

DNB Working Paper

No. 582 / December 2017

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DeNederlandscheBank

EUROSYSTEEM

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* Views expressed are those of the authors and do not necessarily reflect official positions of De Nederlandsche Bank.

Working Paper No. 582

December 2017

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Effects of payment instruments on unhealthy purchases^{*}

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20 December 2017

Abstract

In this online replication study we investigate if the pain of paying in cash – as opposed to paying by cards – can curb impulsive urges to purchase unhealthy or ‘vice’ products. This effect was found by Thomas et al (2011) when comparing the payment instruments cash and credit card. We investigate whether these results also hold in the Netherlands, where the dominant payment methods are cash and debit card. In total, 2,213 participants bought on average 12.3% more unhealthy supermarket products when paying with cards compared to cash. Participants who paid with cards bought more products in general (5.1%), however, the difference for healthy or ‘virtue’ products was not significant. The pattern of the mean scores per payment instrument indicate that paying with cards has a specific effect on vice purchases, but this study does not have the statistical power to show that convincingly. A regression analysis shows that the number of purchases of vice products is partly explained by paying with cards. Other explanatory variables are impulsivity, seduceability, gender, age, education and conscious eating behaviour. Pain of paying did not differ by payment instrument, but was larger for participants that paid with their usual means of payment, either debit card or cash. The present study contributes to the literature of so-called “pay cash, eat less trash” – studies, as it shows that the use of cash limits overall spending and purchases of vice products.

Keywords: payment instruments, consumer behaviour, virtual reality study, pain of paying.

JEL classifications: D12, D14, D18, D83, I12, E58, Z13.

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1 Introduction

1.1 Pain of paying

When people make a purchase, they often experience an immediate ‘pain of paying’, which can undermine the pleasure derived from consumption (Prelec and Loewenstein, 1998). This phenomenon plays an important role in consumer self-regulation. Pain of paying is a psychological effect and even visible in the brain. Knutson et al. showed in 2007 in an fMRI study that activation of the pain centre in the brain, the insula, correlates negatively with buying decisions.

The degree of the pain of paying correlates with the transparency of the payment method (Soman, 2003). The more transparent, the more pain and the less the payer is willing to spend. Transparency is determined by the salience of the payment form, the salience of the amount paid and the relative timing of transaction and money outflow. In Soman’s ordering, cash is the most transparent method. Paying cash elicits thus more pain than other payment instruments, and as a consequence leads to less spending, as can be seen in several studies (for instance Prelec and Simester (2001): cash compared to credit card and Runnemark et al. (2015): cash compared to debit cards). According to Runnemark et al. cash payments, which are more transparent than debit card transactions, make it easier to control spending, and this effect is not solely due to cash-on-hand constraints.

Using a certain payment instrument not only affects spending amounts, it also affects the type of product that is purchased. Thomas, Desai and Seenivasan (2011) observe in an online experiment that consumers are more likely to buy unhealthy food products when they pay by credit card, than when they pay with cash. According to Thomas et al, impulsivity seems to be one of the, if not the most, influential antecedents of unhealthy food consumption. Participants paying with cash reported greater feelings of pain of payment. This aversive visceral response can extinguish consumptive desires. Thomas et al. concluded that consumers can control their impulsive purchases by deciding to use cash instead of credit cards.

This kind of research, also known as “pay cash, eat less trash”, is mostly North-American and as a consequence in most cases the effects of paying by credit cards are compared with cash. As far as we know, the relation between payment method and unhealthy purchases has not been studied in the Netherlands.

In the Netherlands, at the point of sale (POS) two payment instruments are dominant: cash and debit card. In 2016, 45.0% of POS purchases were made with cash and 54.5% with debit cards. The share of credit card payments is 0.5% and therefore considered negligible (DNB/DPA, 2017). This is a different payment landscape than in the United States, where the

use of credit cards is much more common: 33.8% of all non-cash payments are made with credit card (Federal Reserve System, 2017). Since Soman considered the debit card as more transparent than the credit card, because the time between payment and settlement is shorter, it is relevant to see if the results of Thomas et al. also hold in the Netherlands.

1.2 Role of Central Bank

Central banks are responsible for issuing banknotes. That is why it is in their interest not only to know how this product is perceived by the users, but also what the societal effects are of its usage, and how it affects users' behaviour. These effects are partly in favour of alternative payment methods, such as cards. For example, debit card payments seem to be less costly for society as a whole in debit card intensive countries (e.g. Jonker, 2013). Furthermore, cash is said to facilitate illicit activities - which led the Eurosystem to decide to stop the production and issuance of the €500 note. On the other hand, it is obvious that cash has its importance; society is not ready to do without cash (ECB, 2017). Cash is not only useful as a back-up in case of failure of electronic payment means, it also gives users an immediate overview of expenses (e.g. Hernandez et al, 2017) and it is the outstanding payment method for those wishing to make an anonymous payment. Although the importance of these aspects cannot be easily quantified, their combined importance is an argument for DNB to advocate that over-the-counter transactions in cash must remain possible (DNB & Dutch Payment Association, 2016). This notion might even be further supported when cash proves to be a driver for fewer purchases of unhealthy goods. In 2017, the Bundesbank produced some evidence in this direction; Eschelbach showed that paying in cash can save consumers money by making unnecessary and unplanned purchases less likely. This is an advantage of cash of which most consumers are probably not aware.

