviour (ASB) Meta-Analysis***

	Citation, Experiment Number	Outcome Variable	Eye Cues Present			Control					
			N	**ASB Yes**	**ASB No**	***N***	**ASB Yes**	**ASB No**	OR_{log}	Var_{LOR}	SE_{LOR}
1	Ernest-Jones et al (2011)	Litter	273	56	233	289	98	175	-0.85	0.04	0.20
2	Bateson et al (2013)	Litter	305	80	225	297	83	214	-0.09	0.04	0.18
3	Baillon et al (2013)	Destruction of others money	51	9	42	49	19	30	-1.08	0.22	0.47
4	Zengerink (2013)	Litter	630	297	333	314	170	144	-0.28	0.02	0.14
5	Bateson et al (2015), Experiment 1	Litter	147	8	139	137	23	114	-1.25	0.18	0.43
6	Bateson et al (2015), Experiment 2	Litter	216	31	185	97	25	72	-0.73	0.09	0.30
7	Cai et al (2015), Experiment 1	Dishonesty	66	30	36	65	31	34	-0.09	0.12	0.35
8	Cai et al (2015), Experiment 3	Dishonesty	64	18	46	66	22	44	-0.25	0.15	0.38
9	Hoffman et al (2015)	Dishonesty	20	7	13	20	9	11	-0.42	0.42	0.65
10	Palomaki et al (2015)	Dishonesty	105	13	92	86	9	77	0.19	0.21	0.46
11	Huang et al (2015), Experiment 2	Corruption	24	10	14	24	9	15	0.17	0.35	0.59
12	Huang et al (2015), Experiment 3	Corruption	30	11	19	31	24	7	-1.78	0.33	0.57
				Experimental Locations			**Control Locations**				
		Outcome Variable	***N***	**Frequency of ASB Before**	**Frequency of ASB After**	***N***	**Frequency of ASB Before**	**Frequency of ASB After**	OR_{log}	Var_{LOR}	SE_{LOR}
13	Nettle et al (2012)	Cycle Theft	N/A	31	51	N/A	39	15	-1.45	0.14	0.38
14	Keep Britain Tidy (2014)	Dog Fouling	N/A	681	350	N/A	2159	1208	0.08	0.01	0.07

We conducted a homogeneity analysis test to examine the assumption that all of our effect sizes were estimating the same population mean. Our Q-test for homogeneity of variance was significant (Q(11) = 25.37, p = .008), suggesting significant heterogeneity across our studies and requiring us to fit a random effects model to the data. The random effects model produced a meta-analytic effect size of $OR_{log} = -.49$, (SE = .14, 95% CI [-.78 to -.21]). Thus our model suggests the presence of eyes reduced anti-social behaviour. Transforming our effect size to aid with interpretation we found an Odds Ratio (via $OR = e^{OR_{log}}$) of .61, suggesting a c. 40% reduction between conditions. However, since it has been noted that odds ratios can over-estimate the true effect size and that they have been critiqued for being an overly complex and perhaps misleading guide to relative risk (Schmidt & Kohlmann, 2008), we took our analysis one step further and calculated a more readily interpretable relative risk ratio between conditions. The result shows a 33% reduction in anti-social behaviour between the eyes and control conditions (*RR* = -.33, SE = .1, 95% CI [-.52, -.13]). A forest and funnel plot show no evidence of over-dispersion (See figures 2 & 3). In addition, we conducted a test for missing values (after Duval and Tweedie, 2000) finding no evidence to suggest missing reports or publication bias.

Extending our analysis to include Nettle, Nott & Bateson's cycle crime experiment (2012) and Keep Britain Tidy's (2014) dog fouling intervention, we expected and found greater heterogeneity, but little change in the effect size, given that Keep Britain Tidy's large scale experiment found a small increase in anti-social behaviour in the eyes areas in comparison with the control, sufficient to offset the large effect size found in Nettle, Nott & Bateson's cycle crime experiment (OR = 0.82, 95% CI [0.75, 0.92]; OR Log = -0.19, SE = .05). Calculating the Risk Ratio we find a significant Q-value showing greater heterogeneity (Q(13) = 58.44, p = <.0001) than in our initial meta-analysis. Fitting a random effects model to the data our meta-analytic effect size is now $RR = .32$, SE = .09, 95% CI [0.13, 0.50] p = <0.0009, suggesting the presence of eye cues correlates with a reduction in anti-social behaviour of 32%. In Nettle, et al's study the control differed from the experimental stimulus in more ways than just the presence of eyes. The control was no intervention at all, whereas the experimental stimulus was a sign which had eyes but also a police logo and a verbal message. Consequently, it might be argued that either the police logo or the text alone, or the two in combination, caused the reduction in the cycle theft, and not the watching eyes. Similarly, Keep Britain Tidy's intervention posters all included text and various organizational logos. Given the difference in experimental design between Nettle et al (2012) and Keep Britain Tidy (2014) and the other studies included in our analysis we report our overall effect size based on our first, more carefully selective, model.

