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The effect of range of outcomes and magnitude of rewards on lying behavior in anonymous dice-under-cup trials

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Abstract

We examine the effect of changing the structure of the lying opportunity by conducting a laboratory experiment. In particular, we vary the range of possible false outcomes and the magnitude of rewards. We apply the dice-under-cup paradigm which uses anonymous dice rolls to record actual lying behavior by comparing the distribution of participants' stated outcomes to the expected statistical distribution of dice roll outcomes. We find that although some small changes in lying behavior can be achieved with an increase in the possible range of outcomes and by exponentially increasing rewards, lying behavior is generally robust to changes in the lying opportunity structure. Our study concludes that lying behavior seems to be driven by the aim to achieve a certain payoff regardless of conditions.

Keywords: dice-under cup experiment, lying behavior, moral preferences
JEL: C92, D03

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1. Introduction

We are all given, from time to time, opportunities to lie to various extents, and we do lie. Even in a self-reported survey, college students admitted they had lied in one out of three of their social interactions, while community members reported lying in one out of five (DePaulo et al, 1996). The magnitude of and the reasons for lying may change but it cannot be denied that lying is a natural part of human interaction. It is also an ability that is uniquely human; only humans, in the animal kingdom, are capable of using symbols to communicate imaginary, non-real information and events (Meltzer, 2003). Philosophers and psychologists have been fascinated by this phenomenon: moral absolutists like Kant (1785) condemn it while Plato admits the necessity of 'noble lies' to maintain an acceptable status quo ("a contrivance for one of those falsehoods that come into being in case of need, (…) some noble one;" see *Republic III*, 414b-c). While the debate over the morals and ethics of dishonesty is unlikely to ever reach a conclusion, standard economists, pragmatically, assume that everyone lies whenever they have an incentive to do so. Recent experimental studies, however, report a certain degree of lying aversion that depends on the type of lies and on the costs and benefits of lying.

Insights on actual lying behavior have been attained and confirmed empirically through a number of economic experiments, mainly comprising of individuals misreporting private information in a sender-receiver game (see for example Gneezy, 2005), lying about performance (see for example Ariely, Amir and Mazar, 2008), and using a die-under-cup paradigm, which we also use in the current study. In this paradigm, participants are given a completely anonymous and undetectable opportunity to lie for a monetary reward. More specifically, participants are asked to anonymously report the outcome of a single dice throw – higher dice numbers are monotonically linked to higher payoffs, thus individuals have to decide whether to report the outcome truthfully or to lie for a higher payoff (Fischbacher and Heusi, 2008). As all the dice outcomes are equally likely to occur, this paradigm provides an easy way to examine the aggregate extent of lying, as the distribution of outcomes is expected to be uniform and any deviation from it can be interpreted as lying. As there is no monetary incentive for honesty, under classical economic theory all participants should lie to the maximum extent. Therefore, any deviation from lying to the maximum extent must be credited to internal behavioral mechanisms (the existence of moral preferences, for instance) or environmental factors.

Fishbacher and Heusi (2008) first used this method to develop a distribution of reported outcomes that reflected individuals' aggregate lying behavior. This method has been shown to be robust to changes in conditions, and has subsequently been used to demonstrate and explain a range of actions related to dishonesty. Generally, studies using 6-sided dice trials find that the distribution of reported outcomes follows an increasing pattern, whereby the values with the highest payoffs are over-reported and those with the lowest payoffs are under-reported in comparison to a uniform distribution of outcomes (See Appendix 1 for a schematic overview of these studies). Moreover, participants appear to be sensitive to the 'size' of lies; the differences in numerical value between the true and untrue value is important (Hillbig and Hessler, 2013), as well as to the size of the monetary reward associated with lying (Shalvi et al, 2011b). However, given that all the studies use a 6-sided dice and rarely strayed from linearly increasing rewards, it seems that participants face some boundary conditions.

Our paper aims at addressing this gap. More specifically, we examine whether a difference in the structure of the lying opportunity given to participants may result in different distributions of reported outcomes. Does the range of untrue statements they can choose from affect individuals? Does the actual numerical value matter, or do individuals only concern themselves with achieving a desired outcome? Our research is tied with choice architecture, i.e., the idea that the environment and the way the choice is offered influences each decision (Thaler, 2008). The boundary conditions we consider are: 1) the range of possible outcomes to report: a small range (control condition) operationalized by using a 6-sided dice, a medium range operationalized by using a 12-sided dice, and a wide range operationalized by using a 20-sided dice; and 2) the magnitude of the monetary payoffs, operationalized by offering, in one of two 12-sided conditions, payoffs that increase from 0 to 5 Euros in an exponential manner. This is compared with a condition in which rewards increase at a constant rate.

Expanding the existent research on dishonesty can help to shed light on phenomena that can be very damaging to society such as tax evasion and fraud, as well as costly consumer behaviors such as overstating insurance claims and returning worn items. It can help us understand the dynamics behind relatively new and widespread domains such as the intellectual property theft occurring when Internet users illegally download music and film. Whenever there is something to be gained and low or no possibility of being caught, there is potential for a degree of dishonesty. Society traditionally relies on tighter controls, increasing the possibility of being caught, and more severe fines and penalties as effective ways to prevent crime and dishonesty (Mazar and Ariely, 2006). These measures may be effective but they may not necessarily be the most efficient; insights into the internal drivers of honest behaviors can help us develop ways to reduce dishonesty which are not based solely on the expensive implementation of economic incentive-based methods, but take human nature into account. Methods based on behavioral economics insights have already been demonstrated in many randomized controlled trials to be inexpensive, easy to implement, and successful at reducing undesirable behavior (Behavioral Insights Team, 2012).

In terms of relevance to business practice, lying, cheating and dishonest behavior occurs in a wide range of marketing environments, both within and without an organization. There are endless instances of deception among individuals in a business environment, be they employees, customers, managers or partners. An instance where the present research may prove useful is in the domain of self-reporting and negotiating, which managers can encounter often. Whether reporting work hours, sales figures or customer satisfaction levels, there are many opportunities for employees to overstate their claims and sometimes a small lie may result in a big increase in payoffs, for example when slightly inflating sales figures may result in a bonus. Similarly, negotiating an agreement or providing a quote can also lead to arbitrary reductions or increases in stated figures. As discussed earlier, our research will concentrate on how the structure of the lying opportunity affects lying behavior when reporting an outcome.

Our results indicate that lying behavior is robust to changes in range and magnitude of payoffs. Nevertheless, important effects of range and magnitude were observed: (i) using a medium range of untrue statements results in an increase of lying across the range, (ii) using a wide range of untrue statements completely eliminates full income maximizers, or 'homo economicus' behavior, and (iii) no participants reported a payoff of 0 such that they could be considered 'unconditionally honest' or 'fully lie averse.' While previous studies implicitly assumed these two types of behavior would always be observed, the two simple manipulations within our study eliminated both types of behavior.

The remainder of this paper proceeds as follows. The next section discusses the related literature. Section 3 presents our experimental design and procedures. Section 4 discusses the behavioral hypotheses. The main features of the data and the empirical results are presented in Section 5. Section 6 summarizes and concludes.

