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A. Introduction

First of all, it is important to state that my project is a recreation of an economic experiment published in *Psychonomic Bulletin & Review*[1] designed and conducted in 2007 by Adam Alter and Daniel Oppenheimer, a pair of psychologists at Princeton University.

Normally travellers should spend their foreign money based on its value in the currency of their home country. Although it has been observed that travellers spend their foreign cash as if it were monopoly money. If economic rational reigns supreme people should spend their money, regardless of the form it takes, based on its value in the global market at a given time.

A similar phenomenon has been observed of even familiar currencies. The aim of my project is to determine if the value of a dollar changes depending on the form that dollar takes.

I asked volunteers to estimate how many simple objects – gumballs, paperclips and pencils – they could purchase with either a US standard dollar bill or a Susan B. Anthony dollar coin that was presented to them. (Susan B. Anthony dollars are legal tender but, having been produced only from 1979-81 and then again in 1999, they are rarely seen in circulation).

After the volunteers had made their estimates, I asked them to indicate on a scale from 1 to 7, how familiar they were with either the bank note or the coin. They were almost all more familiar with the banknote than the coin. Can it be said that the more recognizable the form of dollar the more people subconsciously think that it is worth?

***Task**: Decide whether or not if there is a correlation between familiarity and estimated purchasing power.*

***Plan**: Survey the maximum amount of people possible with different familiarity levels. Analyse data in attempt to find a correlation and draw a conclusion.*

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[1] The Economist

B. Information/Measurement

There were exactly 100 volunteers who participated in this study. 50 were presented with the bill and 50 with the coin. Each volunteer was between the ages of 16 and 18 years old, and are in the same international high school.

Sorted Raw data collected:

Number of items volunteers estimate the he/she can buy with a one ***dollar bill.***

Familiarity	Gumballs	Paper clips	Pencils	Napkins	Sweets
1	1	1	3	2	3
1	5	24	1	40	5
1	4	50	5	100	12
3	10	20	1	4	20
3	4	10	2	12	2
3	1	3	2	7	5
3	3	10	3	10	3
3	4	10	5	25	6
3	5	20	2	5	10
3	25	30	1	40	30
3	20	50	11	200	50
3	10	100	2	50	10
4	5	10	4	50	50
4	50	100	4	60	3
4	5	20	10	30	10
4	10	100	1	50	10
5	30	250	5	100	50
5	10	50	5	100	20
5	4	20	1	50	50
5	10	5	5	80	12
5	2	50	3	99	10
5	6	50	0	100	2
6	15	30	5	50	20
6	4	30	8	15	8
6	4	25	5	100	6
6	40	50	2	50	20
7	10	200	10	200	90
7	10	205	5	300	80
7	15	50	6	60	30
7	4	50	4	50	20
7	3	50	5	150	20
7	4	25	10	50	100
7	12	100	10	300	20
7	12	100	10	50	40
7	4	200	9	50	100
7	4	170	7	75	12
7	4	50	2	200	70
7	6	100	3	10	60
7	2	50	3	99	80

7	2	75	3	99	15
7	4	70	4	100	20
7	4	100	12	50	100
7	4	50	10	80	80
7	10	250	9	99	100
7	48	40	2	40	20
7	6	32	3	99	11
7	15	20	10	20	50
7	40	250	12	200	50
7	43	150	12	200	50
7	40	120	10	300	50

Numbers of items volunteers think he/she can buy with a one ***dollar coin***

Familiarity	Gumballs	Paper clips	Pencils	Napkins	Sweets
1	2	100	2	50	6
1	10	10	2	5	10
1	3	50	0	10	5
1	2	15	3	0	15
1	3	100	4	100	20
1	3	50	1	1	5
1	2	50	1	10	2
1	5	10	2	20	10
1	0	30	1	20	4
1	10	30	1	75	15
1	4	20	3	4	20
1	20	15	10	15	25
1	10	1	0	0	5
1	5	100	5	200	25
1	20	10	2	100	15
1	60	60	2	1	3
1	20	150	10	20	25
1	4	50	10	50	10
1	6	90	1	0	20
1	50	2	1	20	10
1	5	10	3	100	10
1	4	50	3	10	20
1	5	70	5	30	6
1	10	100	5	50	20
1	0	0	1	0	0
1	20	50	10	50	15
1	6	5	1	4	10
1	2	5	0	50	12
1	8	40	3	10	15
2	3	50	4	20	5
2	1	30	6	100	10
2	1	10	1	10	7
2	4	200	10	50	5
2	5	0	0	1	2
2	2	50	5	100	10
2	2	5	2	30	18
3	5	50	10	50	5
3	4	20	3	12	3
5	20	100	2	40	2
5	4	200	2	100	21
5	4	50	4	120	2
6	4	200	2	100	21
7	20	100	12	200	20

7	4	200	4	100	20
7	50	150	2	300	60
7	4	200	2	100	21
7	4	10	5	20	80
7	4	60	12	250	2
7	9	200	2	150	100
7	4	200	10	40	100

It appears that most people either said that they were very familiar (7) or very unfamiliar (1) with the bill or coin.

50 people looking at the coin: 29 volunteers put a 1 level of familiarity and 8 people put 7. Therefore 37 volunteers were in the extreme levels of familiarity. There are also a majority of the candidates who are very unfamiliar with the coin; this could be expected because the US dollar coin is rarely seen in circulation.

50 people looking at the bill: 24 volunteers put a 7 level of familiarity and 3 people put 1. Therefore 27 were in the extreme levels of familiarity. A majority of candidates were very familiar with the bill.

This would suggest that many people may have never seen the bill or coin before and if they did not know the exchange rate in comparison to their local currency their estimations could be somewhat random. The people who easily recognised the bill or coin are most likely Americans or people who frequently travel to the United Stated, their estimations may therefore more educated.

