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"I can see it in your eyes": Biased Processing and Increased Arousal in Dishonest Responses

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ABSTRACT

According to self-maintenance theory, people notice their dishonest acts and thus experience ethical dissonance between their misconduct and their positive moral self. In this view, dishonesty is facilitated by justifications that redefine moral boundaries. By contrast, the bounded ethicality approach suggests that biased perception prevents people from becoming aware of their dishonesty. We tested the key process assumptions behind these accounts using pupillary responses and fixation data and found physiological evidence for both kinds of mechanisms. In particular, physiological arousal increased at the initial stage of cheating responses. This suggests that people are on some level aware of their wrongdoings. At the same time, however, we found attentional biases that can reduce the likelihood for detecting potentially disadvantageous information. We suggest that dishonest acts come at the internal cost of increased tension, which people aim to avoid by pre-emptive biased processing as well as post hoc justifications. Copyright © 2015 John Wiley & Sons, Ltd.

KEY WORDS pupil dilation; eye tracking; dishonesty; justifications; bounded ethicality

> Why do almost all people tell the truth in ordinary everyday life? […] The reason is, firstly because it is easier; for lying demands invention, dissimulation, and a good memory (Nietzsche, II.54, 1878/1996).

Nietzsche's initial surmise suggests that most people tell the truth most of the time. Nevertheless, lying and cheating abound in everyday life (e.g., Ariely, 2012; DePaulo *et al*., 1996). For example, in a diary study on dishonest behavior, college students and community members reported telling 1–2 lies a day (DePaulo *et al*., 1996). In a like manner, real-life stories of lying and cheating can be found in all walks of life, from personal relationships (Canner, 2008) and sports (Zimniuch, 2009) to the workplace (Murphy, 1993) and academia (DeAndrea *et al*., 2009; Weinstein & Golden, 2007). These examples are supported by a growing body of laboratory studies that have consistently demonstrated the prevalence of dishonesty among ordinary people (Ayal & Gino, 2011; Gino, Norton and Ariely, 2010a; Gneezy, 2005; Mazar *et al*., 2008; Schweitzer *et al*., 2004; Shalvi *et al*., 2011; Shalvi *et al*., 2012). For example, Mazar *et al*. (2008) asked participants to solve 20 adding-to-10 arithmetic problems under time pressure and paid them based on the number of problems they solved correctly. Without the opportunity to cheat, participants were able to solve, on average, fewer than four problems. However, when they were given the chance to lie about their performance, participants claimed that they managed to solve about six problems, on average, correctly. Interestingly, dishonesty in these studies did not stem from the actions of a few people who cheated to the maximum extent possible but rather from the actions of many people who cheated by only a little bit. Because by only cheating to a small extent people forgo personal profit, it is likely that there are reasons for limiting dishonest behavior, which can be classified as having either internal (e.g., cognitive effort and experienced tension) or external (e.g., expected punishment) costs.

The prevalence of such dishonest behavior comes as a striking contrast to decades of research in social psychology suggesting that people strive to maintain a positive self-image (Adler, 1930; Allport, 1955; Jones, 1973; Rogers, 1959; Rosenberg, 1979), value honesty and morality (Chaiken *et al*., 1996; Greenwald, 1980; Sanitioso *et al*., 1990), and perceive themselves as highly moral (Aquino & Reed, 2002). This apparent disparity between people's unethical behavior and their desire to maintain a moral and positive self-image creates ethical dissonance (Ayal & Gino, 2011), which (similar to classic cognitive dissonance; Festinger, 1957) leads to psychological distress that requires tension-reduction mechanisms (Barkan *et al*., 2012). For instance, Barkan *et al.* proposed the "pot calling the kettle black" phenomenon, where people compensate for their own misdeeds by judging others more harshly as a post hoc tension-reduction mechanism that helps people to distance themselves from prior unethical behavior. Similarly, Zhong and Liljenquist (2006) suggested that wiping one's hands served as a moral cleansing mechanism that enabled people to "wash away" the tension associated with previous unethical acts. However, the fact that people are able to simultaneously benefit from dishonest behavior while still maintaining a positive perception of themselves as moral individuals (e.g., Bazerman & Tenbrunsel, 2011; Erat & Gneezy, 2012; Greenberg, 2008; Hilbig & Hessler, 2012; Schurr *et al*., 2012; Terpstra *et al*., 1993; Thau *et al*., 2007) suggests that similar mechanisms are employed before (or during) these

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acts. Nevertheless, the mechanisms that people use to avoid anticipated ethical dissonance and the cognitive processes underlying their tension-reduction mechanisms have not yet been carefully investigated (cf. Ayal *et al.*, 2015; Bazerman & Gino, 2012).

In this article, we address these issues by using eye-tracking data and pupil dilation on top of choice behavior. First, we measured cheating on the level of choice to capture behavior that could be due to both conscious (i.e., people being aware of the correct answer and intentionally lying) and unconscious (i.e., people not even being aware of the correct answer because of unconscious biased processing) cheating. Next, we examined differences in information search patterns and physiological arousal between trials with honest versus dishonest responses to investigate the cognitive process underlying minor dishonest acts and particularly with the aim to tease apart conscious and unconscious sources for cheating. Moreover, gradual manipulations of task difficulty enabled us to test for the effect of ambiguity on dishonest behavior.

Ethical dissonance

Early work on ethical behavior emerged from long-standing philosophical debates (e.g., Kant, 1785) and led to a normative approach in teaching and research (Bazerman & Gino, 2012). This early work focused on what people should do when confronted with an ethical dilemma. However, recent work in social science has shifted towards a more descriptive approach of how people actually behave when facing ethical conflicts (e.g., Ariely, 2012; Gneezy, 2005; Schweitzer *et al.*, 2004; Shalvi *et al.*, 2011). Although this field of behavioral ethics is growing rapidly, researchers have mainly focused on the contextual and social factors that promote or hinder dishonesty (e.g., Mazar *et al.*, 2008; Gino *et al.*, 2013). The cognitive processes governing this misconduct have remained largely unexplored.

Recently, two theoretical frameworks have been proposed to account for the prevalence of dishonest acts of people who perceive themselves as moral. Self-maintenance theory (e.g., Ariely, 2012; Mazar *et al.*, 2008; Gino *et al.*, 2009) suggests that situations in which one is tempted to increase self-profit by acting dishonestly invoke an inherent tension between the desire to maximize utility and the desire to maintain a positive self-image. To reduce this tension, people employ creative strategies that redefine unethical behavior as morally acceptable or justified (Ayal & Gino, 2011; Gino *et al.*, 2013; Shalvi *et al.*, 2015). Stated differently, self-maintenance theory assumes that people are aware that they are about to engage in misconduct, and they are motivated to find self-serving justifications that enable them to cheat without feeling bad about it.

