

A Note on the Exposure Effect and Currency Valuation

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Abstract

This thesis investigates whether the exposure effect, according to which people tend to value an object more the larger their previous exposure to it, affects how people perceive the purchasing power of banknotes. It is done by letting participants look at pictures of either 1000 SEK or 500 SEK banknotes and then estimate the amount of different goods that could be purchased using the displayed banknote. Mean estimates for each good and on an aggregated level are then compared. Despite previous findings in a similar study, this thesis finds no evidence for any difference in perceived purchasing power between the different banknotes.

Keywords: exposure effect, currency valuation, purchasing power, banknotes

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1 Introduction

A cornerstone of classical economic theory is that individuals are able to assign an economic value to any good that might cross their path and that this value is based on processing all available information in a coherent and unbiased manner. The efficient market hypothesis, (e.g. Fama, 1965) especially, rests upon these rather strict assumptions.

That the truth might not be entirely aligned with classical economic theory has been shown in several papers. Thaler (1980) points to the so called *endowment effect*, which causes sellers to assign a higher value to a good than buyers. Similarly, Birnbaum and Zimmerman (1998) show how buyers, sellers and neutral third parties tend to assign different values to the same bits of information on a good on offer, which results in different appraisals of its value.

Sometimes the discrepancy between presumed and actual value might not be related to the good itself, but rather to difficulties in correctly estimating the purchasing power of the currency used. Raghubir and Srivastava (2002) highlight the difficulties faced by people attempting to correctly estimate the real value of a foreign currency. Shafir, Diamond and Tversky (1997) offer enlightening insights into how people tend to value currency in nominal terms rather than relative, so called *money illusion*.

That the effect of such problems in properly estimating the value of money is not limited to the individual himself but can be observed throughout entire economies is shown by Branson and Klevorick (1969) in their work on how money illusion has affected the economy of the United States.

Alter and Oppenheimer (2008) combine economic theories regarding the difficulties in estimating the value of currencies with theories from the field of psychology, namely the so called *exposure effect*, by which people tend to appreciate objects, sounds, geometric forms, pieces of art, names et cetera more the more they have been exposed to them (e.g. Maslow, 1937 and Zajonc, 1968). They test for whether the exposure effect also affects the perceived purchasing power of currency and find that this seems to be the case. It has been argued that such an effect could potentially explain part of the difference between perceived and actual inflation post introduction of the euro in many countries (which has been noted e.g. in Aalto-Setälä, 2006) and serve as a warning to central banks contemplating the introduction of new notes and coins (The Economist, 2008). This thesis will to the extent possible attempt to replicate the experiment on currency valuation and exposure effect from Alter and Oppenheimer (2008) in a Swedish setting.

This thesis is structured as follows: Sections 2 and 3 spell out the reasons for studying the area of choice and specify research question and limitations. Section 4 offers a review of literature both related to the exposure effect and to problems at valuing currency in general. Section 5 presents the methodology by which this study was conducted and its potential weaknesses. Section 6 presents the data acquired as a result of the study and section 7 offers a discussion on the potential reasons for why various results were found or not found. Section 8, finally, presents the conclusions of this thesis.

2 Motivation of study area

The motivation for this research field rests upon two factors: whether the introduction of new currency itself is commonly enough occurring for any potential effect from it having the chance to affect economic actions; and, whether these effects could potentially have

repercussions throughout the wider economy, thus warranting careful study. These two factors will now be considered in order.

Central banks regularly exchange current coins and banknotes for new ones, making the introduction of new currency a more or less common feature in most countries. The reason for doing so is often to make counterfeiting more difficult, but other factors have also been cited, e.g. environmental reasons (Riksbanken, 2011a). Sometimes, such actions have even been taken for pure aesthetic reasons (Alter and Oppenheimer, 2008). Countries sometimes introduce entirely new currencies, for reasons of regime change (e.g. after the collapse of the Soviet Union), because they enter into the European Monetary and Economic Union (EMU), or because the current currency has proven to be unsustainable (e.g. as in the recent case of Zimbabwe). Thus, it could safely be argued that the phenomenon is commonly enough occurring to warrant exploring potential side effects.

If the exposure effect is present also with regards to currency, it could be suspected that it could also have economy-wide repercussions, since similar phenomena have been shown to do so. Support for such an assumption could be found in Branson and Klevorick (1969), who show that money illusion (which distorts the perceived purchasing power of currency in favour of nominal rather than real values) has historically had an effect on the U.S. economy. The adoption of the euro also offers several examples of perceived inflation being higher than real inflation during the first year (see e.g. Aalto-Setälä, 2006); that this could potentially, at least partially, be the result of the physical introduction of new coins and banknotes should not be dismissed out of hand (The Economist, 2008). Thus, it appears both reasonable and warranted to explore the issue.

3 Research question and limitations

This thesis sets out to investigate whether the exposure effect affects how people perceive the purchasing power of Swedish 500 kronor (SEK) and 1000 SEK banknotes. By *exposure effect*, the effect by which people tend to assign a higher value to an object the larger their previous exposure to it, is meant.

For practical reasons, this thesis limits itself to the difference in perceived purchasing power between 500 SEK banknotes and 1000 SEK banknotes, since an uncommon enough currency (1000 SEK) must be used in order to capture any potential effect, while at the same time the difference in nominal value between it and the more commonly occurring currency (500 SEK) should not be too great. By *uncommon* we here mean that the banknote is rarely used in economic transactions. This thesis does not make any attempts at exploring other effects that could possibly distort the perceived value of any of the banknotes in favour of the other.