**Some of the results were much too high and I did not take them seriously and they are not apparent on in the raw data.*

C. Mathematical Processes

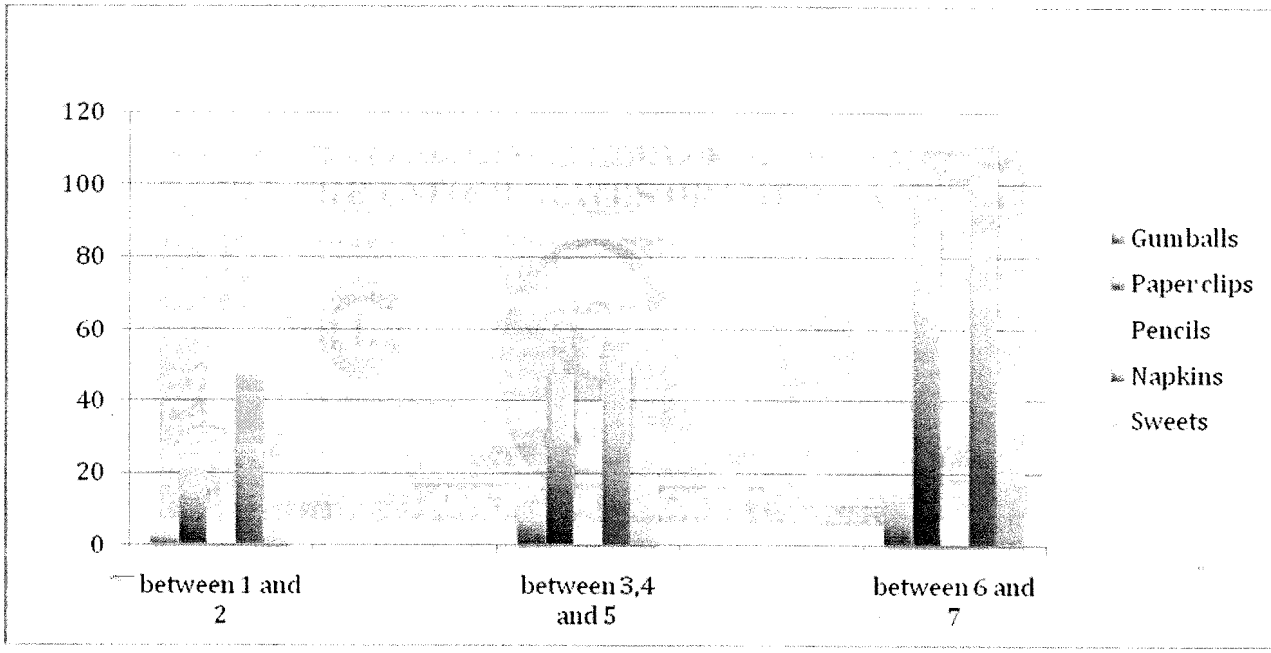
*All values in tables are given correct to 2 d.p.

In this section I am looking to possibly establish a correlation between Familiarity and how much people think they can buy.

Table 1: Mean number of products that people perceived to be able to purchase with a one dollar bill according to how familiar they were with it.

	Between 1 and 2	Between 3,4 and 5	Between 6 and 7
Gumballs	3.33	11.30	13.18
Paper clips	25.00	47.79	94.36
Pencils	3.00	3.53	6.82
Napkins	47.33	56.42	110.57
Sweets	6.67	18.58	47.21

Graph 1: Bar chart representing the mean amount of products that a consumer perceives to be able to purchase with a one dollar bill in accordance with how familiar they were with it.

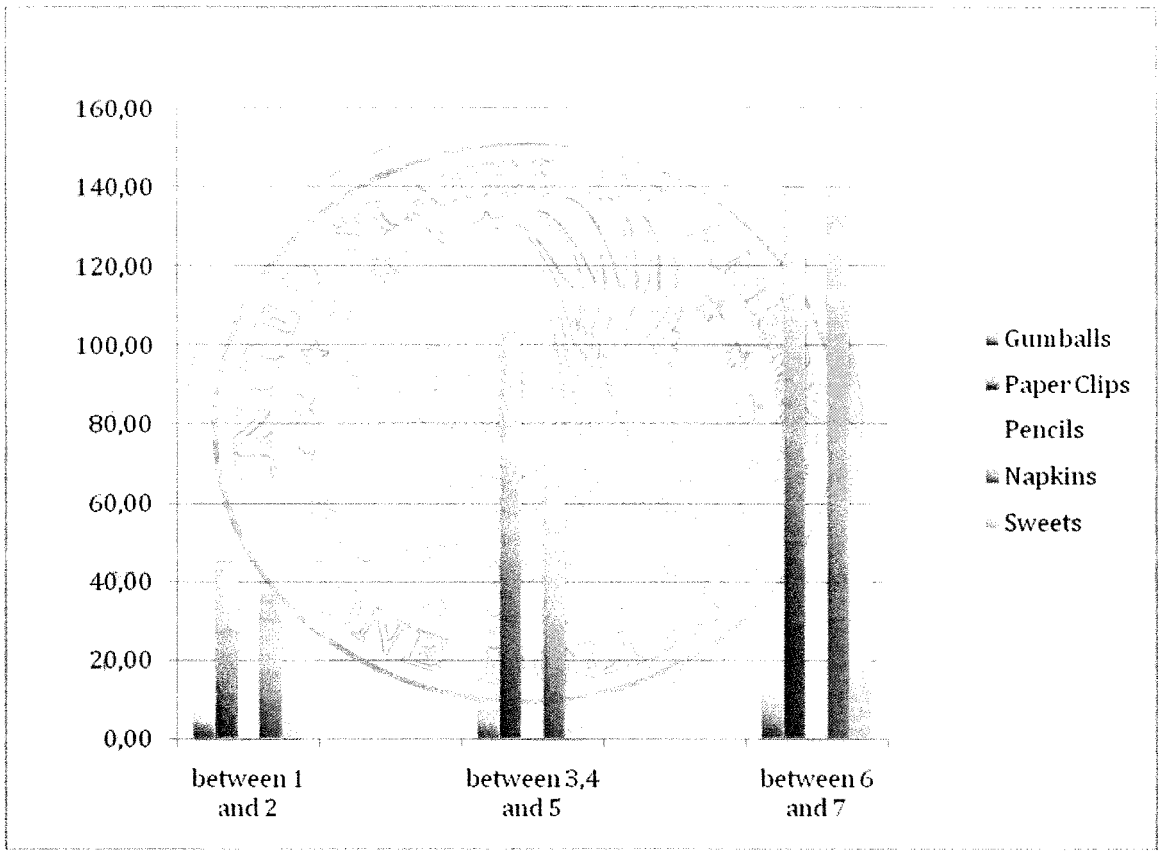


We can see that individuals who are less familiar with the form of dollar perceive that they have an inferior purchasing power.

Table 2: Mean number of products that people perceived to be able to purchase with a one dollar coin in accordance with how familiar their were with it.

	Between 1 and 2	Between 3,4 and 5	Between 6 and 7
Gumballs	8.81	7.40	11.44
Paper Clips	44.94	103.33	140.00
Pencils	3.33	4.20	5.67
Napkins	36.56	64.40	140.00
Sweets	11.53	6.60	47.11

Graph 2: Bar chart representing the mean amount of products that a consumer perceives to be able to purchase with a one dollar coin in accordance with how familiar they were with it.



We can observe that similarity, as in the case of the bill, the people that said that they were more familiar with the form of dollar they perceive themselves to have a higher purchasing power (they can bye more of that particular good). On average and individual who is very unfamiliar (between1 and 2) with the one dollar coin thought that he/she could by just over 40 paper clips. On the other hand individuals that were very familiar (between 6 and 7) with the one dollar coin estimated, on average, that they could bye almost 140 paper clips. This represent an increase of almost 100 more paper clips. Therefore, in comparison to the very unfamiliar people the very familiar people perceived to have nearly **250%** more purchasing power!

