

# Discussion Paper

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**The influence of an  
up-front experiment on respondents'  
recording behaviour in payment diaries:  
evidence from Germany**

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## **Non-technical summary**

### **Research Question**

In this methodological paper we investigate the effect of a behavioural experiment, eliciting respondents' risk preferences, on their recording behaviour in a subsequent one week payment diary. Both the experiment and the diary are part of a representative survey. The experiment randomly assigns an incentive to participants. We ask whether respondents' recording behaviour in the diary part differs depending on whether individuals receive the incentive or not.

### **Contribution**

We contribute to the literature on behavioural experiments in representative surveys and the effects of incentives on data quality. Contrary to most of the existing literature, we do not focus on participation incentives, but on incentives randomly assigned between two stages of the interviewing process, i.e. between a regular questionnaire and self-administered diary. We will therefore be able to assess whether incentives have an effect on data quality given participation.

### **Results**

Our results indicate that the outcome of the experiment has an impact on the quantity of transactions recorded in the payments diary, but does not affect other aspects of data quality. It also has a negligible impact on substantive measures like the cash share. This is good news for survey practitioners and analysts alike: the experiment seems to have some impact on consumers' commitment to the survey diary, but does not induce a bias on the key qualitative results.

# **Nichttechnische Zusammenfassung**

## **Fragestellung**

In diesem methodisch ausgerichteten Papier untersuchen wir die Auswirkungen eines Verhaltensexperimentes zur Messung der Risikopräferenz auf die Qualität der Aufzeichnungen in einem einwöchigen Zahlungstagebuch, welches die Teilnehmer im Anschluss an das Experiment führten. Das Experiment und das Tagebuch waren Bestandteile einer bevölkerungsrepräsentativen Studie. In dem Experiment wurden zufällig einige Teilnehmer bestimmt, die ein finanzielles Incentive erhielten. Wir fragen nun, ob die Qualität der Tagebuchaufzeichnungen davon abhängt, ob eine Personen das Incentive erhielt oder nicht.

## **Beitrag**

Dieses Papier leistet einen Beitrag zur Forschung über Verhaltensexperimente in repräsentativen Bevölkerungsumfragen sowie zur Literatur über die Auswirkungen von Incentives auf die Datenqualität in Surveys. Im Gegensatz zu den meisten bisher veröffentlichten Untersuchungen soll die von uns betrachtete Anreizzahlung nicht zur Teilnahme an der Studie motivieren, sondern wird zwischen zwei Phasen der Befragung zufällig an die Teilnehmer verteilt. Sie erhalten das Incentive nach Beantwortung eines regulären Fragebogens und vor der Aushändigung eines selbst auszufüllenden Tagebuchs. Somit lässt sich beurteilen, ob der finanzielle Anreiz einen Effekt auf die Datenqualität hat, wenn die Teilnehmer bereits zuvor für die Mitwirkung an der Befragung gewonnen werden konnten.

## **Ergebnisse**

Unsere Ergebnisse weisen darauf hin, dass das Experiment einen Einfluss auf die Anzahl der aufgezeichneten Transaktionen im Zahlungstagebuch hat. Auswirkungen auf andere Aspekte der Datenqualität finden wir jedoch nicht. Die Bedeutung des Incentives für zentrale Resultate der Studie wie den Barzahlungsanteil ist ebenfalls zu vernachlässigen. Dies dürfte sowohl die Produzenten als auch die Nutzer von Umfragen freuen: Das Experiment scheint das Engagement der Konsumentinnen und Konsumenten beim Ausfüllen des Tagesbuchs zu erhöhen, verzerrt jedoch nicht die wesentlichen qualitativen Ergebnisse.

# The Influence of an Up-Front Experiment on Respondents' Recording Behaviour in Payment Diaries: Evidence from Germany <sup>1</sup>

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## Abstract

In this paper, we analyse the recording behaviour of German consumers in a one week diary on their point-of-sales expenditures. We are particularly interested in the effect of a behavioural experiment, eliciting respondents' risk preferences, on their recording behaviour. In the experiment, run shortly before the consumers start to fill in the diary, the consumers have the choice between receiving a sure payment of 10 euro and participating in a game. If they opt for playing the game they roll a die and either win 20 euro or nothing. We ask whether respondents' recording behaviour differs depending on whether individuals who do roll the die lose or win. We argue that winners may attach a more positive feeling to the survey than losers and therefore exhibit more commitment to the diary, e.g. by reporting better quality data. Beyond providing evidence on the effect of conducting up-front experiments in representative surveys our results also contribute to the literature on incentives. For participants who roll the die, the experiment can be seen as a tool to randomly assign an incentive to respondents. Our results indicate that the outcome of the game has an impact on the quantity of transactions recorded, but does not affect other aspects of data quality. It also has a negligible impact on substantive measures like the cash share.

**Keywords:** incentives, risk experiments, payment diary, data quality

**JEL-Classification:** C83, D12, E41

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# 1 Introduction

Behavioural economists and psychologists often do experiments with convenience samples (e.g. college students), but recently there is growing interest in embedding behavioural experiments in representative surveys. This is one of the many promising new directions in which survey methodology has been evolving.

The results of such experiments have been analysed at great length, but little is known about the impact of running a behavioural experiment and its outcome on participants' attitude towards the survey and ultimately on data quality in other parts of the study, e.g. the classic questionnaire part. Depending on the set-up of the experiments, there is scope for the experiment to induce biases and measurement error in the collected data. Our paper provides evidence on this issue. We link our experiment to the literature on the role of incentives in surveys. Our incentive experiment differs from the existing literature in two important respects. First, we do not focus on participation incentives, but on incentives randomly assigned to participants between two stages of the interviewing process, i.e. between a regular questionnaire and self-administered diary collecting data on payment transactions. We will therefore be able to assess whether incentives have an effect on data quality given participation. Second, our participants are aware that others have received a different incentive. Thus, they might be upset if they receive nothing or, on the contrary, be very pleased if they win a prize. This positive or negative attitude towards the survey – on top of the monetary value – should result in more pronounced effects of the incentive on data quality, measured along various dimensions. We consider different indicators of item non-response: transactions which are not reported at all as well as incompletely reported transactions. Another measure of data quality is the rounding of transaction amounts.

The basis for our analysis is a risk aversion experiment, which is run between a standard questionnaire type data collection and a self-administered one week diary on consumers' point-of-sale expenditures. In the experiment the consumers have the choice between receiving a sure payment of 10 euro and participating in a game. If they opt for playing the game they roll a die and either win 20 euro if it shows 4, 5, 6 or nothing if it shows 1, 2, or 3. The consumer's choice to play or not to play is a measure of risk aversion. For players, the risk experiment is also an incentive experiment, with a random assignment of an extra incentive if they win and a loss of 10 euros if they lose. On top of the monetary value, "winning" the game may induce a positive attitude towards the survey. Both the monetary incentive itself and the positive attitude from winning should lead to better data quality in the diary.

We find that the behavioural experiment seems to have some impact on consumers' commitment to the survey diary in that they record more transactions, but it does not induce a bias on the key qualitative results. This is good news for survey practitioners and analysts alike.

## **2 Related Literature**

In this section we review the literature on the effects of incentives on data quality. We are not aware of any studies that address directly the effect of behavioural experiments as such on data quality in subsequent data collection and thus we focus on the incentive aspect of our experiment.

The study by Bonke and Fallesen (2010) on Danish data comes closest to what we are doing in this paper. Bonke and Fallesen (2010) study how different incentives, paid out through a lottery, explain people's participation rates, choice of survey mode (CATI/CAWI) and data quality in a large scale Danish survey on time-use and consumption. What makes the study particularly interesting for us is that they investigate data quality in the survey diary context. However, in contrast to our study, their participants are not aware that there are lotteries with varying prizes. They find a strong effect of incentives on response rates as well as mode choice, but no effect per se on data quality. Neither item non-response in the regular questionnaire of their study, nor the number of reported activities or consumed goods and services in the diary differ significantly with the incentives provided, if they analyse both CATI and CAWI respondents. They do find some positive effects of incentives with respect to data quality for CATI interviewees only. That the impact of incentives on data quality may be rather limited has also been documented by other scholars. Davern et al. (2003) and Shettle and Mooney (1999) investigate the impact of incentives on classic measures of data quality like item non-response and the number of edited variables/cases. They find that (prepaid) monetary incentives do not matter for data quality. Similarly Tzamourani and Lynn (2000) show that there is no clear effect of incentives on data quality, concluding that "... the incentives did not affect the respondents' answers in any way, that is they did not induce bias in the responses." (p.16) Göritz (2005) documents for a web-based survey that if respondents are offered an incentive that is contingent on completing all relevant questions in the questionnaire, their reporting behaviour in terms of number of omitted questions and other quality indicators does not differ from that of respondents not offered the incentive. The same seems to hold for web-based studies using access panels (Göritz, 2004).

Whether incentives have a positive, negative or any effect at all on respondents' reporting behaviour is nonetheless still an open question. Studies by Lynn and Sturgis (1997), Singer et al. (2000), Willimack et al. (1995), and James and Bolstein (1990) found – contrary to the studies cited above – that incentives do have an effect on reporting behaviour and data quality. Lynn and Sturgis (1997) experimented with incentives in surveys involving diaries. They find a significant effect of incentives on the number of events recorded in the diary. Goldenberg and Ryan (2009) report that in the US Consumer Expenditure Diary Survey respondents receiving a pre-paid monetary incentive of \$20 or \$40 reported more expenditures and also performed better on other indicators of data quality. A similar result is reported by Goldenberg et al. (2009) for the same type of incentives used in the Consumer Expenditure Interview Survey. Singer et al. (2000) show that for some households, paying an incentive reduces item non-response. However, the effect is very small: “Only 7 percent is explained by both the demographics and the incentives, and incentives alone explain less than 1 percent of the variance in item nonresponse.” (Singer et al., 2000: 180). They also find an impact of incentives on the distribution of responses. Respondents receiving an incentive seem to be in a better mood (see also Schwarz and Clore, 1996) and report more optimistic expectations. Willimack et al. (1995) summarize their findings: “In addition, evidence suggests greater response completeness among responding incentive recipients early in the interview, with no evidence of increased measurement error due to the incentive.” (p. 78). James and Bolstein (1990) find that what they call “large” prepaid incentives of \$ 2 lead respondents to expend more effort on completing questions in the mail survey. They measure greater effort by the length of the respondents' answers, the number of comments and number of words written. Interestingly they also find that large incentives increase “... comments that were more favourable towards the survey sponsor” (p. 346), which signals a stronger commitment to the survey. James and Bolstein (1990) cite several older studies (e.g. Godwin, 1979, and Shuttleworth, 1931) which have also found that respondents receiving monetary incentives have a tendency to provide more comments and more complete responses. A similar result has been found by Goetz et al. (1984).

### **3 Data and Variables**

In this section we describe the Bundesbank's Payment Survey and the behavioural experiment we ran in more detail. We also provide some information about respondent characteristics. Furthermore, we discuss various measures of data quality in payment diary survey which might be affected by the incentives.



### 3.1 The Bundesbank's Payment Survey

In 2014 the Bundesbank conducted the third wave of its payment behaviour survey called "Payment Behaviour in Germany". The survey was run by the market research institute MARPLAN on behalf of the Deutsche Bundesbank. The face-to-face interviews with the respondents were conducted between May and July of 2014.<sup>2</sup> In total 2,036 persons participated in the survey. The survey is representative for the German population aged 18 and older.

