

**Coins versus Bills: Not All Denominations are Created Equal**

**A Senior Honors Thesis For the Department of Interdisciplinary Studies**

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### **Not All Denominations of Currency are Created Equal**

*Through the use of the Ultimatum Game paradigm, it was found that individuals express a preference to bills as opposed to coins. Groups of college students played the Ultimatum Game with either five dollars in the form of single bills or five dollars in the form of dimes. Participants behaved irrationally when considering the money and playing the game. Many individuals, incentivized to play the game with the promise of financial gain, refused to take sums of 'earned' dimes often totaling multiple dollar amounts. It was concluded that individuals value quantities of one dollar bills more than quantities of dimes when summing to the same dollar amount.*

#### **Introduction:**

Everyday, pockets and purses of Americans fill with coins. Many leave the change from their morning coffee in tip jars. Some, upon finding pennies in their pockets, simply throw them away. But however small, pennies do have value just as any other form of United States currency. In this paper, it is assumed that all denominations of United States currency are viewed as money and have value. The difference in value between coins and bills is examined. Specifically, behavior in relation to dimes and one dollar bills is studied.

Intuitively, one can imagine how coins are treated relative to bills. They are placed in one or many of our pockets and fall to the bottoms of our purses. They literally fall through cracks or roll away and can be lost in the blink of an eye. We forget where we place coins and have more trouble doing the mental math with cents as the absolute numbers are large. Compare the length of time it takes to add \$0.83, \$0.68, \$0.24, and \$0.39 (theoretical amounts of coin change) versus \$2, \$5, \$3, \$4, and \$3 (theoretical sums of amounts of bills). Imagine a scenario where you could choose between 20 nickels and a single dollar bill. Which would you prefer. Consider a choice between 21, 22, or 23 nickels and a single dollar bill. You might imagine that one would sacrifice five, ten, or fifteen cents in order to have a paper bill.

This intuition, is validated by scientific literature. A range of factors, well beyond

monetary value, affect our perception and valuation of money. Many of these factors are irrational from the classical economic perspective. They range from physical appearance to the actual types of denominations themselves. A growing body of research is examining how people think about money because it is not as simple as looking at a number.

In their paper, 'Money Illusion' Shafir, Diamond and Tversky (1997), find evidence for, and describe, the eponymous effect. Data suggests that individuals have a tendency to prefer higher nominal pay than pay with a higher purchasing power. This indicates that when considering salary, people are profoundly affected by framing that is related to the presentation of the number (of dollars) describing a potential income. Individuals fail to make a rational choice because of a psychological preference. Moreover, through examining American's behavior regarding foreign currency, Raghubir and Srivastava (2002) show that individuals' spending behavior is influenced by the nominal value of the currency they are handling. Researchers found that if the exchange rate results in one dollar transforming to more than one unit of foreign currency (e.g. Chilean Pesos), people will underspend. Conversely, overspending occurs when a single dollar is exchanged for a partial unit of a foreign currency (e.g. the British Pound). The actual value, or purchasing power, of the money is not translated to our behavior. In the United States, individuals may be experiencing similar cognitive problems when translating values between coins and bills.

The mere appearance of currency effects the way it is valued. Muro and Noseworthy (2013) find that individuals value clean bills more so than dirty bills. It is explained that individuals want to get rid of dirty bills because they are disgusting and have been contaminated by previous holders. Further, individuals place a higher value on new, clean bills because they

“take pride in owning bills that can be spent around others (Muro and Noseworthy, 2013).”

Social stigmas involving ‘penny pinchers’ could influence how individuals feel about spending super small denominations such as dimes nickels and pennies around others similar to dirty bills. Moreover, relating directly to disgust and contamination, it is important to note that the Federal Reserve estimates that the average lifetime of a one dollar bill is 5.9 years (Federal Reserve, 2014). To contrast, coins can last for hundreds of years. It can be assumed that the relative difference in lifetime of these types of denomination would allow coins to be contaminated at a higher level than bills.

To specifically address coins, Bruce et. al. (1983), found that independent of nominal value, the perceived value of coins can be influenced by their shape and weight and color. The researchers found that individuals had a bias towards gold colored coins as well as coins that were relatively thicker. Data suggests that seven sided coins were also valued more than 12 sided coins of a similar diameter. The central conclusion researchers made was that individuals learn “rules about features indicating value in a systematic and independent manner (Bruce et. al., 1983).” Another study by Boustead et. al. (1992), similarly found that the shape and color of a coin influences its perceived value despite its actual value.

