Examining the Impact of Response Time on Deceptive Communication

Preliminary and Incomplete Draft

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Abstract

The inclusion of response time indicators has become a common feature in the contemporary landscape of social media sites. Does the response time carry private information, and do people use it to improve their welfare? We design a modified cheap-talk game to study the intricate interplay between response time, private information, and its influence on users' well-being, tailored to situations where truth discovery demands an investment of time. Our investigation uncovers a noteworthy sender inclination towards truth-seeking behaviors, even in cases where deceptive intentions ultimately prevail. This preference makes the difference between different types of decisions nuanced. Consequently, the receivers are unable to extract substantial welfare gains through the interpretation of response times. In addition, when the senders are aware of the availability of their response time, we find that they are able to manipulate it successfully.

1 Introduction

Numerous economic interactions encompass a range of non-choice information that can profoundly influence the outcomes and value of said interactions. These supplementary elements may take the form of diverse data, signals, or characteristics that are not directly tied to the decisions being made but nevertheless offer valuable insights or contextual understanding. In today's technologically advanced environment, response time serves as a highly convenient metric for the decision-making process. The emergence of modern communication technologies, including Slack, emails, and instant messaging, has significantly facilitated the tracking of response times, making it more practical and accessible.

Response time (RT) can potentially be a valuable tool in addressing asymmetric information, particularly in the context of cheap talk. In scenarios where a car salesperson is driven by the constant desire to make a sale, there is a possibility that they may provide affirmative answers to questions without adequately verifying their accuracy. Similarly, influencers seeking likes and followers may repost popular articles without genuinely engaging with the content or thoroughly reading it. Nevertheless, it is crucial to acknowledge that the response time observed in real-life situations is, in fact, a culmination of both information searching and decision-making processes. This research aims to delve into the strategic use of response time by both senders and receivers and understand how it contributes to their overall well-being within such settings. By studying the strategic behavior, we can gain insights into the tactics employed, assess their impact on outcomes, and develop effective strategies to mitigate adverse effects and enhance communication efficiency in such contexts.

We have modified the conventional cheap-talk game by introducing an opportunity for the sender to invest effort in acquiring the truth. In this adjusted setting, we define the response time as encompassing both the process, if any, of learning the truth and making a decision. This modification allows us to replicate the challenge of distinguishing between the information searching and decision-making processes that occur in real-life scenarios.

The timeline of an individual task unfolds as follows: In Step 1, the senders decide whether to invest effort in learning the truth. Subsequently, in Step 2, senders provide a binary report. Finally, the receivers, upon seeing either the sender's report or the report along with the corresponding response time, make their ultimate decision, which subsequently determines the payoffs for both parties involved. The treatments in this study revolve around whether receivers have access to information regarding the response time beyond the sender's report and whether senders are aware that their response times are being recorded.

Whether the response time carries more information than the report is a matter of whether a sender decides on his report after learning the true state of the world, or he decides first and then chooses whether to learn the truth. Psychological studies have found that serving self-interest is automatic, and it suggests that the sender decides to lie before uncovering the truth. If the payoff is the only concern, then the sender will only learn the truth if he decides to tell the truth, saving the effort of learning the truth otherwise. This is also true if the sender has the preference of not being seen as dishonest. He can use the unknown as moral wiggle room to keep up his image. If this conjecture is correct, the senders would, in principle, make the selfish report very quickly, and therefore the faster the report, the less credible it is. But then the senders would have an incentive to manipulate the response time, and they might delay their reports.

However, the results reveal that senders uncover the truth an impressive 92% of the time. More intriguingly, even when senders opt for a selfish approach, they still uncover the truth 66% of the time. This implies that even though the sender is selfish, he may still hope that the truth is good and so lying at the very beginning was unnecessary. This result makes interpreting the response time more difficult. Even though the response time still carries some extent of private information, it is muted and is less detectable. We found that selfish positive reports take longer than honest positive reports. This suggests that lying is costly and response time carries private information. Moreover, the receivers display a lack of sophistication in understanding the sender's behavior. Furthermore, they mistakenly place more trust in the senders when response-time transparency is present, ultimately leading to unfavorable outcomes for themselves.

This research makes contributions to three areas of the literature. Firstly, it adds to the existing body of knowledge on the decision-making process by demonstrating that deceptive high-payoff reports take longer than genuine high-payoff reports, therefore providing evidence that serving self-interest requires some extent of deliberation. Secondly, it enriches the deception-detection literature by providing empirical evidence that receivers cannot effectively use the response time to detect lies, even though response time serves as a valuable cue. Thirdly, it advances the literature on the strategic use of response time by involving the information-seeking process with decision-making processes. Interestingly, in contrast with the moral-hazard predictions, most senders choose to uncover the truth even though they finally lie to the receivers. This result suggests that even for the selfish sender, the utility of knowing one is not lying for sure is bigger than the disutility of knowing oneself is lying.

In the remaining sections of the paper, Section 2 provides a comprehensive literature review. Section 3 models the strategic lying game. Section 4 outlines the experimental design and hypotheses. Section 5 presents the results. Finally, in Section 6, the paper concludes.

2 Literature Review

This research contributes to three strands of literature. The first strand focuses on the decision-making process of lying and truth-telling. The main focus of this literature is to identify the automatic tendency in decision-making, either serving self-interest or telling the truth. The dual-system approach (Kahneman, 2011; Rubinstein, 2016) would argue that the automatic tendency is always faster than the deliberate approach. To identify the genuine tendency without strategic interaction, the literature focuses on a paradigm introduced by Fischbacher and Follmi-Heusi (2013): subjects privately observe the outcome of a dice, report the outcome, and receive the payoff, either proportionally related to their report, or depending on the correctness of their guess. The key feature of this paradigm is that the experimenter does not observe an individual's truth, and therefore cannot identify any individual report as truthful or not. They can only identify decisions as high-payoff or low-payoff reports, and they distinguish people according to the difference between their observed reporting distribution and the statistically-predicted reporting distribution.

Greene and Paxton (2009) and Jiang (2013) have found that low-payoff reports take longer time than high-payoff reports. Greene and Paxton (2009) have also observed self-control neural activities (in the anterior cingulate cortex and ventrolateral prefrontal cortex) when dishonest people, whose high-payoff reports are much more frequent than predicted, forgo the gain. Shalvi et al., (2012) have found more high-payoff reports in the high-time-pressure condition than in the low-time-pressure condition. All the findings indicate that truth-telling requires extra self-control to resist the temptation, and is therefore a more deliberate approach, while serving the self-interest is the automatic tendency.

However, a limitation of this literature is the inability to distinguish between genuine high-payoff reports or deceptive high-payoff reports, therefore there is no solid evidence that self-interest is the automatic tendency. It's possible that self-interest also requires deliberation. Our design records the truth for each decision, therefore we are able to distinguish between the genuine high-payoff reports and deceptive high-payoff reports. We found that, contingent upon learning the truth, the latter takes longer than the former. This indicates that self-interest is not the automatic tendency, so there is some degree of hesitation. Moreover, our results show that when the transparency of response time is present, the same pattern remains even though senders condense the overall response time; this indicates that this pattern is difficult to manipulate.

The second strand of literature revolves around the identification of cues for detecting deception. This strand of literature centers on interactive games involving a minimum of two players with differing levels of information. This setup allows for the examination of scenarios where the sender has motivations to deceive and explores whether receivers can successfully discern veracity. Within this domain, researchers have explored two modes of deceptive communication: written messages and video clips.

In the case of written messages, receivers are able to detect lies by analyzing the content and linguistic characteristics. Charness and Dufwenberg (2006) found that written chat communication was highly effective in facilitating good social outcomes, with promises (and the subsequent changes in beliefs) being a key ingredient. Chen and Houser (2017) discovered that promises serve as reliable cues, leading receivers to place greater trust in them. However, other factors such as word usage and monetary references were found to be ineffective. On the other hand, video clips provide a more comprehensive set of potential cues, encompassing not only language but also nonverbal elements such as gender, facial expressions, body movements, and hand gestures. Studies conducted by Konrad et al. (2014), Dwenger and Lohse (2019), and Serra-Garcia and Gneezy (2021) revealed that receivers displayed only a slightly better than chance ability in detecting false reports of taxable income. In contrast, Belot and van de Ven (2017) observed that receivers in the role of buyers were able to detect lies of sellers better than chance. Similarly, Bonnefon et al. (2013, 2017) demonstrated that trustors in a trust game exhibited limited ability to detect trustworthiness based on trustees' facial pictures. Todorov et al. (2015) also found that trustors easily formed first impressions from faces, although these impressions were unrelated to stable personality traits.

However, the existing literature on lie detection rarely addresses response time. Considering that previous studies, such as those conducted by Gneezy (2005) and Cai and Wang (2006), revealed that receivers tend to place greater trust in senders than what would be expected based on equilibrium predictions, there may be additional value in analyzing response time for receivers. Our research contributes to this domain by incorporating response time as a potential cue for deception detection. Our findings indicate that even when response time conveys private information, receivers fail to utilize it effectively. Furthermore, when response time is made public, receivers tend to exhibit an excessive degree of trust in senders, leading to slightly worse outcomes for the receivers.