2. Related Literature

Background

In classical economics, the general assumption is that dishonest decisions are based on a trade-off of utilities (Becker, 1968). Only the external benefits are considered, and individuals weigh the possible gains from the dishonest act against the possibility of being caught and the extent of the punishment (Lewicki, 1984); that is, given the chance to lie for a profit and zero opportunity of being caught, everyone would lie to the maximum extent to maximize the utility of their decision. Experimental economics studies, however, have shown that this view on dishonesty is overly pessimistic. When observing actual lying behavior, some people, even with no opportunity of being caught, act completely honestly, and some others lie to the maximum extent. More interestingly, many decide to lie “a little”.

What lies beyond the decision of engaging in dishonest behavior is much more than an estimation of external gains and losses. Mazar, Amir and Ariely (2008) propose a model of self-concept maintenance, which attempts to explain why people do not always choose to lie to the maximum extent available. They suggest that there is an amount by which individuals are comfortable lying; below this threshold, individuals can lie for a gain while still maintaining they are honest people, both in their opinion of themselves and in the eyes of others. This refers to ‘internal’ gains and losses which are arguably as important in the decision making process as the external ones.

It is important to note that individuals value honesty, are aware of the damaging effects of dishonesty, tend to have unrealistically good self-views, and, as such, generally believe they are moral (Steele, 1998). Furthermore, individuals find appearing moral in the eyes of others just as, or even more important than, actually being honest, sometimes even leading to the paradox of lying to appear honest (Fischbacher and Utikal, 2011). Individuals will strive to maintain this 'honest' self-concept even at a cost. This occurs because the norms preferred by a society (in this case, honesty) are internalized into the individuals' self-concept through socialization (Henrich, 2001). Updating one's self-concept is aversive, and one will sometimes prefer to be honest, or to forgo certain rewards, in order to avoid the cognitive effort and discomfort of having to update it (Mazar, Amir and Ariely, 2008). As a result, individuals tend to lie only to the extent that allows them to still believe they are an honest person.

Relevant findings

In studies where performance is anonymously reported for a reward, it is found that participants tend to overstate their performance by 10% to 20%, but no more than that, even if there is no reason for them not to lie to the maximum extent (Mazar, Amir and Ariely, 2008). Similarly, Fischbacher and Heusi (2008) find that only 20% of the participants in their dice-under-cup study lie to the maximum extent. More specifically, they find that 39% of the subjects remain honest, while 41% of the subjects do not tell the truth, but also did not maximize their reward by lying to the full extent possible.

In Fischbacher and Heusi's experiment, the distribution of reported outcomes follows a monotonically increasing pattern (see Appendix 1) which is robust to a series of changes in conditions: the stakes vary from 1-5 CHF[1] to 3-16 CHF, such that the external consequences of lying change so that another participant is worse off if lying occurs; the degree of anonymity varies; and the structure of payoffs changes so that there is an increase in rewards of only .10 CHF between reporting a 4 or a 5. There are a number of studies, however, which raise questions about whether certain boundary conditions – notably, range of outcomes and magnitude – could

[1] Swiss Francs, 1 CFH = .80 EUR

result in different patterns of behavior. These studies, described below, indicate that the unit number associated with the lie, and the magnitude of rewards can affect a person's willingness to lie and could have an impact on the aggregate extent of lying.

Using the same dice-under-cup paradigm, Shalvi et al. (2011b) find that people tend to avoid major lies, i.e. those yielding large material gains, and minor lies, i.e. those yielding little material gains. In the first instance, they argue that the psychological cost of lying is too high (increasing the outcome by a large number is "too much" of a lie) and in the second instance, the monetary reward is too low (it is not worth lying for a very small increase in rewards). Participants who are offered the opportunity for an "intermediate" lie are more likely to take it.

Furthermore, people prefer 'smaller lies,' and the numerical value related to the lie has been shown to matter despite the fact that rationally, on a dice, the number values are not important as all of them have the same probability of materializing. Hilbig and Hessler (2013) test this by modifying the dice-under-cup paradigm so that there is only one winning value, which changed every time. They find that participants modify their answers more often to report the winning outcome when it was a 3 or 4 rather than when it was a 1 or a 6. The middle numbers provide a greater opportunity to lie to those who are only willing to change their score a little (for example by 2 units). On the other hand, if individuals are assigned 6 as a winning number, they are willing to lie only if they throw a 5 or a 4, therefore decreasing their 'opportunity' to lie. This study concludes that it is easier for participants to change their answers to the winning one when it is numerically closer to the number they actually threw. A 'large' lie is avoided and therefore it is worth lying for the monetary reward.

Despite these indications that numerical values and the differences between them are important, no research so far has explored the effect of a wider range of outcomes on lying. A wide range of outcomes means that in order to achieve a high payoff, the relative numerical 'size' of the lie would be greater. At the same time, increasing the number by just a little results in a very small increase in payoffs and therefore may be avoided as "not worth" the lie. This effect can be further exacerbated by offering payoffs in exponentially increasing increments, which would mean that the lie would have to be "big" both in terms of number and change in reward. Increasing the range and offering exponentially increasing rewards may take advantage of people's self-concept maintenance need and result in a reduction of lying.

On the other hand – in contrast to the idea that the numerical value attached to the lie is used as a proxy for the 'size' of a lie – uncertainty and vagueness, in the form of a wide range of possible values to report, has also been shown to encourage lying. Schweitzer and Hsee (2002) demonstrate that when participants are given a wide range of possible figures to report in a negotiation, with costs and benefits staying the same, they communicate self-serving and sometimes untrue information more than when given a narrow range. Respondents also rate the figure they give in a wide-range condition as more "honest" and more "justifiable".

In fact, lying behavior can also be explored in terms of justifications to lie. This process of justification can be explained by the concept of motivated reasoning (Kunda, 1990), whereby people are prone to enhance the consideration of reasons and beliefs that help them arrive at desired conclusions, they shrink the consideration of reasons and beliefs that lead to undesirable conclusions. This ability is however constrained by the extent to which individuals can construct reasonable justifications for the desired conclusion. Ariely, Amir and Mazar (2008) offer an explanation for lie justification, which they call "categorization malleability." They assume that individuals try to categorize their actions, and if there is a way they can justify the action to themselves as not being a "lie" or particularly dishonest, they are more likely to lie. They also show that where steps are taken to reduce malleability, for example, by increasing attention to one's own moral standard through reminders of honor codes, lying decreases.

Categorization malleability is increased when justification to lie is present and this can take on many forms. Justification may arise from external factors or from internal considerations. External factors include social influence, for instance being shown that other participants are clearly lying (Gino, Ayal, and Ariely, 2009) and being led to believe that, in a dictator game, one's partner is competitive and likely to lie (Atanasov and Dana, 2011) increases dishonesty. Internal factors include, for example, believing that the lie is for a good cause because the reward goes to charity (Shalvi et al, 2012) and distancing oneself from the concept of money by using tokens as intermediaries for money (Mazar, Amir and Ariely, 2008). Furthermore, high levels of creativity correlate with higher levels of lying, which Gino (2012) suggests occurs because creative people are better able to think of justifications for their dishonest behavior and therefore avoid updating their self-concept when lying.

To summarize, people prefer smaller lies in terms of numerical values (Hilbig and Hessler, 2013) and want to avoid both minor (too small an increase in rewards) and major (too high unit value difference between real and reported outcome) lies (Shalvi et al., 2011b), as there are instances where the balance between internal and external costs and rewards is not appropriate. The number values associated to lies seem to be used as proxies for the size of the lie, although in some instances the uncertainty reflected in a wide range of possible options seems to be used as a justification to lie more. Individuals use motivated reasoning to justify their behavior to themselves and avoid having to update their self-concept, in which they see themselves as honest and moral. Variance in the levels of possible justification results in variance in lying behavior. The current research extends the dice-under-cup paradigm to explore its boundary conditions in light of these findings.