1.3 Research questions

We are interested to find out if the study of Thomas et al. - mentioned in section 1.1 - can be replicated in the Netherlands; is there a relation between the usage of a payment instrument and the number and value of unhealthy purchases? In addition, we are interested to find out if the role of debit card is similar to the role of credit cards in the study of Thomas et al. Some indications for this assumption is delivered by Just and Wansink (2014). They report that school canteens with cash options have a lower purchase incidence of less healthy foods and higher purchase incidence of more healthy foods, compared to debit card-only canteens.

Furthermore we want to know if the concept of payment pain mediates such an effect.

1.4 Outline

In section 2 we summarise the set-up and findings of the study performed by Thomas et al. as they provide the basis of our study. They make use of representative sample of consumers from an online panel. Each participant is randomly assigned to a payment condition and is asked to do online shopping in a supermarket. The same 10 healthy (or virtue) and 10 unhealthy (or vice) products are offered to each one of them and the number of products and money spent were measured.

Section 3 describes the specifics of the set-up of our study, where we replicate the same approach to the extent possible. In our study, a larger panel is used and typical products were shown that can be bought in Dutch supermarkets.

In section 4 we show the results. Indeed, participants buy more products when paying with cards. Furthermore, they buy fewer vice products when paying in cash. The difference for purchased number of virtue products between payment instruments however was not significant, nor could the interaction effect between payment method and product category be shown to be statistically convincingly.

We conclude with section 5. The main effects as shown by Thomas et al are replicated, more products are bought when using cards and more virtue products than vice products are purchased. Furthermore, we found that paying with cards contributes to purchasing more vice products. However we cannot say with certainty that the effect is stronger for vice products than for virtue.

This study contributes to the literature of so-called “pay cash, eat less trash”- studies and useful insights are provided for authorities, central banks and payment organisations.

2 Thomas' findings

The article in the Journal of Consumer Research by Thomas et al. (2011) consists of four different studies. Our present paper focuses on the replication of the third study: mediation of pain of payment.

One hundred and twenty-five participants were asked to participate in an online experiment and subsequently to complete an online questionnaire. The experiment consisted of a food shopping study which was ostensibly conducted by a large retail chain that was planning to open a store in the town, to understand what types of food consumers buy on a typical shopping trip. The questionnaire was designed to measure the perceived pain of payment during the experiment.

Participants were offered 20 food products, of which 10 were considered to be healthy and 10 unhealthy. The impulsivity and the unhealthiness ratings of the products (as defined during a pre-test) were highly correlated ($r=.91$, $p<.01$) and suggest that unhealthy products also tend to be impulsive.

The 20 products were presented sequentially in random order. On the screen, participants saw the name, a picture and the price of the product. They were asked to either click the "add to shopping cart" button or the "continue shopping" button.

Before the products were shown, participants were assigned to a specific payment condition: credit card or cash. This was done by either showing four credit card company logos accompanied by the statement "the store accepts all major credit cards", or by informing them that the new store accepts only cash payments and that neither credit cards nor checks were accepted.

Thus, the study used a 2×2 mixed factorial design (credit card vs. cash \times healthy vs. unhealthy) with 10 exemplars of healthy and unhealthy products. The results were submitted to an ANCOVA with mode of payments as a between-subjects factor and type of products as a within-subjects factor.

The main effect of the mode of payment on the number of products bought ($F(1,119)=4.04$, $p=.046$) was qualified by a significant mode-of-payment by type-of-product interaction ($F(1,119)=4.46$, $p=.036$). There were more unhealthy impulsive items in the basket when the mode of payment was a credit card ($M=2.90$) than when the mode of payment was cash ($M=1.73$; $F(1,119)=7.60$, $p<.01$). The mode of payment did not affect the number of virtue items in the basket ($M_{cc}=3.31$ vs. $M_{cash}= 2.96$, $F<1$).

3 Method

3.1 Participants

Participants were recruited through the CentERdata research institute which is affiliated with Tilburg University, the Netherlands. CentERdata maintains a large panel that is approximately a cross-section of the Dutch population of 16 years and older, who can be invited to participate in online research. This panel has been widely used by researchers and policymakers.

In total 2,296 panel members (52% male) participated in return for credits within the CenterData panel setting. Participants' ages ranged between 16 and 93 years old (mean age $M=54.8$, $SD=16.5$). The absence of children in the sample largely explains why this is above the Dutch average of 41.3 (CBS, 2015). Mean income (€ 3,016 per month) in the sample is higher than the average of the Dutch population (€ 2,041), and a larger proportion is higher educated (Figure 1). However, on both variables the variance is considerable, so that results of the analysis of variances (ANOVA) are not likely to be substantially influenced by these deviations from the overall population distribution.

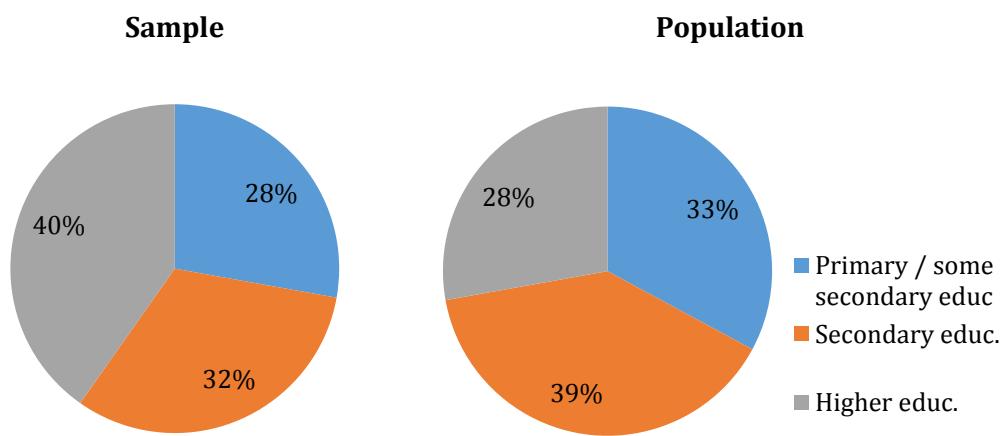


Figure 1 - Level of education in the sample and in the Dutch population (2015 data, Centraal Bureau voor de Statistiek)

3.2 Set-up

This study consisted of two phases, like the study of Thomas et al. The first is a 'supermarket phase', in which participants are presented with consecutive products which they

can choose to purchase or not. Participants were explicitly asked to imagine oneself in real-life shopping. The second phase consists of a survey.

