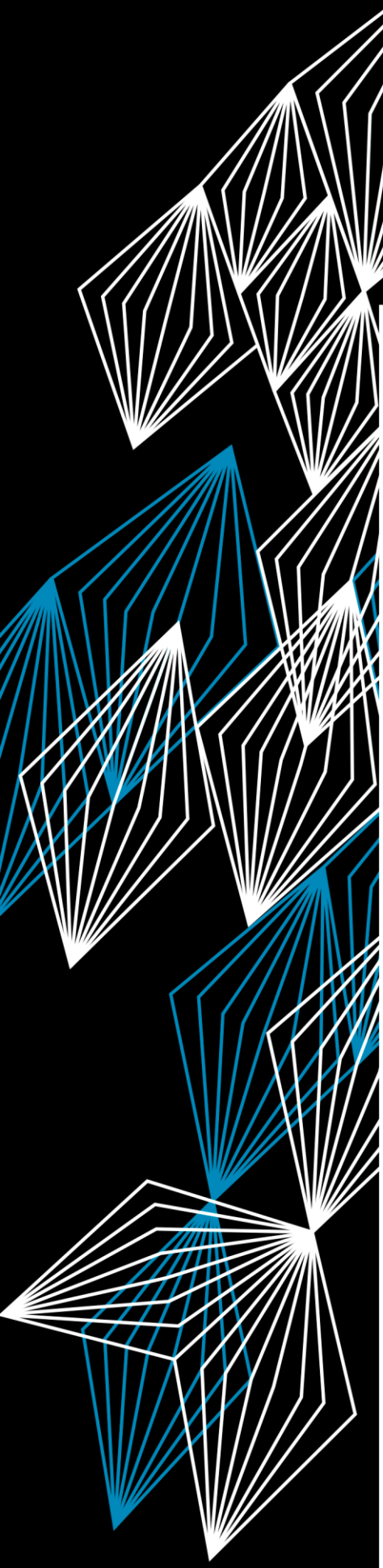

MASTER THESIS

BY LUKA KONING

DIGITAL SIGNATURES:

A TOOL TO PREVENT AND PREDICT DISHONESTY?

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University of Twente, Enschede, The Netherlands

EXAMINATION COMMITTEE

First supervisor: dr. Joris van Hoof

Second supervisor: prof. dr. Marianne Junger

STUDENT NUMBER

1599054

DATE

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UNIVERSITY OF TWENTE.

Digital Signatures: a Tool to Prevent and Predict Dishonesty?

Master thesis by Luka Koning

Communication Studies, University of Twente, Enschede, the Netherlands

Dishonesty is prevalent and causes great damage to society. On an individual level, besides reaping rewards, it also carries a psychological cost for those who engage in it. This principle is used to make people more honest with behavioral interventions, one of them being the well-known 'signature nudge'. Digital transition in society, however, has led to changes in the way people sign, which may affect the effectiveness of this nudge. In two experiments, the current study investigates the relationship between digital signatures and honesty, which builds on previous research by examining novel signature types, the moderating role of personal characteristics, effect decay, and the predicting value of digital signature characteristics. Results show no effect of any signature intervention and no unilateral relation between digital signature characteristics and subsequent behavior. These findings contrast with earlier research and cast doubt on the use of signature interventions as a tool to prevent or predict dishonest behavior.

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Keywords: dishonesty; morality; nudging; digital signature

1. Introduction

Individuals continuously encounter opportunities in which dishonest behavior can result in personal gain (Jacobsen, Fosgaard, & Pascual-Ezama, 2018). While most acts of cheating may be of small size, they appear to be quite common (Ariely, 2012). As such, dishonesty leads to substantial damage to society, both economically and socially (Houser, List, Piovesan, Samek, & Winter, 2016). In recent years, fraud statistics have shown a worrying increase with new reached heights (CBS, 2017; Financial Fraud Action, 2017; Finklea, 2014; Javelin, 2017), of which a crucial part may be due to the dishonest reporting of information.

Arrow (1972) put forward that virtually every commercial transaction has within itself an element of trust. This comes with opportunities for abuse, of which tax authorities and insurance companies are well-known victims. These organizations collect declarations and claims, but, sadly, not all people who submit information do this honestly. Careful investigation of all data is not feasible and will not always lead to the detection of fraudulent information. This calls for a preventive approach, in which nudging can help.

"To nudge" is, in the most literal sense, "to push slightly or gently in a desired direction" (Nudge, n.d.). In behavioral sciences, nudging is known as the act of altering choice architecture, which is the design in which choices are presented (Thaler & Sunstein, 2008). In automatic rather than deliberate ways, the environments in which people act has important effects on their behavior (Dolan et al., 2012). According to Thaler and Sunstein (2008), a neutral design does not exist and any design decision will influence behavior. As such, subtle alterations in products and services may either promote or curb criminal behavior (Clarke & Newman, 2005).

Various experimental studies have shown that nudge interventions can be employed to decrease dishonesty (e.g., Mazar, Amir, & Ariely, 2008; Shu, Gino, & Bazerman, 2011; McDonald, Scott, & Hanmer, 2017; Leal, Vrij, Nahari, & Mann, 2016), but one specific intervention in particular has received a major amount of attention. In the study of Shu, Mazar, Gino, Ariely, and Bazerman (2012), cited in 289 works (according to Google Scholar, on July 1, 2019), it was shown that a signature at the beginning of a form can majorly benefit honesty. Problematically, however, this study focused on signatures in their traditional form, drawn physically, often with pen(cil) and paper. In current, increasingly digital, times, paper forms are a rare sight. Organizations and governments are pushing for online, electronic communication (Finger, 2003; Meijer, 2015), which changes the nature of signatures.

In a study titled "Paperless and soulless […]", Chou (2015a) put forward the impact of this change. Digital signatures, or 'e-signatures', are not perceived as symbolically equivalent to pen-and-paper signatures. Experiments showed that digital signatures may evoke a weaker sense of the signer's presence and involvement, and that, accordingly, people perceive the value of electronically signed documents to be lower: job applications are more likely to be discounted and the chance of contract breach is evaluated as higher. This poses a problem for the digitalization of data collection, which comes with a way of signing, that is, as Chou (2015a) states, already prevalent.

The current study aims to further explore the relationship between digital signatures and honesty. It investigates the effects of novel digital signatures, and tests whether various mechanisms that were found in previous studies apply to digital signatures. The accompanying research question is as follows:

RQ: *"What is the relationship of digital signatures to individual honesty?"*

2. Theoretical Framework

Signatures are used to confirm identity and to declare intent in various areas of life (Barner, 1999). Not until signed, an agreement becomes binding, a declaration can be submitted, or a diploma is awarded. One's signature carries legal power, but, as demonstrated by Shu et al. (2012) and Chou (2015b), may also serve as a psychological tool which promotes honesty.

Following classical crime theory (Becker, 1968), dishonesty takes place when it offers greater expected utility than honesty. Individuals are thought to consider the expected cost of punishment and the benefits of the dishonest act, and make a rational, economic decision. Purely rational economics, however, have long fallen out of grace (Ariely, 2009). An entirely economic perspective on honesty does not explain why tax compliance is as high as it is, when the chance and severity of fines are low (Feld & Frey, 2007). It does not explain why people limit their use of lies, when lies cannot be detected (Shalvi et al., 2011). And, it does not explain why moving a signature field to the start of a form promotes honesty (Shu et al., 2012), when it does not impact the expected utility of fraud.

Newer theories on honesty apply a more sophisticated approach, in which the moral state management of an individual plays a central role. Mazar et al. (2008) present the Theory of Self-Concept Maintenance. It consists of the notion that people like to consider themselves as good and honest, but are also attracted to the benefits of dishonesty. Therefore, individuals will perform dishonest behavior, but only to the extent under which they can maintain their positive view of self. Put differently, dishonest behavior reaps the individual benefits, of economic or other nature, but also causes the individual harm in the form of a psychological cost (see also Thielmann & Hilbig, 2019). Strongly related to this idea is the Moral Balance Model by Nisan (1991), under which an individual's moral balance score is computed from

their former behavior, good or bad. When deciding upon moral behavior, people will evaluate what impact an action will have on their score and aim to keep it above their personal standard.

To reduce or entirely avoid the psychological cost of dishonesty, individuals can first and foremost alter their behavior (i.e., not engaging in dishonest behavior or only to a limited extent). They can also, however, apply tactics that make it easier to cope with their dishonest behavior. Bandura (1986) coined eight interrelated 'moral disengagement' mechanisms, which explain how moral self-regulation may be bypassed. In short, people cognitively misconstrue unethical behavior to increase its moral acceptability, distort the effects of harmful actions, and reduce identification with victims. Relatedly, Shalvi, Gino, Barkan, and Ayal (2015) find that people apply self-serving justifications when they engage in ethical violations. Shu et al. (2011) show that people exhibit moral disengagement and appear to forget moral information when lying. These processes demonstrate how individuals can participate in dishonest behaviour while avoiding negative self-signals.

Such tactics may, however, be countered by choice architectural cues. In the REVISE framework, Ayal, Gino, Barkan, and Ariely (2015) put forward thee principles to defeat dishonesty: reminding (boosting people's moral salience with subtle cues), visibility (increasing people's feeling that they are being seen and identified), and self-engagement (bridging the disparity between people's abstract moral image and actual behavior). For instance, honor codes, relying on the reminding principle, have successfully promoted honesty by making people attentive to their own moral standards, which results in dishonest actions having a higher impact on one's self-concept (Mazar et al., 2008; Shu et al., 2011). As another example, covered under the visibility principle, in the presence of mirrors people act more honestly (Vincent et al., 2013; Gino & Mogilner, 2014).

Ayal et al. (2015) classify the signature intervention applied by Shu et al. (2012) under the self-engagement principle as it obtains self-commitment to act morally prior to behavior. Chou (2015b) extensively sets out an explanation on the honesty promoting effect of signatures, arguing that signatures prompt commitment and compliance because they are powerful symbolic representations of the self. In this line, the symbolic value of a signature may serve as a moral cue (which boosts moral salience), whereas the connection to the self may induce self-awareness. As such, a signature may tap into all three of the principles of the REVISE framework, which would contribute to its effectiveness in curbing dishonesty.