3. Experimental design and procedures

Our experiment uses the dice-under-cup procedure as in Shalvi et al. (2011)[2]. Participants sitting at a computer are informed that they are requested to complete a task consisting of a marketing research survey (a filler questionnaire). In order to determine the payment of this task, they have to shake a dice in a paper cup,[3] and anonymously report the outcome and corresponding payoff.[4] After, the participants are instructed to take their payment from an envelope,[5] which contains 5 euros in small change, taking the correct amount and leaving the rest behind (See Appendix 2 for instruction screens). Participants paid themselves in order to avoid any interaction with others.[6]

The participants were randomly assigned to one of the four treatments, which vary in range of dice outcome and the associated payoffs. Three of the treatments have payoffs increasing linearly from 0 to 5 and they vary on the type of dice used: a 6-sided dice (hereby referred to as *6l treatment*, N=50), a 12-sided dice (*12l treatment*, N=57), or a 20-sided dice (*20l treatment*, N=110). The fourth treatment consists of a 12-sided dice with payoffs increasing exponentially from 0 to 5 (*12e treatment*, N = 59). Table 1 below contains a summary of payoffs. Since the power of the statistical tests depends on the number of possible dice outcomes, participants were split among conditions proportionally.

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[2] They slightly modify the original procedure for anonymous dice rolls Fischbacher and Heusi's (2008).
[3] The dice is in a cup with a hole cut in the top, so that the participant can shake the cup and look at the outcome through the hole, ensuring the secrecy of the outcome.
[4] The participants were told to throw the dice twice to ensure the dice wasn't loaded, but this is done also because it tends to encourage lying, as being exposed to counterfactuals in the form of further dice rolls has been shown to increase the extent of lying (Shalvi et al., 2011).
[5] The envelope is ready before participants enter the lab cubicles.
[6] Social interaction may reduce lying as participants may feel uncomfortable reporting a false outcome to the experimenter (Fischbacher and Heusi, 2008). The envelopes were inspected upon participants exiting the lab.

Table 1: Experiment outcomes and corresponding payoffs

20 –face												
Outcome	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**		
Payoff (€)	0	0.5	0.75	1	1.25	1.5	1.75	2	2.25	2.5		
Outcome	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**		
Payoff (€)	2.75	3	3.25	3.5	3.75	4	4.25	4.5	4.75	5		
12 – face												
Outcome	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Payoff (€) - exponential	0	0.1	0.15	0.2	0.3	0.5	0.7	1.05	1.55	2.3	3.4	5
Payoff (€) - linear	0	0.85	1.25	1.65	2.1	2.5	2.9	3.35	3.75	4.15	4.6	5
6-face												
Outcome	**1**	**2**	**3**	**4**	**5**	**6**						
Payoff (€)	0	1	2	3	4	5						

The experiment was conducted at Erasmus University of Rotterdam in April and May of 2014. In total, 276 students with an average age of 20.7 (51% were males) took part in the experiment.[7]

4. Behavioral hypotheses

With no change in the maximum and minimum payoffs, differences in the range of outcomes (6, 12, or 20) and magnitude of payoffs (exponentially or linearly increasing payoffs) within the lying opportunity are expected to result in differences in lying behavior. As the range of possible outcomes widens but the minimum and maximum rewards stay the same, the increments in rewards become smaller and the unit differences between a low and a high outcome increase (see Table 1). Therefore, participants that roll very low values in a wide range condition may feel that increasing the number by a little is not worth the relatively small increase in payoffs but increasing it by a lot is a 'major lie' because of the large difference between numerical values.

[7] Instead of a show-up fee students received class credits.

This may be exacerbated when the magnitude of rewards is exponential. Increasing the number by a little is not worth the lie as the relative increase in payoff will be extremely low, but increasing the number by a lot brings on a ‘major lie’ both in terms of change of number and in change of reward. Therefore, given that intermediate lies may not be worthy, lying may be reduced in the wide range conditions and the overall percentage of ‘honest’ participants may be higher than in the control treatment. Thus, the following hypotheses are proposed:

Hypothesis 1 (outcome effect): The aggregate extent of lying in the 12 and 20-sided dice treatments is reduced as compared to the 6-sided dice treatment.

Hypothesis 2 (payoff effect): The aggregate extent of lying in the 12-sided dice with an exponential increase in payoffs is reduced as compared to the 12-sided dice with a linear increase in payoffs.

In addition, wider ranges may also give participants scope for categorization malleability by offering outcomes which correspond to half or three-quarters of the total amount or by having some values or outcomes which are round numbers. This may encourage participants to pick certain values, believing that one is not lying, but simply ‘rounding up’ for convenience. Therefore, some numbers may be over-reported. Some dice-under-cup experiments have also been shown to result in the numbers immediately below the highest being over-reported almost as much, or sometimes more than, the highest number (see Appendix 1). Again, this may be due to the fact that it is difficult to justify to oneself a lie to the maximum extent.

Hypothesis 3 (lie justification effect): attempts to justify a lie to oneself will result in round numbers, round payoffs, or payoffs just below the maximum being over-reported in all treatments.

5. Results

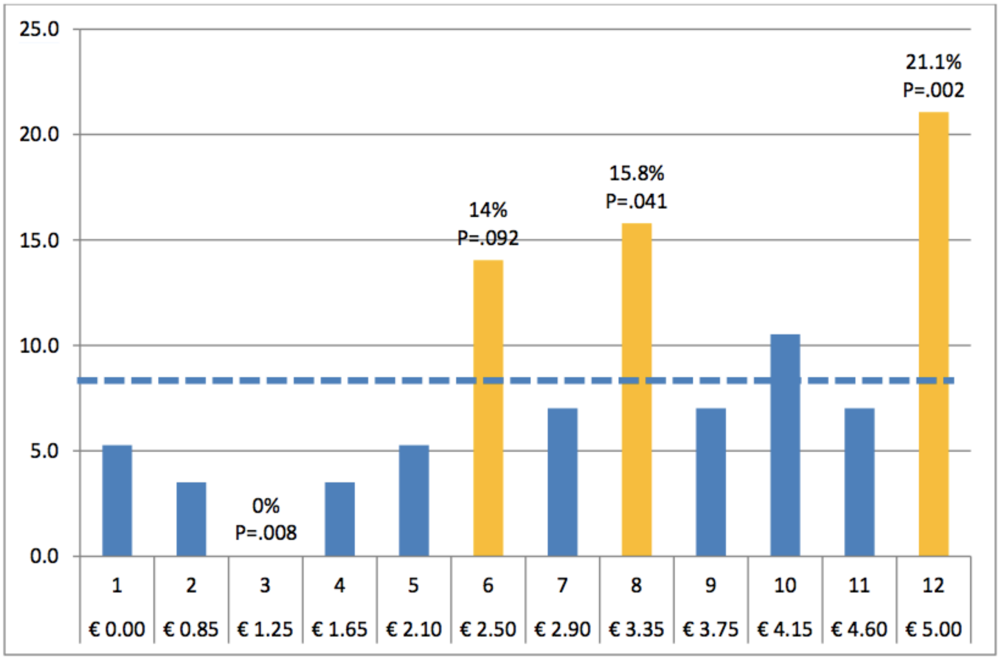
Intensity of lying

As expected, participants lied – the reported outcomes are not distributed uniformly, as would be expected given honesty, but rather generally tend to group towards the high end of the ranges (See Figures 1-4). The One-Sample Kolmogorov-Smirnov Test, which is significant for all conditions (p = .000 for *20l treatment* , *12l treatment*, and *12e treatment*, p = .006 for *6l treatment*), confirms this.