Research has drawn attention to a range of biases that stem from different denominations of currency. Kohli’s 1988 paper, “A Note on Banknote Characteristics and the Demand for Currency by Denomination,” finds that the public on average favors bills of greater value. Further, data suggest that both as both income and price increase, individuals demonstrate a preference for bills of larger values. In addition, an increase in interests rates reduces the preference for larger bill denominations (Kohli, 1988). Regardless of total value, not all bills are

created equal.

Raghubir and Srivastava's "Monopoly Money: The Effect of Payment Coupling and Form on Spending Behavior" 2008 paper highlights how individuals spending behavior differs when using physical money versus gift, credit, or debit cards. After identifying that values on plastic cards are treated differently from physical money, the researchers found that consumers spend more when using a card versus when using cash (Raghubir and Srivastava 2008). Different forms of the same quantity of money are treated differently.

One year later, the same researchers published a paper describing the 'Denomination Effect.' The researchers discovered that the likelihood of an individual spending physical cash is lower when that individual is considering a large single bill as opposed to multiple smaller bills summing to the same value. Further, when individuals felt a need to exert self control when spending, they preferred to receive money in larger denominations versus smaller smaller ones of the equivalent total value (Raghubir and Srivastava, 2009). Moreover, research has found that carrying large amounts of small denominations of money has an 'inconvenience factor' (Lee et. al., 2005). A logical step is to expect that coins totaling a certain quantity are valued less than small bills totaling that same sum.

To frame this research relating to the inconsistencies observed regarding money valuation, one can examine Tong, Zheng, and Zhao's 2013 paper. Through a series of four experiments, the researchers found that participants primed with physical money, were more likely to make utilitarian versus hedonic purchasing decisions. Hedonic consumption is defined as "typically [being] motivated by the desire for fun, excitement, and sensual pleasure, and often involves products or services that are frivolous or luxurious (Tong et. al., 2013)." This finding

highlights that irrational behavior regarding individuals' valuation of money occurs in those who are already more likely to consider utility. Through using physical money, the current paper aims to investigate a denomination effect among those who are more likely to behave in a utilitarian fashion.

The experiment described in this paper uses the Ultimatum Game paradigm as a method to determine if five dollars presented in the denomination of dimes are perceived as having equal value to the same sum in the denomination of one dollar bills. The Ultimatum Game has been used to explore a range of phenomena in behavioral economics (Thaler, 1988). The Ultimatum Game is a two player, one shot game. Player one, the offering player must choose to offer a part of a fixed sum to player two, the receiver. The receiver chooses to either accept the proposal. If the receiver accepts the offer, the sum is divided according to the original offer. If the offer is rejected, both players do not receive money. Both players are given complete information regarding the rules of the game. Offers can be proposed in any real dollar amount (e.g. \$1.83 or 4.00). In this experiment, it is hypothesized that five dollars presented as fifty dimes is valued as less than five dollars presented as five one dollar bills.

To more thoroughly understand the the Ultimatum Game, one can approach the game from a philosophical perspective. Adam Smith's metaphor of the Invisible Hand, discussed in the "Wealth of Nations (1776)" and "A Theory of Moral Sentiments (1759)," describe how the best actions of an individual for an economy are those driven by self-interest. He writes,

"every individual... endeavours as much as he can both to employ his capital in the support of domestic industry, and so to direct that industry that its produce may be of the greatest value; every individual necessarily labours to render the annual revenue of the society as great as he can. He... neither intends to promote the public interest, nor knows how much he is promoting it. By preferring the support of domestic to that of foreign

industry, he intends only his own security; and by directing that industry in such a manner as its produce may be of the greatest value, he intends only his own gain.. (1991)”

Smith would argue that making the most self-interested and rational choice (in the context of the Ultimatum Game) would most effectively benefit society. Had Smith played the game he would seek to maximize his return and offer a penny. Assuming that all players are thinking as Homo Economicus, seeking to maximize their profit, the decision to offer a penny is entirely rational. One would expect the receiving player to accept the offer because a gain of a single cent is greater than a gain of zero cents.

Moreover, John Rawls acknowledges that inequity can be acceptable and in certain conditions fair. He writes, “ If A were not allowed his better position, B would be even worse off than he is (Rawls, 103).” He acknowledges that a given situation can inherently place some in positions of greater power than others. Despite an inequitable situation, the outcome may still be fair and can certainly be beneficial. In the case of the Ultimatum Game, the offerer a better position relative to the receiver. As the position of each player is determined randomly, neither player can influence who has the advantage. No matter the size of the offer the disadvantaged player receives, he will be able to benefit from the game.