This model is supported by the fact that most people choose only to cheat to a certain degree but not to the maximum extent possible (e.g., Gino *et al.*, 2009; Schweitzer, *et al.*, 2004; Shalvi *et al.*, 2011). Moreover, the extent of cheating behavior increases for creative people, who are capable of providing better justifications and inventing convincing stories (Gino & Ariely, 2012). Additional support for self-maintenance theory comes from findings that cheating increases in more ambiguous situations (Mazar *et al.*, 2008) and in cases where the dishonest acts are more easily justified (Shalvi *et al.*, 2011; Shalvi *et al.*, 2015). Presumably, the ambiguity of the situation or the existence of justifications serve as tension-reduction mechanisms that enable people to act dishonestly while maintaining a positive self-image (Ayal *et al.*, 2015; Barkan *et al.*, 2012).

A somewhat different account is suggested by bounded ethicality (Bazerman & Tenbrunsel, 2011). According to this framework, people are cognitively limited and systematically biased in their moral judgments (Banaji *et al.*, 2003; Banaji & Bhaskar, 2000; Chugh *et al.*, 2005). These limitations may include a distorted perception or attentional bias to confirmatory evidence, an emphasis on attenuating circumstances of context and situational factors, or a lowering of moral standards. As a result, people often do not recognize the ethical issues involved in their decisions. Furthermore, a self-serving biased perception can lead people to consider the unethical choice as the right one (although it is not). In both cases, people fail to perceive their own ethical misconduct and remain unaware of it. For example, research shows that individuals can easily recall past instances that reflect positively on their morality but fail to retrieve unethical incidents from their memory (Bazerman *et al.*, 2002; Baumeister & Newman, 1994; Shu & Gino, 2012). Similarly, people tend to judge behavior as unethical based on its outcome (i. e., whether it had a negative or positive consequence) and not on the act itself (Cushman *et al.*, 2009; Gino, Shu and Bazerman, 2010b). Such cognitively bound processes help people to dismiss unethical behavior, reinforce a sense of consistency between behavior and desired moral standards, and sustain positive self-image (Kunda, 1990; Lydon *et al.*, 1988; Ross *et al.*, 1983).

To simplify greatly, self-maintenance theory and bounded ethicality can be seen as two poles along the consciousness continuum. At one extreme, the pure self-maintenance approach suggests that people are completely aware of their own unethical behavior. Because consciously engaging in dishonest acts poses a threat to the moral self, it results in ethical dissonance that requires different types of reduction mechanisms that facilitate and justify this behavior. At the other extreme, the pure bounded ethicality approach suggests that cheating behavior is exclusively driven by unconscious perception biases that do not allow dishonest acts to compromise people's moral standards. The current study was designed to investigate and disentangle both of these influence factors.

In light of the fact that empirical evidence exists in favor of both approaches, we suggest that while self-maintenance and bounded ethicality seem at odds, they actually represent complementary, rather than opposing, accounts of the interplay between dishonesty and the moral self. Specifically, we argue that biased perception, suggested by bounded ethicality, is in fact a (potentially unconscious) way to circumvent the problem of ethical dissonance and tension by making people unaware of information that violates their self-serving response. Because perception guides what visual information is presented to conscious awareness (Balcetis & Dunning, 2006), these biased perception mechanisms can allow people to benefit from dishonest behavior without its associated dissonance.

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Information search

For an in-depth analysis of the mechanisms underlying cheating behavior, we used eye-tracking data to evaluate the locus of attentional processing during the decision-making process. Previous research has shown that attentional processing is accompanied by gaze shifts within the visual field (e.g., He & Kowler, 1992; Sclingensiepen *et al*., 1986) and that the proportion of attention towards particular pieces of information is directly correlated with their corresponding importance in the information search process (e.g., Fiedler *et al*., 2013; Reisen *et al*, 2008). These results suggest that eye-tracking data can serve to indicate the information that was used to execute a decision, and this assumption has prompted studies that utilize eye-tracking in judgment and decision making (Ball *et al*., 2003; Franco-Watkins & Johnson, 2011; Krajbich & Rangel, 2011; Orquin *et al*., 2013; Raab & Johnson, 2007; Rayner, 1999; Russo & Rosen, 1975; Wang *et al*., 2010; for a review, see Orquin & Mueller Loose, 2013). For instance, Ball *et al*. (2003) used eye-tracking to investigate the locus of attentional processing in the Wason selection task (Wason, 1966); Wang *et al*. (2010) used eye tracking to examine which information senders and receivers process during a sender–receiver game (Crawford & Sobel, 1982), and Glöckner and colleagues used eye tracking to investigate the processes underlying risky decision making (Glöckner & Herbold, 2011; Fiedler & Glöckner, 2012) and valuations of risky prospects (Ashby *et al*., 2012).

Here, we used eye-tracking data to examine the visual information that people evaluate during the decision process. If cheating behavior is predominantly unconscious, and motivated reasoning leads people to biased perceptions that the highest-paying alternative is the correct and honest response, we should expect a confirmation attentional bias where the locus of attentional processing in dishonest responses is biased towards the high-paying alternative. Additionally, to reinforce this confirmation bias, this locus of attentional processing should tend to avoid discriminating information, that is, visual information that directly provides relevant information for the task at hand (Bassok & Trope, 1983 and 1984). On the other hand, if people first become aware of the correct answer and only then deliberately decide to act dishonestly, we should expect a more balanced locus of attentional processing that facilitates a more accurate representation of the available information and potentially a bias towards the higher incentivized option at a later stage of the decision process (cf. Shimojo *et al*., 2003).

Physiological arousal

On top of point of gaze, we also measured changes in pupil diameter, an index of autonomic activation that accompanies emotional or cognitive responses to psychological stimuli (Andreassi, 2000; Cacioppo *et al*., 2007; Hochman, Glöckner and Yechiam, 2010b). Pupillary responses have been successfully employed for lie detection (Berrien & Huntington, 1943; Bradley & Janisse, 1981; Lubow & Fein, 1996), deception in strategic decision making (Dionisio *et al*., 2001; Wang *et al*., 2010), and as a measure of affect and arousal (Hochman & Yechiam, 2011; Janisse, 1973). For example, Dionisio *et al*. (2001) found increased pupil diameter when participants answered a set of questions deceptively than when they answered the same set of questions truthfully, and Wang *et al*. (2010) found increased pupillary response before and after participants communicated a deceptive message in a strategic game, and this increase was positively correlated with the magnitude of deception. In addition, research shows that pupils dilate under stress (Yamanaka & Kawakami, 2009) and in response to an increase in cognitive load introduced for example by different levels of task complexity (e.g., Beatty, 1982; Goldwater, 1972). Importantly, increases in physiological arousal may also serve as an indication of cognitive dissonance (Croyle & Cooper, 1983; Elkin & Leippe, 1986). Research on coherence-based models of decision making (e.g., Glöckner & Betsch, 2008) provides support for this hypothesis by showing that a conflict between two pieces of information leads to increased physiological arousal (Hochman, Ayal and Glöckner, 2010a; Glöckner & Hochman, 2011).