In the following sections unanswered questions about honesty nudging and signature interventions are defined. Summarily, this research will examine the honesty effect of various digital signature interventions, how individual differences may moderate this effect, how this effect sustains with repeated choices and over time, and if digital signature characteristics can predict dishonest behavior.

2.1 Signature Type

While pen-and-paper signatures may be very effective at promoting honesty (Shu et al., 2012), digital signatures seem unable to achieve the same. In multiple experiments, Chou (2015b) shows that digital signatures do not increase honesty. There is, however, one exception: a drawn digital signature, which individuals set through drawing their signature with a computer mouse. Unlike clicking a checkbox, entering a PIN, or typing one's name, this type of signature managed to evoke self-presence in participants and to curb dishonesty.

As Chou (2015b) notes, individuals react differently to information written by hand compared to information submitted electronically. James and Engelhardt (2012) have shown that writing a text may lead to higher cognitive engagement than typing it. Furthermore, when people take notes by keyboard, compared to taking notes by hand, it leads to less information

internalization and retention (Mueller & Opperheimer, 2014). Relatedly, experiments show that dishonesty is more prevalent in e-mail communication than it is in pen-and-paper communication (Naquin, Kurtzberg, & Belkin, 2010).

To assess whether a mouse drawn signature is equal to a pen-and-paper signature, Chou (2015b) performed an experiment in which participants could misreport their performance on an anagram solving task. The results showed no significant differences and, therefore, Chou (2015b) concluded that the signature transmission method should not matter. However, given the experiment's small sample size (N = 50), and therefore low statistical power[1], this cannot be taken for granted.

The current state of technology allows for novel signing options, such as a touch drawn signature or uploading a photo of a pen-and-paper signature. Even for the most experienced users it can be hard to make an accurate representation of their signature using a mouse. Drawing with a mouse may feel alien and never quite like regular drawing, while drawing using touchscreen may come as more natural and easy, with the user being in direct haptic contact with the device. Consequently, psychological differences similar to those between typing and writing may exist. This makes it worthwhile to investigate the honesty effects of novel drawn digital signatures, which leads to the following hypothesis:

H1: *"Signature type moderates the honesty effect of digital signatures"*

2.2 Individual Characteristics

Individual differences may moderate the effect of honesty nudging and signature interventions. In this research, digital skills level, financial well-being, and narcissism are examined.

[1] A sensitivity power analysis (conducted with GPower 3.1 [Faul, Erdfelder, Lang, & Buchner, 2007], using a one-tailed alpha significance criterion of .05, a power criterion of 80, and, as in the study, a group 1 sample size of 28 and a group 2 sample size of 22) showed a required effect size of .72 (Cohen's *d*). Following Cohen (1988), this would be a near large effect.

2.2.1 Digital Skills Level

The ‘digital divide’, a term first coined in the second half of the 1990s, refers to the issue of inequality that has surged in the information age (Van Dijk, 2006). Although it first referred to the problem of unequal access to the internet, the focus has shifted to the ‘second-level digital divide’, which concerns differences in people’s online skills (Hargittai, 2002; Van Deursen & Van Dijk, 2011).

As Van Deursen and Van Dijk (2011) show, particularly lower educated individuals experience difficulties in the use of internet technology. For all skill types (operational, formal, informational, and strategic), educational level is a major predictor. Age is also an important factor, but is only a predictor of operational and formal skills. Chou (2015b) notes that digital signatures may evoke less self-presence because such technology is relatively new; only 34% of the U.S. workforce grew up with computers at home (File, 2013) (p. 92).

Between generations and digital skills levels, there may be vast differences in how digital signatures are used and perceived, and therefore also in what psychological effect they may cause. This leads to the following hypotheses:

H2: *“Digital skills level moderates the honesty effect of digital signatures”*

H3: *“Age moderates the honesty effect of digital signatures”*

2.2.2 Financial Well-Being

Financial well-being, defined as the extent to which individuals have financial security and freedom of choice in the present and the future (CPFB, 2015), may be an important factor in people’s behaviour. Budgeting, saving, risky credit card behaviors and compulsive buying are all significantly related to financial well-being (Gutter & Copur, 2011). A field experiment performed by Bhanot (2017) aimed to increase loan repayment rate with honor pledges, but

found minimal impact – with the author concluding that borrowers that fail to repay are often simply unable to do so because of financial hardship.

For those in worse financial situations, earning extra may take priority over maintaining a positive self-concept, or, given their troubles, dishonesty may be perceived as less immoral or justified. As such, those individuals may be less susceptible to honesty nudging interventions. At different levels of financial well-being the effect of a honesty nudge may differ. This leads to the following hypothesis:

H4: *"Financial well-being moderates the honesty effect of digital signatures"*

2.2.3 Narcissism

The American Psychiatric Association (2013) defines narcissistic personality disorder as a "pervasive pattern of grandiosity (in fantasy and behavior), need for admiration, and lack of empathy. . ." (p. 645). Grijalva et al. (2015) note that, besides this clinical conceptualization, a continuous personality attribute of narcissism exists which has been frequently studied and connected to a wide range of consequential outcomes. For example, narcissism has many links to unethical and fraudulent behavior (Lambe, Hamilton-Giachritsis, Garner, & Walker, 2018; Blickle, Schlegel, Fassbender, & Klein, 2006; Williams, Nathanson, & Paulhus, 2010).

Narcissists have a different, more positive, view of self, and appear to operate under a lower level of moral engagement. As such, they may react differently to a honesty nudge which relies on the connection between morality and the self-concept. This leads to the following hypothesis:

H5: *"Narcissism moderates the honesty effect of digital signatures"*

2.3 Effect Decay

Shu et al. (2012) have established that a signature intervention only has an effect on honesty if it is placed before the information reporting moment. Howard, Roe, Nisbet, and Martin (2017) observe that the effect of a honesty priming intervention fades away when individuals are confronted with repeated choices. An analysis of the data of the study that Howard et al. (2017) performed an online replication of (viz., De-Magistris, Gracia, & Nayga, 2013) reveals the same pattern. In two stages of a dictator game, D'Adda, Capraro, and Tavoni (2017) also show the decay of the effect of push and nudge interventions on altruism.

This suggests that honesty nudges temporarily put people in a state during which their behavior is improved, and that, with repeated choices or over time, people will gradually return to their default state. For the design of reporting procedures this is an important phenomenon to examine, which leads to the following hypotheses:

H6: *"The honesty effect of digital signatures decreases with repeated choices"*

H7: *"The honesty effect of digital signatures decreases over time"*

2.4 Dishonesty Prediction

Signature size has been established as a measure of confidence (Bogan & Jankovic, 2018; Zweigenhaft, 1977; Zweigenhaft & Marlowe, 1973; Warner & Sugarman, 1986) and dominance (Jorgenson, 1977; Mailhos, Buunk, & Cabana, 2016). Recently, research has also connected signature size to narcissism (Ham, Seybert, & Wang, 2018; Mailhos et al., 2016).

In an experimental setting, Ham et al. (2018) find that signature size, as a measure of narcissism, predicts misreporting. They validate this result through the examination of notarized signatures of chief financial officers (CFOs) and their organizations, and find that CFO signature size is associated with poor financial reporting quality (viz., more earnings

management, less timely loss recognition, weaker internal control quality, and a higher probability of restatements).

It is worth investigating if this finding can be extended to digital signatures. If so, besides preventing dishonesty, digital signatures may be employed as a fraud indicator. This leads to the following hypothesis:

H8: *"Digital signature characteristics predict dishonesty"*

In two experiments, the relationship of digital signatures to honesty is examined and the hypotheses are tested. Experiment 2 was setup to address the limitations of first experiment and to extend upon it. Therefore, H4 and H5 were only part of the latter experiment.

3. Experiment 1

In cooperation with a Dutch governmental organization, the first experiment tested the effect of various digital signatures in a panel of agricultural entrepreneurs.

3.1 Method

3.1.1 Procedure

Participants were asked to fill in an online questionnaire for improvement of the online services of the organization. Similar to an honesty experiment by Chou (2015b), they were told that the organization was interested in how long it takes people to read four sample texts. Therefore, the organization needed participants to measure how long they spent reading each text. Participants were informed that with longer reading time, they would have more chance of winning one of the lottery prizes (50 vouchers, all worth 20 euros)[2]. Unbeknownst to the

[2] Dissimilar to Chou (2015b), participants were not paid extra per 5 seconds reading time. The research agency that managed the customer panel was not able to individually pay participants, which is why a lottery was used to create incentive for cheating. This is, however, believed to not impact participant behavior (Starmer & Sugden, 1991).

participants, the survey software also measured the time that the participants spent reading, which allowed for the measuring of dishonest overreporting behaviour.

After reading all of the texts, participants' digital skills level was measured (using a digital skills level scale developed by Van Deursen, Helsper, and Eynon [2014]). Demographic variables (age, gender, and educational level) were supplied by the research agency that managed the customer panel. At the end of the survey, participants were asked to describe what they thought that goal of the survey was. Dependent on their condition, they were also asked an additional question about their device input method (see 3.1.2).

At the start of the survey, participants were told that their honesty would be relied upon in this research. Participants were randomly assigned to one of five experimental conditions. If assigned to a signature condition, they were asked to sign via a designated website to continue. After submitting their signature, they received a randomly generated code which they had to enter in the survey.

3.1.2 Experimental Conditions

Table 1 presents the five experimental conditions.

The signature conditions were designed to be as identical to each other as possible, differing only where essential for the specific signing method. For the electronic drawing conditions, a website with a sophisticated electronic canvas was employed (making use of Nowak's [2018] HTML5 signature pad, which is based on code by Dickerson [2015]). Bézier curve interpolation allowed for smooth, pen-and-paper like drawing, with high responsiveness to a user's input. Figure 1 displays screenshots of the websites.

Table 1

Experimental conditions

Condition	Description
Control	Participant provides no signature
Mouse drawn signature	Participant draws signature with a computer mouse
Touch drawn signature	Participant draws signature with a touch device (touchscreen or touchpad)
Pen-and-paper drawn signature	Participant draws signature with a pen(cil) and paper, takes a photo of it, and uploads it
Checkbox signature	Participant provides signature by clicking a checkbox of an honesty statement (‘I declare to answer honestly’ in Dutch)

Figure 1. Screenshots of the mouse/touch, pen-and-paper, and checkbox signature websites.