In contrast, to the theoretical concepts of fairness discussed by Smith and Rawls, research has found that, in ‘community standards of fairness’ (in the context of pricing) are influenced by the reason a good costs a given amount of money (Kahneman et. al., 1986). Individuals felt that it was fair for companies to raise prices when profits were threatened and maintain prices when costs declined. Moreover, they felt it was unfair for companies to “exploit shifts in demand by raising prices (Kahneman et. al., 1986).” Similar to the biases regarding the appearance of currency, this finding highlights the fact that the concept of fairness is not entirely derived from a

rational construct. Perceptions of fairness unexpectedly influence expected utility maximizing behavior.

The discovery of individuals' irrational biases relating to the valuation of money opens the door to further research. The shape, weight, appearance, denomination, and nominal value influence how individuals value money, the foundation of our economy. This study seeks to expand knowledge regarding the biases we exhibit in regard to some of the smallest denominations of United States currency in circulation. Further, the relative value of dimes and one dollar bills has yet to be specifically explored. It is expected that in the Ultimatum Game, individuals will offer larger sums if presented with fifty dimes as opposed to five one dollar bills. This would indicate that individuals place a higher value on one dollar bills than they do on quantities of dimes that sum to the same monetary value.

### **Method:**

#### *Participants:*

Participants were drawn from the Tufts University student body. Undergraduate students were targeted. However, the study did not exclude graduate students. One hundred and six individuals participated playing a total of fifty-three Ultimatum Games. These participants were identified via an advertising campaign for the study conducted across mediums throughout Tufts. Fliers were pasted in central areas on campus including the campus center and the library. Similarly, the fliers were posted to online forums central to the Tufts University community. Forty participants were women (43%) and fifty four were men (57%). Participants ranged in age between 18 and 27 years old.



*Materials:*

The materials used in this study were US currency of varying forms. Sets of fifty dimes were used in one group while sets of five one dollar bills were used in the second group. Grant money was received from the Tufts University Undergraduate Research Fund. Physical money was withdrawn from local banks. Standard, 3x5 index cards were used as the medium for participants to write their offers and indicate acceptance or rejection. A separate tray of smaller denominations of coins was used to provide change when appropriate (e.g. in the event that a person offers a sum not divisible by \$1.00 or \$0.10). Pencils were provided to participants for writing. Rooms were chosen that had a table and any even increment of chairs between six and ten. A script (modified to be consistent with the five dollar sum, opposed to a ten dollar sum) written by professors at the California Institute of Technology in the Division of the Humanities and Social Sciences was used to instruct participants of the rules and conduct of the Ultimatum Game.

*Design:*

The experiment used a between-groups design. The Ultimatum Game paradigm was used to gather information regarding the relative value of different denominations of United States currency. Five dollar sums of different denominations were presented to the participant pairs. Fifty dimes and five dollar bills were the dependent variables for the two groups of participants. The dependent variable was the size of the offer made by participants. The relative size of the offer indicates how the presented denomination is valued. A larger offer indicates that the

presented denomination is valued less highly. Confirmation of the hypothesis would be indicated by a statistically significant result in a one tailed hypothesis test where the group presented with fifty dimes offers more than the group presented with five dollar bills.

To control for the extraneous variable defined by offering participants' aiming to preserve their empathetic/benevolent image, the identity of each individual remained anonymous. Participants could not identify their partner in the game. This concept was emphasized in the instructions that were read to participants before the game was played. Moreover, participants were instructed not to communicate with each other outside their writing of offers and acceptances or rejections of the offers. In this manner, emotional connection was minimized between participants. Likewise, individuals who may have had previous knowledge of other participants, were unable to make confident conscious decisions to favor those potential acquaintances or friends.

*Procedure:*

Participants were recruited through posted fliers and emails from professors and teaching assistants. Coordination with prospect participants occurred via emails, text messages, and phone conversations. Ultimately, individuals signed up for one of many prescheduled participation sessions. Participants arrived and were randomly assigned a position and role in the Ultimatum Game (Player one or player two). The first twenty three pairs played the game with the coin condition, where the offering player received fifty dimes as prompts. The next twenty two pairs were assigned to the dollar bill condition where the offering player received five dollar bills. The final eight pairs were assigned to alternating conditions.