The third body of literature focuses on the value of response time in strategic settings. This emerging literature discusses three main questions: when senders have private information, 1) whether their response time carries private information; 2) whether receivers can extract private information from senders' response times; 3) whether senders manipulate their response time. Frydman and Krajbich (2021) investigated the value of response time in a laboratory social learning game, while Konovalov and Krajbich (2022) examined the value of response time in a laboratory bargaining game. Both studies found that people's decision-making processes align with the drift-diffusion model (Woodford, 2014; Fudenberg et al., 2018), which states that the longer the response time, the smaller the difference between two choices. Cotet and Krajbich (2020) extended their results to the eBay market with experienced agents. Their findings implies that senders' response time carries private information, even in the field. In addition, Frydman and Krajbich (2021) and Konovalov and Krajbich (2022) demonstrated that receivers can infer private information from senders' response times. Furthermore, Konovalov and Krajbich (2022) discovered that individuals attempted to manipulate their response times when they were aware that their times would be revealed, making it less informative to their counterparts. This current research extends the investigation of the value of response time to the setting where it involves the information seeking process. The intuition is that given information acquisition is costly, senders should not uncover the truth when he decides to lie, and therefore lying should be very quick in such a setting, and very informative. However, our results show that many senders uncover the truth even if they decide to lie. In addition, when senders' response time carries private information, receivers are not able to take advantage of it. Finally, senders manipulate their response time to make it more informative. These unpredicted results indicate that there are more behavioral issues involved beyond preference of truth telling.

3 Theoretical Framework

In this section, we present our theoretical framework and discuss its main predictions. The model achieves two goals. First, it captures the relationship between the sender's response time and the type of the report. Second, it highlights the contrast between the situation when the sender is not aware of the availability of the response time and when the sender is motivated to manipulate it. These features generate a rich set of predictions that we then test experimentally.

3.1 Benchmark

In the benchmark, we study the perfect Bayesian equilibria for the cheap talk game with different preferences. We start from the standard cheap talk setting in which players only care about the monetary payoffs, and then extend the model to the situations where the senders have randomized truth telling preference.

3.1.1 Standard Cheap Talk Game

Consider a game played between a sender and a receiver. There is a state of the world ω, drawn from a two-state space $\Omega = \{\omega_L, \omega_H\}$. Both players have the common knowledge that the prior probability of the state ω_H is $\mu_0 \in (0, 1)$.

The sender observes ω and sends a message $m(\omega) \in M = \{\omega_L, \omega_H\}$ to the receiver. The receiver observes m (but not ω) and then chooses an action $a \in A = \{\omega_L, \omega_H\}$.

While the receiver's payoff depends on ω, the sender's payoff does not. We take $u_R : A \times \Omega \to R$ to be the receiver's utility, and $u_S : A \to R$ to be the sender's.

A strategy for the sender maps each state of the world to a distribution over messages $s_S : \Omega \to \Delta M$. A strategy for the receiver specifies a mixed action for her conditional on every message that she may observe $s_R : M \to \Delta A$. We are interested in studying the game's perfect Bayesian equilibria. The equilibirum consists of three elements, s_S, s_R, and a belief system $\beta : M \to \Delta\Omega$; such that:

1. the receiver knows the sender's strategy s_S, and, upon receiving the report m, updates her belief $\beta(\omega|m)$ regarding the state of the world using Bayes' law;

2. given belief β, s_R is optimal for the receiver, i.e., $a(m) = \arg\max_{a \in A} u_R(a, \beta(\omega|m))$, for each $m \in M$;

3. the sender knows the receiver's strategy s_R, and s_S is optimal given s_R, i.e., $m(\omega) = \arg\max_{m \in M} u_S(a(m))$, for each $\omega \in \Omega$.

We consider the setting that the receiver wishes to match her action to the state. That is, her state-dependent payoff is $u_R(a, \omega) = h$ if $a = \omega$, and $u_R(a, \omega) = l$ otherwise, where $h > l$. A rational receiver would choose $a = \omega_H$ when her posterior belief that the state is ω_H is larger than 50%. We assume $\mu_0 < 50\%$. That is, with the prior belief, the receiver would choose $a = \omega_L$. The sender earns a higher payoff if the receiver chooses ω_H. Specifically, her payoff is $u_s(a) = h$ if $a = \omega_H$, and $u_s(a) = l$ otherwise.

In this setting, there are only babbling equilibria, in which the receiver infers no information at all from any message and sticks to the prior belief μ_0, and the sender sends random, uninformative message. This is because if there is any message that the sender can send that will make the receiver choose ω_H, then in equilibrium the sender must send it. Hence the receiver will ignore the message.

3.1.2 Cheap Talk Game with Randomized Truth Telling Preference

According to a survey conducted by Abeler et al., (2019), people have a strong aversion to deception, and they forgo about 3/4 of the potential gain from lying in the individual game. This tendency persists in the strategic games. For strategic communication of private information, senders consistently transmit more information than theoretical predictions (see summary in Lafky et al., 2022). These evidence suggests that people have truth telling preference. Theoretically, it's equivalant to add a cost of lying in the utility function.

In addition, Greene and Paxton (2009) and Jiang (2013) have documented that people are not always telling the truth, or always lying. There are a decent amount of people who sometimes lie, and sometimes tell the truth, given the disadvantage state ω_L. These evidence suggest that people have a randomized truth telling preference. Theoretically, it's equivalent to allow the randomness of the cost of lying.

Now, we modify the sender's utility by adding the random cost of lying c_θ. It's positive and follows a full support distribution $F[\underline{c_\theta}, \bar{c_\theta}]$, with $\bar{c_\theta} \geq \underline{c_\theta} \geq 0$ when the message ω is not true. Formally, we assume her utility function

$$u_S(a, c(\omega, m; \theta)) = h - l\mathbb{1}_{a=No} - c_\theta \mathbb{1}_{\omega \neq m}.$$

As before, a is receiver's action, ω is the true state, m is sender's message. $c(\omega, m; \theta)$ denoting the individual cost of lying. θ captures the heterogeneity of subject's weighting that applies to the lying cost.

If the cost of lying is constantly larger than the potential benefit of lying, i.e., $\underline{c_\theta} > h - l$, truth telling is a strictly dominate strategy for the sender, so she would always tell the truth, i.e., $m(\omega) = \omega$ for each $\omega \in \Omega$. We call this type of the sender the honest sender. If the cost of lying is constantly smaller than the potential benefit of lying , i.e., $\bar{c_\theta} \leq h - l$, the sender (weakly) weights the monetary payoff more than the psychological cost of lying, so she will babble as in the standard model. We call this type of the sender the selfish sender. For any cost distribution in between, the sender would sometimes lie, and sometimes tell the truth. We call this type of the sender the mix sender.

In equilibrium, receiver's strategy depends on the expected probability that the sender is lying. Let ϕ denotes the expected probability of lying, i.e., $\phi = \mathbb{E}P(c_\theta \leq h - l)$. If the sender for sure is a selfish one, i.e., $\phi = 1$, there are only babbling equilibria as in the standard cheap talk game. If the sender is for sure a honest one, i.e., $\phi = 0$, then in equilibrium, the sender always tells the truth, and the receiver always follows the message. There exists a $\bar{\phi}$, such that if the expected probability of lying is small enough, i.e., $\phi < \bar{\phi}$, the receiver will always trust the sender, i.e., $a(m) = m$; the sender will tells the truth if she's at an advantageous state ω_H or the lying cost is large ($c_\theta \geq h - l$) when she's at a disadvantageous state ω_L. Otherwise, the receiver will ignores sender's message, and takes the default action, i.e., $a(m) = \omega_L$; the sender will tells the truth.

3.2 Cheap Talk with Truth Seeking Process

In the context of the randomized lying cost model, we are introducing an additional step at the outset of the game. Rather than being automatically informed about the true state of the world, the sender now has the opportunity to make an informed decision about whether to invest time in uncovering the truth. This mirrors real-world scenarios where an influencer must decide whether to thoroughly research a trending topic before posting a comment, a home inspector needs to determine whether to meticulously examine each piece of technology before providing a report to a prospective second-hand buyer, or an individual must weigh the choice of approaching a director to inquire about job openings for a friend.

Let's begin our analysis by examining the equilibrium outcome, followed by an exploration of the connections between the sender's message and her response time. Additionally, we will investigate whether the sender's decisions would differ when she is conscious of the availability of response time.

3.2.1 Without Response Time

Consider a game that goes beyond the basic cheap talk game by adding an extra step. Now the sender is not automatically being informed of the truth. Instead, she faces a private decision d of whether to uncover the truth, denoted as $d = 1$, or choose not to do so, indicated as $d = 0$. Whether opting to become informed or remain uninformed about the truth, the sender subsequently conveys a message m to the receiver, and the receiver takes an action conditional on m. The key distinction for the receiver, compared to the benchmark scenario, lies in the awareness that any message m could originate from either an informed state ω_L, an informed state ω_H, or an uninformed state.