Figure 2. Forest plot of experiments included in the meta-analysis

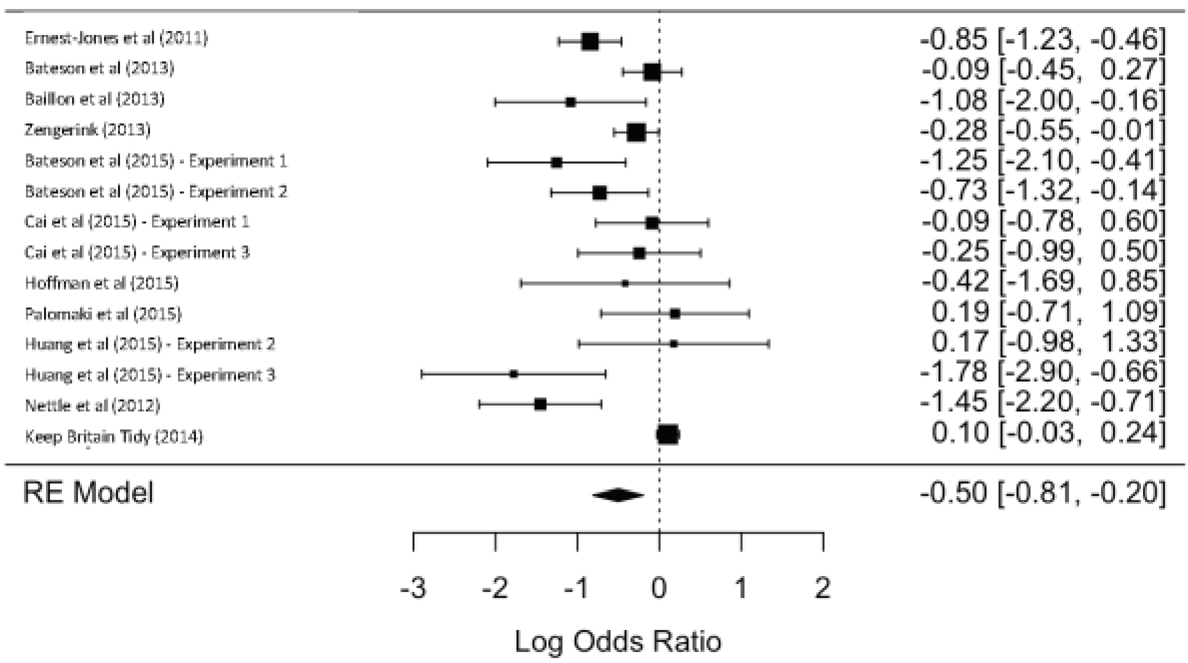
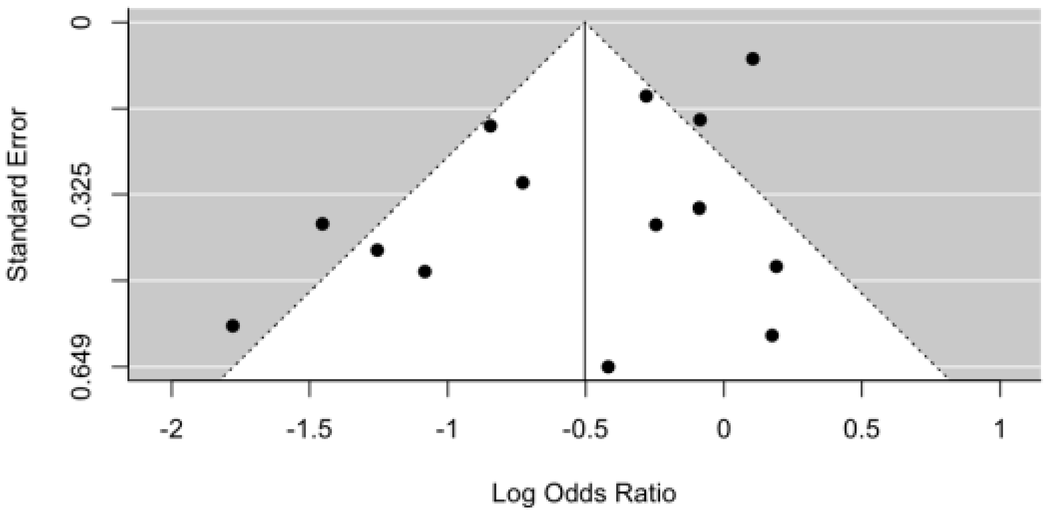