The study considers one between-subject and one within-subject factor. The between-subject factor is Payment Condition, which is determined by a weighted random selection and could be ‘cash’ (40% chance of occurrence), ‘debit card’ (30%), ‘credit card’ (15%), or ‘contactless payment’ (15%). Since the main focus is on the payment instruments cash and debit card, they represent the largest group. Credit card payments are considered in order to be able to compare to the results of Thomas et al, even though most supermarkets in The Netherlands do not accept credit cards. Finally, contactless payment is a rapidly growing payment instrument in The Netherlands, and was therefore added to payment conditions. The within-subject factor is Product Category: half of the products offered in the virtual supermarket are regarded as *virtue* (healthy) products and the other half as *vice* (unhealthy).

Participants used their own computer or mobile device to take part in this study. Several studies indicate that even sophisticated high-level social behaviours can be observed and experimentally manipulated in simple virtual environments (e.g. Kozlov et al, 2010). The first phase of the experiment in which participants were presented with various supermarket articles was programmed using HTML and JavaScript. The following survey was created with Qualtrics.

3.3 Procedure

The supermarket phase starts with an introduction briefly explaining the upcoming study. It explicitly states that the goal of this study is to collect scientific data, to dispel any notion that it is a marketing study. This is different in comparison with Thomas et al., but the panel used in this study can only be used for non-commercial surveys.

After clicking a ‘next’ button, participants are presented with the payment instrument, chosen at random as specified above. An image depicting the chosen payment instrument is shown in the center of the screen (see Figure 2). Below this image is a description of the payment instrument, with the additional message that this is the only accepted means of payment at the store at which they are shopping. After participants click the ‘start experiment’ button, a smaller version of the image appears at the top-right of the browser window (175px wide on larger screens and 75px on smaller screens) and remains there until the end of the supermarket phase, to remind participants how they are paying.



Cash



Debit card



Credit card



Contactless payment

Figure 2 - Images as shown to participants that illustrate the various means of payment.

Participants are then presented with a sequence of 20 products found in a common Dutch supermarket. The name, an image and the price of the product is displayed on the screen. Figure 3 shows the images used. The product images are presented in the middle of the screen and are 400px wide. This size is scaled down to 200px when the experiment is viewed on smaller (tablet or mobile) screen sizes. Two buttons are shown below the product image, at the bottom of the screen. With the left button, participants buy the current item, and with the right one they skip it. When participants buy an item, there is a short animation of the reminder payment image to generate an impression of financial transaction – and make the experiment more tangible for the participants. With the cash image, three coins roll from the image to the left and then disappear. With the debit and credit card images, the card moves to the left and back (simulating a card swipe) and in the contactless payment condition, a transmission icon is briefly displayed on the left of the card. Figure 4 shows this sequence of events during the supermarket phase.

Virtue products	Vice products
	
Salad	Apples
	
Strawberries	Whole wheat bread
	
Tea	Tomatoes
	
Walnuts	Water
	
Carrots	Yoghurt
	
Apple pie	Ice cream
	
Potato chips	Soda
	
Chocolate	Sausage roll
	
Almond paste cake	Muffins
	
Ham and cheese croissant	Cheese sticks

Figure 3 - Vice and virtue products. The products are displayed with prices corresponding to current supermarket prices. Labels are shown in English here, but were displayed in Dutch.