We assume that revealing the truth incurs a cost, which could be associated with cognitive effort or time consumption. The sender's utility function changes to

$$u_S(c_I(d), a, c(\omega, m; \theta)) = -c_I \mathbb{1}_{d=1} + h - l\mathbb{1}_{a=\omega_L} - c_\theta \mathbb{1}_{\omega \neq m}.$$

As before, $c_\theta \sim F[\underline{c_\theta}, \bar{c_\theta}]$, with $\bar{c_\theta} \geq \underline{c_\theta} \geq 0$. We assume the uncovering cost c_I is positive and fixed among individuals. Additionally, c_θ is predetermined prior to the revealing step.

In this setting, if sender's truth telling preference outweights her monetary interest and the cost of uncovering, i.e., $c_\theta > h - l + c_I$, she would opt to uncover the truth and report it. If the sender prioritizes her monetary interest more, specifically when $c_\theta < h - l$, she would babble even if she has uncovered the truth. As a result, she would avoid the cost of discovering and babble. For the cases falling within the range $h - l \leq c_\theta \leq h - l + c_I$, the sender's informed decision hinges on a delicate balance between the cost of uncovering and the potential loss they might incur from lying if she chooses not to be informed.

While there may be various potential outcomes, the model offers a compelling proposition: when the sender chooses to uncover the truth, she is going to report it. This is primarily because the primary incentive for the sender to lie after uncovering the truth is her prioritization of monetary payoff. In such a case, it becomes more advantageous for her to remain uninformed and babble, thereby sidestepping the costs associated with uncovering the truth.

Proposition 1: The sender would report the truth if she chooses to be informed.

In equilibrium, the receiver's decision to either trust the sender's message or disregard it hinges on the probability ϕ that the sender will choose to uncover the truth. When the sender is perceived as highly likely to uncover the truth, the receiver is inclined to follow her message. However, if there is a low likelihood of the sender uncovering the truth, the receiver will ignore the report and opt for ω_L for any message.

3.2.2 With Response Time

Now consider the game that the receiver possesses an additional piece of information about the sender–sender's response time (RT). This RT indicates the duration between when the sender initiates the process of making informed decision and when she eventually transmits her message.

Now, let's initially delve into the scenario where the sender is unaware of the availability of RT. In this context, there is no motivation for her to manipulate RT, and as a result, RT accurately reflects the genuine mechanical and decision-making process. If the sender does not consistently opt for being uninformed and babbling or consistently opt for being informed and telling the truth, RT contains private information about her type of message. Given *Proposition 1*, a very short RT suggests that the sender does not uncover the truth and is likely to babble.

Lemma 1: The longer the sender's RT, the more likely she tells the truth.

The receiver can leverage RT to make more informed decisions instead of relying solely on trust or disregard for the sender's message. When the sender's RT is exceedingly short, that is, when RT is significantly smaller than a certain minimum time threshold denoted as $\underline{t}$, it indicates that the sender did not invest enough time to uncover the truth. In this case, the receiver should make decisions based on the prior distribution and opt for ω_L. Conversely, when RT exceeds this minimum threshold, it implies that the sender has taken the necessary time to discover the truth and is likely to report honestly. Consequently, the receiver should place more trust in the sender's message and act accordingly.

Now, let's examine the scenario where the sender is conscious of the availability of RT. In this context, the honest type of sender will persist in their practice of uncovering the truth and subsequently reporting it honestly. However, the selfish type of sender may opt to emulate the honest type closely. This is the sole opportunity for the receiver to blur the distinction between the two types. To achieve this, the selfish type needs to deliberately prolong their RT, feigning an extended process of uncovering the truth. We assume that the method employed by the sender to extend her RT to a reasonable duration involves following the steps necessary to genuinely uncover the truth. Therefore, even the selfish type may uncover the truth in this scenario.

Assumption 1: The sender is more likely to uncover the truth when she is conscious of the availability of RT.

Because the cost associated with lying after discovering the truth, specifically at state ω_L, is greater than the expected value of the lying cost when remaining uninformed, represented as $c_\theta > \mathbb{E}c_\theta$, certain sender types are inclined to shift from their initial strategy of remaining uninformed and babbling to becoming informed and truthfully reporting. Consequently, in a situation where the sender is aware of the availability of RT, there is a general tendency for her to communicate more truth.

Proposition 2: When the sender is aware of the availability of RT, she is more likely to tell the truth.

4 Experimental Design and Hypotheses

In this section, we describe the laboratory implementation of our model, the main treatments that we conducted.

We begin by describing the implementation of the base game. Six dice was rolled. For each die, there are six possible outcomes, 1,2,3,4,5 or 6. We define 4, 5, 6 as "large numbers", and 1, 2, 3 as "small numbers". The true states related to the outcome of six dice about whether there are 4 or more large numbers, yes (where there are 4 or more “large numbers” on 6 six-sided dice) or no (where there are 3 or fewer “large numbers”). The sender has a chance to uncover the outcome of each die. Her message can be yes or no.

The receiver’s decision, along with the true state, determined the payoffs for both the sender and the receiver as listed in Table 1. The receiver earns \$8 if she correctly guesses the answer of the question. She earns \$4 otherwise. The sender earns \$8 if the receiver guesses that the answer is yes, irrespective of truth. She earns \$4 otherwise. Given this, the prior is $\mu_0 = 34.37\%$. To present our results, we adopt the following notation to distinguish between states, messages, and actions: the state ω is yes or no; the message m is y, or n; and the receiver’s action a is Yes or No.

Truth/Receiver’s guess	Yes	No
yes	(\$8, \$8)	(\$4, \$4)
no	(\$8, \$4)	(\$4, \$8)

Table 1: Monetary Payoff: the first item denotes the sender’s payoff, the the second item denotes the receiver’s payoff.

We include four variations in a 2x2 formats as in Table 2, each differing along two dimensions. The first dimension pertains to whether the receiver observes the sender’s response time, allowing us to examine the impact of information on response time on the receiver’s decision. In specific, the receiver does not learn the sender’s response time in RU condition, and learns it in RI condition. The second dimension revolves around whether the sender is aware that the receiver might have access to his response time, enabling us to investigate how sender’s knowledge of response time availability influences her communication strategy and the subsequent receiver response. In specific, the sender is not aware of the RT availability in SU condition, and aware of it in SA condition. Each sender took part in one condition of SU or SA, and each receiver took part in both conditions of RU and RI. We asked each participant to play as a sender first, and then play as a receiver. This will help the receiver gain some experience when

	Sender Unaware (SU)	Sender Aware (SA)
Receiver uninformed (RU)		
Receiver informed (RI)		

Table 2: Treatments

There are three stages in the experiment as described in Figure 1. In stage 1, subject played the role of a sender. The sender faced an independent series of true states in 10 rounds. At the beginning of each round, 6 computer-generated dice was initially covered, and the sender decided if she would uncover each of them by clicking on the corresponding button. To find out the true state, senders would have to click on buttons to uncover at least three dice, which takes time. Senders have the freedom to uncover any number of the dice, including none, before sending a message. At the end of each round, the sender need to select a message, y (There ARE 4 or more large numbers of the 6 dice) or n (There ARE NOT 4 or more large numbers of the 6 dice), sending to the receiver. In total, each sender sent 10 independent messages at the end of stage 1. In stage 2, subject played the role of a receiver. Each receiver would receive 10 messages from a non-self sender and had to guess the true state for each round, Yes or No. All 10 rounds of messages were provided at once to the receiver. In stage 3, subject played the role of a receiver again. In this stage, the receiver not only got the messages from the sender, also the sender's response time for each round. As in stage 2, all 10 messages and the corresponding response times were provided at once. Each participant took part in one condition of SU or SA as a sender in stage 1, and both conditions of RU and RI as a receiver in stages 2 and 3.

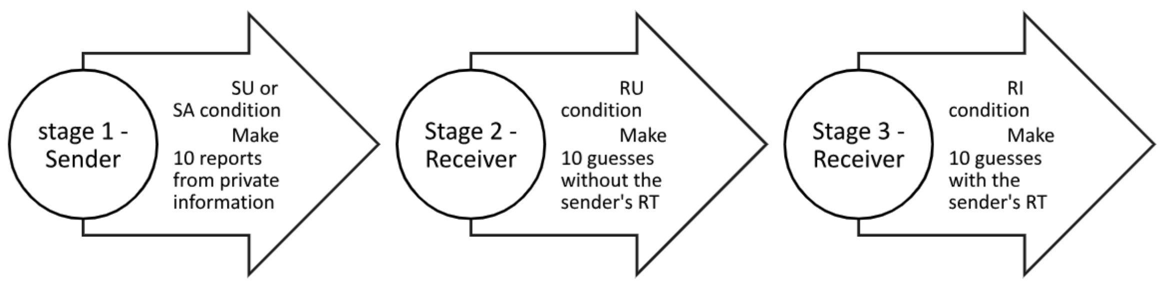


Figure 1: Procedure Steps

In stage 1, senders were randomly assigned to either the SU or SA condition. In the SU condition, senders were unaware if their response time would be provided to the receiver in the later stage. In the SA condition, senders were aware that their response time would be reported to the receivers. Each sender faced an independent series of true states in 10 rounds. Only senders had access to the true state in each round. Each of the 6 computer-generated dice was initially covered, and senders could uncover them by clicking on the corresponding buttons. To find out the true state, senders would have to click on buttons to uncover at least some dice, which takes time. Senders have the freedom to uncover any number, including none, of the dice before reporting the state to receivers in the later stages of the experiment. Senders could report "YES" (There ARE 4 or more large numbers of the 6 dice) or "NO" (There ARE NOT 4 or more large numbers of the 6 dice) by clicking on one of the corresponding buttons.