Because pupil diameter is considered a direct index of cognitive load (Beatty, 1982; Goldwater, 1972), the increase in pupil diameter that was found in response to cheating has been traditionally attributed to the fact that cheating is cognitively demanding (Dionisio *et al*., 2001; Lubow & Fein, 1996; Wang *et al*., 2010). The increased arousal may, however, also reflect the ethical dissonance that stems from the tension between individuals' dishonest acts and their desire to maintain a positive self-image (cf. Elkin & Leippe, 1986).

Under the assumption that cheating behavior simply adds cognitive demands on top of task complexity (e.g., Dionisio *et al*., 2001; Wang *et al*., 2010), the effects of the cognitive demands for solving the task and for cheating should work in the same direction. As a result, pupil diameter should increase with task difficulty both in cheating and non-cheating trials. A different pattern of arousal is expected, however, if the increased dilation mainly reflects affective factors such as ethical dissonance. Specifically, if we assume that increased difficulty level serves as a tension-reduction mechanism because of ambiguity (Ariely, 2012; Gino & Ariely, 2012; Mazar *et al*., 2008), arousal that stems from psychological tension should decrease as difficulty increases. Thus, *only* in cheating responses, level of difficulty should have no (or a reduced) effect on pupil diameter, because this tension reduction effect runs counter the effect of cognitive load. Our current design facilitated fine-tuned analyses that shed light on the determinants of increased arousal in response to dishonest behavior.

Cheating behavior

The Merriam-Webster dictionary definition of "cheating" is "breaking a rule usually to gain an advantage," or "to take something from someone by lying or breaking a rule." In line with this broad definition, research in behavioral ethics typically creates a conflict between accuracy and monetary payoff to measure dishonesty and cheating behavior (e.g., Ayal & Gino, 2011; Mazar & Zhong, 2010; Sharma *et al*., 2014). For example, participants are required to perform a certain task (e.g., a perceptual task), in which they are required to be as accurate as possible. However, to enable

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cheating, the payment scheme is based on the kind of responses that are made rather than on accuracy. In previous works (e.g., Gino *et al*., 2010a; Mazar & Zhong, 2010), the number of times in which the participants selected the high-paying response was assumed to be indicative of dishonest behavior. Nevertheless, this measure of cheating behavior suffers from several limitations. First, it customarily uses one specific response as the high-paying response. As a result, selecting this single option might represent a response bias and not cheating behavior. Second, in some cases, the high-paying option might also be the correct response. Thus, there are cases in which there is an overlap between the correct and the maximizing payoff response. Finally, selecting the high-paying option over the accurate option might also reflect honest mistakes. These mistakes could result, for example, from uncertainty or the fact that people are less motivated to be accurate when they know that their work will be compensated regardless of accuracy.

Thus, in the current work, we modified the perceptual task used in previous research (Gino *et al*., 2010a) to address these limitations and provide a more compelling measure of cheating. Specifically, we used two counterbalanced types of responses (rather than just one, i.e., left and right) to measure cheating behavior. In addition, we focused on errors rather than selecting a specific option(s). To that end, we classified responses into four types: correct hits (cases in which people chose the accurate response that was also the high-paying one), correct rejects (cases in which people chose the accurate response that was also the low-paying one), detrimental errors (cases in which people chose the low-paying response that was also the inaccurate one), and beneficial errors (cases in which people chose the high-paying response that was also the inaccurate one). Based on the definition of cheating, this later type of response was considered cheating, because it violated the experimental "rules" set forth by experimenters—that is, the instructions. If people cheat to increase their payoff, they should make significantly more beneficial than detrimental errors.

Hypotheses

Based on previous research on behavioral ethicality, we derived three sets of hypotheses. These three sets are outlined as follows and summarized in Table 1.

Our first set of hypotheses concerned cheating behavior:

H1a: *Participants will make more beneficial errors (indicating cheating) than detrimental errors.*

Furthermore, based on both self-maintenance theory, which argues that dishonest behavior is more prevalent in ambiguous situations, and Bounded Ethicality, which argues that dishonesty results from cognitive limitations, we predicted that

H1b: *The amount of beneficial errors that indicate cheating as compared with detrimental errors will increase with task difficulty.*

Our second set of hypotheses concerned the locus of attentional processing. For the sake of clarity, this set was formulated according to bounded ethicality. If cheating is conscious and people are aware of the correct answer as suggested by self-maintenance theory, one would not expect a general attentional bias. By contrast, if cheating is driven by biased processing such that people do not even become aware of the right answer, an attentional bias toward the highest-paying alternative is expected. Based on bounded ethicality, we formulated the following hypothesis:

H2a: *Attention will be directed towards the high-paying option in conditions that pose a conflict between accuracy and payoff maximization.*

Moreover, bounded ethicality predicts not only that attention should be biased toward the highest paying alternative but also that attention should be diverted from diagnostic information (i.e., information that differentiates the accurate

Table 1. A summary of the hypotheses as a function of the theoretical approach on which they are based

		Hypothesis	Theoretical approach
Choice behavior	1a	Participants will make more beneficial errors (indicative of cheating) than detrimental errors	SMt and BE
	1b	Cheating rate will increase with task difficulty	SMt and BE
Attentional processing	2a	Attention will be biased towards the highest-paying option (when payoffs can be increased by cheating)	BE
	2b	Less attention will be directed toward diagnostic information if there is a conflict between accuracy and incentives	BE
Physiological arousal	3a	Arousal will be higher on cheating trials than on other trials	SMt and BE
	3b	Arousal should increase with task difficulty for correct responses but not for cheating responses	SMt

SMt, self-maintenance theory; BE, bounded ethicality.

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from the erroneous response), to avoid being able to identify the correct response. By contrast, this pattern is not expected by self-maintenance theory, because under this account, people first identify the correct response and only then choose to cheat to increase personal gain. In line with the bounded ethicality approach we hypothesized

H2b: *Less attention will be directed to diagnostic information on trials in which there is a conflict between accuracy and payoff maximization than on trials in which accuracy is rewarded.*

Finally, our third set of hypotheses concerned physiological arousal as indexed by changes in pupil diameter. Based on previous research, we expected an increase in arousal in response to cheating.