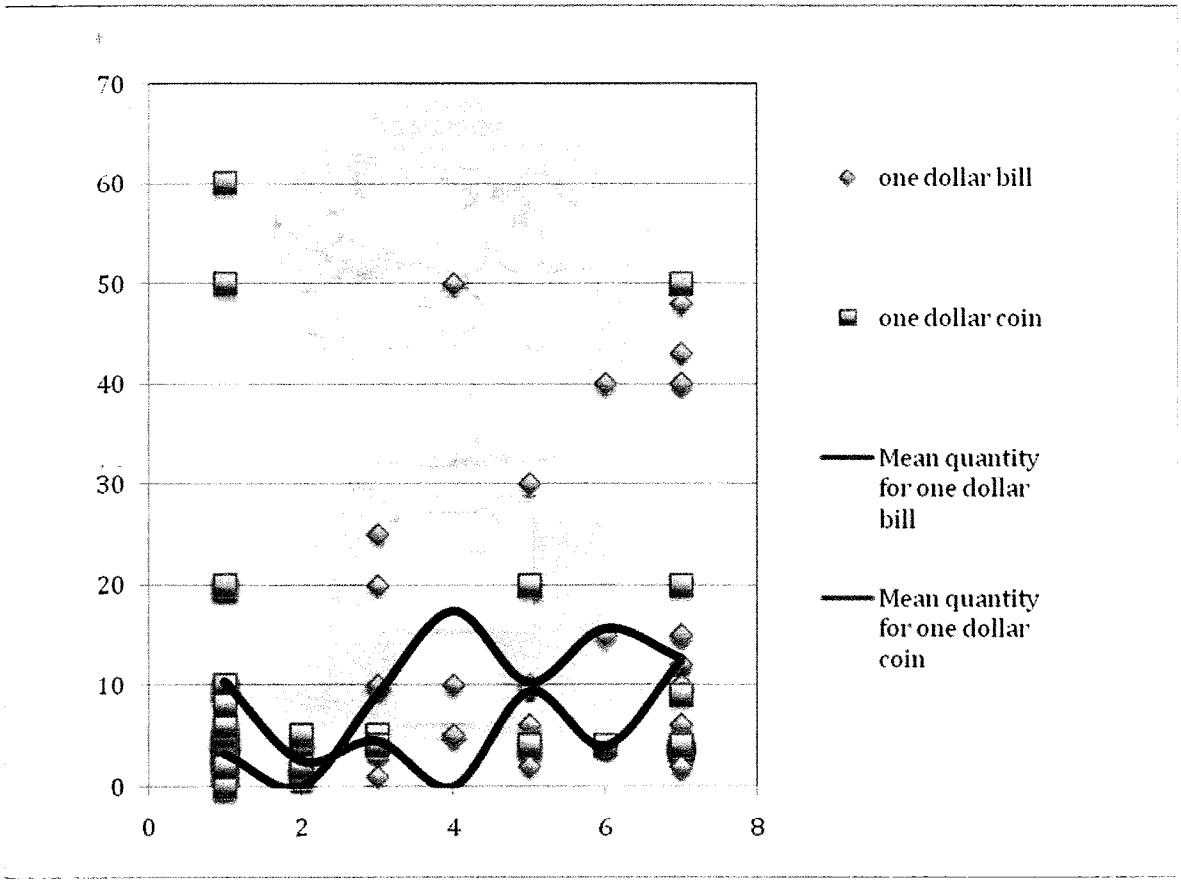
I will now proceed by looking at each item individually and try to find some tendencies using my raw data.

Table 3: Mean amount of Gumballs that people perceived that they could purchase with the dollar in front of them in accordance to how familiar they were with it.

Familiarity	Bill	Coin
1	3.33	10.31
2	0.00	2.57
3	9.11	4.50
4	17.5	0.00
5	10.33	9.33
6	15.75	4.00
7	12.75	12.37

*Some results were much too high as Using the IF and only IF function on Exel in this case I made sure that no results exceeded 60 gumballs limiting the possibility for outliers. If values did exceed 60 they were replaces by a value of 60.

Graph 3: Scatter graph with mean line indicating the change in perceived purchasing power of gumballs according to familiarity.