4 Previous research

This section is divided into two parts. Part one deals with literature related to the exposure effect, starting with Maslow (1937), continuing with Zajonc (1968) and finishing with Alter and Oppenheimer (2008); this also implies the section will start off talking about the exposure effect in general and end with the first attempt at moving it into the domain of behavioural economics. These papers have *not* been chosen in order to provide the reader with a comprehensive overview of the extensive research on the exposure effect, but rather as they provide the reader with a good understanding of what exactly constitutes the exposure effect and how it works.¹ As a majority of readers are assumed not to have a

¹ When presenting relevant previous research on the exposure effect, the progress of science forces one to revert to older papers focusing on its sheer existence, as presented above. More recent research on the exposure effect has primarily focused on studying e.g. the effect of

background in psychology, these papers will be presented quite thoroughly; this is done with the sole purpose of providing the reader with an extensive enough understanding of the exposure effect in order to follow the rationale behind this thesis and the experiment presented within it. Readers already familiar with the exposure effect in general and the work of Maslow and Zajonc within this field in particular would not suffer from skipping the sections about their contributions.

Part two will focus on related topics within the field of economics, in particular so-called *money illusion* and the effects of other similar phenomena. The rationale behind widening the topic covered in this way is partly to acknowledge (though not further pursue) factors that could potentially result in similar outcomes as the exposure effect, partly to show that effects of this kind can in fact have repercussions on the wider economy.

4.1 Research related to the exposure effect

4.1.1 Maslow (1937): The Influence of Familiarization on Preference

In one of the ground-breaking studies on the exposure effect, Maslow (1937) researched the effect of being continuously exposed to a number of different factors during the course of a seemingly unrelated experiment. (Many of these factors would fit neatly into the category of ‘background noise’.) Fifteen students from the Psychology Department of Barnard College were recruited to participate in a ‘fake’ experiment lasting two hours per evening for a total of ten evenings. While participants were engaged in unrelated activities (including e.g. copying sentences from a book of their choice and completing a vocabulary test), they were exposed to a range of disturbances. These were:

subliminal exposure, or to what degree it plays a role in specific settings, topics irrelevant to this thesis. For examples on such more recent papers, see e.g. Yagi, Ikoma and Kikuchi (2009), Crisp, Hutter and Young (2009), and Serenko and Bontin (2011).

- a. A metronome ticking with a frequency of about one beat per second (causing complaints during the first two sessions)
- b. The mandatory wearing of a smock (causing unease, as the temperature was too hot to necessitate any additional clothing)
- c. Assigned seating in alphabetical order (causing unease for some participants, as the lightning varied with different seats)
- d. Large, brightly coloured paintings hung on the wall

During the final session of the experiment, participants were told they were allowed to remove the smock and change seat if they desired; despite both disturbances causing initial complaints among the participants, only one person took this opportunity and decided to take off her smock at the first suggestion and 53 per cent kept it on despite a later, more strongly worded suggestion. None expressed a desire to change to a more convenient seat. For the final session, the metronome was also stopped (this happened during the course of the session) and the paintings removed (before the session), upon which the participants were asked whether they had noticed the change and whether they would prefer to have them reversed. Despite initial complaints with regards to the metronome, three participants wanted it turned back on and nine answered they were indifferent. For the paintings, ten participants had not even noticed they were now missing, but nine answered that they wanted them back.

In addition to the disturbances above, the exposure effect was also tested for within the context of the experiment itself. These were:

- e. Participants were shown not well-known paintings by a range of famous artists, which were during the last session supplemented with a similar quantity of comparable paintings

- f. At each session a number of unfamiliar (Russian) female names were read out loud; these were during the last session supplemented with the same number of new unfamiliar (also Russian) names

During the final session, after the participants had been exposed to the added range of paintings/names, they were asked to rate them on beauty/euphony and on a like-dislike scale. For both paintings and names, the more familiar ones achieved a statistically significant higher rating.

The exposure effect was also tested for by changing certain elements in the design of the ‘fake’ experiment and the tools assigned to the participants for the completion of it towards the final sessions. These were:

- g. The sudden introduction of red rubber bands (previously all rubber bands had been grey); the bands were used to hold together cards on which assignments were completed
- h. The introduction of a new type of paper clip, together with the one previously used
- i. The introduction of a choice between orange and yellow blotters (up until then, only yellow blotters had been available)
- j. The introduction of a choice between lined and unlined cards on which to complete assignments (previously, only unlined cards had been offered)
- k. The opportunity to choose a new book from which to copy sentences (one of the assignments)
- l. The opportunity to change from copying whole sentences to copying only the significant part
- m. The opportunity to change from copying sentences to coming up with original sentences (thus discarding the book used for the initial sessions)

- n. The opportunity to change from a rather cumbersome marking scheme (comprising the numbers 1, 2, 5, 8 and 9) to the simpler T, ?, F system for a True-False test, which was part of the 'fake' experiment
- o. The opportunity to choose between a yellow paper and a blue book with which to complete some of the tasks, when only the former had been available for the first sessions
- p. The opportunity to choose between two kinds of cookies (served during a break in the middle of each session), when only one of the cookies had previously been presented
- q. The opportunity to switch to using a pencil rather than a fountain pen (writing with ink was cumbersome due to the nature of the underlying paper for some of the tasks), when only fountain pens had been allowed for the first sessions