Figure 1: 6-Sided dice, linearly increasing payoffs

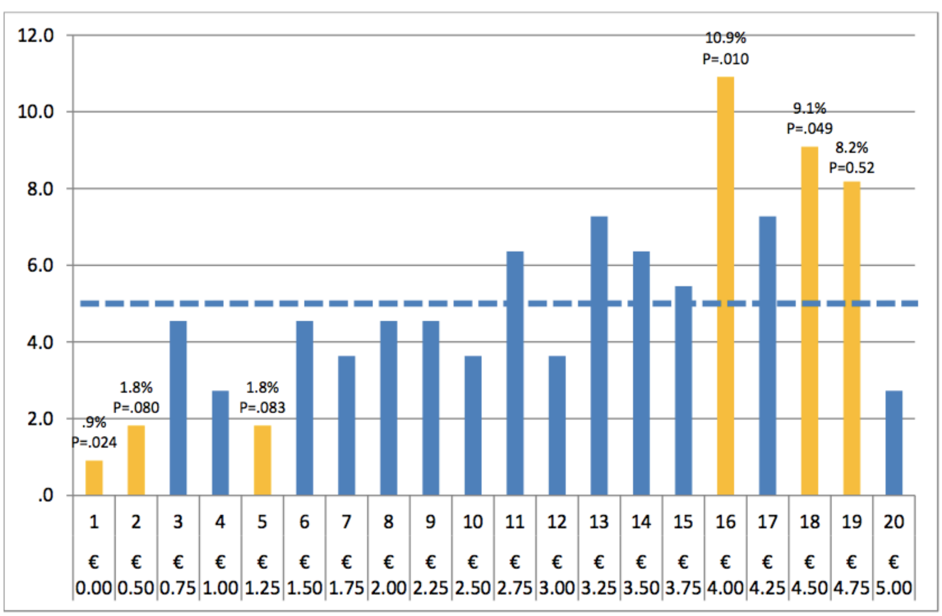
Note: Percentages of reported outcomes and payoffs – data are highlighted and p-value provided where the observed percentage is statistically different from 16.7% (dashed line) in a Binomial test.

Figure 2: 12-Sided dice, linearly increasing payoffs



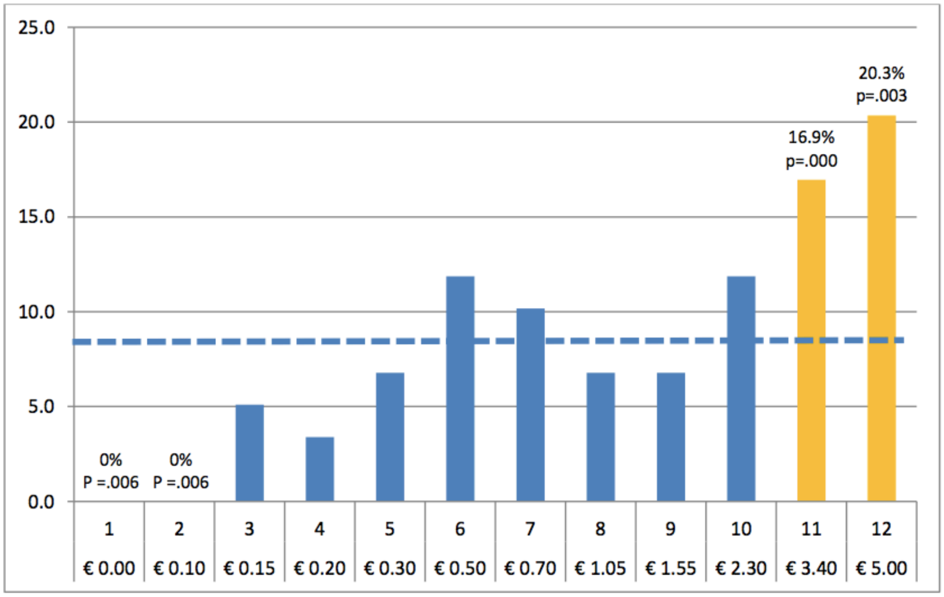
Note: Percentages of reported outcomes and payoffs – data are highlighted and p-value provided where the observed percentage is statistically different from 8.33% (dashed line) in a Binomial test.

Figure 3: 20-Sided dice, linearly increasing payoffs



Note: Percentages of reported outcomes and payoffs – data are highlighted and P value provided where the observed percentage is statistically different from 5% (dashed line) in a Binomial test.

Figure 4: 20-Sided dice, exponentially increasing payoffs



Note: Percentages of reported outcomes and payoffs – data are highlighted and P value provided where the observed percentage is statistically different from 8.33% (dashed line) in a Binomial test.

The observed percentage of each outcome is tested against the percentage expected given honesty (given a uniform distribution) in a Binomial test (See Appendix 3 for a summary).[8] The outcomes that are mentioned significantly more or less than the expected values are considered as 'proof' of lying behavior, while all other outcomes cannot be considered as anything else than having been honestly reported.

A Chi-squared test assessing whether all outcomes occur in equal proportions also confirms that they do not at the 5% significance level for 12-sided diced with linear payoffs treatment (Chi-square = 20, p = .029) and at 10% significance level for 20-sided dice and 12-sided dice with exponential payoffs treatments (*20l treatment*: Chi-square = 28.545, p = .073; *12e treatment*: Chi-square = 15.407, p = .080). The Chi-squared test does not hold for the 6-

[8] Given the small number of participants, a binomial test cannot prove that all outcomes are reported in a proportion significantly different from uniform.

linear condition, suggesting that the frequencies of the outcomes do not vary enough to be considered significantly different from equal (Chi-square = 7.360, p = .195). Furthermore, the mean payoff awarded to participants in this condition is not statistically different from the expected value given honesty (M = €2.78 SD = 1.81 vs. expected value = €2.50, t = 1.094, p = .279). This analysis suggests that lying did not occur in the 6-face condition. The K-S test does show that the distribution is not uniform and a further look into the data shows that this is due to a statistically significant under-reporting of the outcome '3' for a €2 payment (reported in 4% of observations, Binomial test against a value of 16.67% p = .007). Furthermore, while not statistically different from the expected value, the mean payoff is different in the expected direction (higher than) and therefore, for the purpose of this analysis it shall be assumed that the participants who did not report a value of 3 chose to lie and report a higher value (4, 5 or 6).

Range

The difference between expected frequency and the actual frequency (in one of the two directions – above or below) can be interpreted as lying. The statistically significant[9] percentage of individuals who lied in each condition is as follows: *6l treatment* = 12.67%, *12l treatment* = 25.89%, and *20l treatment* = 13.18%.