The survey consists of two main parts, a CAPI interview and a drop-off paper and pencil diary<sup>3</sup>, which was handed out to participants after the completion of the interview.<sup>4</sup> While the interviews contained questions on topics like the ownership and usage of payment instruments, cash withdrawal behaviour, perceived risks of payment instrument usage, and respondents' demographics, the diary collected information on actual transactions over a period of seven days and specifically refers to direct payment transactions at the point-of-sale, i.e. all transactions apart from recurrent transactions like rent payments, insurance fees, telephone and utility bills. The information collected in the paper and pencil diary includes the euro amount of each transaction, the location where the transaction took place (16 different locations including "retail purchases for day-to-day needs", "filling stations", "restaurants", "e-commerce", "payments to private individuals", etc.) and the payment medium used to settle it (cash and a list of eleven cashless payment methods, e.g. debit cards, credit cards, e-payment schemes, payment schemes via mobile phone, contactless card payments). Additionally, respondents had to provide information on cash withdrawals in the diary. The diary contains space for up to eight transactions for each day and some spare pages if more than eight transactions occur on one day. At the top of each page of the diary the respondents were asked to fill in the date and then all transactions pertaining to this date. The printed diary also contains a page with an example of how to fill in the diary and the interviewers

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<sup>2</sup> The sample for the survey was drawn using a random-route procedure developed by the Association of German Market and Social Researchers, the so-called "ADM" (see Hoffmeyer-Zlotnik, 2003, on random route samples). This design implies that at a first stage small geographical areas are randomly drawn from the population of all geographical areas in Germany using pps-sampling. In a second step a random starting point is drawn which is linked to a specific pre-defined (walking) route the interviewer has to follow in order to reach the households. Finally within each household one interviewee is selected using the last birthday rule. When designing the random sample of areas (first stage), care was taken to ensure that consumers from all 16 federal states (Länder) were included in the gross sample.

<sup>3</sup> Respondents were also offered to fill in the diary using an application on their smartphone. Less than two percent of respondents chose this option.

<sup>4</sup> To spread the interviews and collected diary data across the whole survey period, the addresses/random starting points were not given to the field at one point in time, but rolled out continuously, with new addresses/starting points in the field each day. This procedure ensures that interviews are conducted on all days of the week (including weekends and holidays), which implies that payment diaries were also started on each day of the week. In practice we see that more respondents started on Wednesdays (19%) compared to Sundays (9%).

explained the procedure of recording transactions to the respondents when they handed over the diary.

Respondents received incentives both for answering the survey and for filling in the diary. After completion of the CAPI interview the interviewer gave the respondents a pen, a notepad and a package of shredded banknotes. A monetary incentive of 10 euro was sent to everyone who answered the payment diary and returned it to the market research institute. All these incentives were paid to respondents independent of the outcome of the experiment. They do thus not confound our analysis.

A novel feature of the 2014 survey was an experiment which is supposed to elicit respondents' risk aversion. The experiment was run after the face-to-face interview and administered by the interviewers to all respondents.<sup>5</sup> Respondents were free to choose whether they wanted to participate in the experiment. Out of the 2,036 persons completing the CAPI, 1,952 respondents (almost 96%) decided to take part in the experiment.<sup>6</sup> Therefore we can rule out considerable bias in the group of participants due to response rate bias. Consumers who took part in the experiment were given the choice to receive 10 euro or participate in a game. If they opted for playing the game they rolled a die and either won 20 euro if it showed 4, 5, or 6, or nothing if it showed 1, 2, or 3. The expected value of the game is 10 euro and the "assignment" of consumers to one of the two states is obviously random if the die is fair and interviewers do administer the experiment correctly. 982 consumers out of 1,933 participating in the experiment took the 10 euro and 951 consumers rolled the die (see Table 1). The share of winners is about 10 percentage points higher than expected, at almost 60%.

**Table 1 - Overview of sample sizes**

All observations			
1933	<i>Of which:</i>		
	Safe present	Roll die	
	982 (50.8%)	951 (49.2%)	
		<i>Of which:</i>	
		losers	winners
		389 (40.9%)	562 (59.1%)

<sup>5</sup> In contrast to many other behavioural experiments, no subgroup of respondents was selected, i.e. the experiment is carried out using a representative sample of the population.

<sup>6</sup> 19 participants had to be excluded because they either did not return the diary or they returned a diary without any transactions, so that we work with a sample of 1,933 consumers.

It cannot be ruled out that the interviewers deviated from the instructions and e.g. allowed the respondents to roll the die several times or they simply paid out the 20 euro regardless of the number on the die. If it were the case this would mean a deviation from an experimental setting with randomly assigned outcomes. Unfortunately it cannot be checked ex-post why the realized and expected values do not match.<sup>7</sup>

To make sure that no bias with respect to observable socio-demographics exists between winners and losers we run a series of t-tests (for results see Table A1 in the Appendix). All but one come up negative, indicating that the composition of the two groups is very similar. As expected there are significant differences in socio-demographics between those respondents who take part in the game and those who do not.<sup>8</sup> Players are younger, more likely to be male and have on average a higher income. We also run probit regressions with the decision to roll the die (yes/no) as well as the outcome of the roll of the die (win/lose) as dependent variables, and socio-demographic variables as explanatory variables (see Table A2 in the Appendix). They broadly support the results of the individual t-tests. In addition, we use the CAPI interview to check whether winners and losers differ in their self-assessed risk preferences, their technological literacy and their approach towards new payment methods (see Tables A3 and A4 in the Appendix). We do not find any significant differences between the groups in any of our various measures of these concepts. In contrast, participants taking the safe present are significantly more risk-averse and prudent than those who roll the die, which supports the validity of the experiment. What is more, they are less technologically literate (less likely to use the internet and electronic devices) and are more conservative in their payment behaviour (less open to payment innovations, less likely to possess a credit card or use e-payment schemes).

We have also checked for interviewer effects. In the decision to roll the die or not, these effects exist (see Tables A1 and A2 in the Appendix). Respondents who had female interviewers were more likely to roll the die.<sup>9</sup> Interestingly, female respondents with male interviewers were most likely to take the safe present and male respondents with female interviewers were least likely to do so. We do not find significant interviewer

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<sup>7</sup> The survey agency checked with respondents after the interview whether the interviewers actually conducted the experiment or just kept the money for themselves and whether the interviewers correctly noted the result of rolling the die. Respondents confirmed that the experiment had been offered and that the results had been recorded correctly. This is not a thorough check of whether consumers were allowed to roll the die more than once, however. Unfortunately, it is not possible to identify ex-post those interviewers who did not follow the instructions because the average number of interviews per interviewer is only nine. Thus, the law of large numbers does not apply and a deviation of an interviewer's share of winners or losers from the 50% mark is not necessarily a sign of misbehaviour.

<sup>8</sup> For literature on the link between socio-demographic characteristics and risk aversion see e.g. Eckel and Grossman, 2008; Borghans et al., 2009, Halek and Eisenhauer, 2001.

<sup>9</sup> Female interviewers are also younger than male interviewers on average.

effects on winning and losing in the game, although the share of winners (both male and female) is slightly higher when the interviewer was female.

### **3.2 Measures of data quality**

A key decision we had to take is how to measure data quality in payment diary surveys.<sup>10</sup> We follow the literature cited above and look among other things at measures related to item non-response. Item non-response can come in the form of a missing answer for an individual transaction or a missing transaction. We use the “share of incomplete transactions” as our measure of (classic) item non-response of the first type. A transaction is incomplete if any of the required information regarding the transaction is missing.

While classic item non-response is easy to detect and measure, transactions missing completely are harder to examine. Usually no reference statistics are available which would allow the researcher to detect underreporting of transactions. A comparison of the total number of transactions or activities reported by consumers with incentives and those without has thus been used as an indirect measure (e.g. Fricker and Tourangeau, 2010, Axhausen et al., 2002). We follow this literature and look at the total number of transactions reported for each day and their structure with respect to payment methods and transaction size.<sup>11</sup> For cash purchases we have an additional way to assess indirectly the “completeness” of the diary. Using the information on the initial cash balance before the first transaction is recorded in the diary, as well as cash purchases and withdrawals throughout the diary period we can calculate each consumer’s “hypothetical” cash balance at the end of the diary period and compare it with the figures they report directly. If there are significant deviations this would indicate either under-reporting or over-reporting of cash payments or withdrawals, respectively.<sup>12</sup>

Finally we assess the data quality by looking at the share of rounded values (see e.g. Fricker and Tourangeau, 2010). The share of rounded values should be an indicator of less commitment to the survey, as providing an exact figure can be burdensome for consumers.

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<sup>10</sup> Issues related to unit non-response and response rate biases (see e.g. Bonke and Fallesen, 2010, p. 24) are not considered. The reason is that only 7 out of 958 participants who rolled the die did not return the diary or returned an empty diary. Thus, we focus on the 951 remaining respondents in our analysis.

<sup>11</sup> Distinguishing transactions by types is comparable to Fricker and Tourangeau (2010)’s classification of activities into different types, like basic daily activities and other activities.

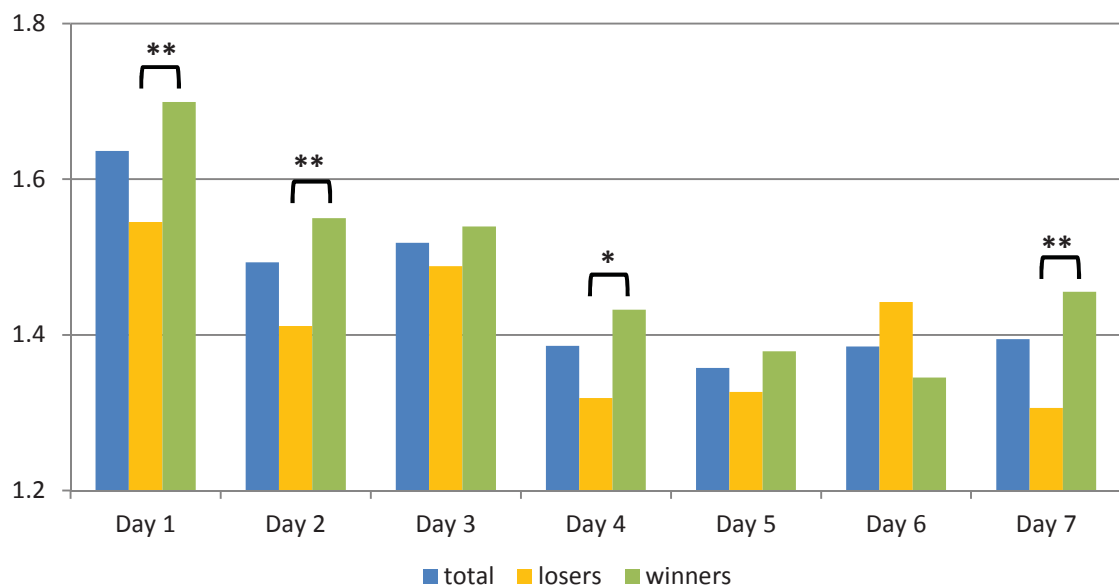
<sup>12</sup> One problem with this measure is that we cannot be certain that the initial cash balance and the final cash balance are reported without error themselves.