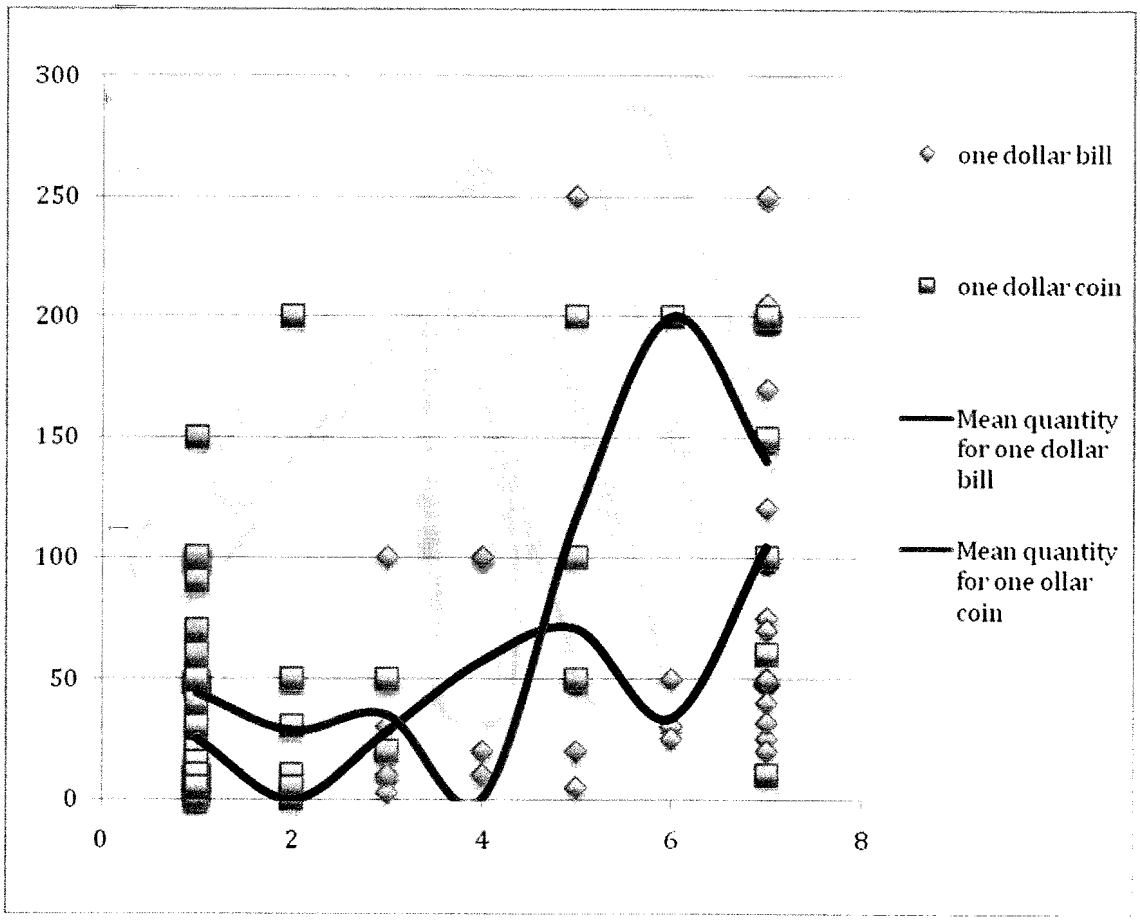


We can observe that no overwhelming trend is visible. In this case we can see that generally it appears that people perceive to have a great purchasing power with the bill in comparison to the coin , except in the case of the people that were very unfamiliar with the dollar.

Table 4: Mean amount of paper clips that people perceived that they could purchase with the dollar in front of them in accordance to how familiar they were with it.

Familiarity	Bill	Coin
1	25.00	43.89
2	0.00	28.11
3	28.11	35.00
4	57.5	0.00
5	70.83	116.66
6	33.75	200.00
7	104.45	140.00

Graph 4: Scatter graph with mean line indicating the change in perceived purchasing power of gumballs according to familiarity

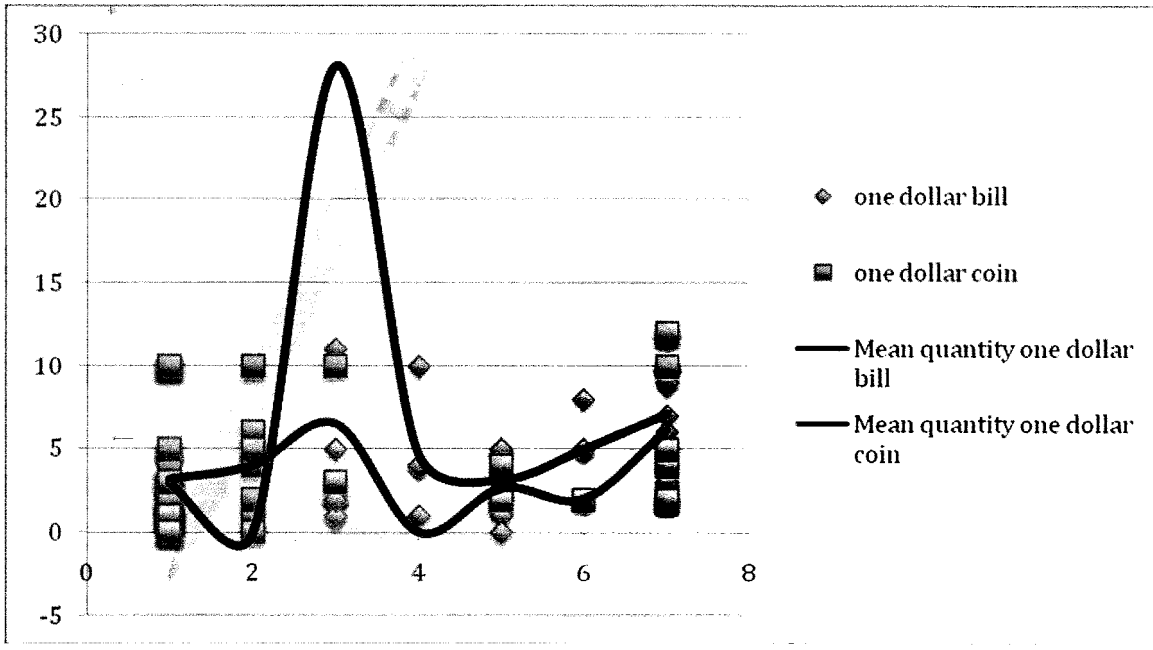


Once again no clear trend is evident but it appear that even though the mean in fluctuation in general the number of paper clips that people think they can bye the more familiar they are.

Table 5: Mean amount of pencils that people perceived that they could purchase with the dollar in front of them in accordance to how familiar they were with it.

Familiarity	Bill	Coin
1	3.00	3.17
2	0.00	4.00
3	28.11	6.50
4	4.75	0.00
5	3.16	2.66
6	5.00	2
7	7.13	6.13

Graph 5: Scatter graph with mean line indicating the change in perceived purchasing power of pencils according to familiarity



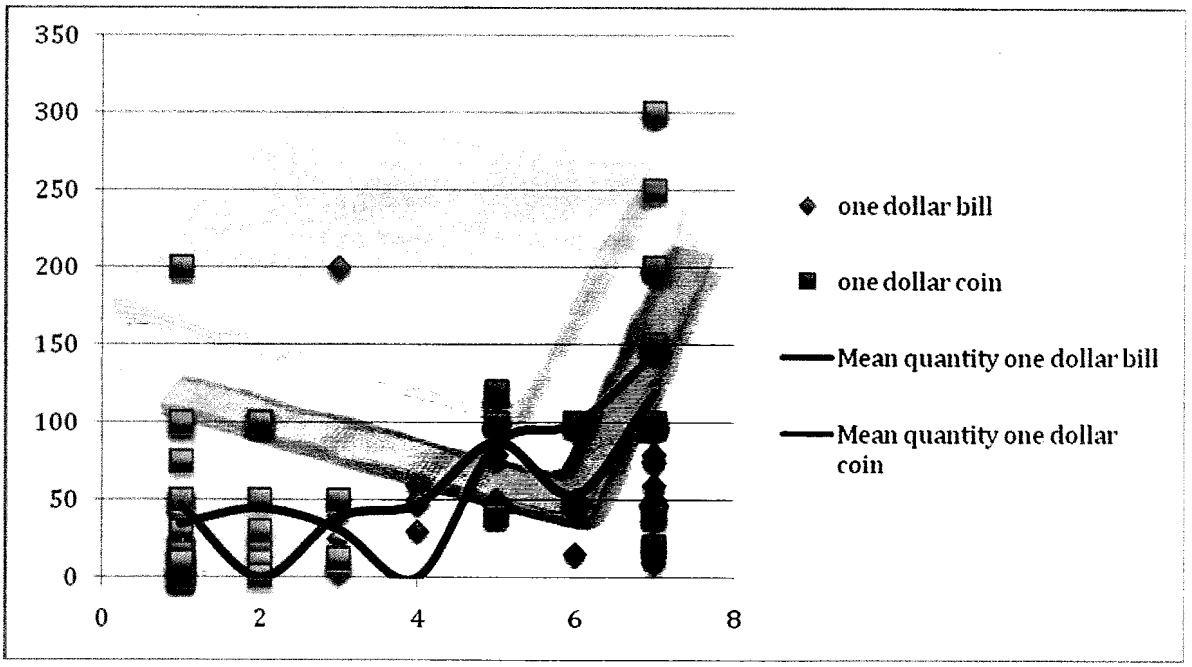
We can observe that absolutely no trend is visible and that in this case. We can see that there is a significant jump in perceived purchasing for the people who said that they were at a 3 familiarity level. This has been cause by a lack a collected for that particular value and one unusually high perceived purchasing power by one or 2 survey candidates.