The percentage of lying in the linear conditions increases as the range of outcomes increases from 6 to 12 but decreases again as the range changes from 12 to 20 – leading to a similar extent of lying in the 6-sided and 20-sided treatments. This suggests that there may be an inverted-U relationship between range and extent of lying. However, there is no statistically

[9] Sum of all the differences between the expected percentage (given a uniform distribution) and the observed percentage of those outcomes that are significantly different from the expected percentage.

significant difference between the average payoffs across the three linear conditions.[10] If only the people who lied are taken into consideration, the average payoff[11] - is even more robust across conditions at €4 for 6 linear and 12 linear and €4.33 for 20 linear (F = .999, p = .379). The difference in the proportion of liars seems to be driven by the fact that in the 12l conditions, people chose to significantly over-report some numbers across the range (6, 8 and 12) while in the 20l condition, people chose to over-report numbers close to the top of the range (16, 18, 19). So in the 12l condition, despite a higher extent of lying, reporting slightly lower outcomes results in the same average payoffs. Looking at the distributions for all three conditions, it seems that generally, outcomes are either under-reported or reported in the expected (honest) proportion up to the half-way point in the range (at midpoint: *6l treatment* = 36% of observations, *12l treatment* = 31.6% of observations, *20l treatment* = 32.7% of observations), at which point over-reporting begins. Therefore, *Hypothesis 1* is not supported in the sense that increasing the range of outcomes did not decrease the amount of lying in both conditions – at best; the proportions of liars increased or stayed the same.

In conclusion, it appears that lying occurred in order to achieve a certain 'acceptable' payoff. Regardless of range and given linearly increasing rewards, individuals lied to achieve or come close to a certain outcome, and modified their behavior accordingly - lying less or more, on aggregate - as long as a certain amount below the maximum available, but above the expected value is achieved. Across linear conditions, all participants achieved on average a payoff 11% above the expected value (mean payoff = €2.92; SD = 1.57 vs. mean expected value = €2.59, t = 3.473, p = .001), while 'liars' achieved a mean payoff 37% above the expected value (mean

[10] One-way ANOVA: M *6l treatment* = €2.78, SD = 1.81; M *12l treatment* = €3.36, SD = 1.38; M *20l treatment* = €3.14, SD=1.29; F = 2.144, p =.140.

[11] (frequency of observations significantly above the expected uniform frequency * the corresponding outcome)/total number of observation significantly above the uniform line.

among ‘liars’ = €4.11 vs. mean expected value = 2.59; t = 12.428, p = .000).

When looked at in more detail, widening the range up to 20 did seem to have some effects – while participants were entirely comfortable reporting 6 and 12 for the maximum reward available, 20 was reported to an extent even lower than expected if participants had been honest (2.7%). While ‘income maximizing’ occurred in the conditions with the narrower range, it did not occur at all in the wide range condition. Participants in the 20-sided treatment were instead drawn to reporting 19 (8.2%), 18 (9.1%), and 16 (14%) for payoffs, respectively, of €4.75, €4.5 and €4. As the 12-sided condition also had an outcome that paid a similar amount (11 – €4.6), but which was not over-reported (7%) it must be concluded that individuals in general do not mind reporting the highest outcome, but did mind doing so in the 20-sided dice linear treatment and chose to report lower numbers instead. The fact that this did not happen in the 12l condition suggests that this is not necessarily a common behavior and something about the range of outcomes has influenced participants. This may have been due to the high unit value of the number which may have made it seem ‘too much’ of a lie or alternatively, knowing that the chance of getting a 20 is very small (1/20) participants may have thought the lie was not ‘credible’ or were unable to justify the lie to themselves – in both cases, participants chose among the ‘next best’ options: the ones just below the maximum, 19 and 18, or the one that gave the next best round outcome and the most reported by far, 16. While it did not reduce the overall extent of lying or the average cost of lying, a wide range did completely minimize income maximizing, or ‘homo economicus’ behavior.

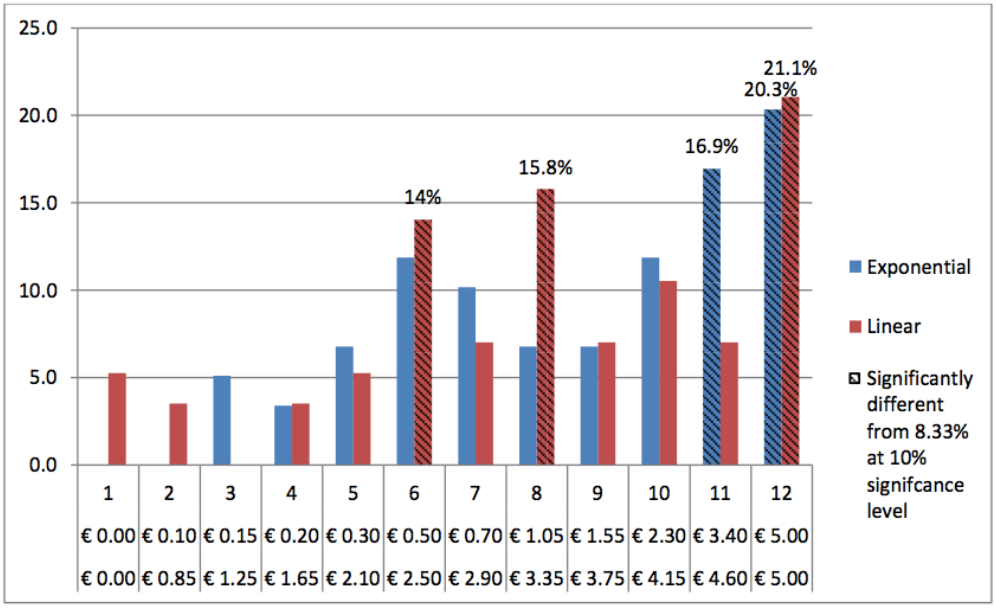
Round outcomes seemed to be favored in the 12-sided dice linear condition, as the values which are over-reported are 6 (14%), 8 (16.8%), and 10 (10.5%) is also the only value amongst the ones not significantly different from the uniform line which was over-reported. This could have been driven by one or a combination of two factors – an innate drive to pick a value with a ‘meaning,’ 6 being the ‘half-way point’ and 8 being the ‘two-thirds points,’ or alternatively, a decision to lie for a minimum acceptable payoff, as both numbers are associated with earning at least half of the maximum amount or at least 3 euros. These insights are in line with literature on justification (Shalvi et al., 2011 and 2012) and *Hypothesis 3* cannot be rejected, suggesting that some values are arbitrarily chosen over others as they appear (not necessarily rationally) more ‘justifiable’ to the individual.

Magnitude

There was a little less lying in the exponential condition (20.6%) than in the linear condition (25.9%), although if all deviations above the uniform line are considered, the proportion of lying is very similar (12e = 29.5% 12l = 28.1%). Although the distributions seem to have some striking differences (See Figure 5), a Mann Whitney U-Test does not reject the null hypothesis that distributions are the same ($Z = -.799$, $p = .424$), suggesting once again that lying behavior is generally robust.

In the exponential condition participants received on average an amount 43% above the expected value (*12e* mean = €2.21 SD = 1.78 vs. expected value = €1.27 $t = 4.040$ $p = .000$) while in the linear conditions participants received on average an amount 20% above the expected value (*12l* mean = €3.36 SD = 1.38 vs. expected value = €2.68 $t = 3.704$ $p = .000$). In the exponential condition, individuals achieved a larger increase in outcome by lying – understandably given the magnitudes of the increases in payoffs.