In stage 1, subject played the role of a sender. The sender faced an independent series of true states in 10 rounds. At the beginning of each round, 6 computer-generated dice was initially covered, and the sender decided if she would uncover each of them by clicking on the corresponding button. To find out the true state, senders would have to click on buttons to uncover at least three dice, which takes time. Senders have the freedom to uncover any number of the dice, including none, before sending a message. At the end of each round, the sender need to select a message, y (There ARE 4 or more large numbers of the 6 dice) or n (There ARE NOT 4 or more large numbers of the 6 dice), sending to the receiver. In total, each sender sent 10 messages at the end of stage 1. In stage 2, subject played the role of a receiver. Each receiver would receive 10 messages from a non-self sender and had to guess the true state for each round, Yes or No. All 10 rounds of messages were provided at once to the receiver. In stage 3, subject played the role of a receiver again. In this stage, the receiver not only got the messages from the sender, also the sender's response time for each round. As in stage 2, all 10 messages and the corresponding response times were provided at once.

There are variations in SA and SU regarding whether the sender knows it in stage 1 from the sender (RI condition). The matching between receivers and senders remained the same as in stage 2. Once again, all 10 reports were provided at once, along with the corresponding response time. Receivers made 10 guesses based on the provided information.

Comprehensive questions were included in each stage to ensure that participants understood the instructions. After completing the three stages, a survey was conducted to collect gender information from each participant. Additionally, participants' creativity was measured by the self-report.

To determine the payment for each participant, we rolled a 10-sided die twice. The first roll determined which of the 10 rounds would count. The second roll determined which condition would count: an odd number indicated that the SU and RU conditions would count, while an even number indicated that the SI and RI conditions would count. Participants were also paid an additional $1 for completing the survey.

We now formulate out hypotheses based on the theoretical propositions.

Based on *Proposition 1* that the sender would only discovers the truth if he decides to tell the truth. We hypothesize that given the mechanical time for truth discovering, the lying "Yes" report takes less time than the genuine "Yes" report.

Hypothesis 1: In both SU and SA, the faster the "Yes" report, the less credible it is.

The next hypothesis predicts the receiver's choices. The null hypothesis is that the receiver does not use the response time at all, and excludes the difference between the two receivers' dimensions, given each sender's dimension. But, they may think that the sender would manipulate the response time in SA, so they rely less on it in such condition.

Hypothesis 2: Receivers use response times to make decisions. But they use these less in SA than in SU.

We further conjecture how the receiver would use the response time. One possibility is that the receiver correctly presumes the pattern, and trusts the longer "Yes" report more than the slower one. Another possibility is that the receiver may think that truth telling is automatic, and views the long response time as more suspicious, as the drift-diffusion model predicts, and therefore trusts the shorter "Yes" report more. We include these two possibilities in the following hypotheses. For each possibility, we hypothesize that the pattern is muted when the sender is aware of the RT availability.

Hypothesis 2a: In SU, the receiver is less likely to follow the short "Yes" report in RI than in RU. The difference between RI and RU is smaller in SA.

Hypothesis 2b: In SU, the receiver is less likely to follow the long "Yes" report in RI than in RU. The difference between RI and RU is smaller in SA.

The next natural question to ask is whether the sender manipulates the response time, and if so, how. If the response time carries private information, it's beneficial for the sender to manipulate the disadvantageous response time to be less informative. The findings in Konovalov and Krajbich (2020) support this idea. Hypothesis 3 posits that the sender would delay his report when they plan to lie.

Hypothesis 3: In SA,overall the senders will lengthen their response time in each round compared to SU.

Based on *Proposition 2* that the informed sender is more likely to tell the truth than the uninformed one, we hypothesize that when the sender is awawre of the availability of RT, he's more likely to be honest.

Hypothesis 4: In SA, the sender is more likely to uncover the true states, and are more likely to tell the truth than in SU.

Last but not least, we're interested in the demographic characteristics in this setting. Gender is a salient demographic feature. The meta-analysis over 380 experiments conducted by Gerlack et al., (2019) suggests that men behaved slightly more dishonestly than women did. Hypothesis 5a extends the gender differences into truth uncovering, lying detection and manipulation of response time.

Hypothesis 5a: Females and males are different in uncovering the true states, truth telling, manipulating the response time, and detecting lies.

Creativity is considered one of the most important skills nowadays. A meta-analysis over 36 studies conducted by Storme et al., (2021) have revealed a weak positive correlation between creativity (measured via the self-report Gough scale), and dishonesty. Given that creative people are more likely to lie, we further conjecture that they are better at detecting lies. Hypothesis 5b posits such heterogeneity.

Hypothesis 5b: Participant who is creative is more likely to lie as a sender and is better at detecting lies as a receiver.

5 Results

5.1 Does response time carry private information about senders' lying behavior?

First, we examine the impact of different decisions on response time (RT), specifically investigating whether genuine "Yes" responses and deceptive "Yes" responses can be distinguished from each other. If our assumption is accurate, the senders would be truthful if they discover the truth, and all selfish decisions are made without being informed. Given that the process of uncovering the truth is time-consuming, genuine reports should be noticeably longer than those that stem from selfish, uninformed decisions.

Table 3 presents the average and standard error of response time for each type of decision. We divided the decisions into two categories: known decisions, where senders uncovered enough buttons to fully ascertain the objective truth, and unknown decisions, where senders did not uncover enough buttons. Initially, our focus was on the Sender Unaware (SU) condition, wherein senders were unaware that their response time would be recorded and subsequently used for analysis. In this condition, senders had no incentive to manipulate their response time, thus providing genuine insights into their decision-making process.

	SU(obs.)	Mean(s.e.)	SA(obs.)	Mean(s.e.)
informed	genuine Yes(86)	12.10s(1.06s)	genuine Yes (87)	10.85s(0.74s)
informed	genuine No(138)	13.48s(0.87s)	genuine No(160)	12.62s(0.66s)
informed	deceptive Yes (51)	13.10s(0.95s)	deceptive Yes(45)	12.67s(0.83s)
informed	deceptive No(1)	9s(0s)	deceptive No(3)	13.33s(1.33s)
uninformed	Yes (24)	8.83s(2.34s)	Yes (25)	6.84s(1.27s)

Table 3: Mean and Standard Error of RT for difference decisions

The most striking finding is that senders uncover the truth the vast majority of the time, around 92% overall. This is also true even if senders lie, in which situation they uncover the truth 66% of the time. This observation strongly violates our hypothesis that senders uncover the truth only if they decide to be honest. The preference for truth-seeking suggests that the utility of knowing one is definitely not lying is bigger than the disutility of knowing one is lying. Even though the majority of senders exhibit considerable truth-seeking preference, some behavior is consistent with our assumption. We find that all unknown decisions were observed to be "Yes," suggesting that there are senders who only care about the payoffs or use the unknown as moral wiggle room. However, they are a minority group.

Given the truth-seeking preference, we then focus on the known decisions, to investigate the potential pattern between the response time and the deception. In the context of these decisions, participants revealed the truth, and any extra time taken was a result of the deliberation process. Firstly, consistent with Jiang (2013), our findings indicate that individuals tend to spend more time deliberating in the round where they are almost certain to be honest ("No" report) compared to the rounds where they can potentially be dishonest or fortunate ("Yes" report). On average, the "Yes" report takes 11.93 seconds, shorter than 13.45 seconds for the "No" report ($p > 0.10$, not significant). We should be cautious that only if there is no tremendous heterogeneity among "Yes" reports, it supports the notion that individuals generally exhibit an automatic inclination to prioritize their own self-interest, while truthful behavior necessitates the ability to resist temptation.

We proceed to dig into the heterogeneity of "Yes" reports. Specifically, we compared different reports with the genuine "Yes" report, which serves as the easiest form requiring no additional temptation. Any extension of the time signifies an intrinsic cost involved. We find that genuine "No" reports took 1.38 seconds longer to process compared to genuine "Yes" reports ($p > 0.30$, not significant), which supports the notion that adhering to truthfulness by foregoing potential gain requires considerable self-control and effort. Deceptive "Yes" reports took 1 second longer to formulate compared to genuine "Yes" reports ($p > 0.40$, not significant), suggesting that there is a positive cost associated with dishonesty after being informed of the truth. This aspect was not accurately captured in previous studies, primarily due to the challenge of distinguishing between genuine and deceptive "Yes" reports. It implies that serving self-interest is not that automatic or unconsciously as previous studies indicate.