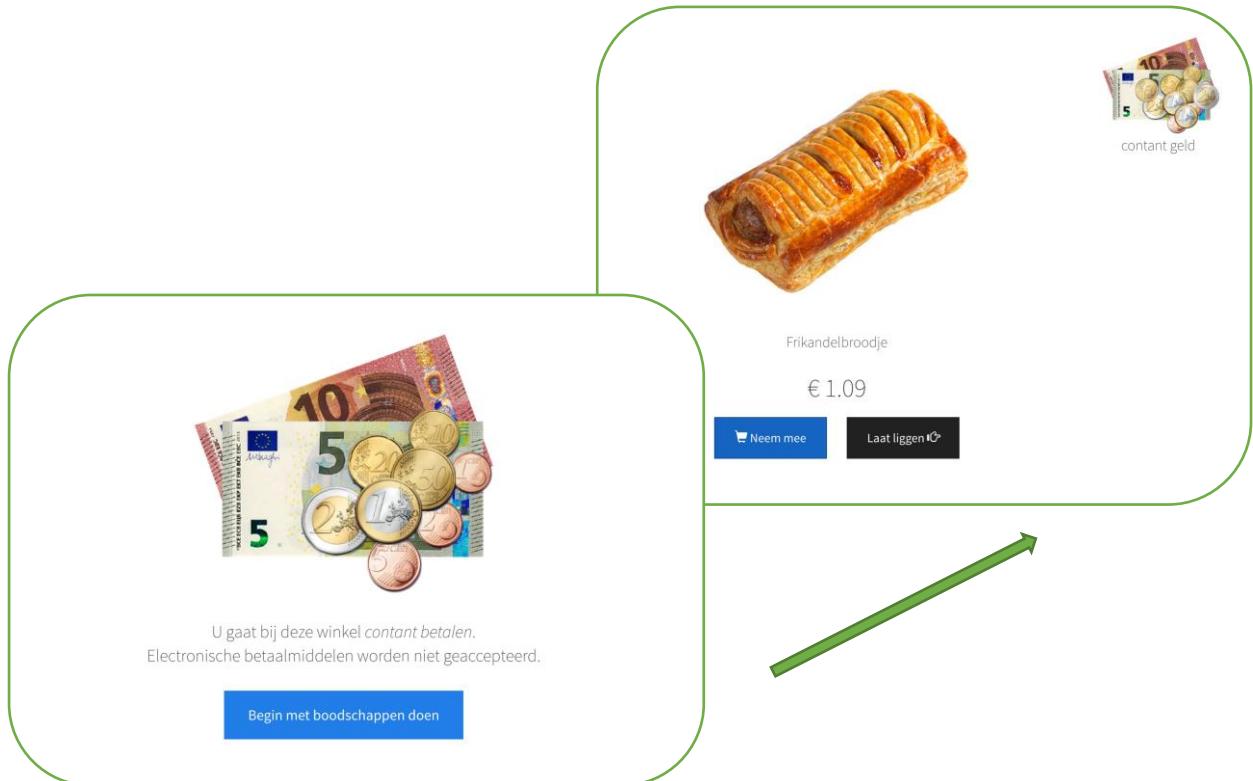


Figure 4 - Example displays. A notification of the payment method is shown first, followed by 20 article displays on which the participant could choose to buy the article or to leave it.

After conclusion of the supermarket phase, participants are redirected to the survey where they have to respond to a questionnaire. Questions are mostly taken from Thomas et al. (2011), who kindly provided us with their questionnaire. Questions are translated into Dutch and then back-translated by a different researcher to assess accuracy. The questionnaire can be found in Appendix A. It queried how many products the participants thought they had bought as a manipulation check. Memories are mostly accurate, with 7.4 products estimated compared to 6.4 actually bought. Other questions concern the health rating of the products and the respondent's feelings while shopping in the virtual supermarket. Subsequently, respondents are asked how they normally shop – whether they are spendthrift or not – and what means of payment they prefer to use in real-life shopping.

3.4 Pilot study

The task and questionnaire were first piloted among 89 students from the Vrije Universiteit Amsterdam. The results prompted us to change a few aspects of the study. The first adaptation was the animation of the reminder image that occurred after an article was purchased. This reminder was absent from the study by Thomas et al. We expected this

animation to draw participants' attention to the fact that they are spending money within the game, which may influence their 'pain of payment' experience. Second, the instructions are improved to emphasize that the assigned payment instrument was the only accepted payment instrument. Third, in the pilot we use the product selection of Thomas et al., but we exchanged some of the virtue products for different ones as the pilot students rated them as only intermediate healthiness (e.g., breakfast cereals that are now known to be too high in sugar content). Finally, we removed some of the questions from the Thomas et al. questionnaire, since they seem to be irrelevant for the current study. As the results of the pilot are highly similar to the ones of the actual study, these changes do not seem to have affected the outcomes.

4 Results

4.1 Descriptives

Participants are randomly assigned to four different groups of payment condition. As randomization occurs at the level of individual participants, percentages of participant in each condition are slightly off target, as can be seen in Table B.1 of Appendix B.

Table 1 shows participants' preference for a payment instrument during real shopping trips. 18% prefer cash, 72% prefer debit cards. To identify the group of participants who prefer to pay with cash, we compare their age, gender, level of education and income to the majority that prefers to pay with cards. Cash-preferring participants tend to be a few years older (59.7 vs 53.5 years old), $F(1, 2195)=46.2$, $p<.001$, poorer (mean net household income € 2,239, versus € 3,142), $F(1, 2195)=7.53$, $p=.006$, and less educated (mean CBS education category 3.4 vs 3.9), $F(1, 2195)=43.6$, $p<.001$, than participants preferring electronic means of payment. No difference is found in the proportion of female and male participants preferring one or the other (51% vs 47% female).

Table 1 - Preference for means of payment in real life shopping

	N	%
Cash	391	17.7
Credit card	17	0.8
Debit card	1584	71.6
Contactless	205	9.3
Missing	16	0.7

Participants put on average 6.38 products in their basket ($SD=3.20$), ranging between zero and ten of the twenty products. They spend on average € 11.74 ($SD= 6.96$) on these products, with a range of € 0 to € 20.45.

Table 2 displays how often the individual products are bought. As can be seen, whole wheat bread is bought by most participants (70%), whereas muffins are only bought by 10% of the participants.

A trick question was asked at the end of the survey, in which participants were given a long text to read, while at the end the instruction was given to ignore the answer options. Nevertheless, 28.7% of participants crossed at least one answer option, suggesting that they did

not read the question properly and may not have read other instructions carefully as well. Conversely, 71.3% did read the instructions carefully. A comparison of those participants that did read instructions carefully with those that did not, shows that careful readers buy somewhat fewer products, $F(1,2191)=8.56$, $p=.003$, which is especially true of virtue products (interaction between trick question answer and product category, $F(1,2191)=4.90$, $p=.027$). However, none of the results reported is altered by adding 'careful reading' as a factor.

Table 2 - Proportion of participants buying each of the individual products, with the classification of the product and the average health rating by participants on a scale from 1 (unhealthy) to 5 (healthy).