The results of these additional tests did not all go in the same direction; e.g. for the rubber bands, participants seemed to simply reach for the one most convenient, regardless of colour. For the cookies, a very large majority decided to take one of each, which would be the polite way of acting. However, at the announcement that with the sessions coming to an end, the cookies should be finished off, 73 per cent chose the familiar kind (in a control group, which had not received the continuous exposure to this particular kind of cookie, only 54 per cent chose it over the second type). On the other hand, when presented with the choice of switching to using the more convenient pencil, seven participants opted to remain with the original fountain pen. Though these participants by themselves did not constitute a majority, four out of the eight students that had opted for the pencil instead immediately switched back to the fountain pen when presented with a task during which paper more susceptible to ink (though not cumbersome to write on using a pencil) was used, despite being told beforehand that they would not be allowed to change back.

Because of the mixed results, Maslow draws the conclusion that there appears to be an exposure effect present, but that this is not the sole explanation for the behaviour of the participants. The strength of the effect seems to vary with individuals and also compete with other effects, e.g. the desire to act politely (in the case of cookies). It also seems as if the exposure effect is not present when the choice of one option over another represents a negligible difference in familiarity-induced utility; e.g. the introduction of a second colour among the rubber bands was not enough to trigger it, instead participants opted for the one that could be grabbed most conveniently regardless of colour.

Maslow chooses to emphasize the results from the experiments on paintings and foreign names, as those tests were treated most adequately and the data most easily analysed from a statistical point of view. These results strongly point in the direction of previous familiarity having a positive effect on liking.

4.1.2 Zajonc (1968): The Attitudinal Effects of Mere Exposure

Zajonc (1968) builds upon a vast array of research conducted on the exposure effect (including Maslow, 1937). He is, however, able to further strengthen this theory both by exposing it in out-of-laboratory settings and, when confined to the constraints of laboratory experiments, by avoiding many of the noise factors present in previous similar research.²

Zajonc (1968) is first able to conclude that words that are more prominently occurring in printed media are preferred over their less frequent antonyms.³ E.g., 100 per cent of participants preferred “able” over its antonym “unable”; “able” is also used 3.89 times

² E.g., most previous research had relied upon experiments in class with participants orally

³ A word’s antonym is its opposite, e.g. “war” is the antonym of “peace”.

more often than “unable”, according to the Thorndike-Lorge count.⁴ That the actual meaning of the word “able” is clearly more positive than its antonym does not explain why the same pattern is seen for more neutral antonym pairs such as on/off, above/below, long/short and inner/outer, indicating that the causality should run in the direction of exposure affecting preferences and not the other way around. (N.B.: This is not the same as saying the entire effect on preferences is due to the exposure effect; as is evident from the tables in Zajonc, 1968, antonym pairs where the meaning of one word clearly has a more positive connotation than the other show stronger differences in preferences.) This evidence is then further supported by a separate study that instead allows participants to state their preferences with regards to various trees, fruits, vegetables and flowers, where the frequency of use in printed media and average preference rating are highly correlated.

Zajonc (1968) then goes on to conduct three experiments of his own. First, he asks 72 participants to indicate on a seven-point scale the degree of positivity they associate with twelve seven-letter nonsense words (participants had been told all the words were Turkish adjectives) after having been showed and asked to pronounce them 0, 1, 2, 5, 10 or 25 times at a previous stage in the experiment (the frequencies according to which the different words were shown were randomised, as was the order in which they were shown). The difference in perceived positivity between words of lower and higher frequencies was highly significant.

In order to avoid a bias effect as the result of higher frequencies of exposure leading to pronouncing becoming easier, which could potentially by itself render a more positive rating from participants, a second experiment was conducted. In this case, instead of words, Chinese characters were used and participants were told they represented

⁴ Thorndike and Lorge put together the first word frequency list for the English language, manually counting and listing 18,000,000 words. The list was published in 1944.

adjectives. In this way the pronouncing part disappeared altogether as participants were simply shown the characters (at randomised frequencies and in randomised order) and then asked to rate them on good-bad scale. The difference in perceived positivity between characters displayed with different frequencies was again highly significant.

In his third experiment, Zajonc (1968) showed participants twelve pictures of male faces; each picture was shown a different number of times with the frequency randomised across the participants. Participants were then asked to rate on a seven-point scale how much they liked the man in each picture. Though less pronounced (in nine out of twelve cases there was a visible effect), the difference was still statistically significant.