Table 6:Mean amount of napkins that people perceived that they could purchase with the dollar in front of them in accordance to how familiar they were with it.

Familiarity	Napkins one dollar bill	Napkins one dollar coin
1	47.33	34.65
2	0.00	44.43
3	39.22	31.00
4	47.50	0.00
5	88.16	86.66
6	53.75	100.00
7	120.04	145.00

*Using the "IF" function on Exel I said that IF a value exceeded 300 that it should be changed and made 300.

Graph 6: Scatter graph with mean line indicating the change in perceived purchasing power of napkins according to familiarity

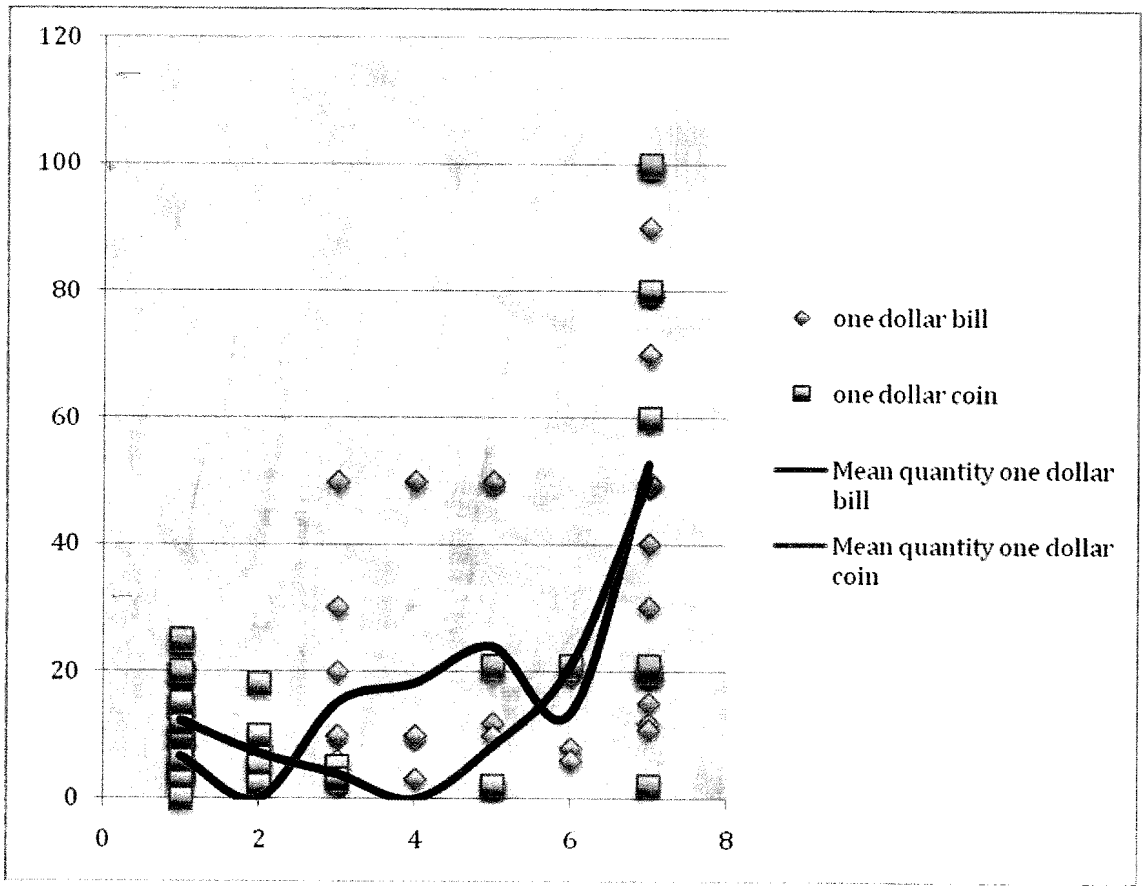


In the case of napkins a trend in much more visible, here neither the bill or the coin is dominant and it appears that generally the more familiar the people are with the form of dollar the more they think they can by with it.

Table 7:Mean amount of sweets that people perceived that they could purchase with the dollar in front of them in accordance to how familiar they were with it.

Familiarity	Sweets one dollar bill		Sweets one dollar coin
1	6.66		12.34
2	0.00		7.22
3	15.11		4.00
4	18.25		0.00
5	24.00		8.33
6	13.50		21.00
7	52.83		50.37

Graph 7:Scatter graph with mean line indicating the change in perceived purchasing power of sweets according to familiarity



We can see that in this case people who are very unfamiliar with the coin and bill perceive to have a relatively low purchasing power in the case of the coin when the familiarity increases to 4 the purchasing power drops yet in the case of the bill the purchasing power rises. Although gradually when looking at the results generated by the candidates that are very familiar with the bill and coin their purchasing powers are very high.

In the past section we can observe a huge dispersion of data such a high dispersion shows that people do not have a precise idea of the value of a dollar.

I will know take the example of Gumballs and look at the results from the data:

Mean: 10.5

Q1 : 4 , Median : 5 , Q3: 10

Max: 60 , Min : 0

Standard Deviation: 12.88

A very large dispersion of the data is apparent

So far through out this study I have not been able to observe any clear trend and make any conclusion when asking myself the question: Can it be said that the more recognizable the form of dollar the more people subconsciously think that it is worth?

It has been difficult to find a pattern because the mean amount is very low from some degrees of familiarity and the scale of familiarity is too wide and many outliers were present for certain products, although it seems to have a positive correlation between the number of items bought and familiarity.