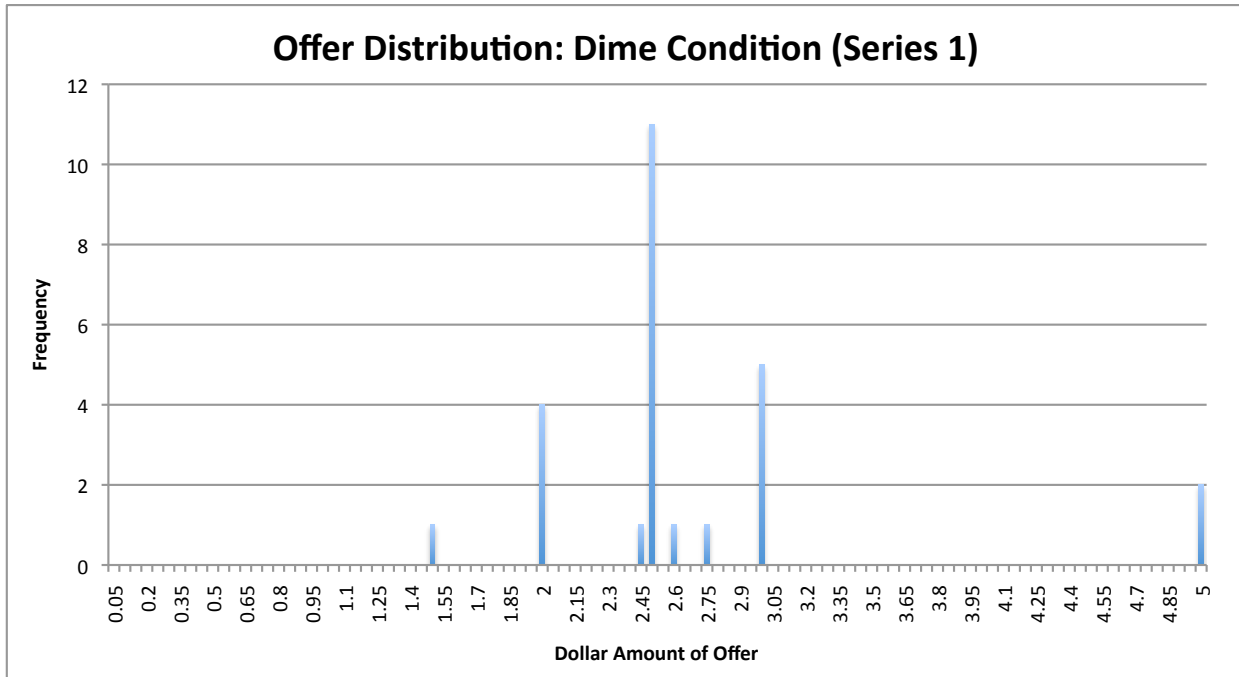
Players entered a room and read and signed the consent form. Upon sitting down players were read a set of instructions for the Ultimatum Game. After the instructions were read, participants had the opportunity to ask clarifying questions. Once all participants affirmed they understood the game in its entirety, the actual play began. Depending on the assigned condition players were presented with either a stack of five dollar bills or a pile of dimes. In both cases, participants were told that the quantity in front of them was a total of five dollars. The offering players proceed to write their offers on an index card and pass them to the primary investigator. The primary investigator then passed the offers to the player twos. The receiving players proceeded to write down the word 'accept' or 'reject' on the same notecard next to the offer. Cards were then collected and the sums of money determined by game play were allotted to the respective players. The primary investigator broke bills or coins if necessary to allot the precise accepted sums. Players did not see the specifics (e.g. writing indicating acceptance or rejection and the size of a given offer) of any other participant's writing. Once participants receive the appropriate sums of money, they signed a receipt and were given a debriefing form.