Figure 5: 12-sided dice, comparison of distributions with linearly and exponentially increasing payoffs.



The percentage of people who did accept the very low payoffs in the exponential condition reduced the average money awarded to participants but it must be noted that the average payoff awarded to "liars" is once again not significantly different between conditions ('liars' mean payoff *12l* = €4, *12e* = €4.35, t = -895 p = .380) and that the value of the payoffs which are over-reported in both conditions are also similar (*12l* = €5, €3.35, €2.50; *12e* = €5, €3.4, and also over-reported although not significantly so, €2.30). This suggests that, once again, the value of the payoff, rather than the lying opportunity conditions, was driving lying behavior. *Hypothesis 2* is therefore also rejected as the distribution of outcomes in the *12e* condition shows that the fact that "large" lies (in terms of changes in numerical and monetary value) are required to achieve a substantial payoff (€2.30 and above) was not a deterrent to lying and in fact may have encouraged it – it may have seemed more acceptable to increase one's stated outcome as the differences in payoff among the lower and medium values are so trivial.

Income maximization was rife in both conditions as many participants were happy to report a 12 (*12l* = 21.1% 12e = 20.3%) however, there is a striking difference between conditions at the other end of the range. In the exponential condition, not a single participant reported an outcome of 1 or 2, accepting a €0 or €0.10 payment. Participants accepted payments of €0 in the linear conditions (*6l* = 18%, *12l* = 5.3% *20l* = 0.9%) but did not in the exponential condition, suggesting that when participants are faced with an exponentially increasing rewards scheme they feel that it is always acceptable or justifiable to lie if a low number is rolled.

6. Discussion and conclusion

This study concludes that lying behavior is in fact robust to changes in range and magnitude of rewards. This study confirms previous research in that individuals do not always lie to the maximum extent but lie across the range of possible outcomes – but it does not confirm that numerical values or more generally the 'size' of the lie has an impact on the extent of lying on aggregate in the sense that there is not statistical sufficient evidence to link range or magnitude to a successful reduction of lying behavior. However, some effects of range and magnitude were observed. A medium range resulted in a high incidence of lying spread out across the range; a wide range resulted in a "normal" (similar to a narrow range) incidence of lying, which was grouped mostly towards the high end of the range.

Furthermore, the two extremes of lying behavior (income maximization and unconditional honesty) were affected. Income maximizers are always expected to report the highest value for the highest payoff, while all those participants who reported a payoff of 0 can be considered unconditionally honest or otherwise fully lie averse, at least in the context of the present relatively low stakes. While not explored in depth, previous studies seemed to assume that these two types of behavior will always occur when an opportunity to lie is present, and studies have confirmed the existence of pure lie aversion, i.e. avoiding a lie for purely internal reasons, not based on outside factors or expectations (Lundquist et al, 2009). However, two simple manipulations within this study achieved a complete elimination of both types of behavior.

Firstly, the widest range (0-20) resulted in a distribution with no income maximization, in contrast to medium and narrow ranges which saw as much as 13.93%[12] income maximizers in the 12l conditions and 1.6% in the 6l condition.[13] Past research introduces a number of possible reasons which may lead to avoidance of the extreme value – reporting a value of 20 may be seen as too "large" or a lie or unjustifiable in terms of maintaining a positive self- concept. Because of the very low probability of throwing a 20, credibility may also play a part, whereby participants subconsciously try to "disguise" their lie by reporting a number they feel less people may be reporting. It shouldn't be ignored that, while for example 12 is not a number with particular features, 20 corresponds to the beginning of a new decimal sequence and participants may irrationally be influenced by that fact, as is the case in psychological pricing. In the same way that in odd pricing, something priced just below a round number irrationally appears to be better value (Lambert, 1975), a similar mental process may occur whereby proving a value "just below" the maximum seems like a disproportionally smaller, and therefore more acceptable, lie.

Secondly, offering exponentially increasing rather than linearly increasing rewards completely removed participant's willingness to accept a payoff of 0 regardless of their aversion

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[12] Calculated by subtracting the expected percentage of the highest outcome, from the observed percentage and multiplying it by 5/6 (11/12) to account for those participants who threw a 6 (12) but would have lied had they thrown another number, as outlined by Fischbacher and Heusi (2008).
[13] This percentage of income maximizers for a condition with a 6-sided dice is low – studies with higher validity due to a higher number of participants have measured proportions of income maximizers ranging from 2.5% (Shalvi et al, 2011) to 22% (Fischbacher and Heusi, 2008).

to lying. The reasoning behind it may vary depending on whether these participants decided to change their outcome to a number a few units higher (2-6) or lie to the maximum or near maximum extent (7-12). In the first instance, if an individual threw a 0, the difference in payoff achieved by increasing the outcome by few units (e.g. changing it so 6, for a payoff of 0.50) is so small that participants may have felt their lie to be very 'small' and 'justified.' This contrasts with the notion that the reward of some lies is too small to warrant lying at all (Mazar, Amir and Ariely, 2008); however, the satisfaction of leaving with some money rather than empty-handed may have been enough for the benefits of the lie to be higher than the costs. In the second instance, participants who decided to report an 11 or 12 may have been influenced by the perceived unfairness of the payment scheme – perceiving the situation as unfair has been shown to increase lying (Atanasov and Dana, 2011).

Finally, this study points in the direction that individuals lie for a certain monetary payoff. This payoff, additionally, tends to be very similar among people who decide to lie, as the distributions in this study show that no over-reporting occurs before the halfway point, and most occurs in order to achieve payoffs between 3 and 5 euros. It seems participants are confronted with the decision on whether to lie to the maximum extent or not, and when they decide not to, choose to settle on the next best option, preferably if it is "justifiable" by a wide variety of circumstances – one of these circumstances possibly being the presence of a round or otherwise "meaningful" number, but most importantly, as long as it results in a high enough reward.

In terms of implications for practice, the insights from this study indicate that when in situations where information may be misreported, one must be aware that not everyone, but up to 25% of people can be expected to lie. When it comes to the structure of the lying opportunity, high ranges will reduce full income maximization; awarding rewards in exponentially increasing schemes, which may seem unfair or unreasonable, even if the minimum and maximum money to earn does not change, reduces individuals' willingness to be honest. Managers and employers can keep this in mind when designing work schemes for employees who self-report work hours or expenses – for example determining how often workers have to report their hours will determine the range of numbers they can report. In this study, the smaller range is the one that lead to the least lying – suggesting that it is most advisable one. Similarly, a very wide range reduced the extent of lying and reduced income maximization; therefore it appears that a medium range would be the most undesirable. However, this does not mean that the average costs of people's lying will change, as it can be expected to robustly sit below the maximum available but well above the lying opportunity's expected value. Therefore when in situations where there is a need for self-reporting or self-grading or generally, situations where dishonesty is an option, one must be wary of an over- reporting of such a below-maximum value.