## 4 Results

### 4.1 Number of transactions

The first indicator of data quality we look at is the number of transactions. We find that winners record significantly more transactions on the first two days and the last day of the diary period than respondents who did not win (see Figure 1 and Table A5 in the Appendix). The higher number of transactions on the last day can be interpreted as an indicator of a strong/enduring commitment to the survey instrument, if one assumes that the willingness to record transactions declines as the diary period progresses.

**Figure 1 – Number of transactions per person per day**



Notes: \*, \*\*, \*\*\* mean difference is significant at the 90%, 95% or 99% level (one-sided t-test).

In order to rule out that socio-demographic variables or the day of the week confound the analysis in Figure 1, we further examine the number of transactions reported – both the total number and the numbers on days 1 and 2, respectively – and the likelihood of reporting any transactions on day 1 and day 2 using regression analysis. Columns (I), (II) and (III) in Table 2 confirm that winners report more transactions in total and on the first two diary days, even after controlling for consumers characteristics like age, gender, income and household size as well as the day of the week (where applicable).<sup>13</sup> The estimated coefficient for “WINNER” of 0.057 in column (I) corresponds to a difference in the number of transactions between winners and losers of almost 0.6, as

<sup>13</sup> The estimation results for the control variables as well as definition of the control variables are reported in Tables A8 and A19 in the Appendix.

can be seen from Table A9 in the Appendix. For the first and second day of the diary the difference between winners and losers also remains significant at conventional levels. This result is mainly driven by the fact that the share of diaries without any transactions on days one and two is significantly lower for winners than for participants not winning the 20 euro (see columns IV and V in Table 2).<sup>14</sup>

**Table 2 - Results of estimations on number of transactions and empty diaries**

Variable	(I) Total number of TA (count)	(II) Number of TA on day 1 (count)	(III) Number of TA on day 2 (count)	(IV) Empty diary on day 1 (dummy)	(V) Empty diary on day 2 (dummy)
	Negative Binomial			Probit	
WINNER	0.057* [0.032]	0.095* [0.051]	0.091* [0.055]	-0.229** [0.097]	-0.224** [0.094]
Control Variables	Included (see Tables A8 and A19 for results and definitions)				
Observations	949	949	949	949	949
alpha	0.129 [0.011]	0.000 [0.000]	0.000 [0.011]		
Chi2	110.55	113.44	99.21	63.50	72.76
Pseudo-R <sup>2</sup>				0.067	0.073

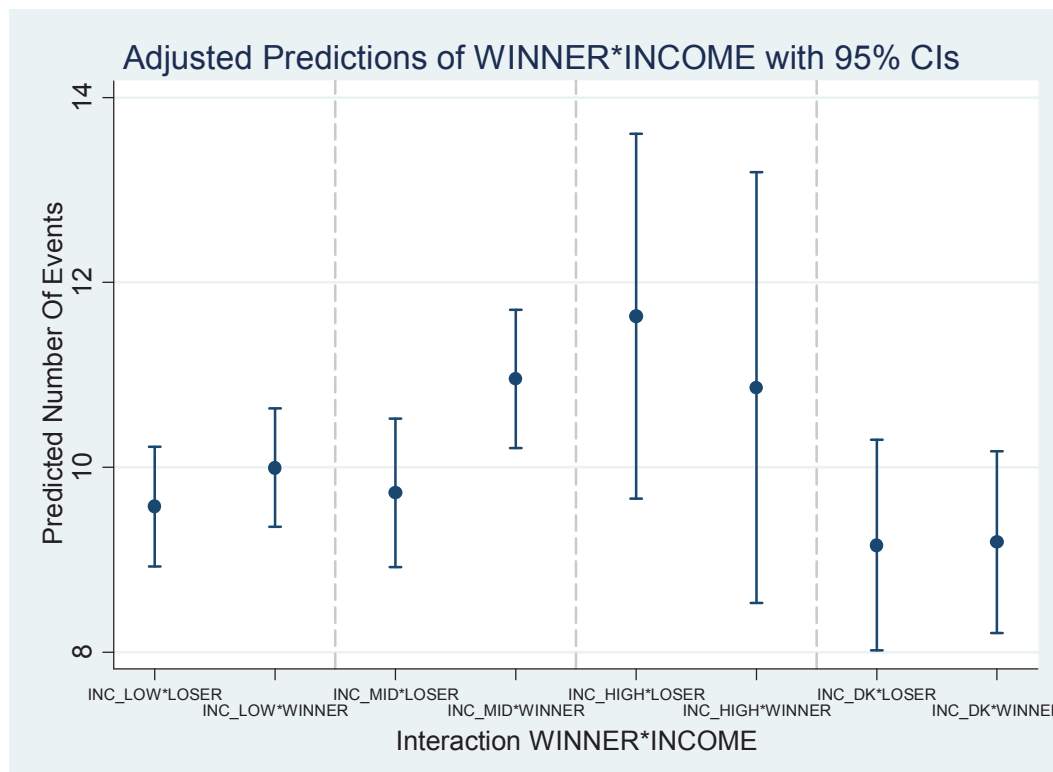
Notes: \*, \*\*, \*\*\* mean coefficient is significant at the 90%, 95% or 99% level. Robust standard errors are given in brackets. TA is transactions.

In Figure 1 and Table A5 we look at a specific day and test whether the number of transactions reported differs between winners and losers. Instead, one can also look at winners and losers separately and examine whether the number of transactions reported per day changes during the diary week for. Tables A6 and A7 in the Appendix show that on the first survey day the number of reported transactions is significantly higher than on the other days for both winners and losers. Winners also report significantly more transactions on days two and three than on the following days. Losers report more transactions on day three than in the rest of the week, while day two does not differ greatly from days four, five, six, or seven. In sum, both winners and losers show a strong initial commitment to the diary, but it appears to be even higher for winners than for losers.

<sup>14</sup> In contrast, the higher number of transactions for winners on the last day of the survey period is driven by differences in the average number of transactions for those individuals who reported any transactions at all.

One could argue that the higher number of transactions for winners is not due to the higher commitment of winners, but can be traced back to an income effect. In that case, winners would simply feel “richer” due to receiving 20 euro and therefore spend more and have more transactions than they if they had not received the money. We do several tests to investigate this income effect. If the income effect existed, it should be larger for consumers with a low income than for those with a high income. Consequently, the difference in transactions reported between winners and losers should be larger for respondents in the lowest income category compared with those in higher income classes. We test this assumption by including an interaction variable  $WINNER*INCOME$  in our regressions on the number of transactions reported and the share of empty diaries, which allows us to identify the effect of winning on the quantity of transactions reported in each income category. The results can be found in Table A10 in the Appendix. Confidence intervals for the predicted outcomes (number of transactions and share of empty diaries) can be found in Table A11. Figure 2 gives a graphical presentation of the estimated number of transactions in the diary week for winners and losers in different income categories. The respective confidence intervals are also shown. As one can see, winners with low income report only slightly more transactions than losers in the same income category. The difference is far from being statistically significant. In the middle income category, winners report significantly more transactions than losers (the difference is 1.2 transactions). Consequently, the higher number of transactions reported by winners in the estimation without interaction terms can mainly be traced back to middle income participants, not to those respondents for whom a potential income effect is expected to be largest.

**Figure 2 - Predictions of number of transactions for winners and losers, by income category**



If winners immediately spent the 20 euro they receive (in addition to their normal spending), their amount spent during the diary week should be higher than the amount spent by losers all else equal. As the 20 euro are most likely spent in cash, we look at the amount of cash disbursed during the week.<sup>15</sup> However, if participants simply feel “richer”, they could also spend the amount by cashless means of payment. Therefore we also consider the total amount of spending during the diary week. As there are a few cases of transactions with very high amounts, which should be regarded as outliers, we do not consider t-tests of differences in means and simple OLS regression appropriate. Instead, we use robust regression (using the Stata command `rreg`) and median regression. Results are presented in Table A12 in the Appendix. All regressions show that there is no statistically significant difference between winners and losers in total spending and cash spending. Although the estimated coefficients for winners are positive, they are far below 20 euro. Again, this leads us to conclude that income effects do not drive our results on the quantity of data reported in the payment diaries.

<sup>15</sup> Below we will also show that the cash share calculated based on the diary data is not statistically different between winners and losers.



To sum up, we find that winners report more transactions than losers, in particular on the first and second diary day. These differences are neither driven by socio-demographics of the respondents, nor by income effects. Whether the high engagement on the first diary days leads to more accurate reporting or gives room to survey exuberance, i.e. respondents report transactions that did not actually take place on that day, is an open issue. Based on the evidence we present here it e.g. cannot be ruled out that consumers either report older payments on day one or change their behaviour and deliberately buy something so they do not have to leave the first days' page of the diary empty.

To shed some light on this latter issue we analyse the structure of payments for each day for the two groups of consumers. If the structure differed significantly this would be an indication of the winners reporting specific or special payments on days one and two.

#### **4.2 Type and size of transactions**

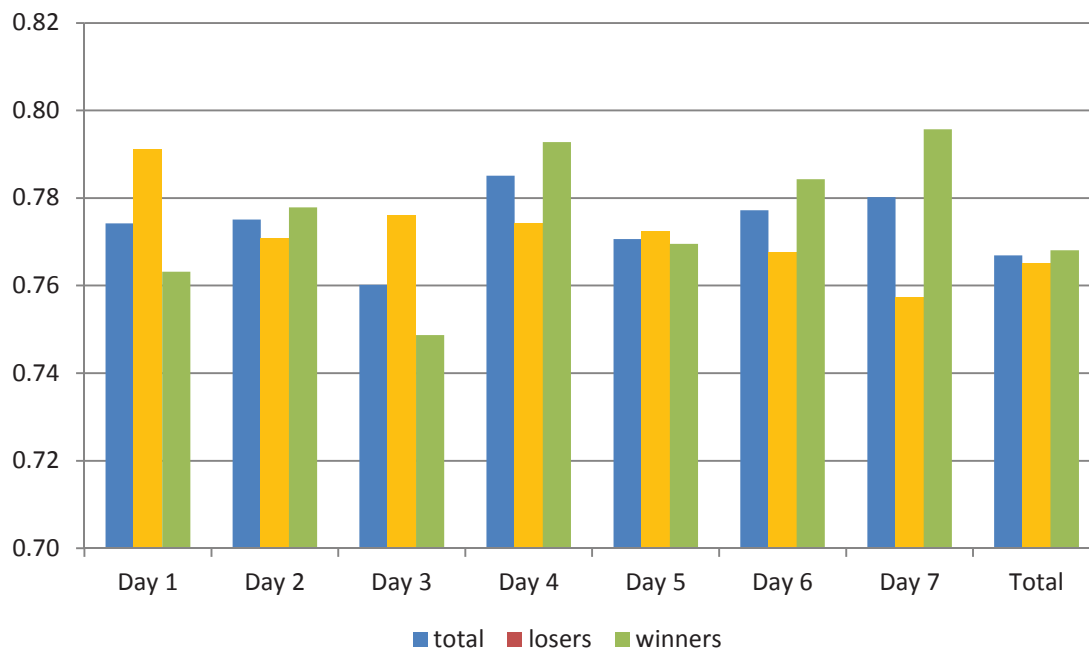
To investigate whether winners report specific or special payments on days one and two, we first look at cash transactions as a specific type of transaction. Figure A1 in the Appendix shows that while no clear decreasing pattern exist with respect to the overall number of cash transactions recorded by the consumers participating in the experiment, days one and two exhibit the highest average number of cash transactions for winners. However, day one also sticks out for losers. Cash transactions thus follow a similar pattern as the total number of transactions described in Section 4.1. Consequently, the higher number of cash transactions could simply be a “sample size” effect and not induce a bias in the analysis of payment behaviour, which is mainly concerned with the share of cash transactions. A higher absolute number of cash transactions for winners would induce a bias only if it were disproportionately higher than in a situation in which they had lost. Put differently, if participants who win report more cash and more non-cash payments, no distortions should occur. In order to identify possible distortions, we compare the cash shares of the two groups of consumers across days.