4.1.3 Alter and Oppenheimer (2008): Easy on the Mind, Easy on the Wallet: The Role of Familiarity and Processing Fluency in Valuation Judgments

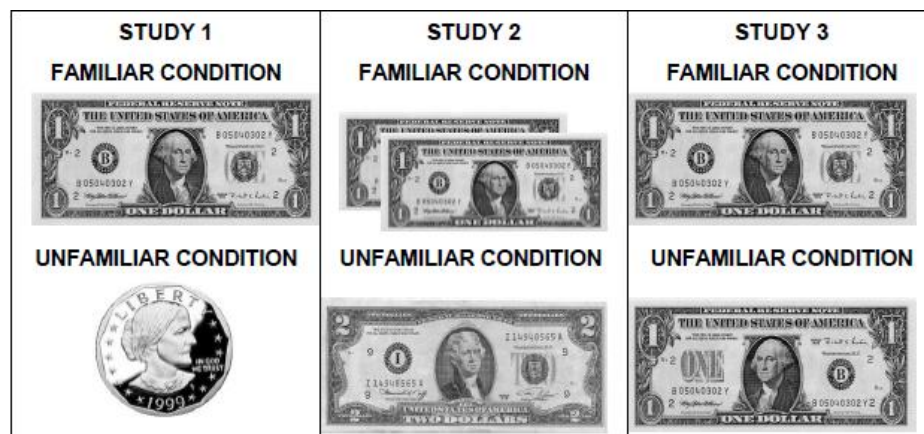
Alter and Oppenheimer (2008) attempt to move the theory of the exposure effect into an economic setting by testing whether previous familiarity with currencies affects the perceived value of these in terms of purchasing power. Alter and Oppenheimer's hypothesis was that less previous exposure to a certain type of currency renders it more difficult to process and results in a lower perceived economic value. They conducted three experiments on Princeton University students and commuters, first showing them a certain currency and then asking the participants to name the number of ten different items they thought could be purchased with the use of the currency in question. Participants were for each experiment split into two treatment groups, with one allowed to consider a currency deemed familiar, while the other was shown an unfamiliar type of currency. The experiments were as follows:

- a) a regular one-dollar banknote (familiar) versus a Susan B. Anthony one-dollar coin (unfamiliar); 37 participants

- b) two regular one-dollar banknotes (familiar) versus a regular two-dollar banknote (unfamiliar); 39 participants
- c) a regular one-dollar banknote (familiar) and a manipulated⁵ one-dollar banknote (unfamiliar), plus a regular one-dollar banknote and the goods to be purchased written in a form less easily processed⁶; 58 participants

Banknotes and coins for the three treatments are shown below.

Fig. 1 Alter and Oppenheimer (2008) treatments



Estimations on the amount of goods the participant thought could be purchased using the displayed currency were turned into standardised Z-scores, in order to measure the estimates for expensive and cheaper goods on the same scale, thus being able to construct one mean estimate for the entire range of goods.⁷ It was then found that, indeed, participants tended to underestimate the purchasing power of lesser-known currencies with p-values of .015 (one-dollar banknote vs. one-dollar coin), .002 (two-dollar banknote vs. two one-dollar banknotes) and .018 (one-dollar banknote vs. manipulated one-dollar

⁵ The manipulation consisted of subtle alterations to the exterior, e.g., George Washington's head being turned to face the left instead of the usual right, the "ONE" seal which on a correct banknote would be on the backhand side being moved to the front and the position of the treasurer's signature being altered.

⁶ Goods were here written in a grey, ten-point Arial font, rather than the normal black, twelve-point Times New Roman font. This treatment was conducted in order to test the hypothesis that goods less easily processed would be valued less, in the same way as less common currencies are.

⁷ For an evaluation of the statistical method used, please see the Discussion part of this thesis.

banknote) obtained.⁸ Alter and Oppenheimer draw the conclusion that the amount of previous exposure to a coin or banknote has a significant effect on its perceived purchasing power and this could be a potential explanation for such confusion at around the time of introducing the euro in many countries. The authors also claim their results mean that central banks should be cautious when making alterations to the existing range of coins and banknotes, as such changes could have unexpected consequences on perceived rates of inflation.

4.2 Research related to other difficulties at valuing currency

Though the particular field of research represented by Alter and Oppenheimer (2008) is a fairly new one with little having been written about it, there are several other research fields that are closely related to it, as they, too, deal with problems which arise while attempting to value the purchasing power of money. The term *money illusion* is used to describe such problems related to issues separating nominal from real values; a commonly cited example is difficulties estimating the effect of inflation on the real value of an increase in the nominal pay rise (see e.g. Marschak, 1943 for some early statistical work on this phenomenon). According to Dusansky and Kalman (1974), a person is suffering from money illusion if “his demand for commodities is affected by an equi-proportionate change in nominal income, initial nominal balance and commodity prices”. Shafir, Diamond and Tversky (2001) cite the result of several surveys that indicate that money illusion is not a mere theoretical possibility, but that it is in fact very much present in the minds of people as they attempt to determine the purchasing power of various currencies.

Branson and Klevorick (1969) are able to show that money illusion is also noticeable on the entire U.S. economy, as nominal wage increases have an effect on real demand for

⁸ As the treatment in which the goods themselves were made less easily processed is not very relevant for this thesis, we will not dwell on those results.

consumption. This result is of particular interest to this paper, as it offers evidence pointing to the fact that individuals' problems at real valuation of currency can in fact potentially affect the economy of an entire country. Fehr and Tyran (2001) build further upon this research and find that, in an experimental setting, negative nominal shocks have a substantially larger impact on behaviour than positive shocks. Also, interestingly, they find that it is not necessary for the entire set of participants to be affected by money illusion for the aggregated effect to be large. In effect, a small group can create significant welfare losses for the entire set of participants, due to the fact that it takes longer to reach a new equilibrium. Fehr and Tyran (2007) show that initial money illusion has lasting effects on equilibria if strategic uncertainty prevails, despite the fact that participants learn to see through the difference between nominal and real values by playing repeated games. In another type of setting, Kooreman, Faber and Hofmans (2004) claim that money illusion as a result of introducing the euro in the Netherlands partially lie behind increasing revenues of a particular charity organisation.

