CONNECTED STRANGERS:
MANIPULATING SOCIAL PERCEPTIONS TO STUDY TRUST

by
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Submitted to the

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in partial fulfillment of the requirements of the degree of

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Abstract

Economic views of trust, grounded in repeated game theory and behavioral economics experiments, largely ignore social factors such as personal relationships between subjects. In this study, we designed a new experimental procedure, the "Social Lending Game", in which aspects of trust are measured as a function of differing social contexts. The procedure harnesses real-world social relationships while keeping subjects' identities confidential. We developed relationship mining methods that categorize social connections into trustful ties, distrustful ties, and neutral ties. Subjects in the Social Lending Game were led to believe they were paired up with a stranger with real social connections to them. The perceived social connections were systematically manipulated to different types and strengths of social ties to measure the effect of social perception on trusting behavior. Surprisingly, we found that people trust strangers as much as they trust a friend's friend. In contrast, people distrust strangers when they are told that there exists no social connection to the strangers. These methods and results point to a number of future research topics that leverage social networks to reinvestigate utility theory, trust-based decisions and risk-taking behaviors in social contexts.

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Chapter 1
Introduction

1.1 Motivation

Trust, risk, and reciprocity are important factors which influence human decisions. Trust has been defined in many ways and been studied across various disciplines [1-3]. Economic views of trust, either rooted in repeated game theory or in behavioral economics experiments, have provided the assumptions to study trust-based behaviors [4]. However, individual choices do not appear to be consistent with these assumptions that a rational decision maker follows [5-7]. People are not exclusively self-interested. More trust and altruism are observed between strangers than empirical assumptions predict. Is there something missing in the economics and game theory assumptions?

The question of how to measure trust accurately and reliably is debated [8-11]. Most of the previous studies have only focused on the utility from monetary exchanges. However, they may over-simplify trusting behavior in social exchanges. Social utilities play as an important role as money or goods in everyday exchanges. For example, in person to person transactions, a purchasing decision is not only based on price but also on perceived

social attributes about the seller. In the context of business, people often refer to their social connection to others in order to gain credibility. This implies that each party in an exchange should not be considered the same. The social accounts of individual behavior should be taken into account while studying trust.

Yet, the previous designs of economics experiments, such as the standard trust game, do not accommodate such social contexts involving real social networks. The assumptions which their experimental models are based on ignore social factors such as the personal relationships between subjects. In addition, the problem of the previous design is that it is difficult to keep the anonymity of paired subjects while investigating behaviors using actual social relationships between them. Furthermore, whether the standard trust game measures trust is still controversial [12]. A new game that incorporates social reality to examine trust-based behavior is needed.

We considered social perception rooted in the network structure of social capitals to study trust-based decisions. Does referring to mutual friends really motivate trust and reciprocity? How do trust-based decisions vary with different strengths of social relationships? Are people more trusting when there exist perceived social connections?

In addition, previous studies show that trust is more essential for ensuring cooperation between strangers than for supporting cooperation among people who directly interact [5]. On the other hand, as virtual interactions increase, there is less to gauge this perceived trust upon. The impression of a person can be shaped by the perceived connections on his or her social networks. Such social perceptions may have greater impact on trust between strangers since there is no other information to rely on. How can we leverage social perceptions to motivate trust between strangers or entry-stage interactions?

1.2 Contributions

We manipulated social perceptions to examine trust, risk preference, and reciprocity. The role of perceived social connections in trust-based exchanges was investigated using real-world social networks.

A new experimental model, embodied as the "Social Lending Game", was designed to leverage social aspects to investigate trust. Differing from existing empirical methods, new assumptions and predictions of trust-based behaviors are proposed. The Social Lending Game incorporates actual social relations. The experimental model accommodates social strategic moves of each individual. It is fundamentally different from empirical methods in the following manners:

First, the emphasis in the Social Lending Game is on the impact of social perception on trust-based behaviors. We developed relationship mining methods, as well as the experimental procedures, to accurately measure trust. The relationship mining methods can serve as a methodology to categorize social relations not only for the present study, but for future research and theories on social ties.

Second, we identified the "free money effect" and other factors that may introduce bias in empirical experiments. We set up a situation where subjects may suffer a loss due to their decisions in the game. This is as opposed to the standard trust game where subjects are offered free money and extra bonus for sure. In addition, the Social Lending Game allows us to investigate how people use money from others. Also, the design allows risk to be examined separate from trust, to address the ambiguity in empirical experiments [12]. Comparing with the standard trust game, the design of the Social Lending Game, with the investment task and the refundable participation fee, can more accurately reflect trust, risk preferences and reciprocity.

We designed and implemented a unique economics experiment platform. In order to integrate actual social networks in the measurement of trust, the platform is connected with Facebook[1]. This platform allows the experiment to incorporate subjects' social identities while their real identities in the experiment are kept confidential. The experiment system, along with the unique endowment procedure and subject pairing method, has confronted one of the biggest challenges in previous economics experiment designs.

[1] Facebook: http://www.facebook.com/ One reason we selected Facebook was that it has been the largest social network since 2008. Also, Facebook users use real identities.

Finally, the unique data gathered from the experiment reveals the effect of social perception on trust, risk preference and reciprocity. We found that people place trust and reciprocity on a complete stranger as much as on a trustful friend's friend. In contrast, people distrust a stranger when they are told that the stranger is not socially connected through any acquaintances. Also, when the perceived connection to a stranger is through negative social ties, people are far more likely to break trust. The results can be applied to everyday exchanges ranging from entry-stage interactions to decisions in the virtual world. Furthermore, the results around risk preferences are different from the prediction. When people believe the stranger is connected through a trustful friend, they tend to make riskier decisions; otherwise, they are risk-averse. Further results show that weather can forecast risk preferences. The findings may serve as basis of future research on individual trusting and risk-taking behaviors as well as interpersonal interactions.