Figure 3 and Table A13 in the Appendix show that the difference with respect to the cash share between those who win and those who lose is insignificant on each of the seven diary days as well as for the whole diary week. Moreover, it is sometimes positive and sometimes negative, and alternates for the first two days.<sup>16</sup>

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<sup>16</sup> A similar picture emerges if we calculate the share of cash transactions for each day by first grossing up all cash transactions and dividing this number by the total number of transactions on the respective day, compared to first calculating the share of cash transactions for each individual and then taking the average, as we did in Figure 3. The additional results are available upon request.

**Figure 3 – Share of cash transactions per person per day**



Notes: Calculated for individuals with more than zero transactions on given day.  
 \*, \*\*, \*\*\* mean difference significant at the 90%, 95% or 99% level (two-sided t-test).

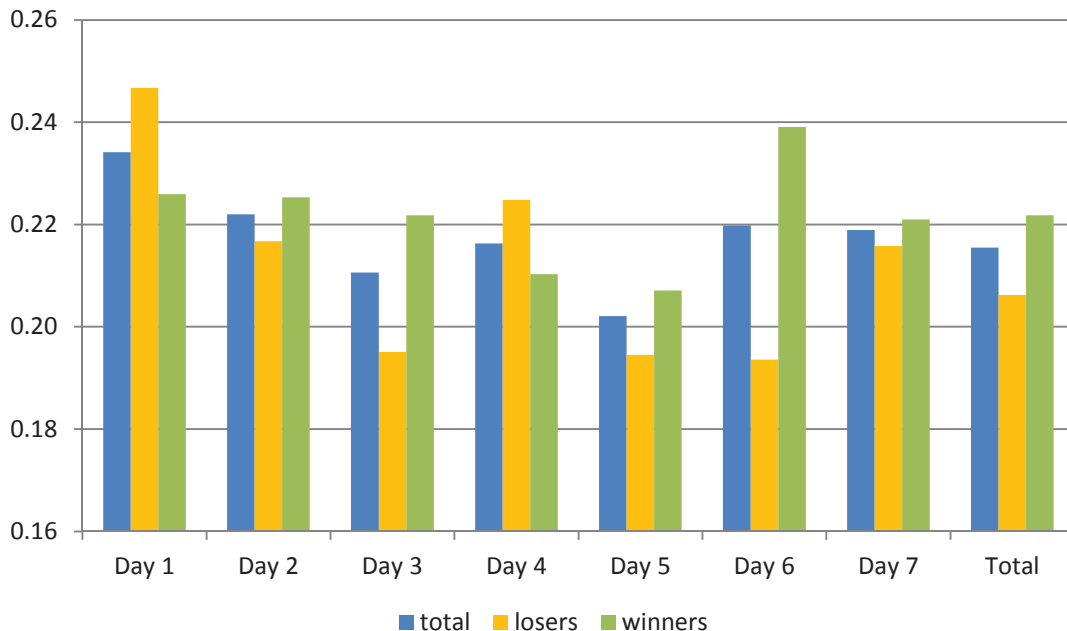
We also see that the cash share shows a high fluctuation between days for winning consumers, while the consumers who lose exhibit the “typical” pattern, i.e. the cash share is highest on day one (see Schmidt, 2014). We do not find significant differences in the reported cash shares between day one and all other days of the diary week – neither for winners nor for losers. Taking this together there is no evidence for a disproportional reporting of cash payments on days one and two for winners.

Another classic categorisation of transactions is by their size (see e.g. Bagnall, 2015). There is evidence that small value transactions are underreported in diary surveys. A high and stable number of small value transactions can therefore be interpreted as a sign of good quality.<sup>17</sup> A higher number of small value transactions below 5 euro and in particular also a higher share among all transactions for winners would suggest that these consumers do exhibit a stronger commitment to the survey. In our study, the difference in the share of small value transactions between winners and losers is not significant (see also Figure 4 and Table A14 in the Appendix). Interestingly, the share of small value transactions below 5 euro is higher for consumers losing in the experiment on day one, but lower overall. This could indicate that winners record relatively more small value transactions as the diary progresses than losers. However,

<sup>17</sup> Small value transactions (below 5 euros) are in essence a subgroup of cash transactions, because almost all those transactions are conducted in cash (see Bagnall, 2015, and Deutsche Bundesbank, 2015).

the differences between winners and losers are insignificant overall and on all individual days.

**Figure 4 - Share of small value transactions (below 5 euro) per person per day**



Notes: Calculated for individuals with more than zero transactions on given day. \*, \*\*, \*\*\* mean difference significant at the 90%, 95% or 99% level (two-sided t-test).

A third related way to describe the structure of transactions is by the average amount spent per transaction (see Table A15 in the Appendix). One can see that the average transaction size is slightly higher on the first three days and the last day of the diary period than on days four to six. However, none of the differences between days is significant – neither for winners, nor for losers, nor for both groups combined. In addition, the differences in average transaction size between winners and losers are insignificant for each diary day and for all days taken together. This is evidence that the higher number of transactions reported on the first days of the diary do not induce a bias on the results. In other words, should participants report transactions from before the diary period on the first diary day, those transactions do have a similar structure as the “real” transactions. In addition, one does not find a significant under-reporting of small value transactions as the diary period progresses.

### 4.3 Final cash balance

Ideally we would be able to compare the recorded pattern of payments with the actual payment pattern and calculate the measurement error directly. This is of course not

possible. We can make use of a specific feature of the diary, however. The diary asks respondents to open their wallet and count the amount of cash in their wallet before they make the first transaction in the diary period. They then record all their (cash) purchases and cash withdrawals for the diary period and are again asked to count the money in their wallet at the end of the diary period. Using the information on the initial cash balance and cash purchases and withdrawals we can calculate each consumer's "cash flow" and in particular their "hypothetical" cash balance at the end of the diary period. The latter can then be compared to the balance they reported after counting the money in their wallet. We assume the final cash balance reported to be of good enough quality to be used as a benchmark and interpret deviations between the two measures to be related to an over- or underreporting of cash withdrawals and cash purchases rather than measurement error on the cash balance reported at the beginning of the diary.<sup>18</sup> We calculate both the difference between the hypothetical cash balance and the actual as well as the absolute value of the difference. Table 3 shows some descriptive statistics and Figure 5 shows the distribution for winners and losers.

**Table 3 - Descriptive statistics of the actual difference in cash balances and the absolute value of the difference in cash balances, in euro**

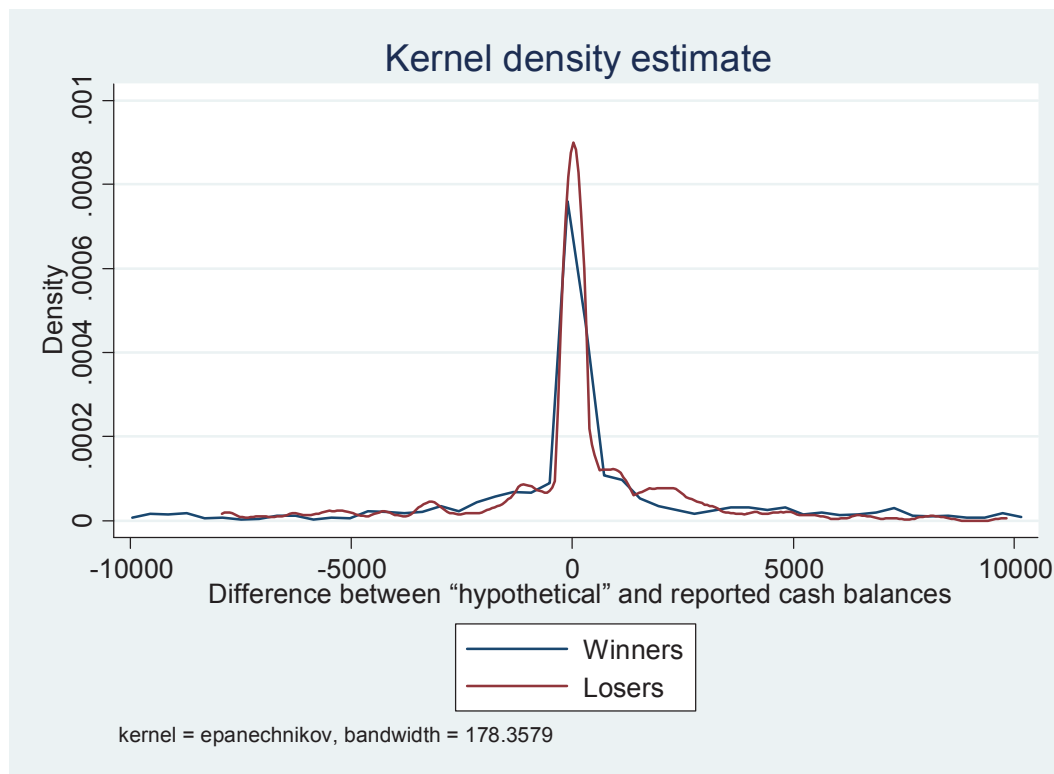
	Difference in cash balances		Absolute difference cash balances	
	Losers	Winners	Losers	Winners
Mean	12.76	2.87	35.29	40.05
Standard deviation	156.51	159.36	153.00	154.26
P10	-32.16	-31.53	0.00	0.00
P25	-0.76	-3.17	0.01	0.09
Median	0.00	0.00	5.01	6.74
P75	10.00	10.11	24.73	35.95
P90	34.38	64.00	65.43	89.86

We first test whether the differences in the cash balances of winners and losers come from the same distribution. A simple t-test reveals that there are no significant differences between the mean difference in cash balances between winners and losers. Furthermore, we cannot reject that the two samples have the same median and variance. The hypothesis that the two samples come from the same distribution cannot be rejected when the Wilcoxon-Mann-Whitney test is performed. All tests performed show the

<sup>18</sup> Differences between actual and hypothetical cash balances can also occur due to missing values. When respondents do not report the payment instrument they used or the amount they paid, the transaction is disregarded in the calculation of the hypothetical cash balance.

same qualitative results both for the difference in cash balances and its absolute value. In sum, there appear to be no differences between winners and losers with respect to this indicator of data quality.