The descriptive statistics displayed in Table 3 lack the capacity to discern variations in response time at the individual sender level. Not every sender makes different types of reports. Under the SU condition, 11 out of 30 subjects told the truth all the time, while 17 of them reported both genuine and deceptive "Yes", and the remaining 2 subjects always reported without being informed. As each receiver exclusively engages with a single sender, it becomes imperative to explore potential differentials in response time within this specific context. To mitigate concerns regarding confounding factors and accommodate the heterogeneity in average decision-making time among senders, we employ a fixed effect model as equation 1. This analytical approach effectively controls for unobserved sender-specific factors that may drive the differences in means, thereby allowing us to robustly assess the nuanced disparities in response time across various decision types. In addition to addressing the concerns, we also account for the number of rounds in our analysis. This adjustment is necessary as decision-making speed tends to increase over time due to the heightened familiarity with the context.

$$RT = a + b \times Report + c \times Decision + d \times Round + e \times index + \epsilon. \tag{1}$$

Within our analytical framework, the "Report" variable assumes binary values where 0 signifies the "Yes" report, and 1 indicates "No" report. Similarly, the "Decision" variable assumes a crucial role by effectively categorizing responses into three distinct classifications: genuine, deceptive, and those falling within the realm of the unknown. It's noteworthy that the deceptive dummy variable encompasses both deceptive "Yes" and "No" reports, yet given the scarcity of deceptive "No" reports (1 in SU, 3 in SA), it bears a resemblance to deceptive "Yes" reports in terms of occurrence. We also control the time trend and individual idiosyncrasies by incorporating round numbers and individual-specific indexes. Therefore, the reference point is the genuine "Yes" report during the initial round for index 1, which is captured by the constant coefficient.

Table 4 describes the ordinary least squares (OLS) regression results. Column 2 presents the outcomes conducted under the SU condition. The coefficients estimated in this regression analysis, along with their corresponding statistical significance, shed light on the relationship between variables. By controlling for the heterogeneity of average response time and accounting for the time trend, we discovered that the coefficient of "No" is not significant ($p>0.19$), which means for a specific round, there is no significant difference between two genuine reports. This observation implies that the self-control efforts required by forgoing potential gain is not too much and can be mitigated by the engagement in the information seeking process. Then we focus on the key of our study, if response time carries private information between genuine and other "Yes" reports. Within the realm of "Yes" reports, it is noteworthy that deceptive ones take significantly 3 seconds longer compared to genuine ones ($p<0.05$), while unknown ones take roughly 5 seconds shorter, albeit without statistical significance ($p>0.30$), due to the relatively limited prevalence of such behavior among senders.

These findings underscore the significance of response time as a valuable indicator

	Dependent variable:	
	Response Time (secs)	
	SU	SA
"No"	1.557	1.931^{**}
	(1.190)	(0.865)
deceptive	3.254^{**}	0.848
	(1.614)	(1.205)
unknown	-4.870	-4.166^{**}
	(4.910)	(2.070)
round	-1.159^{***}	-1.142^{***}
	(0.167)	(0.117)
Constant	17.730^{***}	15.735^{***}
(genuine "Yes")	(2.934)	(2.082)
Observations	300	320
R^2	0.355	0.444
Adjusted R^2	0.275	0.375
Residual Std. Error	8.282 (df = 266)	5.984 (df = 284)
F Statistic	4.429^{***} (df = 33; 266)	6.470^{***} (df = 35; 284)
Note:		*p<0.1; **p<0.05; ***p<0.01

Table 4: Fixed Effects Regression Results: standard error in the parenthesis

in uncovering the truth. On one hand, the presence of a very short response time is indicative of an unknown "Yes". On the other hand, a longer response time associated with a "Yes" implies a higher probability of deception. However, the magnitude of differences are not very detectable. 4.87 seconds shorter and 3.25 seconds longer account for 27.7% shorter and 18.6% longer, pertaining to the benchmark. Neither of them are too far away from the standard deviation, and it can be viewed as mistakes by the receiver rather than a signal.

We conduct a robustness examination by means of OLS regression with clustered standard error on individual level. Our findings reveal that neither the "No" reports, the deceptive ones or the unknown ones are significantly different from the genuine

"Yes" reports as column 3 in Table 5. We also ran individual OLS regressions, 14 subjects-less than half of senders displayed a positive relationship between deception and response time, while 3 subjects displayed the negative relationship.

	Dependent variable:			
	Response Time (secs)			
	OLS		*Clustered S.E.*	
	SU	SA	SU	SA
"No"	1.325	1.493*	1.325	1.493
	(1.240)	(0.866)	(1.220)	(0.918)
deceptive	1.082	1.923	1.082	1.923*
	(1.586)	(1.166)	(1.337)	(1.065)
unknown	-2.944	-4.209***	-2.944	-4.209
	(2.102)	(1.506)	(5.480)	(2.775)
round	-1.158***	-1.149***	-1.158***	-1.149***
	(0.183)	(0.130)	(0.172)	(0.135)
Constant	18.438***	17.301***	18.438***	17.301***
(genuine "Yes")	(1.393)	(1.009)	(1.775)	(1.332)
Observations	300	320		
R^2	0.134	0.236		
Adjusted R^2	0.122	0.226		
Residual Std. Error	9.111 (df = 295)	6.659 (df = 315)		
F Statistic	11.384***	24.330***		
	(df = 4; 295)	(df = 4; 315)		
Note:			*p<0.1; **p<0.05; ***p<0.01	

Table 5: OLS regression Results with Clustered Standard Error: standard error in the parenthesis

In a broader perspective, the findings do not substantiate Hypothesis 1, primarily due to a prevailing inclination among individuals towards truth-seeking behaviors. Given this inherent preference, the temporal dynamics discerned in response times intricately illuminate the cognitive processes underpinning the dichotomy between deceptive and honest disclosures. The empirical evidence illustrates that a longer "Yes" report correlates with a higher probability of deceit. Nevertheless, the statistical significance of these findings is not prominently pronounced.

Result 1: For the informed decisions, the longer the "Yes" report, the higher probability of deceit.

5.2 Do receivers use response times to make decisions?

We still focus on SU condition for the current part, and will turn to the SA condition in section 5.3. Investigating the extent to which receivers incorporate response time in stage 3, characterized by their access to senders' response times, initially appears to offer a straightforward trajectory of inquiry. However, it remains crucial to recognize the potential presence of confounding variables, such as the aggregate frequency of "Yes" reports and social preference, that might dominate the sole primacy of response time within their decision-making framework. The transition from the absence of response time visibility in stage 2 (RU) to its prominence in stage 3 (RI) enables an assessment of response time's supplementary value in shaping receivers' decisions.

First, we investigate whether enhancing response time can lead to improvements in the accuracy of receivers' guesses. Table 6 illustrates the receivers' accurate rate in stage 2 (RU) after observing different reports. Column 2 presents the statistics under the SU condition. In the absence of RT availability, receivers tend to manifest a notably elevated accurate rate of 87.8% when responding to "No" reports. However, this proficiency notably wanes when countering "Yes" reports. The relatively modest accurate rate of 69.6% associated with "Yes" reports underscores the receivers' requirement for supplementary assistance in ascertaining the veracity of such reports. More precisely, the data suggests an inherent tendency among receivers to place a level of trust (63.4%) in senders that surpass the warranted degree (53.4%) subsequent to the reception of a "Yes" report. The proposition arises that an optimization in their decision-making could be attained by harnessing contextual cues to effectively discern deceptive reports from genuine ones, thus improving welfare.

Table 7 provides an overview of the shifts in decision-making among the receivers during the transition from stage 2 to stage 3. In the second column, we delve into the intricate dynamics observed under the SU condition. On the whole, there is a discernible adjustment of 13% in the receivers' choices, indicative of a concerted effort

Sender's Report	SU(RU)	SA(RU)
No	87.8%	90.2%
Yes	69.6%	65.0%

Table 6: Receiver's Accurate Rate Without RT

to enhance their decision accuracy. However, a deeper analysis of the contingent transition rates, the transitions between trusting and not trusting, and vice versa, following the reception of each individual report, raises intriguing insights. Ideally, the receivers should trust the "No" reports more, and "Yes" reports less. The proportional equivalence in transition numbers observed between the bidirectional change under each report suggest that the receivers' endeavors to recalibrate their behaviors might not be yielding the anticipated effectiveness.