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Appendix 1 – Review of dice-under-cup trials

<table>
<tr><th>Publication</th><th>Type of Experiment</th><th>Results - Distribution of lying</th></tr>
<tr><td>Shalvi et al (2011)

Justified ethicality: Observing desired counterfactuals modifies ethical perceptions and behavior</td><td>☐ 6-face dice roll

☐ $1 to $6

☐ One hypothetical conditions

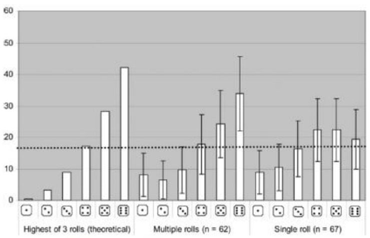
☐ Two real conditions: single roll vs counterfactuals (multiple rolls, but only the first counts)</td><td>

Fig. 2. The theoretical distribution of choosing the highest of three die rolls (left), the percentage of reported rolled outcomes in the *multiple-rolls* (middle) and *single-roll* (right) conditions, Experiment 1. The dashed line represents the honest distribution predicted by chance (16.67% per die face). The error bars represents the 95% confidence interval around the proportion.</td></tr>
<tr><td>Lewis et al (2012)

Drawing the line somewhere: An experimental study of moral compromise</td><td>☐ 6-face dice roll

☐ £0.10 to £0.60

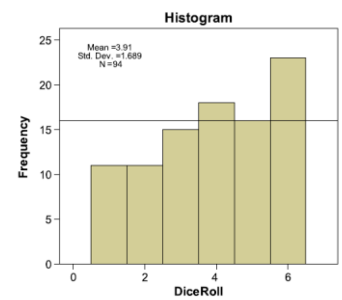
☐ Two conditions; rewards goes to participant vs reward goes to charity</td><td>

Fig. 2. The frequency and percentage of die rolls stated by all the participants compared to the average frequency of 16.</td></tr>
<tr><td>Hilbig and Hessler (2013) What lies beneath: How the distance between truth and lie drives dishonesty</td><td>☐ 6-face dice roll

☐ 1 winning outcome (chosen at random)

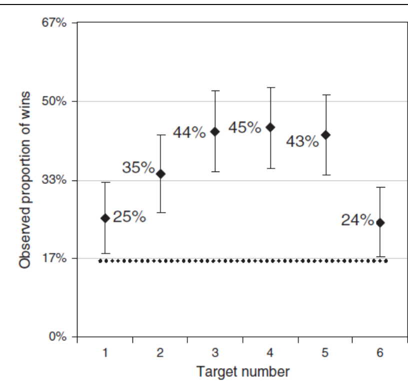
☐ Reward: €5 worth of vouchers</td><td>

Fig. 1. Observed proportion of "yes" responses to the critical question (alleged wins), conditional upon target-number. Error bars represent the 95%-confidence-interval of each proportion. The dotted line indicates the statistically expected proportion of wins assuming complete honesty (16.7%).</td></tr>
<tr><td>Utikal and Fichbacher (2013) Disadvantageous lies in individual decisions</td><td>☐ 6-face dice roll

☐ €1 to €5, 6=0

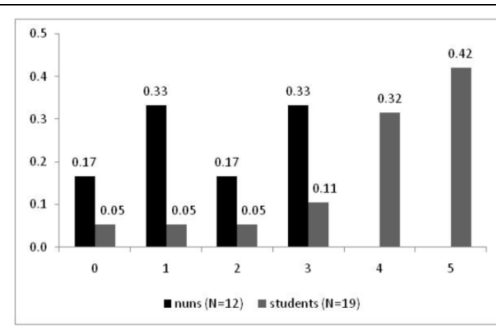
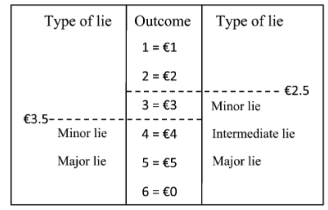
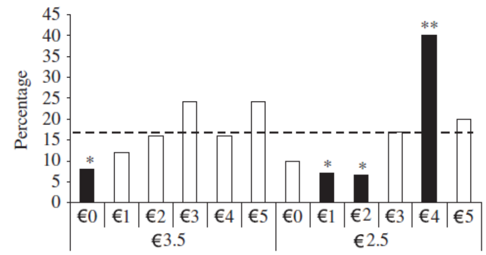
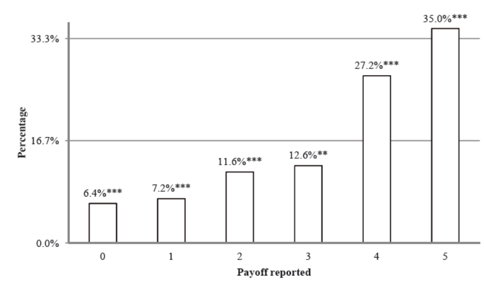
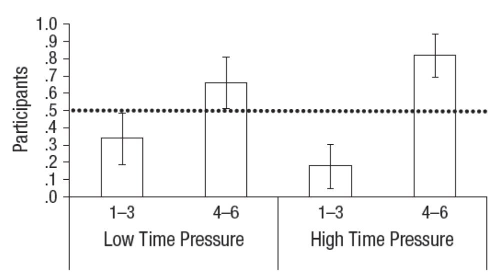
☐ Two conditions: students vs nuns</td><td>

Figure 1: Frequency of payoffs of nuns and students</td></tr>
</table>

Shalvi et al (2011) Ethical Manoeuvring: Why People Avoid Both Major and Minor Lies	6-face dice roll €1 to €5 2 conditions: high exit payoff – minor or major lie vs low exit payoff – minor, intermediate or major lie	 *Figure 1. Type of available lies (minor, intermediate and major) according to condition.*  Note: The horizontal dashed line represents the equal distribution (16.67%). The black bars differ from chance at significant levels (two-tailed): * p < 0.05, ** p < 0.01. *Figure 2. Distribution of reported die outcomes as a function of exit option (€3.5 versus €2.5).*
Fischbacher and Föllmi-Heusi (2008) Lies in Disguise – an Experimental Study on Cheating	6-face die roll 1 to 5 CFH (6=0) (1 CFH – $0.80) 3 conditions: -High stakes (1=3, 2=6, 3=9, 4=12, 5=15, 6=0) -Low stakes (4=4.90, 5=5) -Dictator game (a second participant receives the remaining amount of money) Pattern is robust to changes in condition	 Figure 1. Percentage of reported number of subjects in baseline experiment; first participation only (stars display the significance of two-sided binomial test that the observed percentage differs from 16.7% (*=10%-level, **=5%-level, ***=1%-level)).
Shalvi et al (2012) Honesty requires time (and lack of justifications)	6-face die roll 10 to 60 NIS (New Israeli Shekels – 1NIS = $0.25) Two conditions: low time pressure vs high time pressure	 **Fig. 1.** Results of Experiment 1: proportion of participants who reported die rolls of 1 to 3 versus 4 to 6 as a function of time pressure. The dashed line represents the distribution predicted by chance (50% for rolling a number ≤ 3 and 50% for rolling a number ≥ 4). Error bars represent 95% confidence intervals.

Appendix 2 – Instruction screens

qualtrics

The main part of this research consist of a marketing research survey, in which we are looking for your opinions on a number of products. As these results will be used commercially, for this task you will be paid an additional amount up to 5 euros. Next, you will determine your payment and then you can move on to the marketing research survey.

>>

qualtrics

The additional payment is not not the same for every participant. You determine your own payment by throwing a dice, which is in the cup behind the computer screen.

You can see the exact payment from the following chart. This chart will remain on the screen until you have entered your throw.