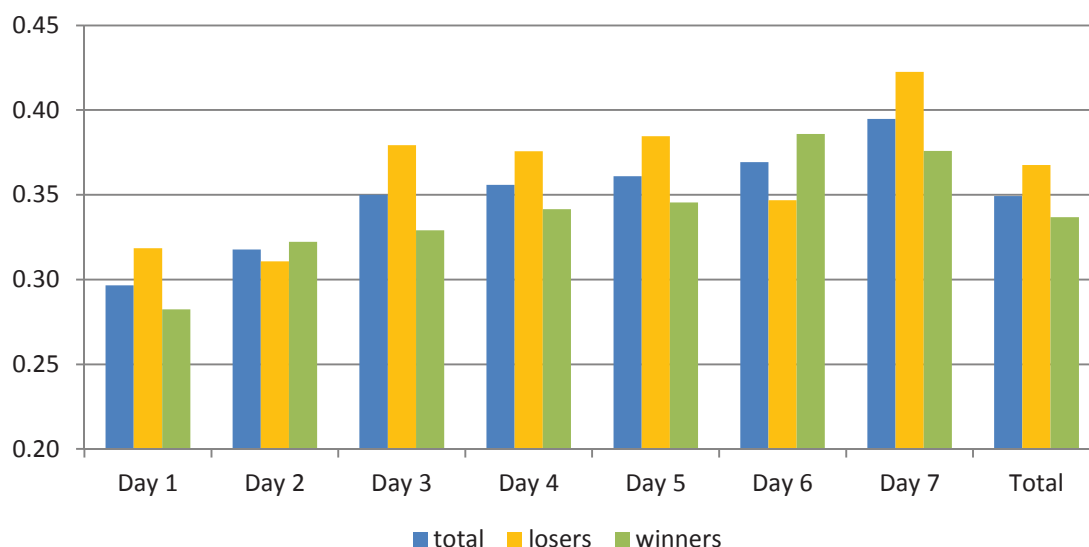
**Figure 5 - Kernel density estimation of the difference between “hypothetical” and reported cash balances at the end of the diary period, in euro cents**



#### 4.4 Incomplete transaction data

In the previous sections we have looked at item non-response with respect to completely missing transactions. In this section we focus on the classic item non-response measures, i.e. missing information on recorded transactions. In the payment diary respondents were asked to answer several questions concerning each single transaction. Besides the amount, the payment instrument used and the location where the transaction took place, respondents were also asked about various circumstances that might have influenced their payment choice. Up to eight variables pertain to one transaction. Giving all the requested information requires reading the diary carefully and remembering the transaction precisely. This can be burdensome for respondents.

**Figure 6 - Share of incomplete transactions per person per day**



Notes: \*, \*\*, \*\*\* mean difference is significant at the 90%, 95%, or 99% level (two-sided t-test).

Figure 6 and Table A16 in the Appendix show that the share of incomplete transactions is around 35% on average. There are slightly fewer incomplete transactions for winners than for losers. The shares of incomplete transactions do not differ significantly overall or for any of the individual days of the diary.

Figure 6 also shows that both winners and losers report more incomplete transactions as the diary week progresses. Pairwise t-tests on the shares of incomplete transactions on the first and second day compared to all other days of the diary show significant differences (results not reported).

#### 4.5 Rounding

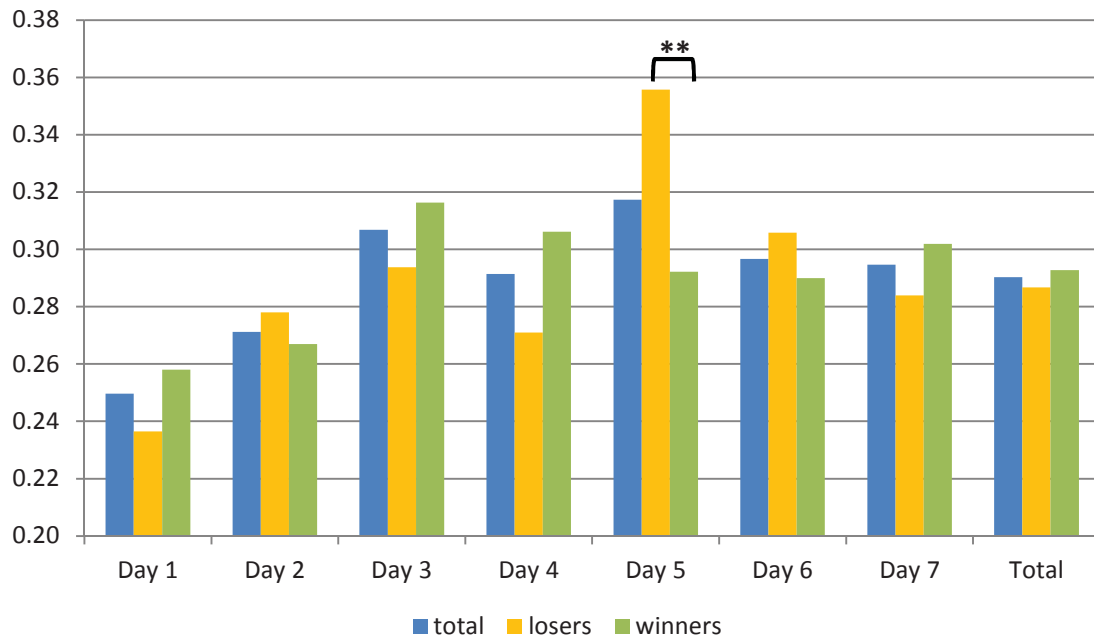
Reporting precise amounts in the diary can be a burden for consumers. They have to remember the exact amount or keep the receipt, for example. Thus, many people round the reported transaction values in the payment diaries. In the 2014 Bundesbank payment diary, we see that on average about one quarter (28%) of all transactions per person per day are rounded.<sup>19</sup> Figure 7 and Table 17 in the Appendix show that this rate is only marginally higher for consumers who win the 20 euro. Consumers winning and those losing in the experiment both show increasing rates of rounded values as the diary progresses, under-scoring the value of this measure as a quality indicator.<sup>20</sup> Overall the

<sup>19</sup> Rounding is defined here as rounding to full euro amounts.

<sup>20</sup> T-tests of the differences between day one and the other days produce significant results for some of the days. However, one has to keep in mind that only the shares of rounded values of those respondents who report transactions on both days of the comparison can be included in the calculations.

difference between the two groups with respect to rounded values is not significant, with the exception of day 5.

**Figure 7 - Share of rounded transaction values per person per day**



Notes: \*, \*\*, \*\*\* mean difference is significant at the 90%, 95%, or 99% level (two-sided t-test)

#### 4.6 Robustness Checks

As Table A1 shows, there are no significant differences in socio-demographics between winners and losers in the experiment. We therefore assumed throughout this paper that differences between winners and losers in the quality indicators are not driven by socio-demographic factors, but by the random outcome of the role of the die. In order to make this assumption more robust, we run a series of regressions with our quality indicators as dependent variable, the outcome of the role of the die (winner or loser) as independent variable and various socio-demographics as control variables. We find that being a winner does not have a significant effect on any of the quality measures (see Table 4 and Table 18 in the Appendix). This indicates that the higher quantity of transactions reported on the first days does not affect qualitative aspects of the results, such as the share of cash transactions, the share of small transactions, the average transaction amount, the share of transactions with incomplete transaction information and the share of rounded transactions.

**Table 4 - Results of estimations on various measures of data quality**

	(I)	(II)	(III)	(IV)	(V)
	Share of cash TA	Share of small TA	Average TA amount	Share of incomplete TA	Share of rounded TA
	OLS	OLS	OLS	OLS	OLS
WINNER	0.006 [0.015]	0.012 [0.014]	1.258 [2.189]	-0.022 [0.023]	0.006 [0.014]
Control Variables	Included (see Table A18 and A19 for results and definitions)				
Observations	949	949	949	949	949
R <sup>2</sup>	0.081	0.077	0.030	0.066	0.049

Notes: \*, \*\*, \*\*\* mean coefficient is significant at the 90%, 95% or 99% level. Robust standard errors are given in brackets. TA is transactions.

## 5 Conclusions

In this paper we analyse the effect of an experiment performed as part of a representative national survey on participants' recording behaviour in a subsequent one-week payment diary. In the experiment participants rolled a die and had the chance to win 20 euro depending on the number on the die. We interpret this as a random assignment of a monetary incentive, where in contrast to most other incentive experiments the person receiving the incentive (winners) knows that they received a higher incentive than some of the other participants. The experiment itself could thus stimulate positive feelings in winners and negative feelings in losers towards the survey and the diary in general. Consequently, we expect winners to report higher quality data in the diary than losers. On the downside, winning the money could lead to survey exuberance, i.e. inducing respondents to report transactions that did not actually take place or took place before the diary started.

We measure data quality with several indicators: the number of transactions recorded, the share of cash transactions, the share of low value transactions (below 5 euro), the share of rounded transactions values, the share of transactions with incomplete information and the concordance of hypothetical and actual cash balances at the end of the diary week. We find that the experiment seems to have some impact on consumers' commitment to the survey diary. The impact on data quality and on the key qualitative results is rather limited, however. Results show that winners report significantly more transactions than losers, in particular on the first, second and last day of the diary. More



specifically, there are fewer diaries without any transactions on the first or the second day for winners. We can rule out that the larger number of transactions recorded on the first days is due to an income effect induced by winning 20 euro. Neither of the other quality measures differs significantly between winners and losers. Furthermore the low variation between the two groups of the cash share and the share of small value transactions indicate that important findings from the diary, such as the overall cash share of point-of-sale transactions and the share of transactions within certain value ranges, are not biased by the outcome of the experiment.

We find evidence that some indicators of data quality deteriorate as the diary week progresses. On the first and second day, respondents round less and report more complete transactions.

To the best of our knowledge, we are the first to look into the effects of behavioural or psychological experiments with monetary rewards carried out during a representative national survey. Including experiments in such surveys is a rather new and promising approach, considering that previously behavioural experiments were often carried out with a non-representative part of the population (e.g. students). However, up to now little is known on how such experiments influence participants' attitude towards the survey to which the experiment is linked. Our research indicates that including an experiment does not affect the survey's data quality negatively.

We were mainly concerned with the incentive effects of the experiment, both monetary and non-monetary. Whether other features of the experiment also play a role for respondents' reporting behaviour is still an open issue. It is feasible to assume that the design and administration of the experiment by the interviewers could potentially confound and even counteract the incentive effects. More research on these issues is necessary.

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## Appendix

**Table A1 – Socio-demographic characteristics of respondents and interviewers by participation and outcome of experiment**

Variable	All observations	Safe present	Roll die			Difference safe vs. roll die	Difference losers vs. winners
			total	loser	winner		
Age in years	46.83	47.95	45.67	46.55	45.06	-2.28***	-1.49
Female	0.56	0.60	0.52	0.50	0.53	0.08***	-0.03
Lives without partner	0.47	0.47	0.48	0.50	0.47	0.02	-0.03
Household size	2.22	2.19	2.24	2.25	2.23	0.05	-0.02
Education (4 groups)	2.06	2.02	2.10	2.07	2.11	0.08*	0.04
Household net income (12 groups)	5.03	4.91	5.16	5.29	5.07	0.25**	-0.22
Individual net income (12 groups)	3.46	3.29	3.63	3.71	3.57	0.34***	-0.14
East German	0.19	0.17	0.21	0.18	0.23	-0.04**	-0.05**
Interviewer female	0.52	0.49	0.55	0.53	0.57	-0.07***	-0.04
Age of interviewer	56.73	57.33	56.11	56.22	56.03	1.22**	0.19
Number of observations	1,933	982	951	389	562		

Notes: Number of observations differs for each variable as some values are missing.  
 \*, \*\*, \*\*\* mean difference is significant at the 90%, 95% or 99% level (two-sided test).