Figure 3. Funnel plot of experiments included in the meta-analysis



4.1 Discussion

In this section we first seek to reconcile our meta-analytic findings with those of Northover et al (2016), and second, extend our eye-cues and anti-social behaviour analysis descriptively. We think this the appropriate way to frame the discussion, given the current replication crisis in psychology (Aarts et al., 2015) and the questions Northover's work raises on the validity of the eye-cue effect. However, it is important to note that there are valid criticisms of Northover's analysis, and no-one, including Northover and colleagues, suggests that their meta-analyses provide definitive evidence that eye cues have no effect on generosity.

Our meta-analysis finds a large effect size, indicating a reduction in anti-social behaviour in the presence of eye cues (*RR=.32*). In marked contrast, in both of the meta-analyses by (Northover et al., 2017) a vanishingly small effect of eye cues on generosity was found. This is true both when comparing the mean difference in donations between an eye cue and a control condition ('mean difference' analysis = .03, SE = .05, 95% CI −.08 to .13), and when examining the probability of donating something rather than nothing ('proportion who gave' analysis, $\mathrm{OR}_{\log} = .16$, SE .10, 95% CI $-.04$ to .35). How do we reconcile our findings that eye cues have a large effect in reducing anti-social behaviour with those of Northover et al. that show no effect of eye cues on generosity?

There has been a broad consensus since the first eye cues experiments (Burnham, 2003; Burnham & Hare, 2007) that if eye cues work it is by making us feel watched. Burnham and Hare called this 'the evolutionary legacy hypothesis' the idea that we have a pronounced responsiveness to feeling watched, adapting our behaviour to protect us from predation, and, later, in social groups, to protect our reputation. If this is so, we should consider the reputational consequences of behaviours when predicting whether eye cues are likely to elicit a strong effect on decision making, and in predicting the direction of any effect. In seeking to reconcile our findings with Northover's. we first consider recent experimental evidence that upholds the intuitive idea that eye cues cause people to feel watched. If eye cues make us feel watched, if feeling watched makes us more aware of our reputation, then the difference between Northover's meta-analytic findings from our own is best explained by the variable effect of generosity on reputation, in comparison with the consistent effect of anti-social behaviour on reputation, as outlined earlier.

Pfattheicher and Keller (2015) have provided the most persuasive evidence that eye cues make us feel watched. In two experiments they showed first that eye cues made people feel watched, and second that those most sensitive to being watched were more responsive to eye cues. In the first experiment, participants read a scenario in which they were asked to imagine wearing an embarrassing T-shirt while walking in a busy corridor with 30 people present or on a train with 50 people in the compartment. The participants were then asked to report how many people they thought would notice them. Their results showed that those entering their estimation on a page with eye cues in the header thought significantly more people would notice them than those in a ‘no eyes’ control. Eye cues seemed to make people feel more watched. In the second experiment they showed that participants’ sensitivity to being watched predicted their responsiveness to eye cues. Measuring participants’ sensitivity to being watched on the public self-awareness scale (Fenigstein, Scheier, & Buss, 1975) (completed online via Amazon Mechanical Turk) they showed that those with very high or chronic self-awareness were more likely to donate some of their participant-payment to a charity if they completed the public self-awareness scale with eye cues present on the screen than in a no-eyes control, whereas those with low public self-awareness showed no difference between conditions.

Keller & Pfattheicher’s experimental findings suggest that it is by making us feel watched that eye cues affect behaviour. First, they found that eye cues make people feel more watched. Second, they showed that people’s differing sensitivity to being watched predicts their responsiveness to eye cues (Pfattheicher & Keller, 2015). If this is true, we can expect eye cues to have similar effects on our behaviour to the presence of other people.