Product	% of participants buying	Product category	Health rating	Price (€)
Whole wheat bread	70.0	Virtue	4.42	2.09
Carrots	66.3	Virtue	4.8	1.39
Snack tomatoes	50.2	Virtue	4.53	1.79
Yoghurt	49.4	Virtue	4.18	1.25
Apples	46.9	Virtue	4.63	2.99
Green tea	44.0	Virtue	4.11	1.49
Strawberries	38.5	Virtue	4.52	3.19
Water	35.0	Virtue	4.55	0.65
Walnuts	32.9	Virtue	4.33	2.49
Large salad with salmon	30.3	Virtue	3.73	3.52
Chips	25.6	Vice	1.27	1.29
Ham and cheese croissant	23.9	Vice	1.69	0.75
Cookies	22.5	Vice	1.47	1.88
Ice cream	20.4	Vice	1.58	1.99
Chocolate bar	18.6	Vice	1.73	2.69
Cheese sticks	16.0	Vice	1.72	2.19
Sausage roll	13.6	Vice	1.3	1.09
Cola	13.5	Vice	1.25	0.57
Apple pie	11.0	Vice	1.77	5.99
Muffins	9.9	Vice	1.54	2.99

4.2 Effect of payment condition on products bought

Figure 5 shows how many vice and virtue products are bought as a function of payment condition. Participants bought more virtue than vice products, $F(1,2209) = 1889.64, p < .001$. However, there is no effect of payment condition on the number of products participants bought, $F(3,2209) = 1.99, p = .113$, nor is there an interaction between product category and payment condition, $F(3,2209) = .356, p = .785$.

Although there is no significant effect of payment condition, means are not exactly equal. In particular, participants that pay with cards seem to buy slightly more products than those that pay with cash. To test this, the three groups with electronic payment are taken together (Figure 6). Now, a small effect of payment condition emerges, $F(1,2211) = 5.23, p = .022$. Participants in the credit card, debit card and contactless payment conditions buy slightly more products ($M=6.52, SD= 3.34$) than participants in the cash condition did ($M=6.20, SD=2.98$).¹ However, even though numerically the effect is larger for vice than for virtue products, there is still no interaction with product category $F(1,2211) = .542, p = .462$. The pattern of means thus shows a specific effect of paying with cards on the number of vice products bought, but the statistical power to prove that this effect is greater than on the number of virtue products bought is not sufficient.

Table 3 summarises the main results and interaction between payment method and

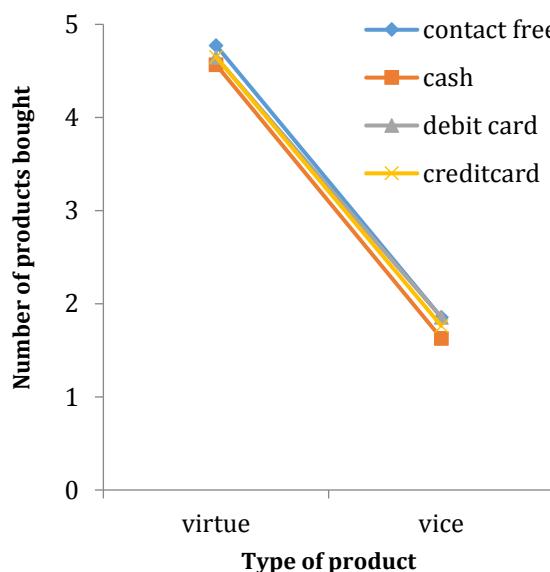


Figure 5 - Number of products bought for each payment method.

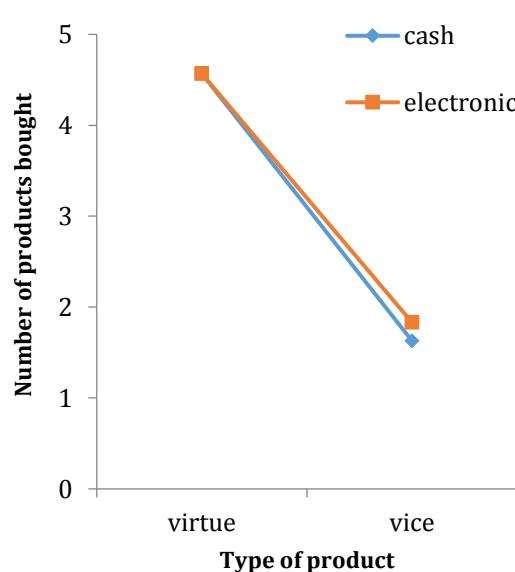


Figure 6 - Number of products bought for cash and electronic payments together

¹ This effect was also found when only debit card and contactless payment were taken together and credit card payers were excluded from the analysis.

number of purchases per product category. The results of Thomas et al. are shown in parentheses. The conclusion is that in both studies there are significantly more impulsive unhealthy items in the basket when the payment instrument is cards. The interaction effect however is not significant in the Dutch case, but it is for Thomas et al. Just as is the case in Thomas' study, more products are bought with cards. Finally, the Dutch buy fewer vice and more virtue products in comparison with Thomas' panel.