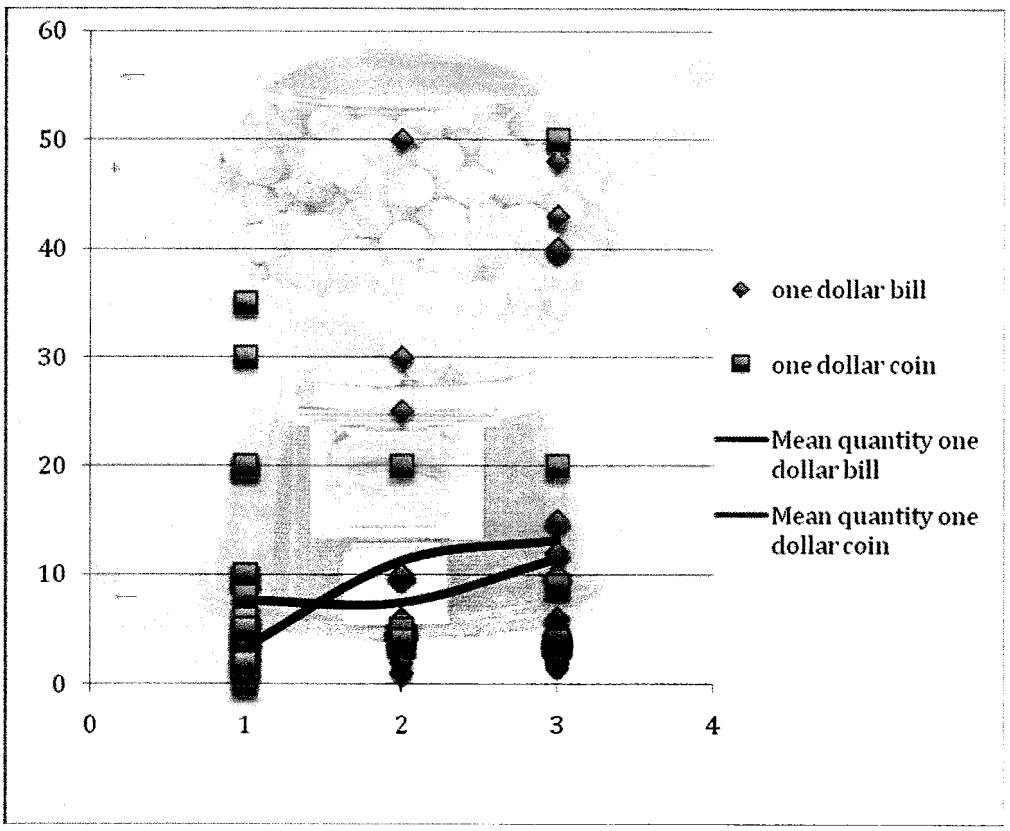
Therefore I have decided to change my approach and, using the same data, group the familiarity levels together into three groups so that trend may be more visible. The three groups are those people who are very unfamiliar (1 and 2) people who are relatively familiar (3, 4 and 5) and those who are very familiar (6 and 7).

Table 8: Mean amount of gumballs that people perceived that they could purchase with the dollar in front of them according to how familiar they were with it.

Familiarity	Bill	Coin

1	3.33	7.55
2	11.26	7.40
3	13.17	11.44

Graph 8: Scatter graph with mean line indicating the change in perceived purchasing power of sweets according to familiarity

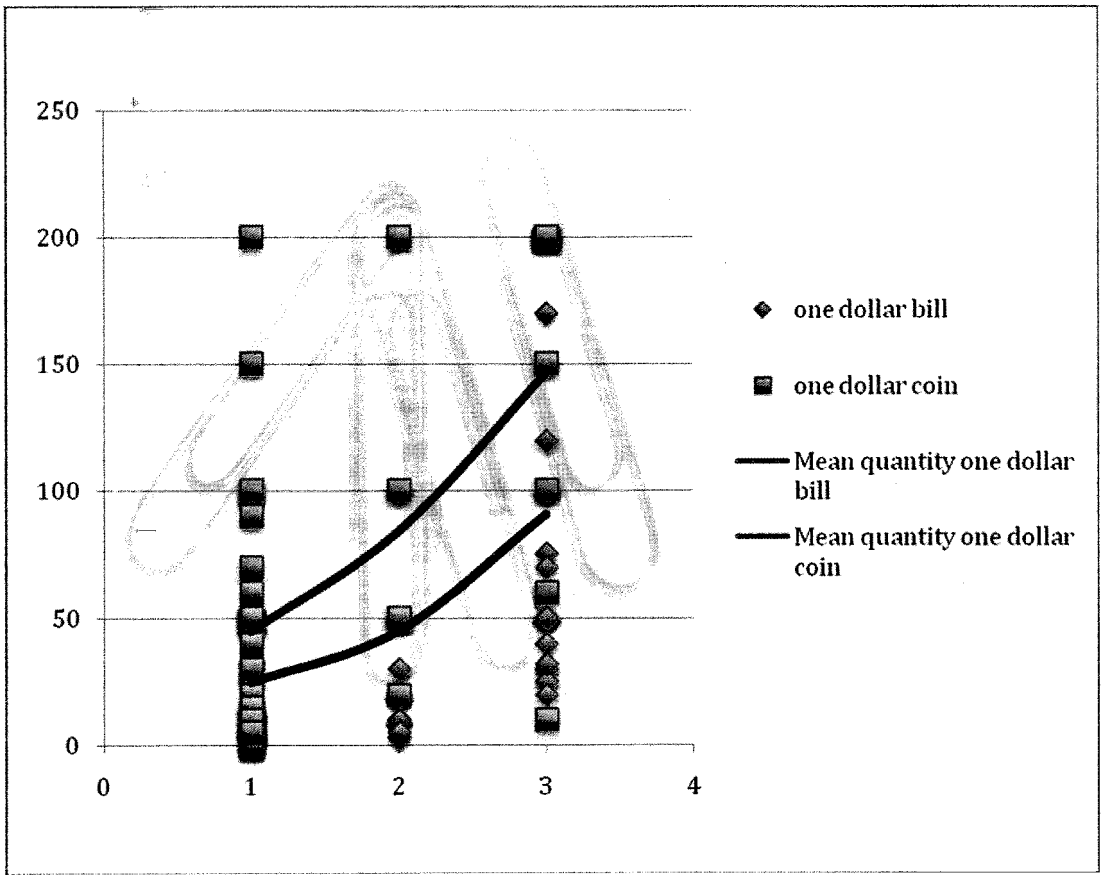


We can see that thanks to the grouped familiarity **levels a much clearer trend is visible**, as familiarity level increases so does the estimated purchasing power.

Table 9: Mean amount of paper clips that people perceived that they could purchase with the dollar in front of them in accordance to how familiar they were with it.