## **Results:**

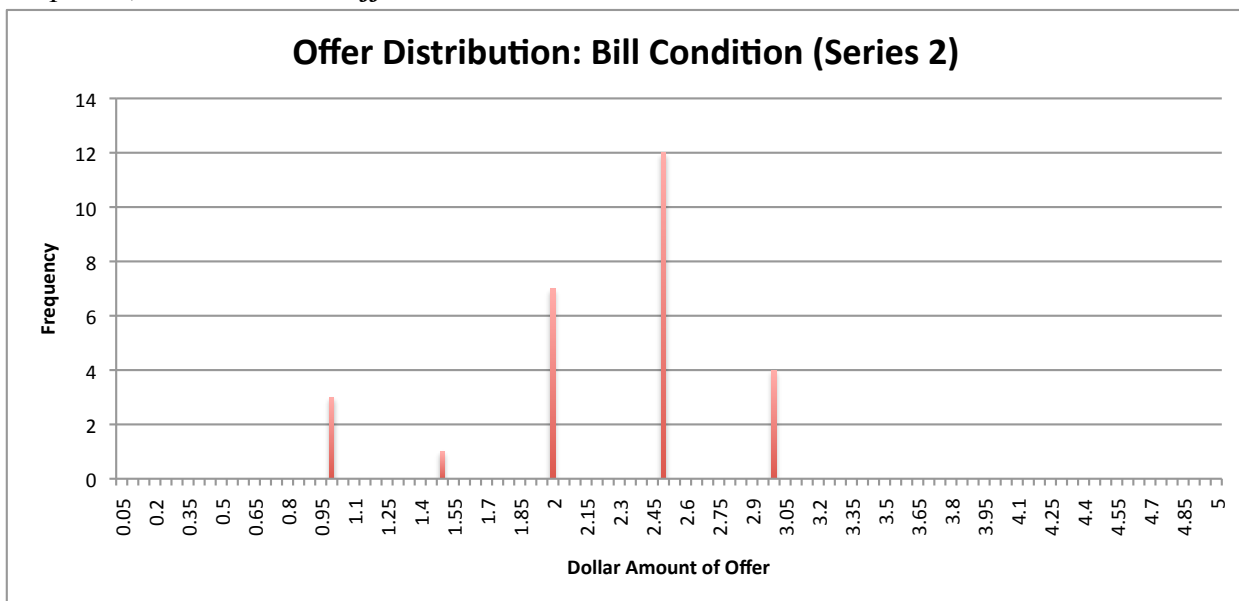
The offer sizes for the the two conditions, the coin condition ( $n=26$ ) and bill condition ( $n=27$ ), were subjected to a between groups  $t$ -test. A one tailed test was used because previous research has indicated a preference towards currency forms that have a higher value (a dollar bill is ten times more valuable than a single dime). Moreover, research has found a bias towards money that is cleaner and has been touched by fewer people. Due to the lifetime of dimes and bills, it is clear that dimes have been touched by more people and are thus dirtier. The difference

between groups was found to be significant, ( $H_0: t=2.45$   $p<.01$ ). Results show that individuals playing the Ultimatum Game with fifty dimes are more likely to make larger offers than those who play the game with five one dollar bills.