Table 3 - Main results of number of products bought per category and interaction with payment instrument (results of Thomas et al. shown in parentheses)

product category	payment instrument			total average
	cash	cards		
Vice	1.63 (1.73)	1.83 (2.90)		1.73 (2.32)
Virtue	4.57 (2.96)	4.68 (3.31)		4.63 (3.14)
total sum	6.20 (4.69)	6.51 (6.21)		

4.3 Money spent

The previous section describes the effect of the payment instrument on the number of purchases. This section presents the relation between the payment instruments and the amount of money that was spent (Figure 7). Again, there is a main effect of product category, $F(1,2209) = 1406.62, p < .001$, but not of payment condition, $F(3,2209) = 2.154, p = .092$, nor is there an interaction between these two factors, $F(3,2209) = .206, p = .893$. Once more, when taking the three electronic payment conditions together, there is an effect of electronic versus cash, $F(1,2211) = 5.58, p = .018$ (Figure 8). Participants in the electronic payment condition ($M = € 12.04, SD = 7.22$) did spend on average more money than the participants in the cash condition ($M = € 11.33, SD = 6.52$). However, there is again no interaction between product category and the payment condition, $F(1,2211) = .325, p = .569$. As in the analysis of the number of products, participants that paid with cards spent more on products in general, but not specifically on vice products.

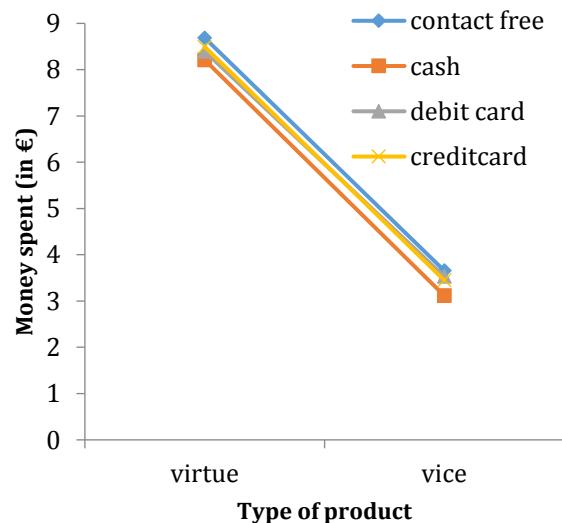


Figure 7 - Money spent for each payment method.

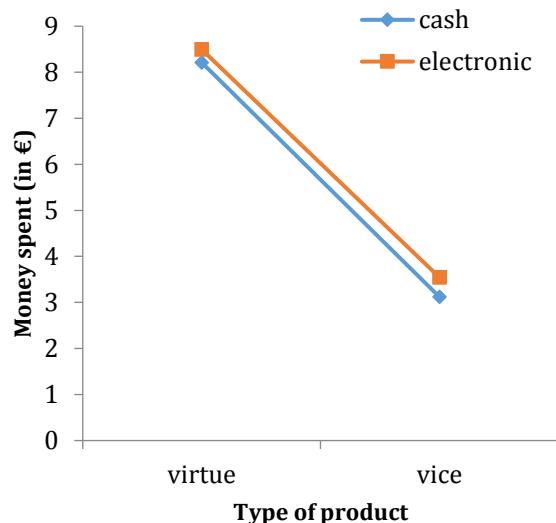


Figure 8 - Money spent for electronic payments together.

4.4 Regression results

To investigate which independent variables predict how many virtue and how many vice products are bought, we run two linear regression analyses (least square method) using SPSS. Table 4 presents the variables that significantly predicted either the number of virtue or the number of vice products bought (see Appendix B for outcomes of full list of variables).

Seven variables were correlated with the number of vice products bought. Participants who judge their shopping behaviour as more impulsive, or easy to seduce, buy more vice products. Participants who try to eat healthily, on the other hand, buy fewer vice products. Men

buy more vice products than women do, and younger participants buy more vice products than older participants do. People with a higher education buy fewer vice products than those with less education. Lastly, reflecting the effect already seen in the previous section, participants paying with cards in the experiment buy more vice products than participants who pay with cash (the effect with virtue products is in the same direction, but not significant).

Different variables are associated with the number of virtue products bought than with vice products bought, and those that overlap have an opposite effect on the two categories of products. This is the case for eating healthily, gender and age: healthy eaters, women and older adults buy more virtue products and fewer vice products than other participants. Moreover, participants who judge their shopping behaviour as reserved buy fewer virtue products, while those who rate their shopping behaviour as disciplined buy more virtue products. Participants who judge themselves as more wasteful buy more virtue products, as do participants who feel happy while shopping in the experiment.

Together, these variables predict choices by participants moderately well. All variables together explain 13.8% of the variance in the number of vice products bought, and 8.3% of the variance for virtue products.

Table 4 - Outcomes of the regression analysis of how many virtue and vice products were bought, with for each predictor the regression coefficient (b) and the significance level (p value)

Variable	Virtue		Vice	
	B	p	B	p
Judges own shopping behaviour as:				
- impulsive	.058	.421	.189	<.001
- easy to seduce	.115	.123	.211	<.001
- reserved	-.181	.002	-.058	.172
- disciplined	.154	.027	.039	.434
Tries to eat healthily	.740	<.001	-.542	<.001
Felt happy during the shopping	.196	.015	.080	.167
Consider themselves more wasteful than stingy	.117	.004	.044	.134
Female gender	.242	.024	-.660	<.001
Age	.015	<.001	-.009	.001
Education in CBS category	-.038	.281	-.108	<.001
Electronic payment condition in experiment	.140	.172	.227	.002

4.5 Pain of paying

Four questions in the survey relate to the amount of pain felt while paying. Participants were asked to rate their perceived level of happiness, pain, easiness and irritation on a 5 level Likert scale. Following Thomas et al. (2011), we sum the answers to a overall pain index and then perform an ANOVA on this index. As predictors, we use the payment instrument as a fixed factor, and preferred means of payment as a random factor (because it is not manipulated). Neither factor shows a main effect ($F<1.3$, $p>.37$), but the interaction between the two is significant, $F(9, 2181)=6.28$, $p<.001$. As can be seen in Table 5, more pain of paying is felt when the assigned method is the same as used in real life. Participants who tend to pay in day-to-day shopping with cash feel more pain when they have to pay with cash in the experiment, than when they pay with a different means of payment. The same is true for participants who prefer debit card payment in real life, or contactless. It was not true of participants who tend to pay with credit card; however, these are few in number.