H3a: *Arousal will be higher on beneficial error (cheating) trials than on other trials.*

In addition, if cheating is associated with increased cognitive demands, we would expect an increase in arousal in response to task difficulty on both honest and cheating trials. By contrast, if as suggested by self-maintenance theory, cheating evokes tension between a positive self-image and the desire to increase personal gain, the increase in arousal in response to difficulty level should be reduced and even eliminated for dishonest responses. This interaction would stem from the reduction in ethical dissonance (which is not predicted by bounded ethicality). Based on this rationale, we formulated the following hypothesis:

H3b: *An interaction is expected in which arousal should increase in response to task difficulty only for correct responses but not for cheating responses (beneficial errors).*

METHOD

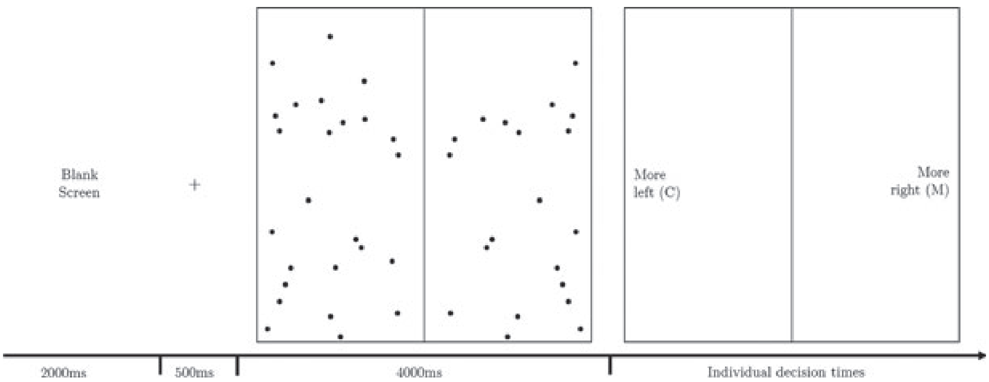
Participants and design

Forty-six students (53% female, mean age = 25.2 years) with normal or corrected to normal vision (mainly from the University of Bonn) took part in the experiment. Participants were recruited from the MPI Decision Lab subject pool using the database-system ORSEE (Greiner, 2004). For two participants, no eye-tracking data were recorded because of technical problems. The study lasted about 30–40 minutes and participants earned €14.19 on average (approximately $19.50), but actual payments were contingent upon their choices. The study used a fully crossed 3 (incentive condition: incentives for accuracy versus incentives-for-left versus incentives-for-right) × 3 (difficulty: easy versus medium versus hard) within-subjects design.

Materials

Participants engaged in the flexible dot task, a perceptual task adapted from the original dot task introduced by Gino, Norton, and Ariely (2010a) to specifically examine the aims of the current experiment. On each trial, participants were presented with a square divided down the middle into two parts by a vertical line. The square included 50 non-overlapping sand-colored dots appearing in different arrangements within a square. Some dots appeared on the right side and some on the left side of the vertical line. The dots were symmetrical in that their position was mirrored on the middle line. After a 4-second exposure to the dots, participants were required to identify which side of the square (right or left) contained more dots, by pressing either on the "C" ("more on left") or "M" ("more on right") key (Figure 1). Participants were fully informed about the procedure. The payout on each trial was contingent on the experimental condition, which manipulated three within-participant incentive conditions presented in three blocks in a counterbalanced order.

Specifically, the perceptual task was divided into three blocks representing one of the incentive conditions, each of which had 42 trials. In the incentive-for-accuracy condition, there was no conflict between accuracy and payment: participants earned 10¢ each time they correctly identified the side of the square containing more dots and 1¢ each time they were wrong. This condition was used to assess participants' baseline ability to accurately identify the side in which more dots appeared. Participants aiming to maximize their profit had to try to be as accurate as possible. By contrast, the incentive-for-right condition introduced a conflict between accuracy and payment: whereas participants were still explicitly requested to accurately judge which side of the square



Note. Colors in the experiments differ from this figure since they were luminance matched (purple and sand) to avoid pupil size variations due to differences in brightness.

Figure 1. Stimulus presentation

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contained more dots, they earned 10¢ for each press of the "more on right" key and 1¢ for each press of the "more on left" key. In a like manner, in the incentive-for-left condition (which was included to control for any possible spatial effects), they earned 1¢ for each press of the "more on right" key and 10¢ for each press of the "more on left" key. Importantly, participants were explicitly and unequivocally instructed to always choose the side with more dots, so that it was clear to them that not doing so constituted a violation of the instruction and therefore a kind of cheating (for a translated version of the full instruction, see https://osf.io/6zhsw/). This manipulation is similar to previous uses of the dots task to measure levels of dishonesty (e.g., Ayal & Gino, 2011; Gino *et al*., 2010a; Sharma *et al*., 2014; Mazar & Zhong, 2010). Specifically, the correct response and the incentivized response are in conflict. Participants aiming to maximize their profit should indicate right/left on all trials (depending on the condition) and disregard the number of dots appearing in the square.

To manipulate difficulty, we varied the difference between the number of dots appearing on each side of the square in each of the conditions. Because the position of the dots in each side is mirrored on the middle line, to create a difference in the number of dots, some dots were missing from one of the sides on each trial. This created three different levels of difficulty (1, 3, or 5 missing dots on one side), which served to represent three levels of task ambiguity (the more difficult the task is, the less clear it is whether people cheat or make "mistakes"). In 50% of the trials, more dots appeared on the left side, and in the remaining 50%, more dots appeared on the right side. Overall, participants completed a total of 126 trials, with 14 trials in each cell of the 3 (incentive conditions) × 3 (difficulty) within-subject experimental design. The high number of repetitions allowed for reliable measurements of information search and physiological arousal. The three incentive conditions and the trials within each condition representing the manipulation of difficulty were presented to participants in random order.

Apparatus

Eye movements were recorded using the Eye Gaze Binocular System (LC Technologies, Clearwater, FL, USA) with a remote binocular sampling rate of 120 Hz and an accuracy of about .45°. Images were presented on a 17″ and a 19″ color monitor with a native resolution of 1280 × 1024 and the SMI RED 250 binocular system with 250 Hz (recording at 120 Hz, the presentation monitor had a resolution of 1680 × 1050). The pixel size of the stimuli was kept constant across all three eye trackers using an 800 × 800 pixel display. PRESENTATION® was used as the experimental software. The core analyses concerning pupil size were run on the raw data, and we decided to analyze attentional biases without aggregation on the fixation level as well, to maintain the same level of aggregation for both analyses. Pupil dilation was calculated as the change in dilation compared with the baseline size in the first 2000 milliseconds of each trial (while the blank screen was presented). Trials with invalid eye-tracking data were excluded.[1] We used the average pupil size from both eyes as the dependent measure.