Outcome	1	2	3	4	5	6	7	8	9	10	11	12
Payoff (€)	0	0.85	1.25	1.65	2.10	2.50	2.90	3.35	3.75	4.15	4.60	5

As soon as you are asked to, please shake the dice in the cup, and look through the hole to see your outcome. Your first throw decides how much you receive.

You may of course throw the dice more than once. These other throws only serve to make sure that the dice is working properly. However, only the first throw counts.

There is an envelope containing 5 euros behind the computer screen. Once you payment has been determined, you can take the correct amount in coins from the envelope and keep it.

If you have any questions, please ask the research assistant. If you are ready, click >>.

>>

qualtrics

Please throw the die now.
Please keep in mind the first number you have thrown.

Outcome	1	2	3	4	5	6	7	8	9	10	11	12
Payoff (€)	0	0.85	1.25	1.65	2.10	2.50	2.90	3.35	3.75	4.15	4.60	5

Now please report the number you have thrown:

And the resulting payment:

Now please open the envelope containing money.

Please take the exact amount corresponding to the number you have reported, and place it in the empty envelope.

Please keep this second envelope as your payment, and leave the envelope with the remaining money on the table.

Outcome	1	2	3	4	5	6	7	8	9	10	11	12
Payoff (€)	0	0.85	1.25	1.65	2.10	2.50	2.90	3.35	3.75	4.15	4.60	5

Thank you! You can now proceed with the marketing research survey.

>>

Appendix 3 – Summary of binomial tests

20-sided dice, linear payoffs– Binomial tests

Outcome	Frequency	Percentage	Category	N	Observed Prop.	Test Prop.	Exact Sig. (1-tailed)
1	1	.9	All other outcomes	109	.99	.95	.024
			Outcome	1	.01		
2	2	1.8	All other outcomes	109	.98	.95	.080
			Outcome	2	.02		
3	5	4.5	All other outcomes	106	.95	.95	.518
			Outcome	5	.05		
4	3	2.7	All other outcomes	108	.97	.95	.189
			Outcome	3	.03		
5	2	1.8	All other outcomes	108	.98	.95	.083
			Outcome	2	.02		
6	5	4.5	All other outcomes	106	.95	.95	.518
			Outcome	5	.05		
7	4	3.6	All other outcomes	107	.96	.95	.344
			Outcome	4	.04		
8	5	4.5	All other outcomes	106	.95	.95	.518
			Outcome	5	.05		
9	5	4.5	All other outcomes	106	.95	.95	.518
			Outcome	5	.05		
10	4	3.6	All other outcomes	107	.96	.95	.344
			Outcome	4	.04		
11	7	6.4	All other outcomes	103	.94	.95	.312[a]
			Outcome	7	.06		
12	4	3.6	All other outcomes	107	.96	.95	.344
			Outcome	4	.04		
13	8	7.3	All other outcomes	103	.93	.95	.192[a]
			Outcome	8	.07		
14	7	6.4	All other	103	.94	.95	.312[a]

			outcomes				
			Outcome	7	.06		
15	6	5.5	All other outcomes	105	.95	.95	.482[a]
			Outcome	6	.05		
16	12	10.9	All other outcomes	99	.89	.95	.010[a]
			Outcome	12	.11		
17	8	7.3	All other outcomes	103	.93	.95	.192[a]
			Outcome	8	.07		
18	10	9.1	All other outcomes	100	.91	.95	.049[a]
			Outcome	10	.09		
19	9	8.2	Outcome	10	.09	.05	.052
			All other outcomes	101	.91		
20	3	2.7	All other outcomes	108	.97	.95	.189
			Outcome	3	.03		

a. Alternative hypothesis states that the proportion of cases in the first group < .95

6-sided dice, linear – Binomial tests

Outcome	Frequency	Percentage	Category	N	Observed Prop.	Test Prop.	Exact Sig. (1-tailed)
1	9	18.0	All other outcomes	41	..8200	.8333	.458[a]
			Outcome	9	.1800		
2	7	14.0	All other outcomes	43	..8600	.8333	.391
			Outcome	7	.1400		
3	2	4.0	All other outcomes	48	.9600	.8333	.007
			Outcome	2	.0400		
4	10	20.0	Outcome	10	.2000	.1667	.317
			All other outcomes	40	.8000		
5	12	24.0	All other outcomes	38	.7600	.8333	.117[a]
			Outcome	12	.2400		
6	10	20.0	All other outcomes	40	.8000	.8333	.317[a]
			Outcome	10	.2000		

a. Alternative hypothesis states that the proportion of cases in the first group < .8333

12-sided dice, linear– Binomial tests

Outcome	Frequency	Percentage	Category	N	Observed Prop.	Test Prop.	Exact Sig. (1-tailed)
1	0	0.0	All other outcomes	59	1.0000	.9167	.006
2	0	0.0	All other outcomes	59	1.0000	.9167	.006
3	3	5.1	All other outcomes	56	.9492	.9167	.265
			Outcome	3	.0508		
4	2	3.4	All other outcomes	57	.9691	.9167	.121
			Outcome	2	.0339		
5	4	6.8	Group 1	55	.9322	.9167	.448
			Group 2	4	.0678		
6	7	11.9	Group 1	52	.8814	.9167	.218[a]
			Group 2	7	.1186		
7	6	10.2	Group 1	53	.8983	.9167	.368[a]
			Group 2	6	.1017		
8	4	6.8	Group 1	55	.9322	.9167	.448
			Group 2	4	.0678		
9	4	6.8	Group 1	55	.9322	.9167	.448
			Group 2	4	.0678		
10	7	11.9	Group 1	52	.8814	.9167	.218[a]
			Group 2	7	.1186		
11	10	16.9	Group 1	10	.1695	.0833	.023
			Group 2	49	.8305		
12	12	20.3	Group 1	47	.7966	.9167	.003[a]
			Group 2	12	.2034		

a. Alternative hypothesis states that the proportion of cases in the first group < .9167

12-sided dice, exponential payoffs – Binomial tests

Outcome	Frequency	Percentage	Category	N	Observed Prop.	Test Prop.	Exact Sig. (1-tailed)
1	3	5.3	All other outcomes	53	.9464	.9167	.304
			Outcome	3	.0536		
2	2	3.5	All other outcomes	54	.9643	.9167	.144
			Outcome	2	.0357		
3	0	0.0	Outcome	56	1.000	.9167	.008
4	2	3.5	All other outcomes	54	.9643	.9167	.144
			Outcome	2	.0357		
5	3	5.3	All other outcomes	53	.9464	.9167	.304
			Outcome	3	.0536		
6	8	14.0	All other outcomes	48	.8571	.9167	.092[a]
			Outcome	8	.1429		
7	4	7.0	Outcome	3	.0536	.0833	.304[b]
			All other outcomes	53	.9464		
8	9	15.8	All other outcomes	47	.8393	.9167	.041[a]
			Outcome	9	.1607		
9	4	7.0	All other outcomes	52	.9286	.9167	.496
			Outcome	4	.0714		
10	6	10.5	All other outcomes	50	.8929	.9167	.323[a]
			Outcome	6	.1071		
11	4	7.0	All other outcomes	52	.9286	.9167	.496
			Outcome	4	.0714		
12	12	21.1	All other outcomes	44	.7857	.9167	.002[a]
			Outcome	12	.2143		

a. Alternative hypothesis states that the proportion of cases in the first group < .9167
b. Alternative hypothesis states that the proportion of cases in the first group < .0833