Factors other than money illusion also compromise people's abilities to estimate the value of goods. Among others, Prelec and Simester (2001) have shown that the use of a credit card for making a payment significantly increases the willingness to pay, compared to when cash is used. Mishra, Mishra and Nayakankuppam (2006) show how people are more reluctant to spend money to buy a particular item if the sum is presented as one large banknote rather than split up across several banknotes of smaller denominations, a phenomenon they refer to as "a bias for the whole". Raghurir and Srivastava (2002) on their hand show how people have large difficulties in attempting to correctly estimate the real value of foreign currency, something that appears to be the result of heavily depending on an anchoring effect in order to work one's way towards the estimate.

Of the above described phenomena, none are expected to affect the outfall of the experiment in this thesis, however money illusion and the anchoring effect in Raghurir and Srivastava (2002) could arguably be considered to be strong competitors in the real world, such as when attempting to explain the difference between perceived and actual inflation after introducing the euro.

5 Methodology and execution

5.1 Experimental methodology

In order to ascertain whether Alter and Oppenheimer's (2008) results would hold up in a Swedish setting, a similar experiment was conducted. Three treatments were used; the first contained a 1000 SEK banknote, the second a 500 SEK banknote and the third two 500 SEK banknotes. The rationale behind this choice of currency was that 1000 SEK banknotes are very rare in the sense that such sums are normally paid for using a bankcard in Sweden. They are also seldom distributed by automatic teller machines. Anecdotal evidence also suggest some stores do not even accept them as payment. Since they constitute the largest SEK denomination at present, chances that somebody would receive it in the form of change must be considered miniscule. Therefore, it is a reasonable assumption that the exposure to this banknote for the participants would have been very limited.⁹

⁹ It could plausibly be argued that the preferred method of payment could vary with age, with older people more inclined to use cash even for more expensive purchases, not having come of age using bank cards initially. Presumably, under such an assumption older people would be less probable to fall victim to the exposure effect in this case. As participants in this experiment were all reasonably young, the assumption of previous limited exposure to the 1000 SEK banknote should, however, still hold.

Fig. 2 1000 SEK and 500 SEK banknotes



The 500 SEK banknote, on the other hand, is the most frequent Swedish banknote in circulation (Riksbanken, 2011b).¹⁰ The treatment containing two 500 SEK banknotes was included in order to make sure that there would be a treatment in which the total sum of the currency displayed would be the same as in the 1000 SEK treatment. However, it was also necessary to include a treatment containing a single 500 SEK bill, so that the potential effect from displaying *two* banknotes rather than *one* could also be controlled for.

¹⁰ Even though the 500 SEK banknote is the most common denomination in Sweden, it could be argued that using an even smaller denomination, e.g. 100 SEK, might have yielded an even higher degree of familiarity among the participants, as it can be argued that, often, purchases potentially requiring the use of a 500 SEK bill would also be accomplished using a bank card. However, for the sake of comparison, it was deemed more appropriate to not make the nominal difference too wide between the different treatment groups. It was also believed that the difference in familiarity between 500 SEK and 1000 SEK banknotes among the participants was high enough in order to still make the supposed effect visible.

Participants were recruited among students at the Stockholm School of Economics, Stockholm University and Viktor Rydberg Gymnasium in Stockholm. Participants from the different pools were randomized and distributed equally across the three treatments in order to avoid potential bias effects related to age and/or other potential factors, such as background, choice of major, and others. All in all, 85 participants were divided equally between the three treatments. Due to the nature of the experiment, only Swedes were recruited as participants.

For most participants, the experiment was conducted in formal sessions with 10-20 participants present, however in some cases, due to participants not being able to attend the formal sessions, individual or smaller sessions were applied.

Participants were given a form to fill out (samples included in the appendix) containing a colour image of the currency in question at the top. (At all sessions, the three different treatments were handed out in equal amounts, thus guaranteeing that participants were randomly assigned to one of them.) Participants were given instructions not to discuss the form with other participants during the lapse of the experiment and address questions only to the facilitator. They were first asked to answer a few standard questions relating to age and sex, which were followed by a request to look carefully at the displayed currency and then rate it according to its aesthetic value on a scale of 1 to 6. This question was included in order to make sure that participants had actually *looked* at the banknote before answering the following questions and not only taken the nominal value into account, as such an outcome would likely have done away with any potential exposure effect.

Participants were then asked to estimate the quantity of four different goods that they deemed could be purchased using the displayed currency. The goods were selected based on two criteria in particular:

- i) Participants should have had a reasonable exposure to the goods in question beforehand
- ii) Goods should be of such a limited economic value per piece that a continuum of goods was created¹¹

The goods chosen were:

- a) sweets of the *Dumle* kind (pieces)
- b) pencils (pieces)
- c) apples (pieces)
- d) milk (litres)¹²

Goods a–c had been chosen as they bore a close resemblance to the goods used by Alter and Oppenheimer (2008). Milk was included to ascertain whether the effect identified by those authors would also be present for a good for which the price is generally well-known, which in that case would have served to offer further strength to their argument.