Familiarity	Paper clips	Paper clips
1	25.00	44.94
2	45.15	84.00
3	90.60	146.66

Graph 9: Scatter graph with mean line indicating the change in perceived purchasing power of paper clips according to familiarity

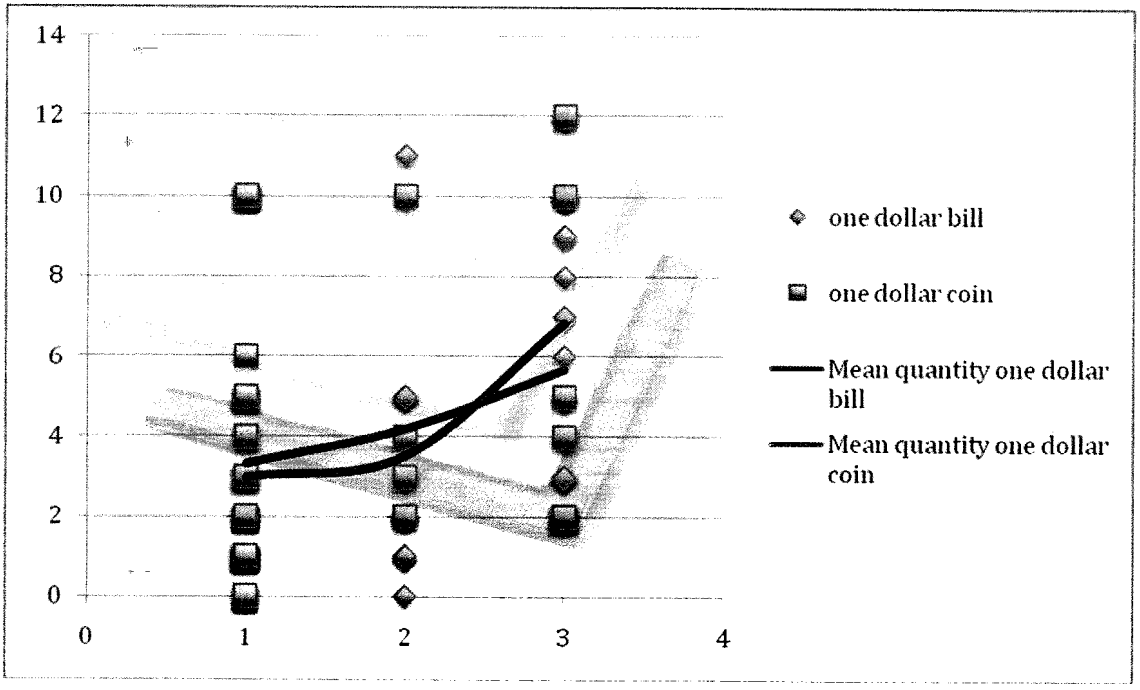


We can see here a strong positive correlation between familiarity and purchasing power. Those who were very unfamiliar estimates on average that they could purchase 44.9 and those who were very familiar estimated on average that they could bye 146 over 3 times more.

Table 10: Mean amount of napkins that people perceived that they could purchase with the dollar in front of them in accordance to how familiar they were with it.

Familiarity	Bill	Coin
1	3.00	3.33
2	3.53	4.20
3	6.82	5.66

Graph 10: Scatter graph with mean line indicating the change in perceived purchasing power of napkins according to familiarity

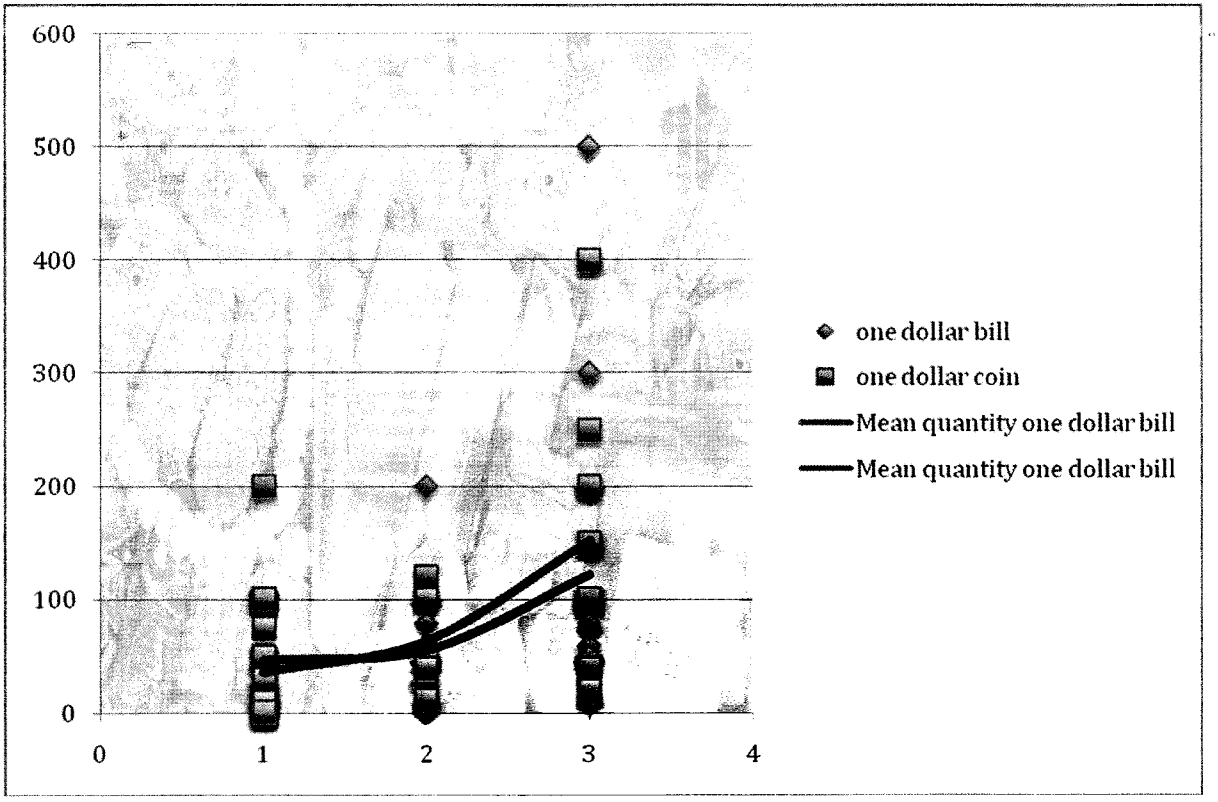


Similar observation as for Graph 8.

Table 11:Mean amount of sweets that people perceived that they could purchase with the dollar in front of them in accordance to how familiar they were with it.

Familiarity	Bill	Coin
1	47.33	36.55
2	56.42	64.40
3	121.29	151.11

Graph 11:Scatter graph with mean line indicating the change in perceived purchasing power of sweets according to familiarity



Moderate positive correlation

One of my greatest problems when faced with this investigation was the large dispersion of the data, certain values I was forced to omit and did not consider these results. However there was still a big deviation amongst the results.

Using the Excel function STDEV (formula for standard deviation) to calculate the standard deviation for each goods Gumballs etc...) I will attempt to determine

whether or not there is a correlation between Familiarity and Standard Deviation using linear regression.