	SU	SA
Total Change	38(13%)	52(16%)
$m = No$, change from NT to T	11	7
$m = No$, change from T to NT	8	12
$m = Yes$, change from NT to T	8	18
$m = Yes$, change from T to NT	11	15

Table 7: Receiver's decision change: NT denotes not trust, T denotes trust

We proceed to examine whether receivers adjust their behaviors based on response times, particularly in response to "Yes" reports. Building upon Result 1, which establishes a negative correlation between the length of response time for a "Yes" report and its perceived credibility, we hypothesize that receivers will place greater trust in relatively shorter response times and exhibit higher skepticism towards longer response times. To empirically test this, we employ a fixed effect regression model as framework 2:

$$Trustchange = a + b \times \mathit{Report} + c \times \mathit{RT} + d \times (\mathit{Report} \times \mathit{RT}) + e \times \mathit{Round} + f \times \mathit{index} + \epsilon \quad (2)$$

Table 8 presents the outcomes of the fixed-effect ordinary least squares (OLS) regression, exploring the relationship between receivers' alterations in guessing and response times. The variable of interest is "trust change," which takes a value of 1 if the receiver transitions from a state of non-trust to trust, -1 if the transition is from trust to non-trust, and 0 if no change occurs. In Column 2, we present the findings pertaining to the situation under the SU condition.

	Dependent variable:	
	Trust change	
	SU	SA
"Yes"	-0.213***	-0.072
	(0.073)	(0.094)
RT	-0.010***	-0.0003
	(0.003)	(0.005)
"Yes" $\times RT$	0.012***	0.008
	(0.004)	(0.007)
round	-0.005	-0.011
	(0.007)	(0.009)
Constant	0.158	0.005
("No" report)	(0.125)	(0.168)
Observations	300	320
R^2	0.181	0.163
Adjusted R^2	0.079	0.060
Residual Std. Error	0.342 (df = 266)	0.391 (df = 284)
F Statistic	1.781*** (df = 33; 266)	1.580** (df = 35; 284)
Note:		*p<0.1; **p<0.05; ***p<0.01

Table 8: Fixed Effects Regression Results on Receiver's Decision Change: standard error in the parenthesis

The observed positive constant (0.158), while lacking statistical significance, indicates a tendency among receivers to bestow relatively more trust upon "No" reports during Stage 3 compared to Stage 2. The more pronounced negative coefficient (-0.213) associated with "Yes" reports signifies an increased inclination among receivers to exhibit skepticism towards "Yes" reports during Stage 3 in contrast to Stage 2. Its significance underscores receivers' disparate treatment of these two types of reports. This differential treatment aligns with the pursuit of enhanced accuracy by receivers in gauging the truthfulness of "Yes" reports, corroborating the trends suggested in Table 4.

The significantly negative coefficient (-0.01) linked to response time implies a general wariness among receivers towards lengthier response times. This suggests that receivers employ response time as a heuristic to discern potential deception. The noteworthy positive coefficient (0.012) on the interaction between "Yes" reports and response time suggests that receivers tend to place relatively higher trust in lengthy "Yes" reports compared to lengthy "No" reports. Ideally, receivers would rely solely on response time when assessing "Yes" reports. The divergent implications of the response time coefficients indicate that receivers did not fully optimize their use of this temporal cue. Evidently, there is an overemphasis on response time for "No" reports, coupled with a misapplication of this criterion for "Yes" reports.

Result 2: Receivers endeavor to leverage response time as a decision-making cue. Broadly, longer reports are met with skepticism; however, intriguingly, receivers exhibit a higher level of trust towards lengthy "Yes" reports compared to their "No" counterparts.

5.3 Do senders manipulate response times? What are the receivers' corresponding reactions?

Given the interplay between response time and the realm of private information, it's rational for the sender to manipulate the response time. The sender, in an ideal setting, would strategically truncate the internal process of struggling when they lie for "Yes", rendering them indistinguishable from the genuine ones. Overall, the behavioral patterns of senders align conspicuously with the conjecture, the average RT in SA is 11.70s, shorter than the average 12.63s in SU. Column 5 in Table 3 shows that almost all types of reports' response times are shorter and less dispersed under SA condition than under SU condition. Evidently, this lends credence to the notion that senders deliberately curtail hesitation as they manipulate their response time.

We then examine if senders successfully make the response time less informed, especially for "Yes" reports. Under the SA condition, deceptive "Yes" reports are remarkably 1.77 seconds longer on average than genuine "Yes" reports ($p = 0.10$). This finding, pointing in the same direction albeit with a higher level of significance, underscores the enduring nature of the inherent contemplation preceding dishonesty. Conversely, unknown "Yes" reports are on average significantly 4 seconds shorter than the genuine ones ($p < 0.01$). It's worth noting that this particular outcome is influenced by an individual who consistently tends to promptly opt for the "Yes" reports. Upon excluding this outlier, the gap between diminishes to 1.14 seconds, much smaller than 3.27 seconds under the SU condition, and ceases to be statistically insignificant ($p > 0.48$).

The above statistics do not take individual heterogeneity into consideration. Under the SA condition, 13 out of 32 subjects told the truth all the time, while 14 of them reported both genuine and deceptive "Yes", and the remaining 5 subjects mixed other types of reports. Column 3 in Table 4 shows the results of a fixed-effect regression. It indicates that the deceptive "Yes" reports bear no statistically-significant distinction from genuine "Yes" reports within the framework of the fixed-effect regression. It suggests that the senders successfully pooled the genuine and deceptive "Yes" reports, and the discernible dissimilarity in overall outcomes appears to be predominantly influenced by a subset of outliers.

Result 3: The sender manipulates response times to carry reduced informativeness under the SA condition. This is achieved through the compression of all response times.

Having established the sender's manipulation strategy, we now shift our focus to the receiver's reactions. Examining the third column of Table 6, it becomes apparent that the accuracy rate in the absence of response time under the SA condition remains comparable to that observed under the SU condition. In parallel, the findings presented in the third column of Table 7 underscore a divergence in receivers' behavioral adjustments under the SA and SU conditions. Furthermore, the insignificant and nuanced outcomes presented in the third column of Table 8 indicate the infrequent utilization of response time by receivers as a catalyst for altering their behaviors.

Result 4: Under the SA condition, receivers exhibit diminished reliance on response time.

5.4 Does transparency of response times change senders' reporting behavior?

We compare the honest rate under two conditions. Figure 2 presents the CDF of the number of honest reports. Notably, the p-value derived from the KS test surpasses 0.75 for both one-sided and two-sided tests. This outcome strongly suggests a near absence of disparity in terms of reporting behavior.

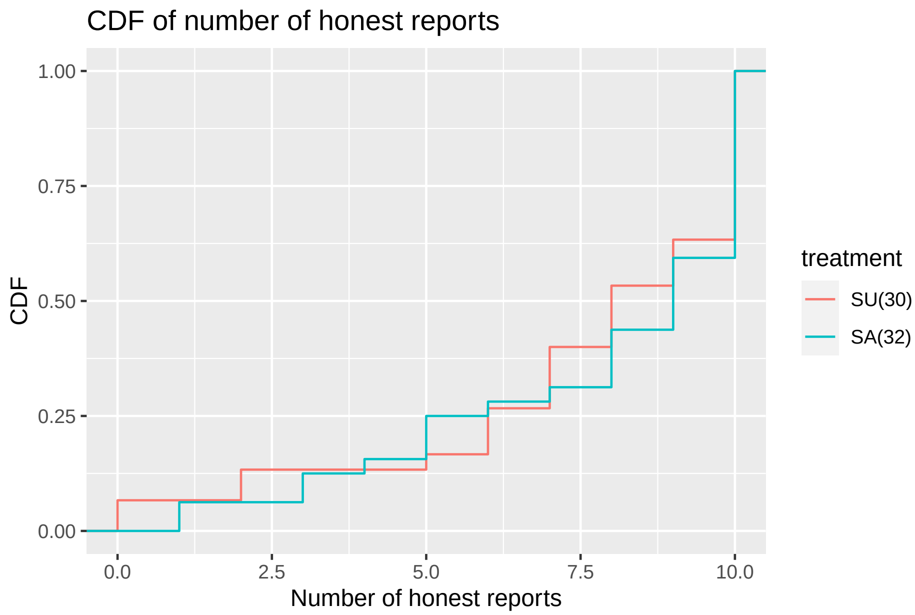


Figure 2: CDF of number of honest reports

Result 5: The awareness of response time availability does not alter senders' honesty rate.

This result is comprehensible. Given the senders' capability to manipulate the response time, its availability should not serve as an additional concern. Consequently, an optimal strategy for senders entails maintaining their existing behavioral patterns.

5.5 What characteristics affect subjects' behavior?

This section delves into an exploration of the potential impact of gender and personality traits on subjects' behavior. These attributes are assessed through self-report methodologies in the post-experiment survey. Specifically, our attention centers on the veracity of disclosures, the inclination towards trust, and the resultant payoffs. The descriptive statistics are synthesized in Table 9, detailing the results concerning gender and creativity across two conditions. A meticulous examination of the data reveals a lack of significant disparities in gender, but subjects under SA condition have higher creativity score than those under the SU condition ($p = 0.03$). Given the small observations under each treatment, we pool the data together for analysis.

	SU	SA
Gender	M 11, F 18, O 1	M 11, F 20, O 1
Creativity: mean(s.e.)	3.83(0.59)	2.09(0.51)

Table 9: Gender and Creativity Statistics: M for male, F for female, O for other.