In order to guarantee a logical flow, participants that participated via mobile devices were not able to be assigned to the mouse drawn signature condition. As participants that take part using laptop and desktop computers may use varying input methods, those in the mouse drawn signature condition were asked about how they control their computer (mouse,

touchscreen, touchpad, or other). Four participants indicated that they used a touchpad and two participants indicated to have made use of a touchscreen; in the analysis, these participants were regarded as having participated in the touch drawn signature condition. For all signatures submitted by participants that were originally assigned to the touch drawn signature condition, the website performed a check to verify to confirm that human touch was indeed used to sign (making use of code by Gilbertson [2016]). For thirteen participants, touch could not be detected; these participants were therefore regarded as having participated in the mouse drawn signature condition.

Submitted signature codes of the survey were matched with the generated codes in the database, in order to link survey data to signature data[3]. Seventeen participants were not willing to sign, and entered a fake code. One participant in the pen-and-paper drawn signature condition uploaded an unrelated photo. These participants were regarded as having participated in the control condition, as they did not provide a valid signature.

3.1.3 Sample

1514 agricultural entrepreneurs, all part of the organization's customer panel, were invited to participate.

675 participants started the survey, and 322 completed it. Of the 353 that did not complete the survey, 27 cancelled their participation on the first page (introduction and informed consent). 277 quit on the page where a signature was required to continue. Cancellation was particularly high among those originally assigned to the pen-and-paper drawn signature condition (N = 119) and the touch drawn signature condition (N = 80), while lower among those originally assigned to the mouse drawn signature condition (N = 43) and checkbox

[3] Signature data for two participants was not saved due to a database upload error. In the case of such a problem, the signature websites were designed to provide the participant with a hardcoded, non-random, client-side code, so that they could continue their participation regardless (and under the assumption that their signature was successfully processed).

signature condition (N = 35). No participants originally assigned to the control group cancelled their participation on the condition page. 49 participants cancelled their participation at a later point in the survey.

Participants that did not complete the survey in full were excluded from the analysis. Three participants that correctly identified the goal of the study were also excluded, leading to a final sample of 319 participants (age mean = 53.32, age SD = 9.834, age min. = 28, age max. = 77, male % = 83.7, female % = 15, unknown gender % = 1.3), with 118 in the control condition, 65 in the mouse condition, 46 in the touch condition, 20 in the pen-and-paper condition, and 70 in the checkbox condition.

3.1.4 Analysis

To test H1, H2, and H3, a UNIANOVA model for overall overreporting rate (DV, continuous) was formed, with as predictors digital skills level (IV, continuous), reading time (IV, continuous), age (IV, continuous), gender (IV, categorical [male/female]), educational level (IV, categorical [low/high; those in possession of at least a bachelor's degree were considered as higher educated]), the experimental condition (IV, categorical), and interaction terms for the experimental condition and each other independent variable. H6 and H7 were tested by, respectively, a repeated measures ANOVA model using the same variables, and a UNIANOVA model using restructured data (in which each text's reporting moment represents a case with z-scores of overreporting rate per text) with time elapsed since signature code submission (IV, continuous) added. H8 was tested in linear regression analyses predicting overall overreporting rate (DV, continuous), separately performed for each signature characteristic (IV, continuous, as listed in Table 2); mouse and touch drawn signatures were analysed both individually and combined, as it was deemed possible that signature characteristics would show a different trend per transmission method, while a combination could increase statistical power.

Overall overreporting rate was computed by subtracting the total reading time recorded by the survey from the total reading time reported by participants, and calculating the proportion of this value compared to the total reading time recorded by the survey. Prior to this, formatting errors of participants (entering seconds as minutes and milliseconds as seconds in the *mm:ss* format) were corrected.

To deal with extreme overreporting and survey measured time, an extreme z-value test with multiple iterations was applied where applicable. In each iteration, the z-score was calculated for the given value list. If the highest absolute z-score was higher than five, the corresponding value was marked as extreme and not used it the next iteration. This was done until an iteration yielded no extreme values. All extreme values were then recoded to the mean plus (or minus) five standard deviations of the final iteration.

Table 2

Signature characteristics computed for mouse and touch drawn signatures

Signature characteristic	Description
Canvas size	Total amount of pixels in the canvas
Pixel amount (absolute)	Amount of drawn pixels in the canvas
Pixel amount (relative)	Amount of drawn pixels, divided by total amount of pixels in the full canvas
Trim size (absolute)	Amount of pixels when the signature image is trimmed to the smallest rectangular form
Trim size (relative)	Amount of pixels when the signature image is trimmed to the smallest rectangular form, divided by total amount of pixels in the full canvas
Time spent signing	How many seconds a participant spent signing before signature submission
Times cleared	How many times a participant cleared the canvas

3.2 Results

On average participants overreport their overall reading time by 25.41 % (SD = 46.41 %). Figure 2 shows the mean overall overreporting rate per experimental condition.

As displayed in Table 3, UNIANOVA analysis shows no mean inequality of overreporting rate between the experimental conditions. As such, the interventions do not have an impact on honesty, and all interventions appear to affect honesty equally (H1). Overall reading time is significantly positively associated with overall overreporting rate. As can be seen in Figure 3, this holds true for all conditions but the pen-and-paper condition, which is reflected in the significant interaction effect between experimental condition and reading time. Furthermore, a higher educational level is near significantly associated with less overreporting. From the lack of interaction between digital skills level and age with experimental condition, it can be concluded that no evidence is found for a moderating role of these factors (H2, H3).

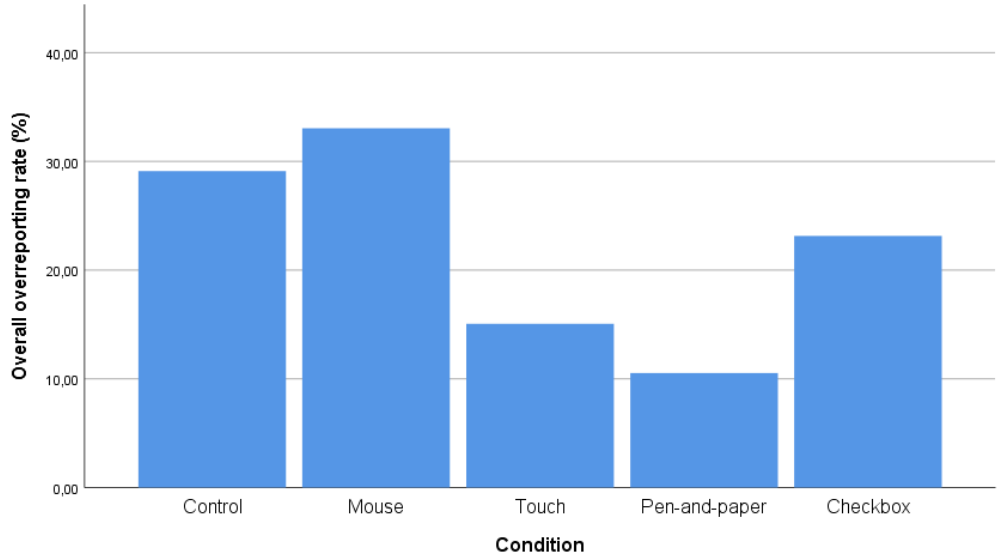

Figure 2. Mean overall overreporting rate per experimental condition.

Table 3

UNIANOVA of participant characteristics and experimental condition on overall overreporting rate

IV	Individual			In interaction with experimental condition		
	F	P	η^2	F	P	η^2
Digital skills level	= .249	= .618	= .001	= 1.592	= .177	= .022
Reading time	= 14.134	< .001***	= .048	= 4.987	= .001***	= .067
Age	= .024	= .877	< .001	= .437	= .781	= .006
Gender (Male/female)	= .365	= .546	= .001	= 1.557	= .186	= .022
Educational level (Low/high)	= 3.291	= .071*	= .012	= 1.301	= .27	= .018
Experimental condition	= 2.183	= .071*	= .03			

* p < .1; ** p < .05; *** p < .01

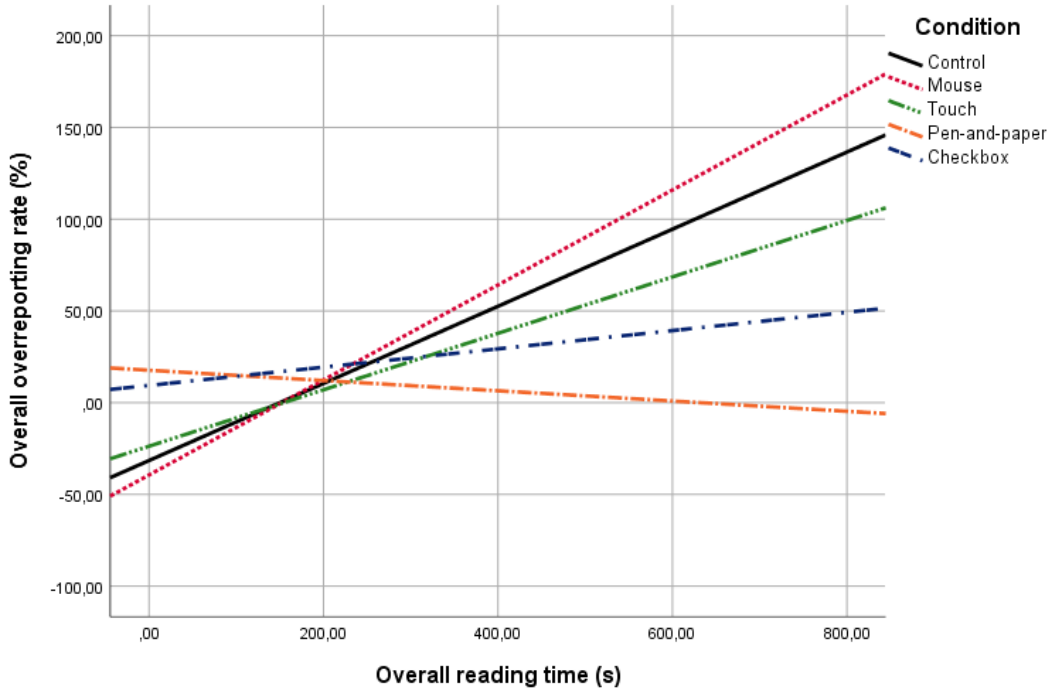

Figure 3. Overall overreporting rate by overall reading time for each experimental condition.