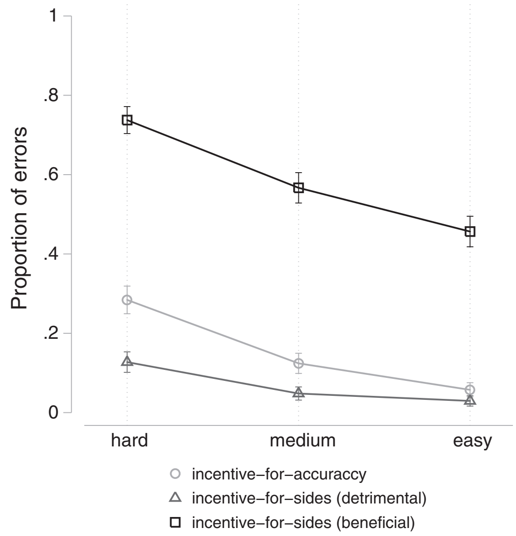

Figure 2. Error rate as a function of condition and difficulty level. Vertical lines represent 95% confidence intervals

Procedure

Upon arrival, participants were seated in front of a computer screen and were calibrated to the Eye Gaze Binocular System (9 point). Each incentive condition started with specific instructions and five practice trials, to familiarize participants with the task (and specific conditions), and presented 42 stimuli in a randomized order. As indicated by the button labels (Figure 1), selections were made by pressing the "C" (more on left) and "M" (more on right) keys on the keyboard. After task completion, participants were informed of the total amount of money they had earned and were paid in private accordingly.

RESULTS

Behavioral results

To test H1a, we examined the errors made by participants for the three incentive conditions (beneficial error and detrimental errors in incentive-for-sides and incentive-for-accuracy conditions), as a function of difficulty level (Figure 2). In line with our cheating interpretation, participants made mainly beneficial errors and very few detrimental errors. In the incentive-for-right trials, for example, many errors were made if the correct answer was "left," but almost no errors were made if the correct answer was "right". For the hard trials in this condition, for instance, participants gave the wrong

[1]For the main analysis of pupil size, we used data from the 2000-millisecond blank screen, the 500-millisecond fixation cross, and the 4000 milliseconds of stimulus presentation. For the fixation analysis, we only analyzed the 4000 milliseconds of stimulus presentation. We also dropped data when there were explicit indications of invalid data from the manufacturer because of blinks and other factors (4.5%), pupil sizes smaller than 1 mm and larger than 10 mm (<0.1%), data points in which the size of one pupil was more than 4 mm larger than the other pupil (<0.1%), and data that were outside the 800 × 800 target range (6%).

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but beneficial answer ("right") in roughly 75% of all cases, whereas the number of detrimental errors (saying "left" if "right" was the correct answer) was only found in 15% of the cases. The "true" error rate in the hard incentive-for-accuracy trials in the same situation (right side is correct) was about 34% and hence between the two values. These asymmetric error rates were observed despite the fact that participants were instructed to be as accurate as possible on all trials.

A 3 (incentive condition) × 3 (difficulty) × 2 (side of correct solution) repeated-measures analysis of variance with error rate as the dependent variable revealed no effect for side ($F(1, 45) = 2.38$, $p = .13$). However, a significant effect was found for condition ($F(2, 90) = 55.45$, $p < .001$) and difficulty ($F(2, 90) = 91.93$, $p < .001$). Importantly, in support of H1a, a significant incentive condition × side interaction was found ($F(2, 90) = 71.31$, $p < .0001$), suggesting that indeed the errors' rate was highly biased toward the high-paying side.

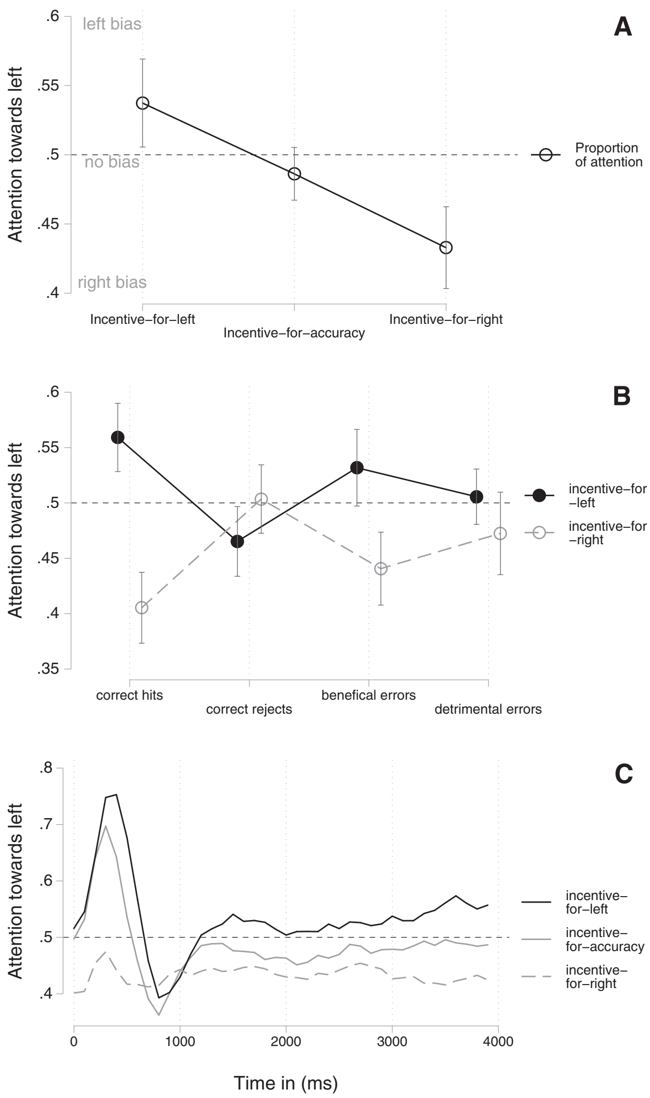
This imbalanced pattern of results demonstrates that errors on the high-paying side are not reflecting mere mistakes because of lack of effort. In fact, on average (and across difficulty levels) on the incentives for side trials, the participants made 59% (Standard deviation *(SD)* = 13) beneficial errors on trials in which the correct answer and the incentive diverged but only 7% (*SD* = 5) detrimental errors. Honest mistakes due to laziness or lack of attention are not likely to be biased to the high-paying side. Thus, these data lend credence to our claim that beneficial errors by choosing the high-paying side in incentive-for-sides trials are indicative of dishonest behavior, as it represents an attempt to break the rule to maximize personal gain.

Moreover, the differences in slopes in Figure 2 indicate that difficulty influenced beneficial errors more strongly than detrimental errors. This visual impression is confirmed by a significant interaction between type of error (beneficial versus detrimental; only incentivized-by-side trials were considered) and difficulty in a regression analysis ($b = -.02$, $t(45) = 5.28$, $p < .001$).[2] Separate analyses revealed that task difficulty had a stronger effect on the beneficial error rate ($b = -.03$, $t(45) = 7.97$, $p < .001$) than on detrimental error rates ($b = -.01$, $t(45) = 4.54$, $p < .001$). These results concerning the increasing spread between the types of errors support H1b, which posited that cheating increases with difficulty.

Because the flexible dots task invoked dishonest behavior, we were next able to test our hypotheses concerning physiological arousal and attentional processing. Importantly, the construction of this flexible task and in-depth analysis of our behavioral results reported earlier provide direct support for our claim that beneficial errors in the incentive-for-sides trials could be mainly interpreted as cheating responses.