5.2 Potential weaknesses of the experimental method

The laboratory setting of the experiment provided an artificial environment quite distant from a regular purchase situation and it could be argued that the results might not be transferable to the real world. This is a valid point, however it should be noted that this is the case with most economic experiments (including Alter and Oppenheimer, 2008); thus, it fits well with the existing body of literature and results should therefore be comparable.

¹¹ Consider the difference between apples and household appliances. For 1000 SEK common sense predicts only a few potential household appliances could be bought, leaving participants with few options to choose between. The amount of apples, on the other hand, is far more difficult to estimate exactly.

¹² For milk, it was specified that regular, not ecological, was asked for.

Another potential weakness concerns the selection of participants. Even though students have for a long time been the preferred category when conducting economic experiments (mostly because of their easy availability), they do not constitute a random sample of the entire population. It could be argued that such a sample, due to age, socioeconomic background and other similar factors, would prove poor representatives of the global band of consumers. This, too, is a valid point. However, since the exposure effect could be considered as a general psychological phenomenon, unrelated to factors such as age and previous experiences, this should prove less a problem than what might be the case for other types of experiments. It could, though, plausibly be argued that the exposure effect would be likely to affect different people to different degrees, but there are no reasons to believe the distribution should differ from the population at large. However, it could still be argued that the assumed lower average age among the student population could mean participants are less accustomed to buying certain goods, which could perhaps affect the results. With this in mind, the goods were chosen on the basis that participants should have had reasonable previous exposure to them, as stated in the section above.

Compared to the study by Alter and Oppenheimer (2008), this experiment used far larger denominations and it is possible this fact could distort the results. The choice of denominations was necessitated by the need to find an existing currency uncommon enough to potentially trigger an exposure effect. With lower denominations being very commonly occurring, the case for an exposure effect to make itself present when faced with a pair of such banknotes (or coins) would be extremely weak and it could probably safely be assumed it would play no role.

With participation in the three different treatments being randomised across subjects in one and the same session, it is possible that subjects might have noted people were filling out different forms. This could perhaps subconsciously affect the cognitive process by which answers to the questions were achieved. In order to avoid such effects, participants were seated not too adjacent to one another, or, when such an arrangement was not possible, screens were placed between subjects. This does not do away entirely with the problem, however no observations of participants recognising other categories of forms than their own were recorded during the conduct of any session.

5.3 Statistical methodology

The choice of statistical method for this thesis was not entirely clear cut. While Alter and Oppenheimer (2008) standardized all answers into Z-scores and then used ordinary t-statistics to come up with a result, this method alone appeared not satisfactory, for a number of reasons. Firstly, it was deemed preferable to compare the estimates for each good independently of the others, as this would provide stronger support for the influence of the exposure effect than would an aggregated analysis. Secondly, due to the high number of statistical outliers, a non-parametric Mann-Whitney U-test test would likely offer more robust results, as this test is not as strongly affected by outliers. The case for Mann-Whitney was further strengthened as a Kolmogorov-Smirnov test failed to support that estimates were normally distributed for one treatment for apples and milk, respectively. (For a run-through on when to use t-statistics and Mann-Whitney, respectively, see e.g. Fay and Proschan, 2010). Because of this, it was decided to report the results both using t-statistics and Mann-Whitney for individual goods and also include an aggregated Z-score test à la Alter and Oppenheimer (2008) for comparison's sake. The answers to the question of perceived aesthetic value were also analysed and are presented as a curiosity in the end.

6 Results

6.1 Descriptive results

Means and standard deviations on the perceived purchasing powers obtained from the experiment are presented in *Table 1*. To make numbers comparable, the results from the 500 SEK treatment have been multiplied by a factor of 2.

Table 1 Means and standard deviations

Mean (standard deviation)	1000 SEK	500 SEK	2 x 500 SEK
Dumle sweets	853 (521)	1003 (890)	984 (721)
Pencils	358 (332)	405 (451)	337 (291)
Apples	306 (186)	328 (175)	238 (162)
Milk (litres)	120 (22)	119 (32)	142 (47)

6.2 Analysis using t-statistics

A double-sided t-test was conducted; since participants were randomized across the different treatments, we can consider the samples to be independent. A p-value of 0.10 should be considered reasonable for which to reject the null hypothesis that the mean purchasing powers are the same. Results are presented in *Table 2*. With only one instance of the p-value being less than 0.10, with the others ranging from 0.16 to 0.96, the null hypothesis could not be rejected.

Table 2 Student t-test analysis

P-values (mean x = mean y)	1000 vs 2x500	1000 vs 500	500 vs 2x500
Dumle sweets	.46	.47	.93
Pencils	.82	.67	.53
Apples	.16	.67	.06
Milk	.92	.96	.95

6.3 Analysis using Mann-Whitney U-test

As can be observed in *Table 3* below, the Mann-Whitney test, too, failed to offer any support for there being any difference between the central locations of the perceived purchasing power of the currency between different treatments. The seemingly strong numbers for two of the apple treatments do not appear to be transferable to any of the other goods, where sigma range between 0.31 and 1.0. Thus, neither using this method could the null hypothesis be rejected.