Commencing with an analysis of gender-based heterogeneity in outcomes, we observe notable distinctions. Specifically, in terms of the honesty rate, male subjects exhibit a truth-telling rate of 64.5

Turning to the assessment of trust rates, our examination reveals intriguing gender-related patterns. For male subjects, the trust rate registers at 74.1

Examining expected payoffs from the sender's perspective, male subjects achieve an anticipated payoff of \$5.50 under both the RU and RI condition, whereas female subjects secure an expected payoff of \$5.70 under both the RU and RI conditions. Female senders' slightly higher expected payoff, though not significant ($p > 0.3$ for each condition) suggests that females benefit from telling more truth. Shifting to the expected payoffs in the role of receivers, male subjects realize \$7.30 under the RU condition and \$7.20 under the RI condition, whereas their female counterparts receive \$7.00 and \$6.90, separately. Remarkably, the disparity by gender proves significant ($p = 0.10$) under the RU condition, while it loses significance ($p > 0.2$) under the RI condition. This finding suggests that within a context of conflicting interests, males gain advantage from suspicion, particularly when they are devoid of the opportunity to manipulate response time. We now wrap up the overall gender heterogeneity.

Result 6: Females tend to tell more truth and trust others more. But males gain advantage from suspicion as a receiver within a context of conflicting interest, when they are devoid of the opportunity to exploit the response time.

We subsequently investigate the impact of creativity on various outcomes. Creativity is quantified using the Gough Scale (Gough, 1979), which offers a potential score range spanning from -12 to 18. A higher score indicates greater creativity. To empirically examine this relationship, we apply a regression framework 3:

$$Y = a + b \times creativity + \epsilon \tag{3}$$

The dependent variable, Y, comprises metrics including sender honesty rate, trust rate under both RU and RI conditions, and payoffs across four distinct role categories ((Sender, RU), (Sender RI), (Receiver, RU), (Receiver, RI)).

Table 10 presents the outcomes of the regression analysis. The presence of statistically insignificant coefficients across all outcomes implies that creativity, particularly when measured through self-report assessments, does not demonstrate a notable impact on the rates of truth-telling, trust, or the resulting payoffs within the experimental framework.

Result 7: Within the experimental framework, there is no observed influence of self-reported creativity on the rates of truth-telling, trust, or the subsequent payoffs.

6 A Calibrated Utility Function

We calibrate the senders' utility function to better understand their behavior. The fact that lying senders chose to discover the truth suggests that knowing the truth is important. One potencial mechanism is that utility of knowing oneself is for sure telling the truth is bigger than the disutility of knowing oneself is lying.

We formulate the sender's utility function by incorporating such preference:

$$u_S(c_I(d), a, f(\omega, m, d; \theta)) = -c_I \mathbb{1}_{d=1} + 8 - 4\mathbb{1}_{a=No} - c_\theta \mathbb{1}_{\omega \neq m} + b_\theta \mathbb{1}_{d=1,\omega=m}.$$

The monetary payoff and the cost of discovering the truth remain the same as before. But now, beyond the random cost of lying c_θ, there is a fixed benefit of knowing that oneself is indeed telling the truth b_θ. The fact that the vast majority of the senders seek truth suggests that the expected value from telling the truth is larger than the cost of discovering.

This utility function could also explain the fast and slow patterns based on the drift diffusion model. The drift diffusion model claims that the larger the difference of the choices, the faster the decision. From now on, we assume that the sender chooses to discover the truth, and the receiver always trusts the sender.

Let's first compare the genuine "Yes" and the genuine "No" reports. Given a *yes* state, the difference between reporting "Yes" and "No" is $D_1 = 8 + b_\theta - (4 - c_\theta) = 4 + b_\theta + c_\theta$. For any realization of c_θ, the sender would always report "Yes", and the range of D_1 varies from $4 + b_\theta + \underline{c_\theta}$ to $4 + b_\theta + \bar{c}_\theta$. Given a *no* state, the difference between reporting “No” and “Yes” is $D_2 = 4 + b_\theta - (8 - c_\theta) = b_\theta + c_\theta - 4$. The sender would only report genuine “No” if $b_\theta + c_\theta > 4$, and D_2 may vary from 0 to $b_\theta + \bar{c_\theta} - 4$. The expected value of D_1 is larger than D_2, so the genuine “Yes” report is faster than the genuine “No” one.

We then compare the genuine “Yes” and deceptive “Yes” reports. For the latter one, given a *no* state, the difference between reporting “Yes” and “No” is $D_3 = 8 - c_\theta - (4 + b_\theta) = 4 - c_\theta - b_\theta$. The sender would report a deceptive “Yes” if $c_\theta + b_\theta < 4$, so the widest range of D_3 can be from 0 to 4. The expected D_3 is smaller than D_1, so the deceptive “Yes” report is slower than the genuine “Yes” one.

	Dependent variable:						
	honesty	trust RU	trust RI	SProfit RU	SProfit RI	RProfit RU	RProfit RI
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
creativity	0.080	0.017	0.014	-0.027	-0.047	-0.027	-0.010
	(0.118)	(0.130)	(0.120)	(0.037)	(0.034)	(0.032)	(0.033)
Constant	7.361***	7.868***	7.846***	5.699***	5.771***	7.196***	7.067***
	(0.507)	(0.561)	(0.515)	(0.159)	(0.147)	(0.139)	(0.142)
Observations	62	62	62	62	62	62	62
R^2	0.008	0.0003	0.0002	0.009	0.031	0.012	0.001
Adjusted R^2	-0.009	-0.016	-0.016	-0.008	0.015	-0.005	-0.015
Residual Std. Error (df = 60)	2.918	3.231	2.967	0.915	0.849	0.802	0.817
F Statistic (df = 1; 60)	0.467	0.018	0.014	0.544	1.913	0.709	0.083

Note: $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

Table 10: Creativity Results

Appendix: Interfaces

PART I

Part 1 consists of 10 rounds, in which each of you will play the role of a sender. In each round, the computer generates outcomes of 6 dice. The outcome of each die is randomly drawn from the set 1, 2, 3, 4, 5, 6.

We define the outcomes 1, 2, 3 as "small numbers", and 4, 5, 6 as **"large numbers"** .

You can privately learn the outcomes of the 6 dice by clicking the dice buttons on your screen. Each button will uncover the outcome of 1 die, and you can uncover as many as you want. The outcomes of the dice will not change with the total buttons you click to uncover. Then you need to report on the question if there are 4 or more "large numbers" by choosing "Yes" or "No". Your report could be independent from the outcomes of the 6 dice.

Your payment as a sender

Your payment will be based on the Parts 2 and 3 of the experiment. You will be matched with another player, who's a receiver, and his choices will determine your payoff as a sender.

The receiver in Parts 2 and 3 has to answer the same question as in Part 1, without the ability to learn the true outcomes. However, he will receive your report to inform him to guess the answer.

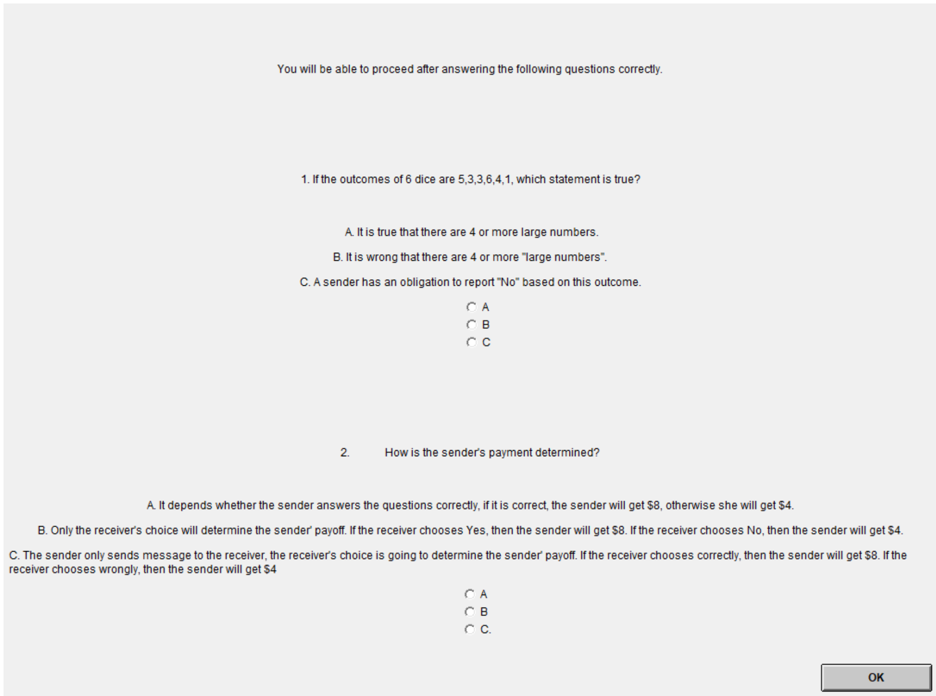
If the receiver chooses **Yes** (there ARE 4 or more "large numbers"), you will get **$8** , regardless of the true answer.