Repeated measures ANOVA analysis (sphericity violated under Mauchly's test: $\chi(2) = .53$, $p < .001$) shows that mean inequality in overreporting rate over the four texts does not significantly exist (Greenhouse-Geisser: $F(2.177, 605.081) = .6$, $p = .563$, $\eta^2 = .002$). There is also no interaction effect with experimental condition (Greenhouse-Geisser: $F(8.706, 605.081) = 1.317$, $p = .226$, $\eta^2 = .019$), which means there is no statistical proof for effect decay with repeated choices (H6), though, for all conditions but the pen-and-paper condition, mean overreporting rate is highest for the first text (see Figure 4). Accordingly, UNIANOVA analysis with restructured data (each text's reporting moment as a case) shows a significant decrease in overreporting as time elapsed since signature code submission increases ($F(1, 1221) = 93.279$, $p < .001$, $\eta^2 = .071$), but no interaction with experimental condition ($F(4, 1221) = .583$, $p = .675$, $\eta^2 = .002$), which means no effect decay over time is found (H7).

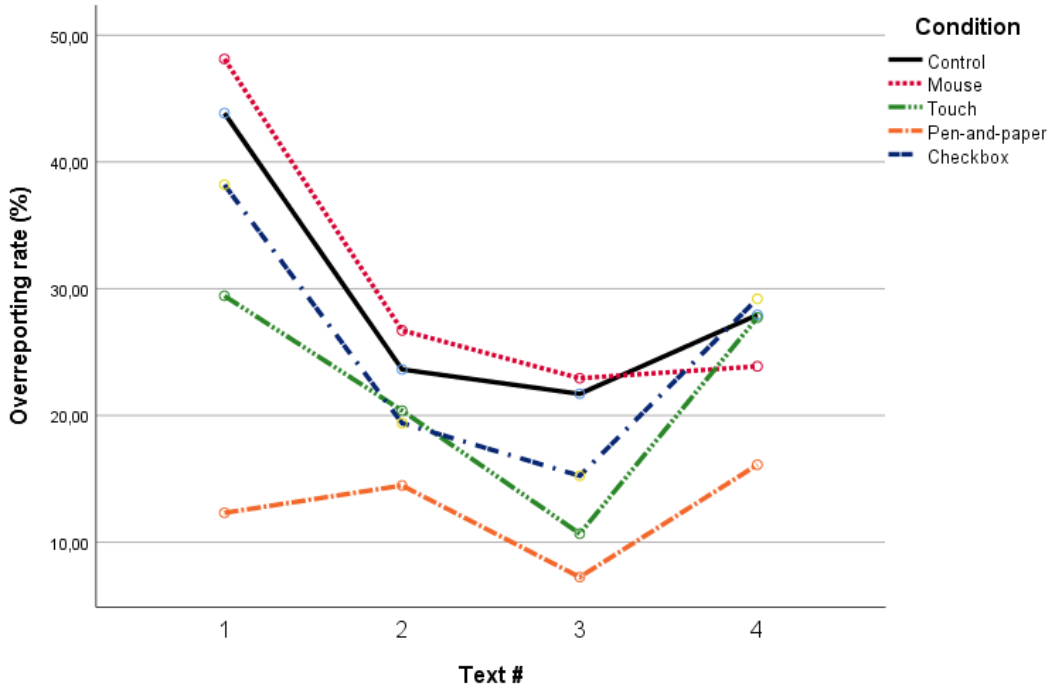

Figure 4. Overreporting rate per text for each experimental condition.

The linear regression analyses for H8 are shown in Table 4. While combining mouse and touch drawn signatures does not lead to any significant results, separating the two types does. Particularly, in mouse drawn signatures relative trim size is negatively associated with overreporting, while in touch drawn signatures the opposite holds true. Absolute trim size, however, is associated with overreporting for both mouse and touch drawn signatures, though only near significantly for mouse drawn signatures. Greater digital signature size may be associated with dishonesty, but different characteristics show conflicting results (H8).

Table 4

Separate linear regression analysis outcomes for each signature characteristic predicting overall overreporting rate

Signature characteristic	Mouse drawn signatures			Touch drawn signatures			Mouse & touch drawn signatures		
	P	B (sign)	R^2	P	B (sign)	R^2	p	B (sign)	R^2
Canvas size	= .568	> -.001 (-)	= .005	= .142	< .001 (+)	= .048	= .817	> -.001 (-)	< .001
Pixel amount (absolute)	= .064 *	= -.002 (-)	= .053	= .07 *	= .001 (+)	= .073	= .716	< .001 (+)	= .001
Pixel amount (relative)	= .182	= -5.539 (-)	= .028	= .291	= 3.836 (+)	= .025	= .37	= -2.481 (-)	= .007
Trim size (absolute)	= .057 *	< .001 (+)	= .056	= .009 ***	< .001 (+)	= .146	= .93	> -.001 (-)	< .001
Trim size (relative)	= .043 **	= -.665 (-)	= .064	= .012 **	= .975 (+)	= .135	= .303	= -.257 (-)	= .01
Time spent signing	= .956	= .009 (+)	< .001	= .522	= .205 (+)	= .009	= .559	= .083 (+)	= .003
Times cleared	= .825	= -.882 (-)	= .001	= .317	= -7.605 (-)	= .023	= .791	= -.89 (-)	= .001

* p < .1; ** p < .05; *** p < .01

3.3 Discussion

The results of Experiment 1 do not provide significant proof for any hypothesis. A slight trend, however, shows that touch and pen-and-paper signatures may positively influence honesty. The high cancellation rate among the latter two conditions may have influenced these results, decreasing statistical power and creating a potential self-selection bias.

Additionally, the average overreporting rate in this experiment was 25.41 %. In Chou's (2015b) experiment, those in the control condition overreported by 77.36 %, and those in the most effective signature condition (mouse drawn) by 58 %. An essential difference between the both experiments is the sample: Chou's (2015b) experiment was conducted on Amazon Mechanical Turk (MTurk). Prior research shows that MTurk participants are strongly financially motivated (Ipeirotis, 2010; Litman, Robinson, & Rosenzweig, 2015) and commonly lie about their characteristics to be eligible for paid tasks (Chandler & Paolacci, 2017; Sharpe Wessling, Huber, & Netzer, 2017). A customer panel could have a different motivation for participation (i.e., helping the organization by providing useful feedback, rather than earning money), which could explain the difference in overreporting. A lower default occurrence of dishonesty may have made it more difficult to find a honesty effect.

4. Experiment 2

The second experiment addresses the limitations of the first experiment, and tests the effect of various digital signatures in a sample of Amazon Mechanical Turk (MTurk) workers.

4.1 Method

4.1.1 Procedure

Adapting a method of Rahwan, Hauser, Kochanowska, and Fasolo (2018), but using the die-under-the-cup paradigm (Fischbacher & Föllmi-Heusi, 2013) instead of a coin toss for

increased measurement sensitivity, online participants were asked to play ten rounds of a die roll game. In each round, participants had to roll a die once, and report the outcome. They were allowed to use any die, be it physical or virtual, as long as it were fair and six-sided. When rolling 1 to 5, participants would earn a potential bonus of that number in dollar cents, and when rolling 6 they would earn nothing. The nature of this task allows participants to act dishonestly and claim more bonus than they deserve, while this is, on an individual level but not on the group level, undetectable. Participants were informed that their overall bonus would be compared to that of a random other participant, and if it were equal or higher, they would enter the lottery. One in five participants in the lottery would then be paid their overall bonus.

In four attention checks (two regarding the bonus outcome of die rolls and two regarding the conditions for entering the competitive lottery), participants' understanding of the instruction was confirmed.

After the die roll game, following Rahwan et al. (2018), participants filled out a morality scale and were offered the opportunity to donate a percentage of their overall potential bonus payment to one of six charities. Then, they filled out the Single Item Narcissism Scale (Konrath, Meier, & Bushman, 2014), their financial well-being and digital skills level were measured (using, respectively, the CPFB [2015] Financial Well-Being Scale, and the same digital skills level scale as in Experiment 1, developed by Van Deursen et al. [2014]), and demographic data was collected. Dependant on their condition, they were also asked an additional question about their device input method (see 4.1.2).

Prior to the die roll game, participants had to certify that the to be submitted information would be correct. Assigned to one of five experimental conditions, this was done by providing a signature or, in the control condition, simply continuing to the next page.

4.1.2 Experimental Conditions

The experimental conditions were the same as in Experiment 1 (see 3.1.2), apart from the previously Dutch message of the checkbox signature being translated to 'I declare to be honest'.

87 participants in the mouse drawn signature condition were recoded to the touch drawn signature condition, of which for 32 touch was detected and 55 reported to have used a touchpad. 47 participants in the touch condition were recoded to the mouse condition, because touch was not detected by the web page and they did not report having used a touchpad.

4.1.3 Sample

MTurk was used for sample recruitment. MTurk is a crowdsourcing platform via which "workers" complete "human intelligence tasks" and get paid for doing so (Amazon, n.d.). It is commonly used in academic research (Chandler & Shapiro, 2016), as it can quickly deliver inexpensive, high-quality data and offers a diverse sample that is significantly more diverse than a college sample (Buhrmester, Kwang, & Gosling, 2011).

After the first 323 participants, cancellation in the pen-and-paper drawn signature condition was high (completed per condition at that time: 103 control, 69 mouse, 60 touch, 15 pen-and-paper, 76 checkbox). Worker reviews of the HIT, as found on Turkopticon (a website where workers share information on MTurk requesters and tasks), revealed that workers may have considered the pay too low for a photo upload task. To address this, the pay was upped from 0.25 $ to 0.5 $. An evaluation of the cancellation rate of 603 participants that were paid 0.5 $ indicated that the measure had an insignificant effect[4]. A final group of 64 participants was recruited under a pay of 0.25 $, with only assignation to the pen-and-paper condition possible.