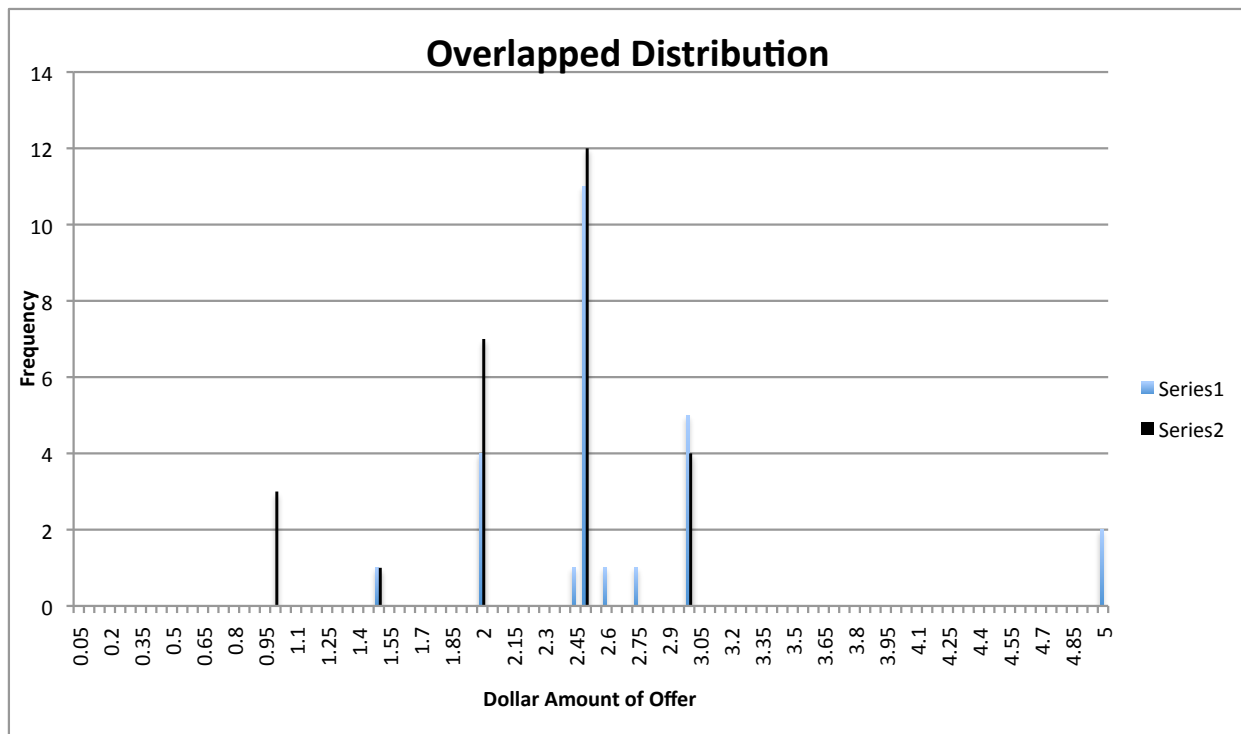
Graph 1.1, *Dime Condition Offers*



Graph 1.2, *Bill Condition Offers*



Graph 1.3, *Condition Comparison*



As only two players rejected offers (an irrational behavior), it is surprising to observe incongruent offer sizes between conditions. The data are interpreted to infer that individuals place a lesser value on dimes than they do on one dollar bills when totaling the same overall monetary value. Table 1.1 shows the basic statistical properties of each condition.

Table 1.1, *Statistical Summary of Conditions*

	<u>Dollar Bill Condition</u>	<u>Dime Condition</u>
Number of Trials	27	26
Mean	2.24	2.68
Standard Deviation	0.58	0.77
Standard Error	0.11	0.15

Data was collected on the behavior of individuals after receiving the appropriate sum of money in the denomination matching their condition. Table 1.2 displays individuals' behavior in regard to the physical money they received. It is shown that of the total fifty-three games played, nine recipients, entirely on their own accord, denied to take part or all of the sum to which they were entitled. The sizes of the sum ranged from \$0.50 to \$3.00. All individuals in the bill condition left \$0.50 while those in the coin condition left between \$2.00 and \$3.00. This does not account for offerers in the dime condition who proceeded to offer the entire sum of \$5.00. By acting in this manner, individuals offering the entire sum of money indicated that the 'cost' of carrying around five dollars in dimes was greater than the five dollars sum itself. Including the two offers of \$5.00, 20.1% of pairs (at least one component of the pair) did not value the coins enough to keep them. Further, within 11.3% of pairs, an individual refused to take between two and five dollars in dimes. Examining the dime condition in isolation, 19.2% left their shares of money. Each individual in the dime condition who left their money, left the entire sum. It is critical to note that not a single player did not accept, and keep a one dollar bill.

Table 1.2, *Post Game Behavior*

	<u>Dollar Bill Condition</u>	<u>Dime Condition</u>	<u>Total</u>
Left Coins (Multiple of 50 cents)	4	5	9
Left Bills	0	0	0

Especially when considering 'Money: A Bias for the Whole,' it is of interest to note, that of all the 53 offers made, only two offers had a smallest unit (in respect to denomination of money) of less than 10 cents. In the dime condition, the sum could be considered to be made of

up of 50 'whole' dimes.

### **Discussion:**

The results are consistent with the hypothesis. As the offers from individuals in the dime condition were, on average, larger than those from the one dollar bill condition, researchers can conclude that five dollars presented as fifty dimes is valued as less than five dollars presented as five one dollar bills.

This finding is consistent with a body of research examining irrational and unexpected valuation of currency. Individuals' 'Bias for the Whole,' predicts a resistance to spend a quantity that is represented in a 'whole' larger denomination (Mishra et. al., 2006). The findings in my experiment, are congruent as the five, one dollar bills more closely represent the 'whole' than do the 50 dimes.

Muro and Noseworthy's research shows that individuals prefer spending bills that they are proud to show off in front of others, hence the bias for clean bills versus dirty ones (Muro and Noseworthy, 2013). This is directly relevant to the current study when accounting for social stigmas regarding penny pinching and stingy behavior in our society. It is by no means, illegal, but certainly abnormal, to use coins to pay for goods that cost more than a dollar. Further, it can be assumed that individuals know coins have longer lifetimes than bills. With the same logic, individuals realize that more people have touched the average coin than the average bill. Thus, the 'disgust factor,' describing individuals aversion to dirty currency, referenced in that same paper (Muro and Noseworthy, 2013), is congruent with the findings in the current paper as well.