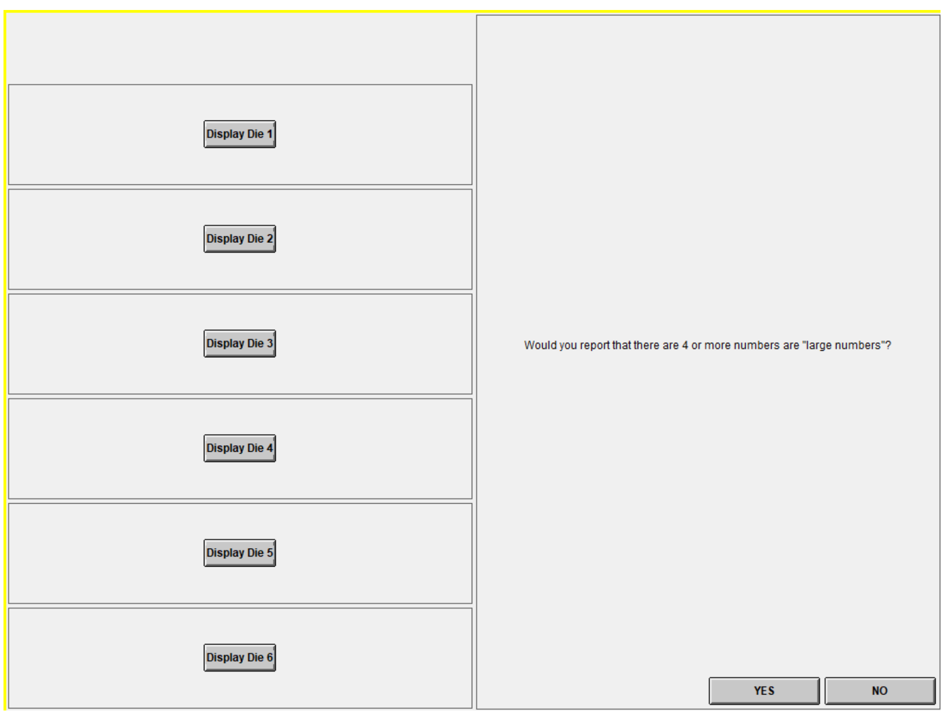
If the receiver chooses **No** (there ARE **NOT** 4 or more "large numbers"), you will get **$4** , regardless of the true answer.

The receiver gets $ 8 if his guess is right, and $4 if his guess is wrong.

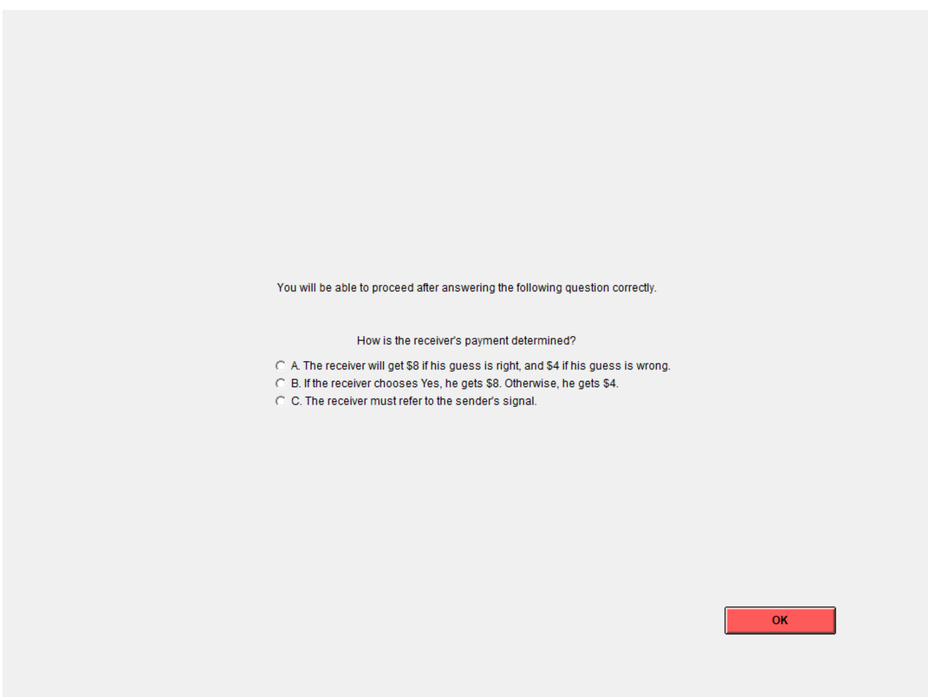
If the instructions is clear to you, you may go to the next screen to answer comprehension questions.

OK


You will be able to proceed after answering the following questions correctly.
1. If the outcomes of 6 dice are 5,3,3,6,4,1, which statement is true?
A. It is true that there are 4 or more large numbers.
B. It is wrong that there are 4 or more "large numbers".
C. A sender has an obligation to report "No" based on this outcome.
A
B
C
2. How is the sender's payment determined?
A. It depends whether the sender answers the questions correctly, if it is correct, the sender will get $8, otherwise she will get $4.
B. Only the receiver's choice will determine the sender' payoff. If the receiver chooses Yes, then the sender will get $8. If the receiver chooses No, then the sender will get $4.
C. The sender only sends message to the receiver, the receiver's choice is going to determine the sender' payoff. If the receiver chooses correctly, then the sender will get $8. If the receiver chooses wrongly, then the sender will get $4
A
B
C.
OK


Display Die 1
Display Die 2
Display Die 3
Display Die 4
Display Die 5
Display Die 6
Would you report that there are 4 or more numbers are "large numbers"?
YES
NO


PART II
Now you are a receiver, who will get 10 reports from a sender in Part 1, one for each round. You'll get reports all at the same time.
It is up to you whether you would like to refer to the reports from the sender to make your guesses or not. You will need to make 10 guesses on "If there ARE 4 or more 'large numbers' in the 6 dice". Your guess will be either "Yes" (there ARE 4 or more "large numbers") or "No" (there ARE NOT 4 or more "large numbers").
Your payment as a receiver
For any question, you will get $8 if your guess is right, and $4 if your guess is wrong.
If the instructions is clear to you, you may go to the next screen to answer comprehension questions.
OK


You will be able to proceed after answering the following question correctly.
How is the receiver's payment determined?
A. The receiver will get $8 if his guess is right, and $4 if his guess is wrong.
B. If the receiver chooses Yes, he gets $8. Otherwise, he gets $4.
C. The receiver must refer to the sender's signal.
OK

Now you are a receiver to review the 10 reports from a sender in Part 1.

You are seeing all 10 reports from the sender. It is up to you whether you would like to refer to the reports from the sender to make your guesses or not. You need to make 10 guesses on "If there ARE 4 or more 'large numbers' in the 6 dice".

Your payment as a receiver

You will get $8 if your guess is right, and $4 if your guess is wrong.

Round	1	2	3	4	5	6	7	8	9	10
Sender's Report	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No
Your decision	○ No ○ Yes	○ No ○ Yes	○ No ○ Yes	○ No ○ Yes	○ No ○ Yes	○ No ○ Yes	○ No ○ Yes	○ No ○ Yes	○ No ○ Yes	○ No ○ Yes

Submit

PART III

Now, you need to re-make 10 guesses on the questions. But, in addition to the reports from the sender, you will also know the time that the sender used to generate each report.

Your payment as a receiver

Your payment is the same as before. For any question, you will get $8 if your guess is right, and $4 if your guess is wrong.

OK

Now, you need to re-make 10 guesses on the questions. But, in addition to the reports from the sender, you will also know the time that the sender used to generate each report.

You are seeing all 10 reports and the response time from the sender. It is up to you whether you would like to refer to the answers from the sender to make your guesses or not. You need to make 10 guesses on "If there ARE 4 or more 'large numbers' in the 6 dice"

Your payment as a receiver

Your payment is the same as before. You will get $8 if your guess is right, and $4 if your guess is wrong.

Round	1	2	3	4	5	6	7	8	9	10
Response Time (in sec)	1	0	0	1	0	0	0	0	0	0
Sender's Report	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Your decision	○ No ○ Yes	○ No ○ Yes	○ No ○ Yes	○ No ○ Yes	○ No ○ Yes	○ No ○ Yes	○ No ○ Yes	○ No ○ Yes	○ No ○ Yes	○ No ○ Yes

Submit

Survey

By completing this survey, you will receive additional $1, which will be added to your total earnings.

1. What's your gender? ○ Man ○ Woman ○ Other

2. Please indicate which of the following adjectives best describe yourself. Check all that apply.

☐ Capable	☐ Egotistical	☐ Conventional
☐ Honest	☐ Original	☐ Self-confident
☐ Artificial	☐ Commonplace	☐ Informal
☐ Intelligent	☐ Narrow interests	☐ Sexy
☐ Clever	☐ Humorous	☐ Dissatisfied
☐ Well-mannered	☐ Reflective	☐ Submissive
☐ Cautious	☐ Conservative	☐ Insightful
☐ Wide interests	☐ Sincere	☐ Snobbish
☐ Confident	☐ Individualistic	☐ Suspicious
☐ Inventive	☐ Resourceful	☐ Unconventional

OK