[4] Cancellation rate was 69.33 % (104 out of 150) under 0.25 $ and 60.92 % (145 out of 238) under 0.5 $. A binary two-tailed t-test showed that this difference was insignificant ($t(386) = 1.684$, $p = .093$).

The final amount of participants was 989 (age mean = 34.98, age SD = 11.335, age min. = 18, age max. = 78, male % = 52.3, female % = 47.3, other gender % = .4), with 247 in the control condition, 165 in the mouse condition, 222 in the touch condition, 150 in the pen-and-paper condition, and 205 in the checkbox condition.

4.1.4 Analysis

To test H1 to H5, a UNIANOVA model for overall bonus (DV, continuous), self-reported morality (DV, continuous), and percentage donated (DV, continuous) was formed, with as independent variables the same as in the model of Experiment 1, and added financial well-being (IV, continuous), narcissism (IV, continuous), pay (IV, categorical [0.25/0.5 $]), plus their interaction terms with experimental condition. Similarly, H6, H7, and H8 were tested with the according models from Experiment 1, updated with the relevant new variables.

4.2 Results

Compared to the expected overall bonus (.25 $), based on the outcome distribution of a fair six-sided die, participants' overall bonuses (M = .293, SD = .079) are significantly higher ($t(988) = 16.843$, $p < .001$, Cohen's $d = .54$), which indicates that dishonesty has taken place. Figure 5 shows the mean overall bonus per experimental condition.

UNIANOVA analysis (displayed in Table 5) shows no significant mean inequality between experimental conditions for overall bonus, self-reported morality, or donation percentage. As such, the interventions have no impact, and all interventions have an equal effect (H1). Age is negatively associated with overall bonus. Additionally, male participants significantly claim more overall bonus than female participants. No other factors are able to significantly predict overall bonus, but higher educated participants donate more to charity than lower educated participants, while, conversely, a higher digital skills level is associated with donating less, but also with higher self-reported morality. Narcissism is associated with lower

self-reported morality. Finally, an interaction effect is found between experimental condition and financial well-being on self-reported morality. Under low financial well-being, those in the control condition report lower self-reported morality than those in signature conditions. As financial well-being increases, those in the control condition eventually self-report higher morality (see Figure 6). Besides this interaction, there is no evidence for participant characteristics affecting the effect of the signature interventions (H2, H3, H4, H5).

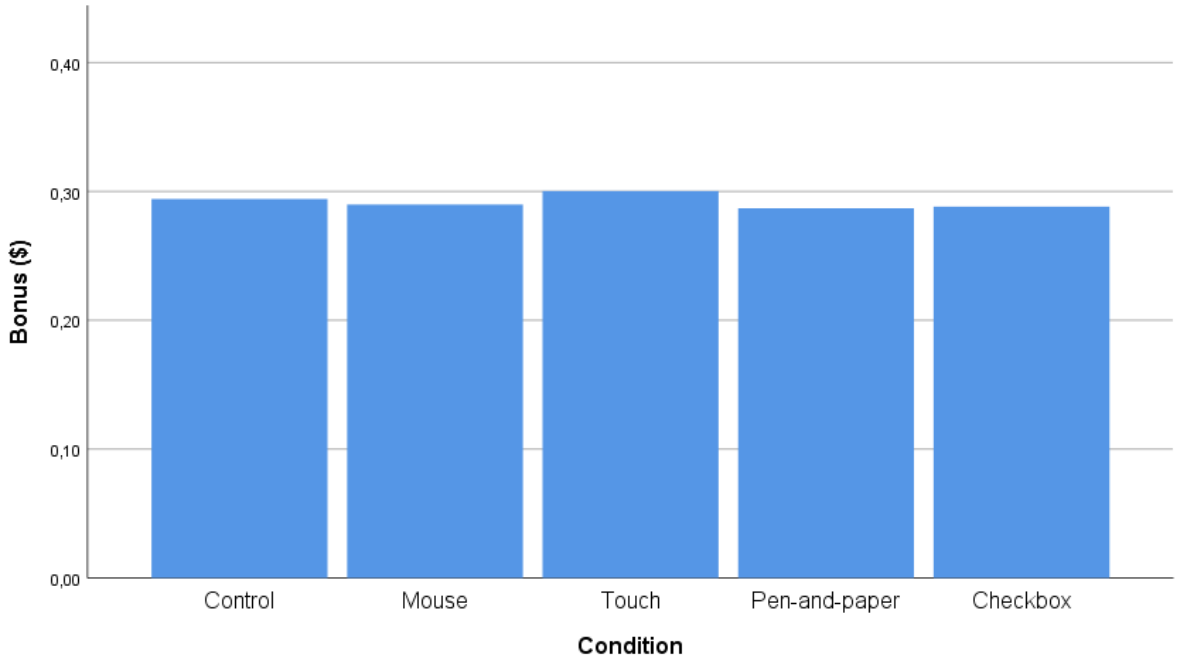

Figure 5. Mean overall bonus per experimental condition.

Table 5

UNIANOVA of participant characteristics and experimental condition on overall bonus, self-reported morality, and donation percentage

IV	DV	Individual			In interaction with experimental condition		
		F	p	η^2	F	p	η^2
Financial well-being	Bonus	= .138	= .719	< .001	= .51	= .728	= .002
	Morality	= 1.309	= .253	= .001	= 3.265	= .011**	= .014
	Donation	= .179	= .672	< .001	= .738	= .566	= .003
Digital skills level	Bonus	= .002	= .965	< .001	= .547	= .702	= .002
	Morality	= 33.35	< .001***	= .034	= .656	= .623	= .003
	Donation	= 4.078	= .044**	= .004	= .936	= .442	= .004
Narcissism	Bonus	= .06	= .807	< .001	= 1.039	= .386	= .004
	Morality	= 29.509	< .001***	= .03	= .236	= .918	= .001
	Donation	= 1.371	= .242	= .001	= 1.46	= .212	= .006
Age	Bonus	= 4.614	= .032**	= .005	= .975	= .42	= .004
	Morality	= .045	= .831	< .001	= .411	= .801	= .002
	Donation	= 1.295	= .255	= .001	= 1.272	= .279	= .005
Gender (Male/female)	Bonus	= 5.209	= .023**	= .005	= .391	= .815	= .002
	Morality	= 2.015	= .156	= .002	= 1.607	= .17	= .007
	Donation	= 1.89	= .17	= .002	= .604	= .66	= .003
Educational level (Low/high)	Bonus	= 2.702	= .101	= .003	= 1.281	= .276	= .005
	Morality	= .471	= .493	< .001	= .267	= .899	= .001
	Donation	= 5.84	= .016**	= .006	= .877	= .477	= .004
Pay (0.25/0.5 $)	Bonus	= .809	= .369	= .001	= .746	= .561	= .003
	Morality	= 1.04	= .308	= .001	= .21	= .933	= .001
	Donation	= 3.023	= .082*	= .003	= 1.374	= .241	= .006
Experimental condition	Bonus	= 1.081	= .365	= .005			
	Morality	= .974	= .421	= .004			
	Donation	= 366	= .833	= .002			

* p < .1; ** p < .05; *** p < .01

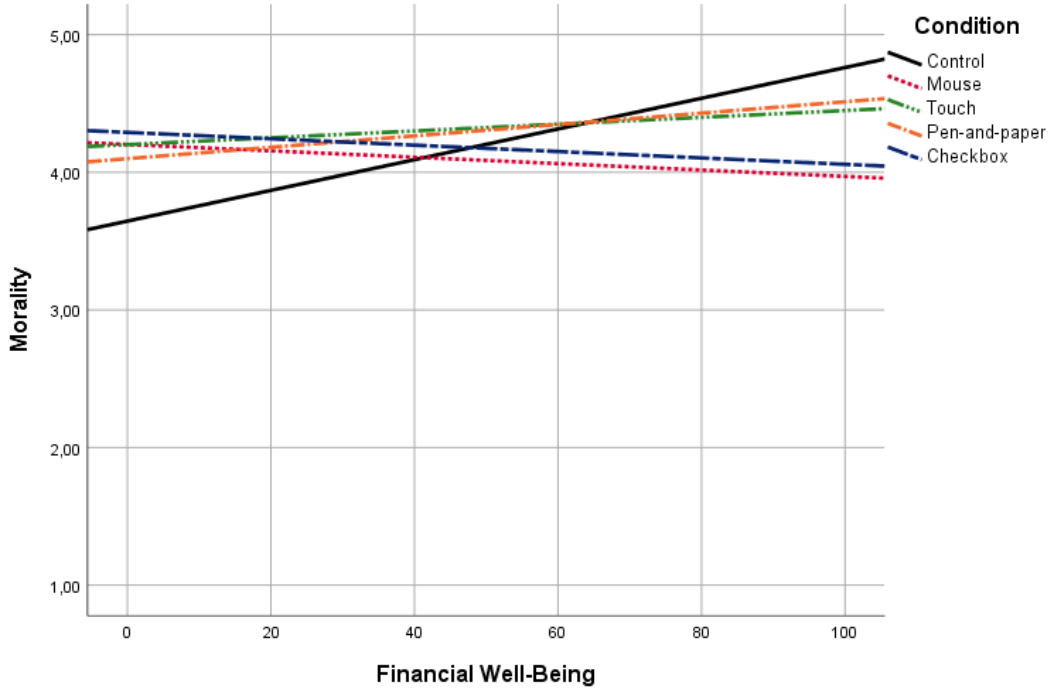

Figure 6. Self-reported morality by financial well-being for each experimental condition.

Repeated measures ANOVA analysis (sphericity violated under Mauchly's test: $\chi(2) = .919$, $p < .001$) shows that mean inequality in bonus over the ten separate die roll game rounds near significantly exists (Greenhouse-Geisser: $F (8.836, 8597.002) = 1.763$, $p = .071$, $\eta^2 = .002$). There is, however, no interaction effect with experimental condition (Greenhouse-Geisser: $F (35.342, 8597.002) = 1.034$, $p = .393$, $\eta^2 = .004$). Furthermore, the bonus means per round do not show a gradual decrease (see Figure 7). Therefore, there is no evidence for effect decay with repeated choices (H6). Accordingly, UNIANOVA analysis with restructured data (each round's reporting moment as a case) shows a significant decrease of bonus as time elapsed since signature code submission increases ($F (1, 9833) = 50.881$, $p < .001$, $\eta^2 = .005$), but no interaction with experimental condition ($F (4, 9833) = 1.119$, $p = .346$, $\eta^2 < .001$), which means no effect decay over time is found (H7).