Attentional bias

We tested the second set of hypotheses concerning attentional biases in the 4 seconds of dot presentation. As shown in Figure 3A, there were biases in the predicted direction, in that the participants focused more on the high-paying side in the incentive-for-sides conditions. This descriptive result was also confirmed in a regression analysis predicting the proportion of attention to the left (again using cluster corrected standard errors at the participant level). In line with H2a, for both incentive-for-side conditions, the distributions of attention differed significantly from the incentive-for-accuracy condition (incentive-for-left: $b = .051$, $t(43) = 3.93$, $p < .001$, incentive-for-right: $b = -.053$, $t(43) = -4.97$, $p < .001$). Taking into account that an unbiased distribution of attention would result in a proportion of attention to the left side of .5, the first coefficient of $b = .051$, for example, means that the total amount of time that attention was directed to the left side increased by 5.1% if there was an



Note. In panel C that attention distribution in *incentive-for-accuracy* trials follows the natural reading direction which looks similar to the attention distribution in *incentive-for-left* trials

Figure 3. Attentional biases in the presentation phase aggregated (A), as a function of response type within the incentive-for-side condition (B) and the temporal dynamics over the course of the decision for all three conditions (C). The horizontal dashed line at $y = .5$ indicates the equal distribution of attention towards both sides (i.e., no bias); lower versus higher values indicate biases to the left versus right. Vertical lines represent 95% confidence intervals

[2]Here and in all subsequent regression analyses, we corrected for dependencies in error terms due to repeated observations by clustering the standard errors on the individual subject level (Hayes & Cai, 2007; Roger, 1993).

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incentive to choose left. Hence, in this condition, on average, 55.1% of the attention time was directed towards the left side and only 44.9% to the right side of the task stimuli.

The magnitude of the attentional biases also differed between response types on incentive-for-sides trials (Figure 3B). Crucially, for the trials in which there was a conflict between accuracy and payoff maximization in that the correct answer was not on the higher paying side, stronger attentional biases were found for beneficial errors (cheating) than for responses in which the participants were honest and left the money on the table (correct rejects). Descriptively, on beneficial error trials, information search was more similar to trials in which the participants correctly selected the higher paying side (correct hits). A regression analysis predicting the proportion of attention allocated towards the left side revealed that there was a significant main effect for incentive condition (2 = *incentive-for-left* [reference group], 3 = *incentive-for-right*, $b = -.10$, $t(43) = -6.07$, $p < .001$). More importantly, all three interaction terms between incentive condition and response type (1 = *correct hits*, 2 = *beneficial errors* [reference group], 3 = *correct reject*, and 4 = *detrimental errors*) were significant. In line with the descriptive result presented earlier, beneficial error responses were accompanied by a 19% higher attentional bias to the higher paying side than correct rejects ($b = .19$, $t(43) = 7.88$, $p < .001$). Furthermore, there was a considerably smaller but still significant difference between beneficial error responses and correct hits, in that attentional biases were 4% higher for the latter ($b = .04$, $t(43) = 2.52$, $p = .02$). Finally, attentional biases were more pronounced for beneficial error responses than for situations in which the participants made detrimental errors that lowered their payout (i.e., beneficial versus detrimental errors: $b = .12$, $t(43) = 4.03$, $p < .0001$).

An analysis over time revealed that the relative attentional bias was stable over time (Figure 3C). Adding the respective interaction terms between time and incentive condition did not lead to an improvement in the regression model. The latter finding is noteworthy because it indicates that the result was not driven by classic gaze cascade effects (i.e., increasing attention to the chosen option over time; Shimojo *et al.*, 2003; see also Fiedler & Glöckner, 2012). Note also that this attentional bias completely overrides the reading direction effect observed in the incentive-for-correct trials (i.e., looking left and then right in the first second). When the opportunity to cheat presented itself (incentive-for-sides trials), participants started the information search by immediately looking at the highest-paying side.

To test H2b, which posited that less attention would be directed toward diagnostic information if there was a conflict between accuracy and incentives, we utilized the fact that the display of dots on both sides was symmetric to analyze whether participants had spotted the relevant information to make a correct decision. Specifically, because the presentation of dots was symmetric, participants had to notice the dots that were present on one side but missing on the other side to identify the correct answer. Thus, we calculated a dichotomous *attention to missing dots* score (0 = *no* and 1 = *yes*) for each trial and participant indicating whether attention was either on (one of the) missing dots on the side that had more dots or the respective empty spot on the side containing fewer dots.[3] On the incentive-for-accuracy trials, participants directed significantly more attention to the missing dots than on the incentive-for-sides trials ($b = -.037$, $t(43) = 2.07$, $p < .05$). Hence, there was support for H2b that the participants would pay more attention to relevant (diagnostic) information on trials in which they were motivated to provide a correct response.

For both incentive conditions, there was more attention to the missing dots on correct (correct hits and correct rejects, p (attention to dot) = .54) than wrong responses (beneficial and detrimental errors, p (attention to dot) = .35; $b = .18$, $t(43) = 8.83$, $p < .001$), but this difference was roughly the same for the incentive-for-sides condition and the incentive-for-accuracy condition, and there were no significant interactions between incentive condition and response type (all $p > .16$).

Physiological arousal

Finally, to test our third set of hypotheses concerning differences in arousal, we analyzed differences in pupil dilation (measured as changes in pupil size[4] from baseline) between response types and conditions (incentive-for-accuracy versus incentive-for-sides). In line with H3a, arousal was higher on trials where the participants made beneficial errors (indicating cheating) as compared with the remaining trials on the incentive-for-sides conditions and also compared with responses on the incentives-for-accuracy conditions (Figure 4A). This descriptive result is confirmed by respective comparisons in a regression analysis using cluster correction at the level of participants (beneficial error trials versus other responses: $b = .012$, $t(43) = 1.79$, $p = .04$ (one-sided test); beneficial error trials versus incentive-for-accuracy condition: $b = .04$, $t(43) = 5.15$, $p < .001$).[5]

Figure 4B provides more detailed information concerning the differences between response types and the development of arousal over time. As can be seen from the figure, in incentive-for-sides trials, a difference in arousal appears early in the decision process, even before the dots are presented. However, after the dots appear (i.e., after the second vertical line in the figure), this increase in arousal in incentive-for-sides is not further accentuated and the development of pupil dilation over time follows similar patterns on both incentive-for-accuracy and incentive-for-side trials. In line with the visual impression, further statistical analyses revealed that both differences remained significant and even increased in magnitude when analyzing arousal at the blank screen and the fixation cross alone (beneficial error trials versus other responses: $b = .017$, $t(43) = 2.52$, $p = .02$; beneficial error trials versus

[3]We thereby used small accepted areas (areas of interest) of +/−15 pixels for each dot to avoid including other dots in the area of interest as well, and as in the analyses earlier, we conducted the analysis on the raw data for more fine-grained resolution (i.e., without calculation of fixations).