Table 3 Mann-Whitney U-test analysis

Assym. two-sided sigma (median x = median y)	1000 vs 2x500	1000 vs 500	500 vs 2x500
Dumle sweets	.61	.90	.75
Pencils	.99	.31	.54
Apples	.00	.58	.00
Milk (litres)	.94	.80	1.0

6.4 Analysis using aggregated Z-score analysis

For this analysis estimates for each good were standardised into Z-scores across treatments, after which a mean score comprising all goods for each treatment was calculated. Then the null hypothesis that the mean Z-score for treatment x was the same as the mean Z-score for treatment y was tested using t-statistics. Results are displayed in *Table 4*. As can be seen, the aggregated analysis, too, fails to identify any difference between the perceived purchasing power in various treatments. With p-values in the range of 0.26 and 0.63, the null hypothesis could not be rejected.

Table 4 Student's t-test analysis using aggregated Z-scores

P-values (mean x = mean y)	1000 vs 2x500	1000 vs 500	500 vs 2x500
Aggregated Z-score	.63	.44	.26

6.5 The aesthetic value of banknotes

As data had also been collected for the aesthetic value of the currency perceived by the respondents (though only as a manipulative question), these results were also analysed. Means and standard deviations are displayed in *Table 5*.

Table 5 Means and standard deviations for perceived aesthetic value of banknotes

Aesthetic value	1000 SEK	500 SEK	2x500 SEK
Mean (standard deviation)	3.42 (1.06)	3.96 (.62)	4.26 (.86)

Table 6 displays the p-value for testing the hypothesis that mean perceived aesthetic values are the same.

Table 6 Student's t-test analysis for aesthetic value of banknotes

P-values (mean x = mean y)	1000 vs 2x500	1000 vs 500	500 vs 2x500
Aesthetic value	.00	.03	.17

As can be seen, it can be said with sufficient statistical significance that the perceived aesthetic value of 1000 SEK banknotes is lower than that for 500 SEK banknotes; this would seem to be the only significant result of this thesis. That the p-value is relatively high for the comparison between one 500 SEK note and two 500 SEK notes should come as no surprise.

7 Discussion

This thesis has not been able to confirm the results presented in Alter and Oppenheimer (2008), as it has not found any evidence in support of the hypothesis that the exposure effect would play a role in estimating the real value of currency. There are several potential explanations for this fact.

Though the experiment in this thesis was designed with the purpose of achieving as close a resemblance to the original one as possible, it was not an exact replica. In order to find a

banknote uncommon enough for participants to look at, 1000 SEK had to be used, which is worth significantly more than the \$1 and \$2 denominations used by Alter and Oppenheimer (2008). It is not inconceivable to assume that with such large denominations the task to quantify the amount of relatively very inexpensive items becomes more difficult. That participants indeed found the task hard is confirmed by the often very large standard deviations recorded among their estimates. However, one could argue that with such difficulties, the role of the exposure effect, if present, would probably increase in significance, as participants would have to rely on similar cognitive measures.

There is also a discrepancy between the statistical methods used to analyse the results from the two sets of experiments. While in this thesis, the main analysis is comprised of a comparison between the mean estimate of a particular good in one treatment to the mean estimate of the same good in another treatment, Alter and Oppenheimer first standardise the estimates into Z-scores in order to compare all goods across a single scale for each treatment (which is done in this thesis only as a way to ensure comparability with Alter and Oppenheimer). As their raw data is not presented, it is not possible to draw any conclusions with regards to whether the difference is significant among all the goods and not just on the aggregated level. However, when faced with mean estimates of the single goods in each treatment, it is obvious that Alter and Oppenheimer's participants, too, found the estimation part quite difficult. E.g., even though the mean perceived purchasing power per USD for Hershey's kisses in one experiment was 21.27 pieces for the familiar condition and only 14.19 pieces for the unfamiliar one (which would seem to offer support for the authors' hypothesis), in another experiment it was 25.86 pieces for the unfamiliar condition, i.e. higher than for the familiar condition in the first experiment (which would make no sense if the exposure effect played a significant part). For four out of the ten goods participants were asked to consider, this observation in fact holds true; for

another three, the difference is so small it could not possibly be statistically significant. Continuing our cross-experimental analysis, there is something even more telling, which is that in the two experiments where some participants were asked to estimate the purchasing power of one genuine (familiar) one-dollar bill, the estimates vary quite substantially; e.g. 70.67 vs. 47.50 (paperclips), 9.88 vs. 3.33 (wrapping paper, square feet), 10.75 vs. 39.90 (Mexican pesos) and 57.08 vs. 13.60 (skittle candy). This observation holds true for no less than eight out of ten goods. To summarise: the same \$1 banknote renders very different mean purchasing power estimates.

The vulnerability of Alter and Oppenheimer's data is further strengthened by the low number of observations; if we assume that participants in each experiment were split evenly among the treatments, we end up with a maximum of twenty participants per treatment, which in most cases would be considered too few, especially with regards to the ambivalence of their results.

The above stated critique against Alter and Oppenheimer (2008) does, however, not mean that the exposure effect could be ruled out as a factor affecting how people value the purchasing power of money. The experimental setting brings with it an artificial aura, quite far from the natural environment in which people make their everyday purchase decisions. It might simply be that this effect is difficult to capture in an unnatural setting. It is also possible that participants reverted to mathematics and used the price they thought appropriate for the various goods and then simply divided the sum in front of them by this number. This would presumably do substantial damage to any attempt at capturing psychological effects that might affect the way we value money in a natural setting. The wide range of purchasing power estimates obtained would, however, seem less likely if many participants had reverted to such tactics.