**Table A2 – Results of regression of socio-demographic characteristics of respondents and interviewers on the probability of rolling the die and winning in the experiment**

Variable	(I)	(II)	(III)	(IV)
	Roll die	Winner	Roll die	Winner
	Probit			
AGE_45_64	-0.052 [.069]	-0.019 [.098]		
AGE_65+	-0.228* [.127]	-0.181 [.191]		
FEMALE	-0.166*** [.061]	0.061 [.089]		
INT_45_64	-0.063 [.091]	-0.003 [.130]		
INT_65+	-0.026 [.102]	-0.107 [.144]		
INT_FEMALE	0.163*** [.059]	0.105 [.085]		
AGE_18_44			-0.131	0.022
*INT_45_64			[0.116]	[.158]
AGE_18_44			-0.176	-0.031
*INT_65+			[0.138]	[.193]
AGE_45_64			-0.379**	0.140
*INT_18_44			[0.193]	[.299]
AGE_45_64			-0.186	-0.005
*INT_45_64			[0.120]	[.168]
AGE_45_64			-0.083	-0.086
*INT_65+			[0.137]	[.188]
AGE_65+			-0.126	-0.207
*INT_18_44			[0.299]	[.419]
AGE_65+			-0.373**	-0.042
*INT_45_64			[0.174]	[.264]
AGE_65+			-0.332*	-0.353
*INT_65+			[0.181]	[.276]
MALE			0.188**	0.132
*INT_FEMALE			[0.088]	[.121]
FEMALE			-0.141	0.091
*INT_MALE			[0.086]	[.129]
FEMALE			0.003	0.162
*INT_FEMALE			[0.083]	[.119]
HH_SIZE_2	-0.059 [.072]	0.047 [.105]	-0.068 [0.072]	0.050 [.106]
HH_SIZE_3	-0.001 [.090]	-0.085 [.129]	-0.003 [0.091]	-0.080 [.130]
HH_SIZE_4+	-0.021 [.091]	0.013 [.130]	-0.024 [0.091]	0.020 [.131]
EDU_MEDIUM	-0.046 [.072]	0.117 [.105]	-0.041 [0.072]	0.120 [.105]
EDU_HIGH	0.094 [.094]	0.254* [.131]	0.097 [0.095]	0.268** [.132]
EDU_UNI	-0.012 [.103]	0.013 [.148]	-0.008 [0.104]	0.021 [.149]

Continues on next page

INC_MID	0.069 [.073]	0.074 [.104]	0.071 [0.073]	0.071 [.104]
INC_HIGH	0.267* [.143]	-0.179 [.188]	0.268* [0.144]	-0.196 [.188]
INC_DK	0.043 [.097]	0.114 [.140]	0.045 [0.097]	0.106 [.140]
REGION_EAST	0.180** [.077]	0.159 [.107]	0.171** [0.078]	0.160 [.108]
OCC_TRAIN	-0.082 [.154]	-0.147 [.223]	-0.082 [0.154]	-0.144 [.224]
OCC_WORK	0.063 [.097]	-0.044 [.145]	0.068 [0.097]	-0.042 [.146]
OCC_OTHER	-0.029 [.129]	0.129 [.191]	-0.020 [0.129]	0.135 [.193]
CONSTANT	-0.153 [.176]	-0.029 [.254]	0.065 [0.163]	0.025 [.237]
Observations	1929	949	1929	949
Chi2	48.41	18.83	52.88	19.90
Pseudo-R <sup>2</sup>	0.018	0.015	0.020	0.016

Notes: \*, \*\*, \*\*\* mean coefficient is significant at the 90%, 95% or 99% level.  
Robust standard errors are given in brackets.

**Table A3 – Respondents’ self-assessment of risk preference by participation and outcome of experiment**

Variable	All observations	Safe present	Roll die			Difference safe vs. roll die	Difference losers vs. winners
			total	loser	winner		
Dares <sup>1</sup>	3.06	3.24	2.86	2.82	2.90	0.37***	-0.08
Adventurous <sup>2</sup>	3.22	3.39	3.05	3.07	3.04	0.34***	0.03
Imprudent <sup>3</sup>	3.14	3.27	3.00	2.97	3.02	0.27***	-0.05
Prudent <sup>4</sup>	2.19	2.03	2.36	2.34	2.37	-0.33***	-0.03
Stocks <sup>5</sup>	1.87	1.82	1.93	1.91	1.94	-0.11***	-0.03
Number of observations	1,933	982	951	389	562		

<sup>1</sup>My philosophy of life is “Who dares wins.”

<sup>2</sup>I am an adventurous person. I love situations with uncertain outcomes.

<sup>3</sup>In some situations I am imprudent and take an unnecessary risk.

<sup>4</sup>My philosophy of life is “Prudence is the better part of valour.”

<sup>5</sup>Stocks are for gamblers.

Notes: Number of observations differs for each variable as some values are missing.

\*, \*\*, \*\*\* mean difference is significant at the 90%, 95% or 99% level (two-sided test).

Each variable is measured on a four-point scale (1=“fully agree”/2= “agree”/3=“rather disagree”/ 4= “strongly disagree”).

**Table A4 – Respondents’ self-assessment of technological literacy and payment behaviour by participation and outcome of experiment**

Variable	All observations	Safe present	Roll die			Difference safe vs. roll die	Difference losers vs. winners
			total	loser	winner		
Internet usage <sup>1</sup>	0.83	0.80	0.85	0.85	0.86	-0.06***	-0.01
Electronic devices <sup>2</sup>	1.93	1.98	1.88	1.86	1.89	0.10***	-0.03
Payment innovations <sup>3</sup>	1.37	1.34	1.40	1.40	1.41	-0.06***	-0.01
Credit card ownership <sup>4</sup>	0.33	0.29	0.38	0.37	0.38	-0.09***	-0.00
E-payment schemes <sup>5</sup>	0.44	0.40	0.48	0.48	0.47	-0.08***	0.00
Number of observations	1,933	982	951	389	562		

<sup>1</sup>Binary variable (0=no; 1=yes).

<sup>2</sup>Self-assessment of statement: “Electronic devices make my everyday life easier.” Measured on a four-point scale (1=“fully agree”/2= “agree”/3=“rather disagree”/ 4= “strongly disagree”).

<sup>3</sup>Self-assessment of openness towards new payment methods (1=“I adhere to familiar payment methods even when the variety of new payment methods increases.”; 2=“I am open to new payment methods if they have proved to stand the test of time.”; 3=“I try out new payment methods as soon as they are available.”)

<sup>4</sup>Binary variable (0=no; 1=yes).

<sup>5</sup>Use of e-payment schemes, binary variable (0=no; 1=yes).

Notes: Number of observations differs for each variable as some values are missing.

\*, \*\*, \*\*\* mean difference is significant at the 90%, 95% or 99% level (two-sided test).



**Table A5 – Number of transactions per person per day**

	Roll die			Difference losers vs. winners
	total	losers	winners	
Day 1	1.636	1.545	1.699	0.154**
Day 2	1.493	1.411	1.550	0.139**
Day 3	1.518	1.488	1.539	0.051
Day 4	1.386	1.319	1.432	0.114*
Day 5	1.358	1.327	1.379	0.053
Day 6	1.385	1.442	1.345	-0.097
Day 7	1.394	1.306	1.456	0.150**
Total	10.170	9.838	10.400	0.562**

Notes: \*, \*\*, \*\*\* mean difference is significant at the 90%, 95% or 99% level (one-sided t-test).

**Table A6 – Results of one-sided t-tests for difference in number of transactions reported per day by winners**

	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Day 1	**	***	***	***	***	***
Day 2		-	*	***	***	*
Day 3			*	**	***	-

Notes: \*, \*\*, \*\*\* mean difference is significant at the 90%, 95% or 99% level (one-sided test).

Each cell gives the results of a one-sided t-test, testing whether the average number of transactions on the day indicated on the left of the table (days 1, 2, or 3) is larger than the average number of transaction on the day indicated in the column header.

**Table A7 – Results of t-tests for difference in number of transactions reported per day by losers**

	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Day 1	**	-	***	***	*	***
Day 2		-	-	-	-	*
Day 3			**	**	-	**

Notes: \*, \*\*, \*\*\* mean difference is significant at the 90%, 95% or 99% level (one-sided test). Each cell gives the results of a one-sided t-test, testing whether the average number of transactions on the day indicated on the left of the table (days 1, 2, or 3) is larger than the average number of transaction on the day indicated in the column header.

**Table A8 – Results of estimations on number of transactions and empty diaries**

Variable	(I)	(II)	(III)	(IV)	(V)
	Total number of TA (count)	Number of TA on day 1 (count)	Number of TA on day 2 (count)	Empty diary on day 1 (dummy)	Empty diary on day 2 (dummy)
	Negative Binomial			Probit	
WINNER	0.057* [0.032]	0.095* [0.051]	0.091* [0.055]	-0.229** [0.097]	-0.224** [0.094]
AGE_25_34	0.051 [0.061]	-0.045 [0.111]	0.124 [0.126]	-0.035 [0.221]	0.006 [0.208]
AGE_35_44	0.232*** [0.064]	0.223** [0.110]	0.274** [0.124]	-0.166 [0.228]	-0.159 [0.212]
AGE_45_54	0.205*** [0.062]	0.127 [0.109]	0.211* [0.124]	-0.075 [0.224]	0.051 [0.205]
AGE_55_64	0.193*** [0.069]	0.124 [0.118]	0.246* [0.136]	-0.110 [0.236]	-0.051 [0.224]
AGE_65+	0.208** [0.093]	0.160 [0.159]	0.219 [0.166]	0.126 [0.289]	-0.227 [0.271]
FEMALE	0.022 [0.033]	0.004 [0.053]	-0.002 [0.056]	0.036 [0.103]	-0.001 [0.099]
HH_SIZE_2	0.031 [0.040]	0.135** [0.062]	-0.015 [0.069]	0.007 [0.120]	-0.062 [0.115]
HH_SIZE_3	-0.044 [0.045]	0.019 [0.078]	-0.029 [0.080]	0.089 [0.151]	-0.211 [0.149]
HH_SIZE_4+	0.010 [0.048]	0.127* [0.074]	0.012 [0.082]	0.012 [0.156]	-0.079 [0.146]
EDU_MEDIUM	0.097** [0.041]	0.032 [0.063]	0.105 [0.067]	0.128 [0.122]	-0.155 [0.113]
EDU_HIGH	0.247*** [0.048]	0.155* [0.080]	0.204** [0.082]	0.147 [0.154]	-0.296** [0.147]
EDU_UNI	0.269*** [0.057]	0.213** [0.092]	0.234** [0.094]	0.153 [0.170]	-0.121 [0.169]
INC_MID	0.061 [0.039]	0.086 [0.060]	0.042 [0.071]	-0.169 [0.123]	-0.076 [0.115]
INC_HIGH	0.140* [0.076]	-0.031 [0.113]	0.283** [0.112]	-0.256 [0.225]	-0.468* [0.243]
INC_DK	-0.070 [0.049]	-0.064 [0.081]	-0.009 [0.089]	-0.092 [0.162]	-0.101 [0.160]
REGION_EAST	0.007 [0.039]	-0.037 [0.064]	0.188*** [0.066]	0.069 [0.120]	-0.091 [0.118]
OCC_TRAIN	0.046 [0.089]	0.162 [0.150]	-0.003 [0.171]	-0.174 [0.299]	0.175 [0.273]
OCC_WORK	0.047 [0.058]	0.195** [0.090]	0.002 [0.100]	-0.173 [0.171]	-0.110 [0.163]
OCC_OTHER	-0.041 [0.079]	0.069 [0.122]	-0.022 [0.132]	0.265 [0.214]	0.017 [0.209]