[4]Pupil size was calculated as the average pupil size of the left eye and right eye.

[5]Note that inter-individual differences in cheating behavior induce systematic differences in cell sizes, which can cause problems in analyses of variance or related approaches. We used a regression-based approach with cluster correction for standard errors as mentioned earlier to avoid these problems.

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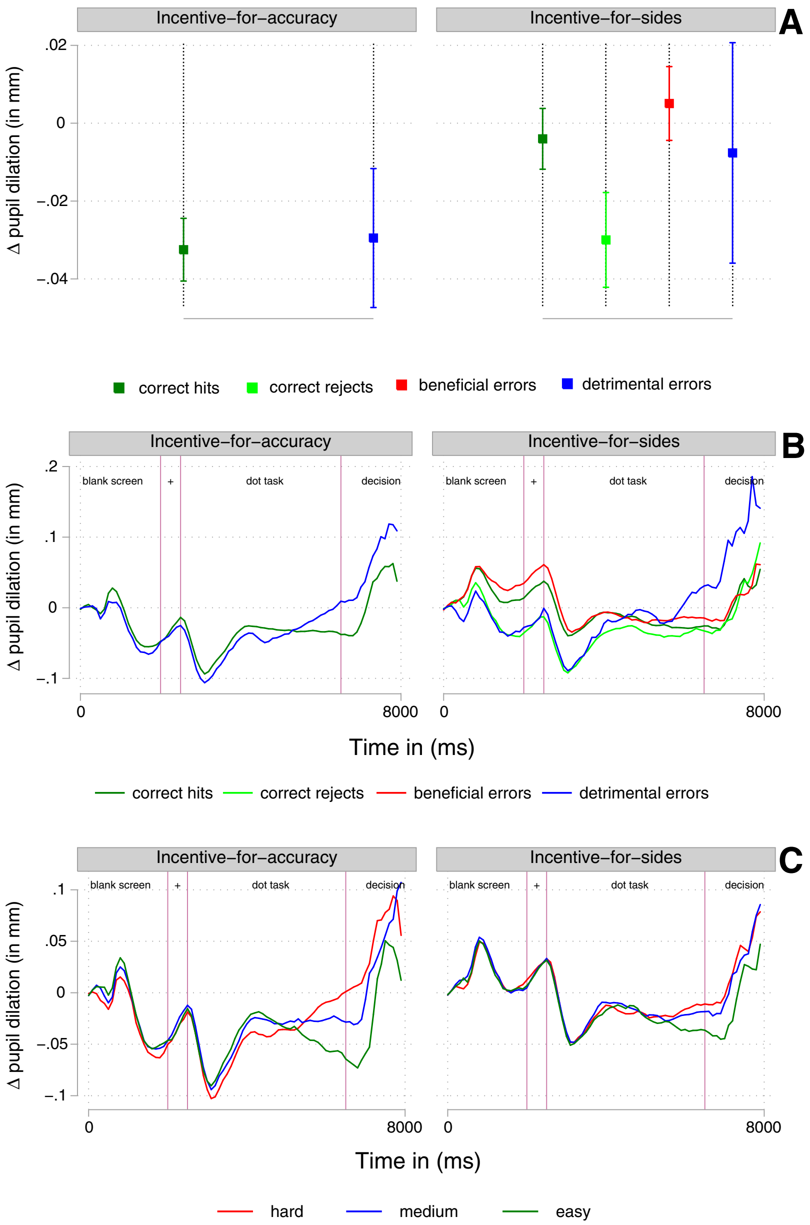

Note. For the incentive-for-accuracy trials all correct responses are collapsed to beneficial responses / correct hits and all error responses are collapsed to detrimental errors since all correct answers are beneficial and all errors are detrimental due to the incentive for accuracy.

Figure 4. Pupil dilation aggregated (A), over the time course of presentation (B), and as a function of the four response types and difficulty levels (C). Vertical lines represent 95% confidence intervals

incentive-for-accuracy condition: $b = .06$, $t(43) = 8.02$, $p < .001$). Because previous research has shown increased arousal in response to cheating (Dionisio *et al.*, 2001; Lubow & Fein, 1996; Wang *et al.*, 2010), the increase in arousal occurring before the dots are presented suggests that participants made a decision whether they intend to cheat or not even before the information-search process. In line with this interpretation, arousal before the dots appeared were elevated for both cheating and correct responses, because at this stage, the participants did not know whether cheating would be necessary or whether the correct response was also the high-paying one.

Interestingly, when we examined how arousal was affected by awareness in cheating responses, pupil dilation responses were only slightly and not significantly smaller for trials with attention as compared with trials without attention to the missing dots ($b = -.01$, $t = -1.02$, $p = .32$). Together with the result that arousal was higher only prior to the dot presentation, this finding further supports our claim that people already decide whether to cheat or not before the relevant information is presented.

To test H3b that posited that arousal should increase with task difficulty for correct responses but not for cheating responses (beneficial errors), we also examined the effect of task difficulty on arousal over time for different kinds of responses. Because effects of task difficulty can only play out after the dots are presented, we normalized pupil dilation for this analysis to the pupil size that prevailed at the

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beginning of the presentation phase and analyzed the 4000 milliseconds of the presentation phase alone. First, we regressed dilation on difficulty, time, response (beneficial error versus correct response), and their two-way and three-way interactions for the incentive-for-sides trials alone. The three-way interaction was not significant ($p > .22$) suggesting that H3b was not supported by the data.

However, a different pattern was observed when we examined both incentive-for-sides and incentive-for-accuracy trials. In line with previous research (Beatty, 1982; Goldwater, 1972), arousal increased with cognitive load over time on incentive-for-accuracy trials. In contrast, this was not the case for the incentive-for-sides trials (Figure 4C). To test this effect statistically, dilation was again regressed on difficulty, time, incentive condition (incentive-for-accuracy versus incentive-for-side), and their two-way and three-way interactions (difficulty—i.e., number of dots missing—and time bins were used as continuous measures). The analysis revealed a significant three-way interaction ($b = .0003$, $t(43) = 2.86$, $p < .01$).[6] Moreover, a simplified analysis considering only the final second of the dot presentation revealed a significant incentive condition × difficulty interaction ($b = .008$, $t(43) = 2.45$, $p < .05$). This pattern of results suggests that difficulty increased arousal over time solely on the incentive-for-accuracy trials but not on the incentive-for-sides trials. This suggests partial support for the idea underlying H3b that increasing difficulty reduces the tension that results from the decision whether to cheat or not. These results should be further examined in future research, to determine whether this more general effect is consistent.