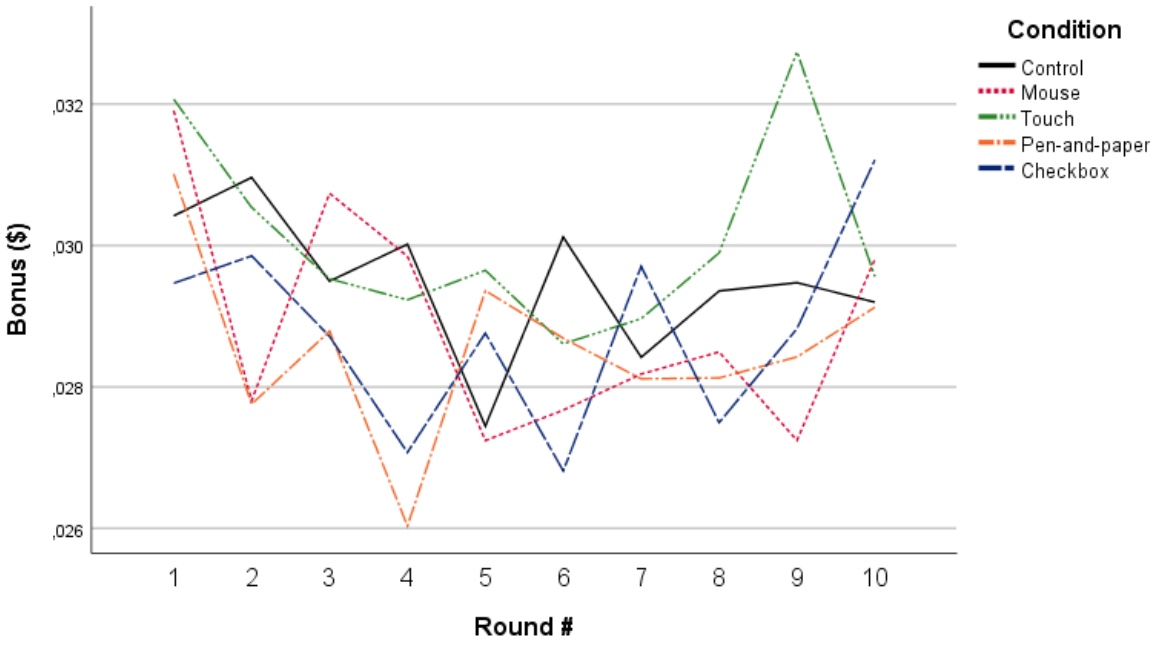

Figure 7. Mean bonus per round for each experimental condition.

The linear regression analyses for H8 are shown in Table 6. Relative pixel amount is significantly negatively associated with overall bonus for touch drawn signatures. Conflictingly, trim size of touch drawn signatures is significantly positively associated with narcissism. A lack of any other significant relationship between signature size measures and the four dependent variables indicates that digital signature size may not be of use in predicting narcissism or unethical behaviour. Time spent signing is significantly positively associated with overall bonus, but also with donation; times cleared is near significantly positively with narcissism, but also near significantly negatively with overall bonus. Therefore, though (near) significant, these measures do not reach agreement, and digital signature characteristics seem unable to unilaterally predict narcissism or honesty behaviour (H8).

Table 6

Separate linear regression analysis outcomes for each signature characteristic predicting narcissism, overall bonus, self-reported morality, and donation percentage

Signature characteristic	Mouse drawn signatures			Touch drawn signatures			Mouse & touch drawn signatures		
	p	B (sign)	R^2	p	B (sign)	R^2	p	B (sign)	R^2
Canvas size									
Narcissism	= .668	< .001 (+)	= .001	= .287	< .001 (+)	= .005	= .483	> -.001 (-)	= .001
Bonus	= .781	< .001 (+)	< .001	= .394	< .001 (+)	= .003	= .169	< .001 (+)	= .005
Morality	= .452	> -.001 (-)	= .003	= .675	> -.001 (-)	= .001	= .454	< .001 (+)	= .001
Donation	= .183	> -.001 (-)	= .011	= .89	> -.001 (-)	< .001	= .107	> -.001 (-)	= .007
Pixel amount (absolute)									
Narcissism	= .708	> -.001 (-)	= .001	= .071 *	< .001 (+)	= .015	= .683	> -.001 (-)	< .001
Bonus	= .928	< .001 (+)	< .001	= .691	> -.001 (-)	= .001	= .793	< .001 (+)	< .001
Morality	= .514	> -.001 (-)	= .003	= .377	> -.001 (-)	= .004	= .676	< .001 (+)	< .001
Donation	= .145	= -.001 (-)	= .013	= .772	< .001 (+)	< .001	= .23	< .001 (+)	= .004
Pixel amount (relative)									
Narcissism	= .343	= -.116 (-)	= .006	= .174	= .071 (+)	= .008	= .45	= -.039 (-)	= .001
Bonus	= .73	= -.002 (-)	= .001	= .045 **	= -.006 (-)	= .018	= .175	= -.003 (-)	= .005
Morality	= .692	= .019 (+)	= .001	= .903	= -.003 (+)	< .001	= .285	= .024 (+)	= .003
Donation	= .165	= -3.207 (-)	= .012	= .373	= 1.061 (+)	= .004	= .439	= -.805 (+)	= .002

Trim size (absolute)									
Narcissism	= .308	< .001 (+)	= .006	= .03 **	< .001 (+)	= .021	= .508	< .001 (+)	= .001
Bonus	= .918	< .001 (+)	< .001	= .401	< .001 (+)	= .003	= .225	< .001 (+)	= .004
Morality	= .229	> -.001 (-)	= .009	= .22	> -.001 (-)	= .007	= .711	> -.001 (-)	< .001
Donation	= .097 *	> -.001 (-)	= .017	= .613	< .001 (+)	=.001	= .233	> -.001 (-)	= .004
Trim size (relative)									
Narcissism	= .428	= .006 (+)	= .004	= .038 **	= .01 (+)	= .019	= .154	= .006 (+)	= .005
Bonus	= .343	< .001 (+)	= .006	= .968	< .001 (+)	< .001	= .619	> -.001 (-)	= .001
Morality	= .674	= -.001 (-)	= .001	= .886	< .001 (+)	< .001	= .965	> -.001 (-)	< .001
Donation	= .145	= -.192 (-)	= .013	= .129	= .174 (+)	= .01	= .703	= -.033 (-)	< .001
Time spent signing									
Narcissism	= .085 *	= .014 (+)	= .018	= .666	= .003 (+)	= .001	= .059 *	= .01 (+)	= .009
Bonus	= .524	< .001 (+)	= .002	= .033 **	= -.001 (-)	= .02	= .044 **	< .001 (+)	= .011
Morality	= .483	= .002 (+)	= .003	= .15	= .004 (+)	= .009	= .197	= .003 (+)	= .004
Donation	= .047 **	= .313 (+)	= .024	= .027 **	= .303 (+)	= .022	= .002 ***	=.322 (+)	= .025
Times cleared									
Narcissism	= .099 *	= .23 (+)	=.017	= .904	= -.017 (-)	< .001	= .052 *	= .190 (+)	= .01
Bonus	= .271	= -.006 (-)	= .007	= .256	= -.009 (-)	= .006	= .085 *	= -.008 (-)	= .008
Morality	= .928	= -.005 (-)	< .001	=.741	=.023 (+)	< .001	= .778	= -.012 (-)	< .001
Donation	= .565	= 1.531 (+)	= .002	= .429	= 2.557 (+)	= .003	= .223	= 2.435 (+)	= .004

* p < .1; ** p < .05; *** p < .01

5. General Discussion

5.1 Findings

Across two experiments, no significant effect of any digital signature was found on subsequent moral behaviour. Accordingly, there was no evidence for related hypotheses about variation between signature type, the moderating role of individual characteristics, and effect decay. While some signature characteristics were found to have a significant relationship to honesty, self-reported morality, charitable giving, or narcissism, a uniform relation is lacking (with similar measures conflicting within each experiment, and the two experiments not finding evidence for the same measures). Therefore, all hypotheses are rejected.

The results support the idea that digital signatures are not equivalent to pen-and-paper signatures in terms of their effectiveness as a psychological tool to promote honesty (Chou, 2015a), but bring into question whether drawn types of digital signatures are indeed an exception to that (cf. Chou, 2015b). Furthermore, the inclusion of a pen-and-paper signature condition makes for a contrast with the original study of Shu et al. (2012), casting doubt on signature interventions and underlying theory as a whole. It should be noted that the amount of studies on honesty that experimented with signature interventions in isolation is very limited, there being only three studies besides the current (viz., Chou, 2015b; Kettle et al., 2017; Shu et al., 2012): despite having gained a fair amount of attention, signature interventions are still relatively unestablished as a tool to promote honesty.

Additionally, the results do not convincingly support the connection of characteristics of mouse and touch drawn signatures to narcissism and dishonest behaviour. Therefore, the findings of Ham et al. (2018), which indicated that the size of a pen-and-paper signature can predict misreporting, could not be extended to the digital context. The predictive power of

one's signature may be lost in the digital transition, perhaps simply due to the changed transmission method (which could cause people to draw differently and uses a scaling canvas).

The null results are in line with several other studies that display a trend of failed replications in honesty nudging. For instance, Kettle, Hernandez, Sanders, Hauser, and Ruda (2017) experimented with various short messages and tasks that were applied to CAPTCHA pop-up windows before Guatemalan taxpayers filled in an online tax form. They found that the nudges, which were taken from multiple earlier studies, did not enhance honesty. Similarly, Corrigan-Gibbs, Gupta, Northcut, Cutrell, and Thies (2015) found that honor codes, previously proven successful in promoting honesty by Mazar et al. (2008) and Shu et al. (2011), may not have any effect. A mass direct replication by Verschuere et al. (2018) of the well-known Ten Commandments experiment by Mazar et al. (2008) showed no effect, too, and there are more related replication studies that show null results (e.g., Howard, Roe, Nisbet & Martin, 2017; Pashler, Roher, & Harris, 2013). This casts doubt on the effectiveness of some well-known honesty enhancing interventions, even though they are supported by the original evidence and replication studies do also confirm earlier results (e.g., Schild, Heck, Ścigala, & Zetter, 2019).