Moreover, the disutility of carrying coins, modeled by Lee, is also in line with my

findings. Carrying around twenty five dimes (the mode accepted offer) for example, is inconvenient (Lee et. al., 2005). To use them, to buy something that is \$1.10, for example, one must count eleven items as opposed to two items when one has both dimes and dollar bills. Regarding the physical disutility, a dime weighs 2.268 grams (Coin Specifications) while the weight of a dollar bill weighs one gram (U.S. Bureau of Engraving and Printing). The difference grows exponentially as bills are substituted for dimes summing to the same value.

Months after the process of conducting the research for the current paper began, Sotiris Vadoros published a paper in *Experimental Economics* examining the difference in consumer spending when individuals were handling coins versus paper bills. His study presents two findings. First, consumers prefer smaller monetary value in bills than a higher value in coins. Second, he found that individuals “carrying coins are more likely to make a purchase of small value than people not carrying coins (Vadoros 2013).” My paper presents findings that are in line with those presented by Vadoros (2013). Despite the papers examining the same concept, the current paper provides further insight into coin vs bill valuation because of both the use of the Ultimatum Game paradigm and the use of United States currency as opposed to British currency.

Certain segments of society are influenced by, if not formed entirely by monetary systems specific to that society. The current study provides insight directly into the American paradigm. Second, the experiment Vadoros used to determine that bills were preferred to dimes involved having a group pick between a £5 note and £5.10 in coins (two £1 coins, four 50p coins, five 20p coins, and a 10p coin). As a result of using the Ultimatum Game paradigm in the current paper, participants’ behavior was tracked after they were allotted money. The observation that



participants often left between fifty cents and three dollars after ‘earning’ the money through game play there is a strong indication that the extent of the preference towards bills rather than coins is still not entirely realized.

Despite the finding in the current study, indicating that people value bills more than coins, it is believed that the results do not show the full strength of the bias towards bills for reasons beyond Vandoros’ analysis. The Ultimate Game demonstrates how money is treated in the world where individuals must balance costs and benefits but its relative complexity (requiring significant cognitive processing, especially if Theory of Mind is considered). When examining the data collected regarding the offer sizes of the participants in the respective categories, one must consider the bias towards fairness and how it effects behavior in the Ultimatum Game. In ‘Anomalies: The Ultimatum Game,’ Thaler describes that in a given Ultimatum Game study, one third of participants split the initial sum (Thaler, 1988). In a study where five-year-olds played the Ultimatum Game, participants viewed fair as equal (Wittig and Jensen, 2013). As recruited participants anticipated spending a very brief period of time with the study, pressure to finish could result in more simplified thought patterns, more resembling those of five year olds. Rand, Tarnita, Ohtsuki, and Nowak also publish findings that show a bias towards even splits in the Ultimatum Game (2013). In another paper Chimpanzees, our closest relative, were shown to be rational actors, not considering fairness (Jensen et.al, 2007). This highlights the fact that humans are profoundly effected by a fairness bias. The results in the current paper show a significance difference despite over forty percent of participants splitting the five dollars.

Moreover, within the Ultimatum Game itself, a range of biases exist. For example, biases

relating to the gender of player two are demonstrated in Solnick's 2001, "Gender Differences in the Ultimatum Game." Offers are larger when offerers know a man will receive, they are more likely to offer larger sums. The converse was found to be true for women (Solnick, 2001). Individuals play the Ultimatum Game differently when using physical money as opposed to while using tokens or points (Shen and Takahashi, 2013). It was found that offers are, on average, greater when using physical money (Shen and Takahashi, 2013). However, as the current paper compares two groups that both use physical money, the resulting difference between groups is still significant. In another recent study, findings suggest that the perception of each individual's 'rights' to whatever resources are being allocated influence the distribution (Baumard et. al., 2013).

Furthermore, the facial expression of recipients, specifically if a face was judged to be smiling or angry, was found to effect game play (Mussel et. al., 2013). In my experiment, while individuals did not know with whom they were paired, they could see every participants face taking part in the study. If everyone in the group were smiling, the facial expression of individuals would be relevant. Despite this, significant results show that the facial bias did not completely mask results indicating a bias for bills as opposed to coins. It is also important to note that familiarity effects value judgements. Currency forms that are more familiar than others were found to have greater purchasing power (Alter and Oppenheimer, 2008). Because each time an individual pays for something they reach for their wallet (where they store their bills), it can be assumed that the one dollar bills presented in the current study are more familiar to us. The bias for bills in the current experiment was observed despite the familiarity bias.