There is also the possibility that the selection of subjects could have affected the outcome. Even though, for practical reasons, a very common method to gather enough participants is to make use of students, this of course does not constitute a random sample of the population at large. Students are younger and perhaps more analytical in their way of reasoning compared to non-students. However, in this case it should matter less as most of the papers quoted in this thesis have also used students for their experiments and still achieved their results.

Finally, it could not be ruled out that cultural differences between Swedish and American participants could have affected the outcome, though with similar difficulties in reaching a consensus about the purchasing power of one and the same bill, this does not seem all too likely.

8 Conclusions

This thesis has not been able to transfer the findings of Alter and Oppenheimer (2008) to a Swedish setting and finds no support for there being any difference between the perceived purchasing power of 1000 SEK and 500 SEK banknotes, respectively.

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Appendix 1 - 1000 SEK form



Välkommen till detta experiment i nationalekonomi! Experimentet går till på så vis att du ombeds besvara frågorna i denna enkät. Under den tid då experimentet pågår ska du ej kommunicera med övriga experimentdeltagare – eventuella frågor som uppstår under genomförandet får bara ställas till experimentledaren. Räck vid behov upp handen för att påkalla experimentledarens uppmärksamhet.

1. Jag är född år:
2. Jag är (ringa in ditt svar): man kvinna
3. Överst på den här sidan ser du en bild av en svensk 1000-kronorssedel. Titta noga på sedeln och ange sedan hur vacker du tycker att den är med hjälp av följande skala:
1: Mycket ful
2: Ful
3: Ganska ful
4: Ganska vacker
5: Vacker
6: Mycket vacker

Skriv ditt betyg här:

4. Uppskatta antalet av följande varor, som du borde kunna köpa för den avbildade sedeln:
- | | |
|-------------------------------|-------------|
| a) Dumlekolor | _____ st |
| b) Blyertspennor | _____ st |
| c) Äpplen | _____ st |
| d) Mellanmjölk (ej ekologisk) | _____ liter |

Appendix 2 - 500 SEK form



Välkommen till detta experiment i nationalekonomi! Experimentet går till på så vis att du ombeds besvara frågorna i denna enkät. Under den tid då experimentet pågår ska du ej kommunicera med övriga experimentdeltagare – eventuella frågor som uppstår under genomförandet får bara ställas till experimentledaren. Räck vid behov upp handen för att påkalla experimentledarens uppmärksamhet.

5. Jag är född år:

6. Jag är (ringa in ditt svar): man kvinna

7. Överst på den här sidan ser du en bild av en svensk 500-kronorssedel. Titta noga på sedeln och ange sedan hur vacker du tycker att den är med hjälp av följande skala:

1: Mycket ful

2: Ful

3: Ganska ful

4: Ganska vacker

5: Vacker

6: Mycket vacker

Skriv ditt betyg här:

8. Uppskatta antalet av följande varor, som du borde kunna köpa för den avbildade sedeln:

a) Dumlekolor _____ st

b) Blyertspennor _____ st

c) Äpplen _____ st

d) Mellanmjölk (ej ekologisk) _____ liter

Appendix 3 – 2 x 500 SEK form



Välkommen till detta experiment i nationalekonomi! Experimentet går till på så vis att du ombeds besvara frågorna i denna enkät. Under den tid då experimentet pågår ska du ej kommunicera med övriga experimentdeltagare – eventuella frågor som uppstår under genomförandet får bara ställas till experimentledaren. Räck vid behov upp handen för att påkalla experimentledarens uppmärksamhet.

Jag är född år:

Jag är (ringa in ditt svar): man kvinna

Överst på den här sidan ser du en bild av två svenska 500-kronorssedlar. Titta noga på sedlarna och ange sedan hur vackra du tycker att de är med hjälp av följande skala:

- 1: Mycket fula
- 2: Fula
- 3: Ganska fula
- 4: Ganska vackra
- 5: Vackra
- 6: Mycket vackra

Skriv ditt betyg här:

Uppskatta antalet av följande varor, som du borde kunna köpa för de två avbildade sedlarna tillsammans:

- a) Dumlekolor _____ st
- b) Blyertspennor _____ st
- c) Äpplen _____ st
- d) Mellanmjölk (ej ekologisk) _____ liter

Appendix 4 - 1000 SEK form (English translation)



Welcome to this experiment in economics! In this experiment you will be asked to fill out this questionnaire. During the course of the experiment you are not to communicate with other participants – questions should only be submitted to the facilitator. If needed, please raise your hand in order to call the facilitator.

My year of birth is:

My sex is (please circle answer): male female

At the top of this page a Swedish 1000 SEK banknote is displayed. Please look at it carefully and rate how beautiful you think it is using the below scale:

- 1: Very ugly
- 2: Ugly
- 3: Fairly ugly
- 4: Fairly beautiful
- 5: Beautiful
- 6: Very beautiful

Please write you rating here:

Now, please estimate the amount of the following goods that you should be able to purchase using the displayed banknote.

- a) Dumle sweets _____ pieces
- b) Pencils _____ pieces
- c) Apples _____ pieces
- d) Milk (not ecological) _____ litres