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SUNDAY	n.a.	-0.683*** [0.123]	-0.644*** [0.124]	0.461** [0.185]	0.987*** [0.199]
TUESDAY	n.a.	-0.030 [0.098]	-0.254** [0.105]	-0.037 [0.178]	0.488** [0.201]
WEDNESDAY	n.a.	0.189** [0.083]	-0.164 [0.103]	-0.530*** [0.174]	0.308 [0.203]
THURSDAY	n.a.	0.036 [0.093]	-0.040 [0.096]	-0.218 [0.175]	0.401** [0.190]
FRIDAY	n.a.	0.089 [0.096]	0.055 [0.091]	-0.449** [0.193]	-0.083 [0.208]
SATURDAY	n.a.	0.110 [0.097]	-0.023 [0.106]	-0.142 [0.184]	0.266 [0.208]
CONSTANT	1.933*** [0.083]	0.009 [0.156]	0.092 [0.173]	-0.496 [0.309]	-0.584* [0.315]
Observations	949	949	949	949	949
alpha	0.129 [0.011]	0.000 [0.000]	0.000 [0.011]		
Chi2	110.55	113.44	99.21	63.50	72.76
Pseudo-R <sup>2</sup>				0.067	0.073

Notes: \*, \*\*, \*\*\* mean coefficient is significant at the 90%, 95% or 99% level. Robust standard errors are given in brackets. TA is transactions.

**Table A9 - Predicted number of events for winners and losers**

	Winner			Loser		
	Estimate	Standard error	95% Confidence Interval	Estimate	Standard error	95% Confidence Interval
Total number of TA (count)	10.278	0.219	[9.850; 10.707]	9.712	0.227	[9.267; 10.158]
Number of TA on day 1 (count)	1.637	0.052	[1.534; 1.739]	1.489	0.060	[1.371; 1.606]
Number of TA on day 2 (count)	1.493	0.052	[1.391; 1.595]	1.363	0.059	[1.247; 1.479]
Empty diary on day 1 (dummy)	0.159	0.016	[0.128; 0.189]	0.221	0.022	[0.178; 0.264]
Empty diary on day 2 (dummy)	0.194	0.017	[0.161; 0.228]	0.262	0.023	[0.217; 0.307]

Notes: Effects are estimated at the mean of other regressor variables. TA is transactions.

**Table A10 – Results of estimations on number of transactions and empty diaries including interaction terms**

Variable	(I)	(II)	(III)	(IV)	(V)
	Total number of TA (count)	Number of TA on day 1 (count)	Number of TA on day 2 (count)	Empty diary on day 1 (dummy)	Empty diary on day 2 (dummy)
	Negative Binomial			Probit	
WINNER	0.043 [0.046]	0.064 [0.075]	0.084 [0.083]	-0.184 [0.136]	-0.231* [0.131]
AGE_25_34	0.050 [0.061]	-0.046 [0.111]	0.118 [0.126]	-0.030 [0.220]	0.006 [0.208]
AGE_35_44	0.232*** [0.064]	0.222** [0.110]	0.266** [0.124]	-0.170 [0.227]	-0.157 [0.213]
AGE_45_54	0.208*** [0.061]	0.126 [0.109]	0.209* [0.124]	-0.077 [0.222]	0.053 [0.205]
AGE_55_64	0.192*** [0.069]	0.123 [0.118]	0.240* [0.136]	-0.096 [0.235]	-0.055 [0.224]
AGE_65+	0.210** [0.092]	0.161 [0.159]	0.221 [0.165]	0.131 [0.285]	-0.227 [0.271]
FEMALE	0.026 [0.033]	0.006 [0.054]	0.003 [0.057]	0.027 [0.103]	0.001 [0.099]
HH_SIZE_2	0.033 [0.040]	0.134** [0.062]	-0.018 [0.069]	0.003 [0.121]	-0.058 [0.115]
HH_SIZE_3	-0.045 [0.045]	0.019 [0.078]	-0.037 [0.080]	0.093 [0.150]	-0.212 [0.148]
HH_SIZE_4+	0.011 [0.048]	0.128* [0.074]	0.012 [0.082]	0.014 [0.156]	-0.078 [0.146]
EDU_MEDIUM	0.098** [0.041]	0.033 [0.063]	0.107 [0.067]	0.132 [0.122]	-0.158 [0.112]
EDU_HIGH	0.245*** [.048]	0.156* [0.080]	0.209** [0.082]	0.157 [0.155]	-0.301** [0.147]
EDU_UNI	0.264*** [0.057]	0.213** [0.093]	0.236** [0.094]	0.176 [0.171]	-0.132 [0.169]
INC_MID	0.015 [0.056]	0.049 [0.095]	0.038 [0.100]	-0.031 [0.176]	-0.120 [0.165]
INC_HIGH	0.195** [0.095]	-0.042 [0.143]	0.385** [0.152]	-0.406 [0.309]	-0.417 [0.318]
INC_DK	-0.045 [0.072]	-0.112 [0.121]	-0.166 [0.148]	-0.205 [0.270]	-0.024 [0.244]
REGION_EAST	0.008 [0.039]	-0.038 [0.064]	0.183*** [0.066]	0.063 [0.120]	-0.088 [0.118]
OCC_TRAIN	0.049 [0.089]	0.163 [0.150]	-0.000 [0.170]	-0.176 [0.298]	0.178 [0.273]
OCC_WORK	0.050 [0.057]	0.198** [0.090]	0.003 [0.099]	-0.175 [0.170]	-0.109 [0.163]
OCC_OTHER	-0.039 [0.079]	0.067 [0.123]	-0.025 [0.132]	0.262 [0.213]	0.019 [0.209]

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SUNDAY	n.a.	-0.680***	-0.652***	0.456**	0.985***
		[0.123]	[0.125]	[0.185]	[0.199]
TUESDAY	n.a.	-0.027	-0.259**	-0.037	0.487**
		[0.098]	[0.105]	[0.177]	[0.201]
WEDNESDAY	n.a.	0.192**	-0.170	-0.530***	0.305
		[0.083]	[0.104]	[0.175]	[0.204]
THURSDAY	n.a.	0.035	-0.044	-0.209	0.399**
		[0.094]	[0.096]	[0.176]	[0.190]
FRIDAY	n.a.	0.089	0.048	-0.449**	-0.088
		[0.096]	[0.091]	[0.193]	[0.208]
SATURDAY	n.a.	0.112	-0.035	-0.142	0.263
		[0.097]	[0.106]	[0.185]	[0.208]
WINNER*	0.077	0.060	0.008 [0.125]	-0.263 [0.221]	0.080 [0.211]
INC_MID	[0.070]	[0.117]			
WINNER*	-0.112	0.013	-0.212	0.271	-0.111
INC_HIGH	[0.146]	[0.217]	[0.208]	[0.408]	[0.455]
WINNER*	-0.040	0.075	0.233	0.183	-0.133
INC_DK	[0.094]	[0.158]	[0.179]	[0.331]	[0.318]
CONSTANT	1.937	0.024	0.105	-0.521	-0.580*
	[0.085]	[0.159]	[0.180]	[0.310]	[0.318]
Observations	949	949	949	949	949
alpha	0.129	0.000	0.000		
	[0.011]	[0.000]	[0.000]		
Chi2	118.33	115.57	102.29	67.80	72.57
Pseudo-R <sup>2</sup>				0.070	0.074

Notes: \*, \*\*, \*\*\* mean coefficient is significant at the 90%, 95% or 99% level. Robust standard errors are given in brackets. TA is transactions.

**Table A11 – Predicted number of transactions for winners and losers in different income groups**

	Coefficient	Standard error	95% Confidence Interval
<b>Total number of transactions (count)</b>			
LOSER*INC_LOW	9.575	0.331	[8.927; 10.224]
WINNER*INC_LOW	9.994	0.327	[9.353; 10.636]
LOSER*INC_MID	9.719	0.410	[8.916; 10.522]
WINNER*INC_MID	10.956	0.381	[10.210; 11.702]
LOSER*INC_HIGH	11.634	1.007	[9.661; 13.607]
WINNER*INC_HIGH	10.861	1.190	[8.529; 13.192]
LOSER*INC_DK	9.156	0.580	[8.020; 10.293]
WINNER*INC_DK	9.186	0.502	[8.202; 10.170]

Notes: Effects are estimated at the mean of other regressor variables.

**Table A12 – Results of estimations on total amount spent and cash spent during the week**

Variable	(I)	(II)	(III)	(IV)
	Amount spent during the week	Amount spent during the week	Cash spent during the week	Cash spent during the week
	Robust regression	Median regression	Robust regression	Median regression
WINNER	7.577 [8.545]	6.165 [11.267]	4.885 [5.093]	3.254 [6.525]
AGE_25_34	35.377* [19.717]	40.220* [23.229]	22.607* [11.751]	27.625*** [10.308]
AGE_35_44	44.650** [20.169]	53.603** [23.732]	30.675** [12.021]	39.167*** [10.420]
AGE_45_54	65.811*** [19.602]	75.323*** [24.665]	43.954*** [11.683]	49.040*** [10.760]
AGE_55_64	72.762*** [20.964]	90.105*** [29.363]	49.914*** [12.494]	57.896*** [13.322]
AGE_65+	65.277** [25.480]	78.520** [32.524]	51.374*** [15.186]	63.344*** [20.820]
FEMALE	15.948* [8.931]	5.238 [10.968]	8.052 [5.323]	13.623** [6.754]
HH_SIZE_2	23.566** [10.584]	37.773*** [14.456]	6.358 [6.308]	6.594 [8.274]
HH_SIZE_3	22.915* [13.080]	18.883 [14.365]	0.355 [7.796]	4.181 [8.803]
HH_SIZE_4+	63.653*** [13.212]	65.488*** [18.954]	13.985* [7.875]	15.518 [11.564]
EDU_MEDIUM	17.525* [10.461]	16.515 [11.609]	2.071 [6.235]	3.371 [7.866]
EDU_HIGH	34.942*** [13.200]	42.575** [18.413]	0.869 [7.867]	1.599 [9.562]
EDU_UNI	24.665* [14.879]	44.655* [23.233]	-11.994 [8.868]	-16.198 [14.304]
INC_MID	51.947*** [10.545]	65.548*** [14.344]	17.137*** [6.285]	18.461** [8.203]
INC_HIGH	60.137*** [19.076]	103.160*** [35.659]	20.552* [11.370]	29.417* [16.961]
INC_DK	6.001 [14.159]	4.950 [19.316]	-2.832 [8.439]	-9.530 [9.956]
REGION_EAST	-5.813 [10.623]	-7.188 [12.260]	-3.208 [6.332]	-11.125 [6.941]
OCC_TRAIN	-26.970 [26.068]	-17.163 [33.842]	-14.440 [15.536]	-14.494 [20.049]
OCC_WORK	17.757 [14.953]	21.403 [21.428]	-4.688 [8.912]	-1.848 [17.771]
OCC_OTHER	-41.508** [19.566]	-22.648 [21.224]	-19.830* [11.662]	-22.173 [20.399]
CONSTANT	72.786*** [24.876]	48.143 [30.731]	61.947* [14.826]	49.489** [20.091]
Observations	949	949	949	949
Pseudo-R <sup>2</sup>		0.072		0.042

Notes: Median regression with bootstrapped standard errors (1,000 repetitions).