When considering the external validity of the current study (using the Ultimatum Game),

it is expected that the question of scale will be addressed. It is intuitive to think, that given a situation where the offering player is working with a relatively large sum (e.g. one thousand dollars), they would behave differently than while working with a smaller sum (e.g. five dollars). This question was addressed by researchers who conducted a study in Indonesia. There, where costs are low by US standards, participants played the Ultimatum Game with a sum equivalent to three times the monthly expenditure for a typical citizen. Findings show that the only significant change from Ultimatum Games played with lower stakes is that recipients are more likely to accept smaller percentages of the total (Cameron, 1999). Even so, the purpose of the current paper was to determine if there was a significant difference between the valuation of coins and bills when considering small sums of money. When designing the study, one goal was to provide insight applicable to the pricing strategies for business.

From a methodological standpoint, the study could have been improved by separating all offerers and recipients. Individuals may have acted while considering others' personal opinions of them. While participants did not know the identity of their partners, they could guess. Additionally, because all participants attended Tufts University, individuals likely realized that there was a high chance of them seeing others who participated around campus at a later date. Those people could have considered future social relationships while playing the game. The statistical significance of results, however, indicates the strength of the newly identified bias. Another indication of the strength of the bias towards bills is that about 70% of participants in the fifty dime condition made some disparaging comment relating to dimes when the appropriate quantity of money was allocated. Comments such as "Dimes? really?" and "what am I supposed to do with these?" were among the most frequent phrases used.

Findings from the current paper can be generalized to a range of populations. The population was composed of entirely Tufts University students. Demographically and culturally, the participants are similar to students seeing higher educational degrees across the country. Findings can be confidently generalized to other university students. As the experiment only included students, it is unclear as to whether or not the findings can be generalized to non-students. With respect to the specific preferences between bills and coins, generalization must be made in a circumspect manner. It is important to note that specifically dimes were used and not quarters, as they are utilized in other ways (e.g. parking meters or laundry). Other coins could present specific utilities that have yet to be identified.

The implications of the study relating to pricing, however, are potentially relevant to all demographics. Findings from the current study indicated that students have a preference for one dollar bills as opposed to 10 cent coins. The most practical application of the findings presented in this paper is in the pricing of items where consumers are more likely to pay with cash. If stores priced their items in a manner that more frequently provided change in the form of full dollar amounts consumers would be happier. Perhaps they would be more likely to choose that store, that did not give change in coins, as opposed to the competitor. A range of marketing tactics could be employed to facilitate this strategy.

To better understand the extent of the bias for dollar bills, future researchers could construct a similar experiment to that used by Vandoros (2013) but rather than offer just the one choice, arrange a continuum that finds the ultimate limit of the bias. Based on the results in the current paper, one could predict that an individual may sacrifice even a forty percent increase in order to receive a bill rather than a set of coins when considering the smallest United states note,

the one dollar bill.

From a philosophical standpoint, the findings suggest that individuals do not consider their decisions in the same manner as Adam Smith and John Rawls. Neither of the two would have rationalized the rejection of an offer by considering fairness. The concept of fairness seems to be embedded in our emotions and barely touched upon by the Homo Economicus that lies within each of us.

Further research could replicate the experiment in the current paper but substitute all full dollar bills for brand new, 'crisp' notes. A better understanding of the strength of the bias mentioned previously in Muro and Noseworthy's 2013 paper could help businesses in the same manner as the implication of the aforementioned pricing strategy that minimizes coin transactions. If a business only gave freshly inked bills when giving change consumers may prefer that business to its competitors.

### **Conclusion:**

A statistically significant difference was found between the treatment of dimes and one dollar bills in the context of the Ultimatum Game. Evidence suggests that individuals place a higher value on dollar bills than dimes summing to the same amount. Insight from this finding should be applied throughout the commercial world. This is especially true where purchases are being made with small sums of physical money. While it is not surprising to discover a bias of individuals favoring bills to coins, the extent of the bias proves to be intriguing. There is a commercial need for the further study of money and valuation biases. The scope of potential applications is wide. We must reconsider our age-old assumptions about the money in our

pockets. Findings from this study could have wide reaching implications on how goods are priced in stores. In places where smaller transactions are the norm, change (coins) represents a larger portion of the sums of money individuals consider. When coins are received, findings suggest that individuals may value them at an irrationally low level. To capitalize on this finding, stores could adjust their pricing to make customers receive the change they value. If a store could provide this service, customers may be happier choosing that store. Not only would the customer be more likely to return, and loyalty be created, but stores would increase their margins.

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