While pain of payment is thus modulated by whether participants pay with their regular mode of payment, it still has to be established that this pain affects behaviour. Within the experiment no relation is found between pain of paying and the number of vice products bought ($r=-.023$, NS); there is one with the number of virtue products, but it is positive ($r=.07$, $p=.001$), contrary to our expectation. The pain of paying does correlate negatively with the difficulty that participants reported in curtailing their expenses in real life – the more pain is felt, the less difficulty curtailing expenses ($r=-.065$, $p=.002$), and with impulsivity during shopping ($r=-.04$, $p=.002$). Pain correlates positively with how disciplined participants say their shopping is ($r=.08$, $p<.001$) – i.e., more pain goes together with more disciplined shopping.

Table 5 - Experience of pain during payment as a function of payment condition and of preferred means of payment in day-to-day shopping. The highest value per preference group is presented in bold, while values based on less than 50 observations are greyed out.

Preference in real-life shopping	Assigned payment method			
	Cash	Credit	Debit	Contactless
Cash	15.16	12.98	14.08	12.74
Credit card	13.83	12.67	14.20	11.67
Debit card	14.37	14.20	14.94	14.14
Contactless	13.66	15.79	14.46	15.82

5 Conclusions

This replication attempt of Thomas' study firstly shows that in the online experiment, Dutch participants buy more virtue products than vice products (respectively 4.6 and 1.8 products). Also, participants buy somewhat more products in general when they pay with cards in the experiment compared to when they pay with cash (respectively 6.5 and 6.2). More specifically, participants who paid with cards buy significantly more vice products than participants paying with cash (respectively 1.8 and 1.6). This pattern is also present for the number of virtue products, however it is not statistically significant. It cannot be said with certainty that the effect is stronger for vice product than for virtue products.

Further, the number of purchases of vice products can be explained by variables such as impulsivity, seduceability, gender, age, education and conscious eating behaviour.

The main effects of Thomas et al. (2011) are replicated in the Dutch situation. However, the statistical significance of the interaction between payment instrument and product category is not replicated.

The perceived pain of paying in the present study does not correlate with the number of products bought. However, the pain perceived by participants while spending money does correlate with several statements about their shopping habits in real life, e.g. respondents with a more disciplined shopping behaviour in real life, experience more pain during the experiment.

Interestingly, there is a group of participants who prefer to pay with cash in real life, and feel the highest level of pain while paying with cash in the experiment. This suggests that this group uses cash payments as a means of budget control – with the pain they feel while paying as a disincentive to their spending. A similar effect is found for participants who prefer to pay with cards (mostly using debit card), but in these participants the modulation of pain is half as strong. In both cases, extra pain does not result in buying fewer products. This may indicate that usage of a preferred payment instrument goes together with its perceived transparency.

Finally, we think this study provides useful insights for authorities, central banks and payment organisations on the relation between payment instrument and spending behaviour of consumers.

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Appendix A: full questionnaire

Q1.1 How many products do you think you bought?

[0..999] products

Q1.2 How much money do you think you spent on your shopping?

Fill in a round number in euros.

[0 9999] euro

You will get to view all the products again. You can rate them on how healthy you think they are. So this question is about how healthy **you think** that a product is, i.e. there are no wrong answers.

Q2.1 Apple pie

- Unhealthy (1)
- Slightly unhealthy (2)
- Neither unhealthy nor healthy (3)
- Fairly healthy (4)
- Healthy (5)

Q2.2 Apples

Q2.3 Whole wheat bread

Q2.4 Salmon fillet

Q2.5 Green tea

Q2.6 Walnuts

Q2.7 Strawberries

Q2.8 Snack tomatoes

Q2.9 Sausage roll

Q2.10 Can of Coke

Q2.11 Crisps

Q2.12 Ham and cheese croissant

Q2.13 Almond-paste cake

Q2.14 Muffins

Q2.15 Chocolate bar

Q2.16 Cheese sticks

Q2.17 Carrots

Q2.18 Ben & Jerry's ice cream

Q2.19 Water

Q2.20 Yoghurt

Q4.1 Below you will find some phrases describing shopping behaviour. Please indicate to what extent each of these phrases describes your shopping behaviour.

	Does not describe me at all (1)	Does not describe me (2)	Somewhat describes me (3)	Describes me (4)	Describes me completely (5)
Impulsive (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Easily tempted (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Extravagant (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Reckless (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Reserved (5)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Disciplined (6)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Love spending money (7)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q5.1 To what extent do you apply the following principle?

	Never (1)	Rarely (2)	Sometimes (3)	Often (4)	Always (5)
I try to eat healthily (3)	<input type="radio"/>				

Q6.2 Which payment instrument were you asked to use previously in the experiment?

- (1) Cash
- (2) Credit card
- (3) Debit card
- (4) Contactless
- Don't know

Q6.3 Some people believe that the payment instrument that they use influences their state of mind when spending money. How did you feel when using this payment instrument when shopping?