Despite the rejection of all hypotheses, the results of the current research do indicate that certain participant variables have a small but significant influence on honesty behaviour:

a) In Experiment 2, it appeared that higher age is positively associated with honesty, which is in line with the findings of previous research (e.g., Friesen & Gangadharan, 2013; Fosgaard, 2016).

b) In Experiment 2, male participants lied more than female participants. The dishonesty literature appears to largely support this finding (e.g., Friesen & Gangadharan, 2012; Capraro, 2018), though results remain mixed on the gender effect (see review in Jacobsen & Fosgaard, 2018).

c) Charitable giving was higher among higher educated participants, as has been well-established in previous research on philanthropy (see review in Bekkers & Wiepking, 2011).

d) Digital skills level was associated with both higher self-reported morality and donating less. It is theoretically unclear why digital skills level is a predictor herein, though connection between the two dependent variables might be explained by moral balance theory (e.g., Nisan, 1991; see also Merritt, Effron, & Monin, 2010), considering that morality was reported before deciding upon the donation (an opportunity to restore moral balance).

e) Narcissism was strongly related to lower self-reported morality, but it did not predict actual behaviour. That narcissists do not report themselves as more moral than the average person has been previously found (Campbell, Rudich, & Sedikides, 2002), but the proposed link between narcissism and fraudulent behaviour (see 2.2.3) could not be confirmed.

f) Controlling for educational level and other participant variables in the model, it appeared that participants that spent longer on reading the texts in Experiment 1 also overreported their reading time more (both absolutely and relatively). This phenomenon is perhaps formed via exponentially increased feelings of entitlement (see Poon, Chen, & DeWall, 2013) as reading time increases, or a cognitive bias of some sort which facilitates the addition of an exponentially increased number as reading time increases.

5.2 Limitations

The main limitation of this research is the potential self-selection bias due to cancellation at signature submission, of which the effect is unclear. Particularly the pen-and-paper condition suffered from this. After completion of Experiment 1, it was hoped that MTurk participants – who were paid for participation – would not show this problem, or at least to a much lesser extent. Unfortunately, cancellation rate remained high, even after doubling the payment. The effort that is involved for participants, as well as possible legal and privacy concerns, troubles

digital signature experiments. Behaviour of those not signing may be quite different from those that do. Future research may be able to avoid this potential bias by increasing participation pay to a great enough extent (which may become quite costly when aiming for a sufficient sample size) or performing an experiment in a setting where signing is mandatory and self-selection is not possible (e.g., in a field experiment in cooperation with a governmental organization).

More minor limitations concern the administration of certain variables, such as measurement of narcissism through the Single Item Narcissism Scale (Konrath et al., 2014). Though validated, it lacks accuracy compared to more elaborate methods of assessing the personality trait (e.g., the multifactor 40-item Narcissistic Personality Inventory [Raskin & Hall, 1979]). Experiment 2 had real financial consequences, but the overall pay was relatively low, which may have played a role in finding no effect of financial well-being on behaviour. Similarly, doubling participants' pay had no effect; herein, the limiting factor is that it only concerned an absolute increase of 0.25 $. Finally, unlike Ham et al. (2018), the current model of signature characteristics predicting dishonest behaviour did not control for the length of participants' names, which may have caused a reduction in statistical power.

5.3 Conclusion

In sum, digital signatures do not show a positive impact on honesty, regardless of signature type, and no proof was found for the additional hypotheses. As such, policy makers should think twice before implementing digital signatures, particularly those that require more effort and are detested by users (which may surge emotional justifications for unethical behaviour [Shalvi, Van Gelder, & Van der Schalk, 2013]), as they may not be of use for preventing or predicting dishonesty at all. Future research that investigates digital signatures in a context in which self-selection cannot occur is needed, so that an informed decision can be made about the inclusion of digital signatures in data gathering processes relying on submitters' honesty.

6. Declarations

6.1 Availability of Data and Materials

The research data and materials that support the findings of this study are available in the Open Science Framework repository at https://osf.io/z6527/ (DOI 10.17605/OSF.IO/Z6527).

6.2 Disclosure

There are no competing interests to be reported.

6.3 Acknowledgements

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7. References

Ariely, D. (2009). The end of rational economics. *Harvard business review*, *87*(7-8), 78-84.

Ariely, D. (2012). *The (honest) truth about dishonesty*. New York, NY: Harper Collins Publishers.

Amazon. (n.d.) *Human Intelligence through an API: Access a global, on-demand, 24x7 workforce*. Retrieved from https://www.mturk.com/

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders (DSM-5®)*. American Psychiatric Pub.

Arrow, K. J. (1972). Gifts and exchanges. *Philosophy & Public Affairs*, 343-362.

Ayal, S., Gino, F., Barkan, R., & Ariely, D. (2015). Three principles to REVISE people's unethical behavior. *Perspectives on Psychological Science*, *10*(6), 738-741.

Bandura, A. (1986). Social foundations of thought and action: A social cognitive theory. Englewood Cliffs, NJ: Prentice-Hall.

Barner, B.A. (1999). *Black's Law dictionary* (7th ed.). St. Paul, Minnesota: West Group.

Becker, G. S. (1968). Crime and punishment: An economic approach. In *The economic dimensions of crime* (pp. 13-68). Palgrave Macmillan, London.

Bekkers, R., & Wiepking, P. (2011). Who gives? A literature review of predictors of charitable giving part one: religion, education, age and socialisation. *Voluntary Sector Review*, *2*(3), 337-365.

Bhanot, S. P. (2017). Cheap promises: Evidence from loan repayment pledges in an online experiment. *Journal of Economic Behavior & Organization*, *140*, 246-266.

Blickle, G., Schlegel, A., Fassbender, P., & Klein, U. (2006). Some personality correlates of business white-collar crime. *Applied Psychology*, *55*(2), 220-233.

Bogan, V. L., & Jankovic, L. M. (2018). *The "Write" Size of Trading Behavior: Overconfidence, Prices, and Bubbles in Experimental Asset Markets*.

Buhrmester, M., Kwang, T., & Gosling, S. D. (2011). Amazon's Mechanical Turk: A new source of inexpensive, yet high-quality, data? *Perspectives on Psychological Science*, *6*(1), 3-5.

Campbell, W. K., Rudich, E. A., & Sedikides, C. (2002). Narcissism, self-esteem, and the positivity of self-views: Two portraits of self-love. *Personality and Social Psychology Bulletin*, *28*(3), 358-368

Capraro, V. (2018). Gender differences in lying in sender-receiver games: A meta-analysis. *Judgment and Decision Making*, *13*(4), 345-355.

CBS. (2017). *Geregistreerde criminaliteit; soort misdrijf; regio*. Retrieved from http://statline.cbs.nl/statweb/publication/?dm=slnl&pa=83648ned

Chandler, J. J., & Paolacci, G. (2017). Lie for a dime: When most prescreening responses are honest but most study participants are impostors. *Social Psychological and Personality Science*, *8*(5), 500-508.

Chandler, J. J., & Shapiro, D. (2016). Conducting clinical research using crowdsourced convenience samples. *Annual Review of Clinical Psychology*, *12*.

Chou, E. Y. (2015a). Paperless and soulless: E-signatures diminish the signer's presence and decrease acceptance. *Social Psychological and Personality Science*, *6*(3), 343-351.

Chou, E. Y. (2015b). What's in a name? The toll e-signatures take on individual honesty. *Journal of Experimental Social Psychology*, *61*, 84-95.

Clarke, R. V., & Newman, G. R. (2005). *Designing out crime from products and systems* (Vol. 18): Willan Publishing.

Cohen, J. (1988). *Statistical power analysis for the social sciences*. Routledge.

Corrigan-Gibbs, H., Gupta, N., Northcutt, C., Cutrell, E., & Thies, W. (2015). Deterring cheating in online environments. *ACM Transactions on Computer-Human Interaction(TOCHI)*, *22*(6), 28.

CPFB. (2015). *Measuring financial well-being: A guide to using the CPFB Financial Well-Being Scale*. Retrieved from https://www.consumerfinance.gov/data research/research-reports/financial-well-being-scale/

D'Adda, G., Capraro, V., & Tavoni, M. (2017). Push, don't nudge: Behavioral spillovers and policy instruments. *Economics Letters, 154*, 92-95.

De-Magistris, T., Gracia, A., & Nayga Jr, R. M. (2013). On the use of honesty priming tasks to mitigate hypothetical bias in choice experiments. *American Journal of AgriculturalEconomics*, *95*(5), 1136-1154.

Dickerson, R. (2012). *Smoother Signatures: Capturing even more beautiful signatures on Android*. Retrieved from https://medium.com/square-corner-blog/smoother-signatures-be64515adb33

Dolan, P., Hallsworth, M., Halpern, D., King, D., Metcalfe, R., & Vlaev, I. (2012). Influencing behaviour: The mindspace way. *Journal of Economic Psychology*, *33*(1), 264-277.

Faul, F., Erdfelder, E., Lang, A. G., & Buchner, A. (2007). G* Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior research methods*, *39*(2), 175-191.

Feld, L. P., & Frey, B. S. (2007). Tax compliance as the result of a psychological tax contract: The role of incentives and responsive regulation. *Law & Policy*, *29*(1), 102-120.

File, T. (2013). Computer and internet use in the United States. *Current population survey reports*, (P20-568).

Financial Fraud Action. (2017). *Fraud The Facts 2017: The Definitive Overview of Payment Industry Fraud*. Retrieved from https://www.financialfraudaction.org.uk/fraudfacts17/assets/fraud_the_facts.pdf

Finger, M., & Pécoud, G. (2003). *From e-Government to e-Governance? Towards a model of e-Governance*. Paper presented at the Proceedings of the 3rd European Conference on E-Government-ECEG.

Finklea, K. (2014). *Identity Theft: Trends and Issues*. Retrieved from https://fas.org/sgp/crs/misc/R40599.pdf

Fischbacher, U., & Föllmi-Heusi, F. (2013). Lies in disguise—an experimental study on cheating. *Journal of the European Economic Association*, *11*(3), 525-547.