Psychologists have long shown that the ‘mere presence’ of others can affect behaviour (Markus, 1978; Zajonc, Heingart, & Herman, 1969), that gaining cooperative benefits depends often on sustaining a good reputation (Barclay, 2013; Izuma, 2012; Van Vugt, Roberts, & Hardy, 2007), and that reducing anonymity can make people more cooperative as it puts their reputation at stake (Yoeli, Hoffman, Rand, & Nowak, 2013). If eye cues make people feel watched, and thereby affect decisions and change behaviour, it is likely that they do so by prompting people to give greater consideration to their reputation.

Consequently, we suggest that Northover et al (2016) may have found no effect of eye cues on generosity because whether one should give more or less when watched is not clear.

Nettle et al found in their dictator game that eye cues affected people's decisions as to whether to be generous or not in opposite directions. (Nettle, Bateson, et al., 2012). Similar effects were found in a taking game (an inverse dictator game). Participants who took a lot in the control condition took less when eye cues were present, whereas participants who took very little in a control condition took more in the presence of eye cues (Chowdhury et al., 2014). Although Northover et al (2016) showed there is no consistent shift in the proportion who gave when eye cues were present, it does seem that eye cues can both increase and reduce generosity dependent on the situation, suggesting that perhaps we should not expect consistent eye cue effects on generosity. Such a conclusion accords with the logic that being too conspicuously generous is not always reputation-enhancing, and perhaps explains why the effects across the different experimental designs analysed in Northover et al (2016) produce conflicting effects and a neutral over-all effect size.

In contrast, our meta-analysis suggests watching eyes produce a more consistent and robust effect on anti-social behaviour – the result, we suggest, of there being few situations, regardless of individual differences, in which being observed engaging in anti-social behaviour might be seen to be advantageous.

4.2 Summary of Evidence

Our meta-analysis has shown that the presence of watching eyes reduces the risk of anti-social behaviour by 32%. We note that this contrasts with a recent robust meta-analysis on the effect of eye cues on generosity, which showed an effect size close to zero (Northover et al 2017). We suggest this may be a product of individual differences and the complexity of the concept of generosity in the context of observation.

4.3 Limitations

Our meta-analytic model incorporates varied experimental designs which may weaken the overall findings. Stronger evidence for the eye cue effect on anti-social behaviour would have been forthcoming had there been more replications of successful experiments and less design diversity. Our meta-analysis also rests on narrow foundations and it would be premature to place too much weight on our findings without further research. Additionally, we might be seeing a typical spate of strong effects in early research in the antisocial behaviour field, and thus an exaggerated effect size. Finally, in looking only at the main effect of eye cues, we have coded data as having shown no effect in Keep Britain Tidy's 2014 experiment when the authors reported an effect in more nuanced analyses accounting for mediating and moderating variables. As more studies are published examining the watching eyes effect on anti-social behaviour, more nuanced meta-analysis will be possible providing greater insight than we are able to.

4.4 Conclusions

Our meta-analysis of the eye cue effect on anti-social behaviour suggests eye cues may reduce anti-social behaviour by 32%. Using the standard criteria (Chen et al., 2010) this would be below the threshold for a small effect, but what matters here is not whether an effect size is large or small according to statistical guidelines but rather whether the effect size is meaningful (Aberson, 2011; Coe, 2002). In criminological analysis, for example, even smaller effect sizes may suggest significant crime declines (Weisburd, Telep, Hinkle, & Eck, 2010).

Our effect size, a 32% risk reduction for anti-social behaviour when eye cues are present, represents a meaningful effect in real-world terms. In its last *Costs of Crime* report the UK's

Home Office estimated that crime costs the UK economy between £35bn and £60bn a year (Brand & Price, 2000). Taking the lower end of the estimate, a 1% reduction in crime might be said to equate to a saving of £350,000,000. While we do not claim the watching eyes effect is anything like a panacea, the evidence so far suggests it could be a highly cost-effective criminal deterrent in some circumstances.

Finally, we suggest that the watching eyes effect provides a useful route to studying the wider effects of surveillance on behaviour, allowing researchers to test the effect of feeling surveilled independent of the confounding effects of deterrence or reputational concern. Our meta-analytic evidence suggests that just feeling watched can cause people to reduce criminal and anti-social behaviour and, as such, is likely to lead to a further proliferation in the application of the watching eyes effect in real-world interventions. An important focus for this research must be whether people habituate to eye cues over time, or whether the effect is robust. If such field experiments and government initiatives incorporate an evaluative design, they might yet yield significantly greater evidence to challenge or support our findings.

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