- (1) sad face

- (2) slight frown
- (3) neutral face
- (4) smiley face
- (5) happy face

Q6.4

- It was painful (1)
- It was a bit painful (2)
- Neither painful nor painless (3)
- Almost painless(4)
- Painless (5)

Q6.5

- Worried (1)
- Slightly worried (2)
- Neither worried nor relaxed (3)
- Almost relaxed (4)
- Relaxed (5)

Q6.6

- Annoyed (1)
- Slightly annoyed (2)
- Neither calm nor annoyed (3)
- Almost calm (4)
- Calm (5)

Q7.1 The following questions are about your shopping behaviour. Which of the following descriptions applies to you most?

- 1 = Tightwad (finds it hard to spend money on anything) (1)
- 2 (2)
- 3 (3)
- 4 (4)
- 5 (5)
- 6 = About the same, or none of the above (6)
- 7 (7)

- 8 (8)
- 9 (9)
- 10 (10)
- 11 = Spendthrift (finds it hard to limit spending) (11)

Q7.2 Some people find it hard to limit their spending. They often spend money - for instance on clothes, meals, holidays, telephone calls - when it would be better not to. Other people on the other hand find it hard to spend money. Possibly because spending makes them nervous, they often do not spend money on things that they should be spending money on.

a. How well does the first description fit you? This means, do you find it hard limit your spending?

- Never (1)
- Rarely (2)
- Sometimes (3)
- Often (4)
- Always (5)

Q7.3 b. How well does the second description fit you? This means, do you find it hard to spend money?

- Never (1)
- Rarely (2)
- Sometimes (3)
- Often (4)
- Always (5)

Q7.4 Below you will see a scenario that describes two types of shoppers. After reading the descriptions of the two types of shoppers, please answer the question that follows.

Mr A. accompanies a good friend on a shopping spree at a local shopping centre. When they enter a big department store, Mr A. sees that it has 'Today only sales' where everything is reduced by 10-60%. He is aware that he does not need anything, but he still can't control himself and in the end spends about €100.

Mr A. accompanies a good friend on a shopping spree at a local shopping centre. When they enter a big department store, Mr B. sees that it has 'Today only sales' where everything is reduced by 10-60%. He realises he can buy lots of things that he needs for bargain prices, but the idea of spending money is keeping him from actually buying these things.

In the light of your own shopping behaviour, who do you resemble most: Mr A., or Mr B?

- Mr A (1)
- .(2)
- About equally, or neither of the two? (3)
- .(4)
- Mr B (5)

Q9.1 When you go shopping in real life, which payment instrument do you use most often?

- Euro banknotes (1)
- Credit card (2)
- Debit card logo (3)
- Contactless payment (4)

Q8.5 Recent research into human decision making, shows that choices are influenced by context. Differences in how people feel, their knowledge and experience, and their environment may influence their choices. In order to understand how you made your choices in our previous experiment, we would like to know more about you. We are specifically interested in whether you take the time to read instructions - if not, your choices in our experiment may not say much about your choices in real life. In order to show that you have read the instructions, please only tick the box in front of "non of the above". Thank you very much for your attention.

Please tick the boxes in front of all the words that describe your feelings.

- Interested (1)
- Tense (2)
- Excited(3)
- Angry (4)
- Strong (5)
- Guilty (6)
- Afraid 7
- Hostile (8)
- Enthusiastic (9)
- Proud (10)
- Annoyed (11)
- Alert (12)
- Ashamed (13)

- Inspired (14)
- Nervous (15)
- Determined (16)
- Alert (17)
- Rushed (18)
- Active 19
- Anxious (20)
- None of the above (21)

Appendix B: Additional tables

Table B.1 below gives the actual, as opposed to intended, distribution of participants across payment instruments. Table B.2 gives the full outcome of the regression analyses performed to explain the number of virtue and vice products that participants bought.

Table B.1 -Distribution of participants across payment instruments

Payment instruments	N (%)
Contactless	337 (14.7%)
Cash	904 (39.4%)
Credit card	321 (14.0%)
Debit card	651 (28.4%)

Table B.2 - Outcomes of the regression analysis, with the regression coefficient (B) for each predictor, student t value, and associated p value. Significant results are flagged in bold

Variables	No. of virtue			No. of vice		
	B	t	p	B	t	p
Please indicate to what extent each of these phrases describes your shopping behaviour.						
- Impulsive	.058	.806	.421	.189	3,635	.001
- Easily tempted	.115	1,544	.123	.211	3,946	.001
- Extravagant	.120	1,691	.091	.047	.916	.360
- Reckless	.010	.117	.907	.040	.681	.496
- Reserved	.181	-3,083	.002	.058	-1,368	.172
- Disciplined	.154	2,212	.027	.039	.782	.434
- Loves spending money	.098	1,638	.102	.029	.674	.500
I try to eat healthily	.740	8,315	.001	.542	-8,456	.001
How did you feel when using this payment instrument when shopping?						
Happy - Unhappy	.196	2,441	.015	.080	1,382	.167
painful	.023	.298	.766	.031	.559	.576
worried	.106	-1,147	.251	.039	.595	.552
annoyed	.130	1,534	.125	.078	1,272	.203

Which of the following descriptions applies to you most?			
Tightwad - Spendthrift	.117	2,912	.004
In the light of your own behaviour, who do you resemble most, Mr A. or Mr B?	.041	.839	.402
Gender	.242	2,258	.024
Age of the household member	.015	4,319	.001
Net monthly income	1.67E-5	1,353	.176
Education in CBS categories	.038	-1,078	.281
electronic or cash in daily life	.245	1,817	.069
electronic or cash in experiment	.140	1,365	.172

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