**Table A13 - Share of cash transactions per person per day**

	Roll die			Difference losers vs. winners
	total	losers	winners	
Day 1	0.774	0.791	0.763	-0.028
Day 2	0.775	0.771	0.778	0.007
Day 3	0.760	0.776	0.749	-0.027
Day 4	0.785	0.774	0.793	0.019
Day 5	0.771	0.772	0.770	-0.003
Day 6	0.777	0.768	0.784	0.017
Day 7	0.780	0.757	0.796	0.038
Total	0.767	0.765	0.768	0.003

Notes: Calculated for individuals with more than zero transactions on given day.

\*, \*\*, \*\*\* mean difference significant at the 90%, 95% or 99% level (two-sided t-test).

**Table A14 – Share of small value transactions (below 5 euro) per person per day**

	Roll die			Difference losers vs. winners
	total	losers	winners	
Day 1	0.234	0.247	0.226	-0.021
Day 2	0.222	0.217	0.225	0.009
Day 3	0.211	0.195	0.222	0.027
Day 4	0.216	0.225	0.210	-0.015
Day 5	0.202	0.195	0.207	0.013
Day 6	0.220	0.194	0.239	0.046
Day 7	0.219	0.216	0.221	0.005
Total	0.216	0.206	0.222	0.016

Notes: Calculated for individuals with more than zero transactions on given day.

\*, \*\*, \*\*\* mean difference significant at the 90%, 95% or 99% level (two-sided t-test).

**Table A15 – Average transaction amount per person per day (in euro)**

	Roll die			Difference losers vs. winners
	total	losers	winners	
Day 1	26.07	28.48	24.51	-3.97
Day 2	25.21	25.29	25.16	-0.13
Day 3	26.36	25.53	26.97	1.44
Day 4	24.83	25.90	24.07	-1.83
Day 5	24.07	24.22	23.98	-0.24
Day 6	23.83	23.99	23.72	-0.27
Day 7	28.12	26.42	29.28	2.86
Total	26.61	26.08	26.98	0.90

Notes: Calculated for individuals with more than zero transactions on given day.

\*, \*\*, \*\*\* mean difference is significant at the 90%, 95% or 99% level (two-sided t-test).

**Table A16 - Share of incomplete transactions per person per day**

	Roll die			Difference losers vs. winners
	total	losers	winners	
Day 1	0.297	0.319	0.282	-0.036
Day 2	0.318	0.311	0.322	0.012
Day 3	0.350	0.379	0.329	-0.050
Day 4	0.356	0.376	0.342	-0.034
Day 5	0.361	0.385	0.345	-0.039
Day 6	0.369	0.347	0.386	0.039
Day 7	0.395	0.423	0.376	-0.047
Total	0.349	0.368	0.337	-0.031

Notes: \*, \*\*, \*\*\* mean difference is significant at the 90%, 95%, or 99% level (two-sided t-test).



**Table A17 - Share of rounded transaction values per person per day**

	Roll die			Difference losers vs. winners
	total	losers	winners	
Day 1	0.250	0.237	0.258	0.022
Day 2	0.271	0.278	0.267	-0.011
Day 3	0.307	0.294	0.316	0.023
Day 4	0.291	0.271	0.306	0.035
Day 5	0.317	0.356	0.292	-0.064**
Day 6	0.297	0.306	0.290	-0.016
Day 7	0.295	0.284	0.302	0.018
Total	0.290	0.287	0.293	0.006

Notes: Calculated for individuals with more than zero transactions on given day. \*. \*\*. \*\*\* mean difference is significant at the 90%. 95% or 99% level (two-sided t-test).

**Table A18 – Results of estimations on various measures of data quality**

Variable	(I)	(II)	(III)	(IV)	(V)
	Share of cash TA	Share of small TA	Average TA amount	Share of incomplete TA	Share of rounded TA
	OLS	OLS	OLS	OLS	OLS
WINNER	0.006 [0.015]	0.012 [0.014]	1.258 [2.189]	-0.022 [0.023]	0.006 [0.014]
AGE_25_34	0.007 [0.034]	-0.063** [0.030]	0.964 [3.639]	-0.002 [0.049]	-0.028 [0.034]
AGE_35_44	0.024 [0.034]	-0.043 [0.031]	1.310 [2.915]	-0.026 [0.050]	-0.046 [0.034]
AGE_45_54	0.002 [0.034]	-0.088*** [0.031]	4.727 [3.250]	0.026 [0.049]	-0.026 [0.033]
AGE_55_64	0.033 [0.036]	-0.105*** [0.033]	6.893 [4.307]	0.078 [0.054]	-0.040 [0.035]
AGE_65+	0.042 [0.044]	-0.096** [0.039]	4.340 [5.255]	0.108* [0.065]	-0.020 [0.041]
FEMALE	0.026* [0.016]	-0.016 [0.015]	-6.283** [3.164]	-0.001 [0.023]	-0.035** [0.015]
HH_SIZE_2	-0.050*** [0.018]	-0.029* [0.017]	8.825** [4.270]	0.024 [0.028]	0.021 [0.017]
HH_SIZE_3	-0.043* [0.023]	0.006 [0.022]	4.171** [1.826]	0.033 [0.034]	0.044** [0.022]
HH_SIZE_4+	-0.078*** [0.023]	-0.062*** [0.020]	8.172*** [2.724]	0.091*** [0.035]	0.079*** [0.022]
EDU_MEDIUM	-0.020 [0.017]	0.032* [0.017]	2.503 [1.716]	-0.080*** [0.029]	-0.001 [0.018]
EDU_HIGH	-0.071*** [0.024]	0.027 [0.023]	3.760 [5.173]	-0.108*** [0.034]	0.007 [0.022]
EDU_UNI	-0.076*** [0.027]	0.044* [0.022]	1.710 [3.331]	-0.118*** [0.039]	-0.030 [0.022]
INC_MID	-0.020 [0.019]	-0.037** [0.017]	2.941 [2.185]	0.015 [0.027]	0.033** [0.017]
INC_HIGH	-0.012 [0.033]	0.002 [0.032]	2.216 [3.473]	0.005 [0.052]	0.003 [0.030]
INC_DK	-0.037 [0.026]	0.021 [0.023]	4.410 [3.461]	0.010 [0.038]	-0.011 [0.023]
REGION_EAST	-0.001 [0.018]	0.027 [0.017]	-2.783 [3.091]	-0.115*** [0.025]	-0.016 [0.017]
OCC_TRAIN	-0.014 [0.045]	0.065 [0.045]	6.136 [13.135]	-0.008 [0.065]	0.050 [0.042]
OCC_WORK	-0.036 [0.026]	-0.001 [0.021]	-1.923 [3.351]	0.046 [0.039]	0.023 [0.022]
OCC_OTHER	0.050 [0.033]	0.045 [0.033]	-7.881** [3.753]	0.116** [0.054]	-0.004 [0.035]
CONSTANT	0.831*** [0.042]	0.280*** [0.038]	20.154*** [4.926]	0.347*** [0.063]	0.284*** [0.041]
Observations	949	949	949	949	949
R <sup>2</sup>	0.081	0.077	0.030	0.066	0.049

Notes: \*, \*\*, \*\*\* mean coefficient is significant at the 90%, 95% or 99% level. Robust standard errors are given in brackets. TA is transactions.

**Table A19 – Construction of regression variables**

Variable name	Type	Description
WINNER	Dummy	Outcome of roll of the die. One, if person wins 20 euro.
AGE_18_24	Dummy	One, if respondent is aged 18 to 24. Reference category.
AGE_25_34	Dummy	One, if respondent is aged 25 to 34.
AGE_35_44	Dummy	One, if respondent is aged 35 to 44.
AGE_45_54	Dummy	One, if respondent is aged 45 to 54.
AGE_55_64	Dummy	One, if respondent is aged 55 to 64.
AGE_65+	Dummy	One, if respondent is aged 65 or above.
FEMALE	Dummy	Gender of respondent. One, if gender is female.
HH_SIZE_1	Dummy	Number of persons living in respondent's household (including children). One, if household size is one. Reference category.
HH_SIZE_2	Dummy	Number of persons living in respondent's household (including children). One, if household size is two.
HH_SIZE_3	Dummy	Number of persons living in respondent's household (including children). One, if household size is three.
HH_SIZE_4+	Dummy	Number of persons living in respondent's household (including children). One, if household size is four or more.
EDU_LOW	Dummy	Educational attainment of respondent. One, if education is low (no educational degree (yet), lower secondary education of less than 10 years) or if education is "other/don't know". Reference category.
EDU_MEDIUM	Dummy	Educational attainment of respondent. One, if respondent has secondary education of at least 10 years.
EDU_HIGH	Dummy	Educational attainment of respondent. One, if respondent has upper secondary education (=qualification for entering university).
EDU_UNI	Dummy	Educational attainment of respondent. One, if respondent has university degree (including university of applied sciences).
INC_LOW	Dummy	Respondent's personal monthly net income. One, if income is less than 1.500 euro. Reference category.
INC_MID	Dummy	Respondent's personal monthly net income. One, if income is between 1.500 and 3.000 euro.
INC_HIGH	Dummy	Respondent's personal monthly net income. One, if income is more than 3.000 euro.

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INC_DK	Dummy	Respondent's personal monthly net income. One, if "don't know/no answer".
REGION_EAST	Dummy	Respondent's region of residence. One, if region is East Germany.
OCC_HOME	Dummy	Respondent's current occupation. One, if respondent is not working or working at home (pensioner, unemployed person, homemaker). Reference category.
OCC_TRAIN	Dummy	Respondent's current occupation. One, if respondent is in training (student, apprentice, volunteer in federal volunteer service ("Bundesfreiwilligendienst")).
OCC_WORK	Dummy	Respondent's current occupation. One, if respondent is working outside the home (employee, public servant, self-employed person).
OCC_OTHER	Dummy	Respondent's current occupation. One, if "other/don't know".
SUNDAY	Dummy	One, if transaction takes place on Sunday.
MONDAY	Dummy	One, if transaction takes place on Monday. Reference category.
TUESDAY	Dummy	One, if transaction takes place on Tuesday.
WEDNESDAY	Dummy	One, if transaction takes place on Wednesday.
THURSDAY	Dummy	One, if transaction takes place on Thursday.
FRIDAY	Dummy	One, if transaction takes place on Friday.
SATURDAY	Dummy	One, if transaction takes place on Saturday.

**Figure A1 – Number of cash transactions per person per day**