Fosgaard, T.R. (2016). *Students cheat more: Comparing dishonesty of a student and a representative sample in the laboratory*. Mimeo, University of Copenhagen.

Friesen, L., & Gangadharan, L. (2013). Designing self-reporting regimes to encourage truth telling: An experimental study. *Journal of Economic Behavior & Organization*, *94*, 90-102.

Friesen, L., & Gangadharan, L. (2012). Individual level evidence of dishonesty and the gender effect. *Economics Letters*, *117*(3), 624-626.

Gilbertson, D. (2016). *The only way to detect touch with JavaScript*. Retrieved from: https://codeburst.io/the-only-way-to-detect-touch-with-javascript-7791a3346685

Gino, F., & Mogilner, C. (2014). Time, money, and morality. *Psychological Science*, *25*(2), 414-421.

Grijalva, E., Newman, D. A., Tay, L., Donnellan, M. B., Harms, P. D., Robins, R. W., & Yan, T. (2015). Gender differences in narcissism: A meta-analytic review. *Psychological bulletin*, *141*(2), 261.

Gutter, M., & Copur, Z. (2011). Financial behaviors and financial well-being of college students: Evidence from a national survey. *Journal of Family and Economic Issues*, *32*(4), 699-714.

Houser, D., List, J. A., Piovesan, M., Samek, A., & Winter, J. (2016). Dishonesty: From parents to children. *European Economic Review*, *82*, 242-254.

Howard, G., Roe, B. E., Nisbet, E. C., & Martin, J. F. (2017). Hypothetical Bias Mitigation Techniques in Choice Experiments: Do Cheap Talk and Honesty Priming Effects Fade with Repeated Choices?. *Journal of the Association of Environmental and Resource Economists*, *4*(2), 543-573.

Ham, C., Seybert, N., & Wang, S. (2018). Narcissism is a bad sign: CEO signature size, investment, and performance. *Review of Accounting Studies*, *23*(1), 234-264.

Hargittai, E. (2002). Second-level digital divide: Differences in people's online skills. *First monday*, *7*(4).

Ipeirotis, P. G. (2010). *Demographics of Mechanical Turk*.

Jacobsen, C., Fosgaard, T. R., & Pascual-Ezama, D. (2018). Why do we lie? A practical guide to the dishonesty literature. Journal of Economic Surveys, 32(2), 357-387.

James, K. H., & Engelhardt, L. (2012). The effects of handwriting experience on functional brain development in pre-literate children. *Trends in neuroscience and education*, *1*(1), 32-42.

Javelin. (2017). *Identity Fraud Hits Recod High with 15.4 Million U.S. Victims in 2016, Up 16 Percent According to New Javelin Strategy & Research Study*. Retrieved from

https://www.javelinstrategy.com/press-release/identity-fraud-hits-record-high-154-million-us-victims-2016-16-percent-according-new

Jorgenson, D. O. (1977). Signature size and dominance: A brief note. *The Journal of Psychology*, *97*(2), 269-270.

Kettle, S., Hernandez, M., Sanders, M., Hauser, O., & Ruda, S. (2017). Failure to CAPTCHA attention: Null results from an honesty priming experiment in Guatemala. *Behavioral Sciences*, *7*(2), 28.

Konrath, S., Meier, B. P., & Bushman, B. J. (2014). Development and validation of the single item narcissism scale (SINS). *PLOS one*, *9*(8), e103469.

Lambe, S., Hamilton-Giachritsis, C., Garner, E., & Walker, J. (2018). The role of narcissism in aggression and violence: A systematic review. *Trauma, Violence, & Abuse*, *19*(2), 209-230.

Leal, S., Vrij, A., Nahari, G., & Mann, S. (2016). Please be honest and provide evidence: deterrents of deception in an online insurance fraud context. *Applied Cognitive Psychology*, *30*(5), 768-774.

Litman, L., Robinson, J., & Rosenzweig, C. (2015). The relationship between motivation, monetary compensation, and data quality among US- and India-based workers on Mechanical Turk. *Behavior research methods*, *47*(2), 519-528.

Mailhos, A., Buunk, A. P., & Cabana, Á. (2016). Signature size signals sociable dominance and narcissism. *Journal of Research in Personality*, *65*, 43-51.

Mazar, N., Amir, O., & Ariely, D. (2008). The dishonesty of honest people: A theory of self-concept maintenance. *Journal of marketing research*, *45*(6), 633-644.

McDonald, J. A., Scott, Z. A., & Hanmer, M. J. (2017). Using self-prophecy to combat vote overreporting on public opinion surveys. *Electoral Studies*, *50*, 137-141.

Meijer, A. (2015). E-governance innovation: Barriers and strategies. *Government Information Quarterly*, *32*(2), 198-206.

Merritt, A. C., Effron, D. A., & Monin, B. (2010). Moral self-licensing: When being good frees us to be bad. *Social and personality psychology compass*, *4*(5), 344-357.

Mueller, P. A., & Oppenheimer, D. M. (2014). The pen is mightier than the keyboard: Advantages of longhand over laptop note taking. *Psychological science*, *25*(6), 1159-1168.

Naquin, C. E., Kurtzberg, T. R., & Belkin, L. Y. (2010). The finer points of lying online: E-mail versus pen and paper. *Journal of Applied Psychology*, *95*(2), 387.

Nisan, M. (1991). The moral balance model: Theory and research extending our understanding of moral choice and deviation. *Handbook of Moral Behavior and Development Application*, *3*, 213-249.

Nowak, S. (2018). *HTML5 canvas based smooth signature drawing*. Retrieved from https://github.com/szimek/signature_pad

Nudge. (n.d.). In *Dictionary.com Unabridged*. Retrieved from http://www.dictionary.com/browse/nudge

Pashler, H., Rohrer, D., & Harris, C. R. (2013). Can the goal of honesty be primed? *Journal of Experimental Social Psychology*, *49*(6), 959-964.

Poon, K. T., Chen, Z., & DeWall, C. N. (2013). Feeling entitled to more: Ostracism increases dishonest behavior. *Personality and Social Psychology Bulletin*, *39*(9), 1227-1239.

Rahwan, Z., Hauser, O. P., Kochanowska, E., & Fasolo, B. (2018). High stakes: A little more cheating, a lot less charity. *Journal of Economic Behavior & Organization*, *152*, 276-295.

Raskin, R. N., & Hall, C. S. (1979). A narcissistic personality inventory. *Psychological reports*.

Schild, C., Heck, D. W., Ścigała, K. A., & Zettler, I. (2019). Revisiting REVISE:(Re) Testing unique and combined effects of REminding, VIsibility, and SElf-engagement manipulations on cheating behavior. *Journal of Economic Psychology*.

Shalvi, S., Dana, J., Handgraaf, M. J., & De Dreu, C. K. (2011). Justified ethicality: Observing desired counterfactuals modifies ethical perceptions and behavior. *Organizational Behavior and Human Decision Processes*, *115*(2), 181-190.

Shalvi, S., Gino, F., Barkan, R., & Ayal, S. (2015). Self-serving justifications: Doing wrong and feeling moral. *Current Directions in Psychological Science*, *24*(2), 125-130.

Shalvi, S., Van Gelder, J. L., & Van der Schalk, J. (2013). Emotional justifi cations for unethical behaviour. *Affect and cognition in criminal decision making*, 197-210.

Sharpe Wessling, K., Huber, J., & Netzer, O. (2017). MTurk character misrepresentation: Assessment and solutions. *Journal of consumer research*, *44*(1), 211-230.

Shu, L. L., Gino, F., & Bazerman, M. H. (2011). Dishonest deed, clear conscience: When cheating leads to moral disengagement and motivated forgetting. *Personality and Social Psychology Bulletin*, *37*(3), 330-349.

Shu, L. L., Mazar, N., Gino, F., Ariely, D., & Bazerman, M. H. (2012). Signing at the beginning makes ethics salient and decreases dishonest self-reports in comparison to

signing at the end. *Proceedings of the National Academy of Sciences*, *109*(38), 15197-15200.

Starmer, C., & Sugden, R. (1991). Does the random-lottery incentive system elicit true preferences? An experimental investigation. *The American Economic Review*, *81*(4), 971-978.

Thaler, R. H., & Sunstein, C. R. (2008). *Nudge: Improving decisions about health, wealth, and happiness*. Penguin.

Thielmann, I., & Hilbig, B. E. (2019). No gain without pain: The psychological costs of dishonesty. *Journal of Economic Psychology*, *71*, 126-137.

Van Deursen, A. J., Helsper, E. J., & Eynon, R. (2014). Measuring digital skills. From digital skills to tangible outcomes project report.

Van Deursen, A., & Van Dijk, J. (2011). Internet skills and the digital divide. *New media & society*, *13*(6), 893-911.

Van Dijk, J. A. (2006). Digital divide research, achievements and shortcomings. *Poetics*, *34*(4-5), 221-235.

Verschuere, B., Meijer, E. H., Jim, A., Hoogesteyn, K., Orthey, R., McCarthy, R. J., ... & Barbosa, F. (2018). Registered replication report on Mazar, Amir, and Ariely (2008). *Advances in Methods and Practices in Psychological Science*, *1*(3), 299-317.

Vincent, L. C., Emich, K. J., & Goncalo, J. A. (2013). Stretching the moral gray zone: Positive affect, moral disengagement, and dishonesty. *Psychological science*, *24*(4), 595-599.

Warner, R. M., & Sugarman, D. B. (1986). Attributions of personality based on physical appearance, speech, and handwriting. *Journal of Personality and Social Psychology*, *50*(4), 792.

Williams, K. M., Nathanson, C., & Paulhus, D. L. (2010). Identifying and profiling scholastic cheaters: Their personality, cognitive ability, and motivation. *Journal of experimental psychology: applied*, *16*(3), 293.

Zweigenhaft, R. L. (1977). The empirical study of signature size. *Social Behavior and Personality: An International Journal*, *5*(1), 177-185.

Zweigenhaft, R. L., & Marlowe, D. (1973). Signature size: Studies in expressive movement. *Journal of Consulting and Clinical Psychology*, *40*(3), 469.