DISCUSSION

Minor dishonest acts on the part of ordinary people are highly prevalent in everyday life (Canner, 2008; DePaulo *et al*., 1996; Gino, Ayal & Ariely, 2013; Mazar *et al*., 2008; Murphy, 1993; Shalvi *et al*., 2011), but the underlying cognitive processes of such behavior are largely unexplored (Ariely, 2012; Ayal & Gino, 2011). The main aim of the current paper was to advance our understanding of the cognitive mechanisms guiding dishonest behavior and to assess the extent to which people are aware of their own dishonesty. To do so, we introduced a flexible task that allowed to simultaneously investigate behavioral, attentional, and pupillary responses in tempting situations to cheat.

In line with previous findings (e.g., Gino *et al*., 2009; Mazar *et al*., 2008; Shalvi *et al*., 2011) and with our first set of hypotheses (H1a and H1b), we found that when given the opportunity, participants cheated to a certain extent in order to increase personal gain. The accuracy level was relatively high (about 83% accuracy across the different difficulty levels) on the incentive-for-accuracy trials, suggesting that participants were able to correctly identify the side containing more dots when they were financially motivated to do so. However, accuracy reduced, and the amount of errors increased in the incentive-for-sides trials where participants were paid according to the side they chose and not based on their performance. The main indication that this reduction in accuracy reflects cheating was that judgmental errors were not random but rather highly biased in that participants made many beneficial errors but very few detrimental errors. Furthermore, the fact that beneficial errors were highly sensitive to the difficulty level and detrimental errors were less so supports previous findings showing that cheating increases in more ambiguous situations (Gino & Ariely, 2012; Mazar *et al*., 2008).

Existing models of behavioral ethicality assume that tempting situations to cheat create a conflict between the desire to maintain a positive moral self-image and the competing desire to maximize personal gain (Ariely, 2012; Bazerman & Tenbrunsel, 2011). Ayal and Gino (2011) defined this tension as ethical dissonance, which people are motivated to resolve by justifying their behavior before or after they engage in ethical violations (for a review, see Barkan *et al*., 2012; Shalvi *et al*., 2015). The use of pupillary responses in the current experiment enabled us to directly examine the psychological implications of ethical dissonance.

In particular, our use of eye-tracking data to examine the locus of attentional processing provides important insights into the cognitive mechanisms behind unethical behavior and points to another way in which people deal with ethical dissonance. In line with H2a, we found a strong attentional bias toward the highest paying side. Presumably, this information search pattern represents a preference bias that leads people to look for the option they would generally prefer (Pittarello *et al*., 2015). In line with H2b, the pattern of results demonstrated that people focus less on the diagnostic information (missing dots) on trials that provide an incentive to cheat as compared with trials in which this incentive did not exist. This suggests that the information people take into account while making a decision is influenced by their desires and motivations (Balcetis & Dunning, 2006; Kunda, 1990). Thus, in line with the bounded ethicality approach (Bazerman & Tenbrunsel, 2011), our results provide evidence that at least to some extent, unethical behavior is unaware and facilitated by biased processing of information. Presumably, this motivated and biased perception might be another type of preemptive tension-reduction mechanism guided by top–down constraints.

Finally, in line with our third set of hypotheses (H3a and H3b), we found increases in pupil diameter when participants made beneficial errors (i.e., chose the highest paying side when it was the wrong answer) that indicate dishonest behavior. As previous research (and Nietzsche's surmise quoted earlier) suggests, this increase might simply be an indication of the fact that unethical behavior is cognitively demanding (Dionisio *et al*., 2001; Wang *et al*., 2010). Alternatively, it is also possible that the observed increase in arousal stemmed from the ethical dissonance (Ayal & Gino, 2011; Barkan *et al*., 2012) triggered by the disparity between people's moral values and self-interest behavior (cf. Elkin & Leippe, 1986; Glöckner & Hochman, 2011). H3b was designed to disentangle these two possibilities. Specifically, because

[6]We furthermore found no main effect for difficulty ($p = .545$), but two significant two-way interactions involving time (incentive condition × time: $b = -.001$, $t = 3.93$, $p < .001$; difficulty × time: $b = -.0006$, $t = 3.48$, $p < .001$).

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physiological arousal is considered a direct indication of cognitive load (e.g., Beatty, 1982; Goldwater, 1972), one might expect dilation to increase as task complexity increases and the effect might be additive (or even super additive) to the costs of cheating. By contrast, if physiological arousal reflects ethical dissonance (as we suggest), the increase in arousal as a function of complexity should be eliminated for cheating responses. Because difficult tasks are more ambiguous, and thus unethical behavior should be more easily justified (Gino & Ariely, 2012; Mazar *et al*., 2008; Shalvi *et al.*, 2015), task complexity should attenuate ethical dissonance. While H3b was not fully supported, a more general analysis provided some support for the idea that difficulty influences tasks that allow cheating differently than tasks that incentivize people to be accurate. Specifically, we found an interaction between incentive condition and task difficulty in which arousal was sensitive to task difficulty on incentive-for-accuracy trials but not on incentive-for-sides trials. In other words, when participants were motivated to provide a correct response (and only an effect of task complexity on arousal was assumed), pupil diameter increased in response to task difficulty. However, when participants were faced with a tempting opportunity to cheat (and the effects of task complexity and ethical dissonance on arousal were assumed to work in opposite directions), this effect was eliminated.

Further support for the claim that cheating behavior leads to ethical dissonance rather than cognitive demands comes from the finding that arousal differences were apparent before information was presented. Naturally, arousal in this case could not be due to increased cognitive load, but it could reflect conflicting cognitions. Presumably, participants decided to select the high-paying side beforehand, and because they knew that this might require them to cheat, they experienced tension.

Although there was a clear link between attention to the missing dots and response accuracy, no strong link between this local attention and arousal in the cheating trials could be established. In light of our arousal results, this suggests that the decision to cheat is mainly made before information is presented. As a result, people experience a dissonance between the possibility of obtaining personal gain and the desire to maintain a positive self-image, but because of self-serving perception distortion mechanisms, they are not totally aware of this (e.g., Dehaene *et al*., 2006; Laeng *et al*., 2012). Interestingly, when we looked at the data, we noticed that physiological arousal did not decrease in response to cheating over the trials in this study. This suggests that the ethical dissonance was not diminished with repeated experience of dishonest responses (cf. Barkan *et al*., 2012; Shalvi *et al*., 2015). It seems that although our pre-emptive biases and motivated reasoning mechanisms work hard to create a reality that justifies selfish behavior, at a pre-consciousness level people still seem to "know" that their behavior is wrong.

In conclusion, the results provide support for the relevance of both accounts with regard to the underlying mechanism of dishonest responses. To the best of our knowledge, we are the first to show physiological evidence for both influence factors within one study. Thus, in line with our assumption, rather than conflicting with each other, both self-maintenance theory and bounded ethicality serve as complementary accounts of how people resolve the conflict between their desire to increase gain and the desire to maintain a positive moral self. Arousal is increased in cheating responses, thus indicating some level of awareness, which is in line with the self-maintenance approach. At the same time, there is evidence for attentional biases that lead people to be less likely to become aware that their desired answers are wrong.

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