For an illustration of the following tables see graph below

Standard deviation and Familiarity for gumballs

Familiarity	STDEV value
1	8.14
2	11.32
3	14.45

**Using LinRegTTest on GDC*

Equation of the line: **y=4.9+3.15x**
Linear correlation coefficient 'r' **= 0.999**
Here we observe a very strong positive linear correlation because 'r' value is extremely close to 1.

Standard deviation and Familiarity for paper clips

Familiarity	STDEV value
1	44.25
2	55.28
3	69.53

Equation of the line: **y=31.07+0.64x**
Linear correlation coefficient 'r' = **0.994**
Once again in this case we see a very strong positive linear correlation.

Standard deviation and Familiarity for pencils

Familiarity	STDEV value
1	3.05
2	2.96
3	3.67

Equation of the line: **y=2.61+0.31x**
Linear correlation coefficient 'r' = **0.802**
In case we continue to see a relatively strong positive linear correlation.

Standard deviation and Familiarity for napkins

Familiarity	STDEV value
1	43.62
2	47.10
3	115.81

Equation of the line: **y= -3.35+36.1x**
Linear correlation coefficient 'r': **0.88**
We have therefore a relatively strong correlation.

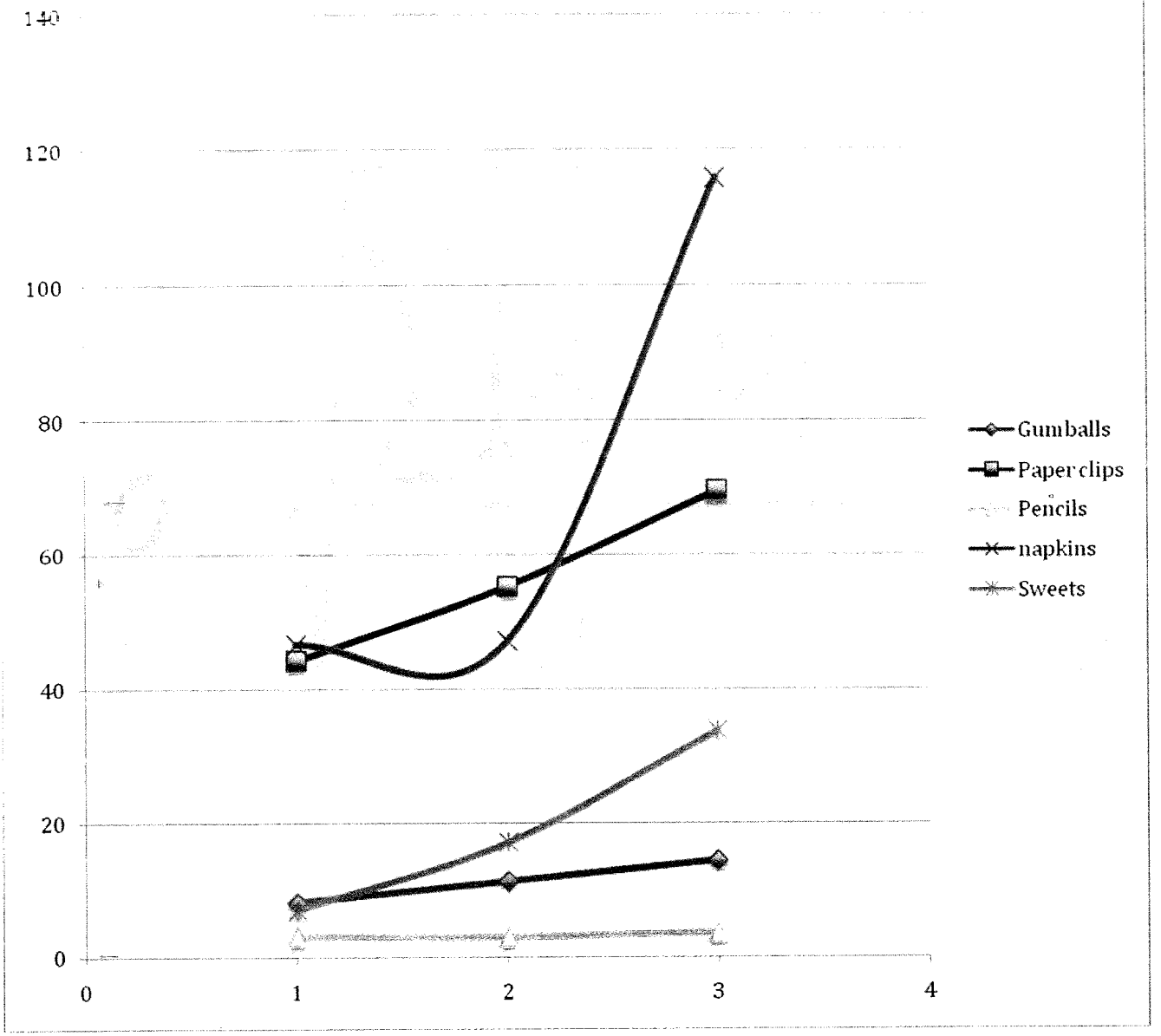
Standard deviation and Familiarity for sweets

Familiarity	STDEV value
1	7.02
2	17.08
3	33.74

Equation of the line: **y= -7.44+13.36x**
Linear correlation coefficient 'r': **0.98**
A very strong positive linear correlation

When observing the very strong results found for 'r' one must not forget that I was only measuring the correlation between 6 values. This therefore limits its accuracy.

GRAPHICAL ILLUSTRATION: Standard deviation (y-axis) and Familiarity (x-axis)



After observing this graphical representation and considering the 'r' values found using the GDC I can conclude that there is a strong to very strong positive linear correlation between familiarity and standard deviation. In general terms people that were very familiar with the bill or coin gave a greater ranging estimations of how much they could buy.

Conclusion:

After examining the data, looking at the results for many different products I can conclude that there is indeed a moderate to strong positive correlation between familiarity and purchasing power. I have l also observed that it appears that there is a slight prejudice in favour of paper money and against coinage and generally people perceive that they can by more with a bill than a coin when looking at the mean lines on the same graph.

A similar result conclusion was reached by Adam Alter and Daniel Oppenheimer. This could in part explain many modern day economic phenomenons such as the low value of the euro when it was first introduced on the financials market on January first 1991. The fact that people where not familiar with the new currency made them perceive that they could by less with it (low purchasing power) so the value was low. As time progressed it steadily rose in value as people came to recognise it more. The results of this study could become vital information for economic speculators interested in currency exchange.

I have observed another phenomenon which is that people that who were more familiar with the bill or coin tended to give much more varied results i.e the standard deviation was greater at greater levels of familiarity.

However there are many constraints to my general conclusion: I could have asked volunteers from a more varied audience, I only asked students.

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The Economist print edition. Science and Technology. Irrational Economics. Article: Look and Feel. April 3rd 2008.