1.3 Roadmap

The motivation and an overview of the present work are given in chapter 1. Chapter 2 critically reviews the empirical assumptions and methods in research around trust, with specific focus on the measurement of trust in social context. The summary of this chapter leads to the idea that trust-based decisions should be measured when games accommodate social strategic actions. A new experimental model that leverages social aspects to examine trust was proposed.

Chapter 3 extends the experimental model to the research framework that leverages social perception to study trust. The core elements in the present study are defined. It covers the scope of trust, the dynamics underlying social perception, and the challenges we confronted around this topic. Differing from empirical methods, new assumptions and predictions of trust-based behaviors are proposed.

Along the lines of leveraging social perception to study trust, chapter 4 and chapter 5 cover the two major domains of this study -- the composition of forming social perceptions and the foundation of measuring trust. Chapter 4 describes the relationship mining methods we developed to categorize and create social perception. Relevant theories and methodologies around social ties are reviewed. Chapter 5 presents the Social

Lending Game. By leveraging relationship mining using actual social network data, the Social Lending Game served as an experimental model which investigated how social perceptions influence trust-based decisions. A critical comparison between the designs of the Social Lending Game and of empirical economics games is provided. We identified noisy factors such as the "free money effect" in previous studies. The fundamental differences and uniqueness of the present game design are discussed at the end of chapter 5.

Chapter 6 describes the design and implementation of the experiment and elucidates how the relationship mining results are integrated with the Social Lending Game in the experiment. It demonstrates seven experimental treatments leveraging social perceptions to examine trust. In addition, it uncovers the unique endowment procedure and subject pairing methods. Chapter 7 gives the technical details in system design. It shows how the experiment platform integrates actual social networks, and how the interface accommodates the experimental treatments. Combining chapter 6 and 7, it reveals the methodologies we developed to incorporate actual social identity while keeping anonymity in the experiment regarding trust-based behaviors.

The findings from the experiment are shown in chapter 8. The results of this study appear in the following sequence: First, the summary of the data and the analysis procedure are provided. Second, we considered social perceptions polar, and analyzed its effect on trust. Third, we argued the conclusion from previous studies regarding trust between strangers. We formed our theory supported by experimental evidence. As opposed to the polarity of social perception, we analyzed the strengths of social perceptions thereafter. Finally, unexpected findings around risk preference are disclosed. Chapter 9 concluded this work and points to directions for future research opportunities and applications.

Chapter 2
Measuring Trust

2.1 Empirical Assumptions

A long-established tradition in economics assumes human beings to be exclusively self-interested. Since Adam Smith, "the vast forces of greed" and the mechanics of self-interest have been fundamental to most economic accounts of individual behavior and aggregate social phenomena [4]. Game theoretic modeling has also viewed agents as being concerned with maximizing their own utility.

Based on these assumptions, several approaches were developed to measure trust, trustworthiness and reciprocity. Since Berg, et. al proposed the trust game, it has become the standard measurement of trust [3]. However, experiments using the trust game rarely end in the perfect Nash equilibrium. Empirical assumptions predict that self-interest should lead to no trust in the game. Trust game experiments show substantially more trust and altruism than equilibrium predicts.

Several papers have shown that the behavior in the trust game is affected by other motivations besides trust in the partner. Levitt and List argue that in the lab there are

several factors, such as experimenter's scrutiny, that may induce the more socially acceptable reactions [13]. Other factors include individual risk aversion [8-9] and altruism [10-11]. These results raise the question: Can we trust the trust game to accurately measure trust?

Despite the debate over whether the standard trust game measures trust, previous studies show that people deviate from purely self-interested behavior in a trusting and reciprocal manner [5]. This raised the bigger question: Is there something missing in the economics and game theory assumptions?

2.2 Trust in Social Exchanges

In everyday exchanges, people decide how to bargain with one another not only based on the transaction value, but also based on with whom they encountered. Decisions that lead to such social exchanges usually involve trust. However, most experimental studies that investigated trust simply match anonymous random subjects with one another. Also, game theoretic models and most economics models assume all partners are the same. The design in empirical games has coupled with the assumption that all players were self-interest. It leaves no room for social accounts of individual behavior.

Several previous studies considered the influence of the partner when studying behavior in social exchanges. Blount compared the effect of causal attributions on choice in social decision making when the partners were perceived as humans versus machines [14]. Ball, et. al tested for the effect of social status in a laboratory experimental market [15]. Mulford, et al. examined the perceived physical attractiveness of a partner and examined both cooperative-versus-defect choices and play-versus-not-play in a prisoner's dilemma game setting [16]. Scharlemann, et al. investigated the influence of the facial expression (a smile) of a partner on strategy taken in a 2-player game [17]. Slonim and Garbarino allowed partner selection in trust game and modified dictator game[18]. Others have focused on differences between genders in socially-oriented (selfless) behavior, individually-oriented (selfish) behavior, and risk-taking tendency [19-21]. However, none of them has focused on the influence of social relationships between the paired subjects.

A previous study focused on social capital and trust [22]. They looked at whether trusting behavior and trustworthiness rise with the number of common friends the subjects have. However, their experiment was run with friends, or with people who were asked to interact with each other beforehand, to provide a list of their common friends. This design introduced bias from the prior knowledge about the paired partner, especially when the paired partners were already friends before participating in the study. Research has shown that cumulative interactions can be construed as an important form of knowledge-based or personalized trust [23-28]. In addition, the decisions can be influenced by other factors such as gender, facial expression, physical attractiveness, social status, etc [15-21]. The results may not reflect the effect of social capital on trust and trustworthiness.

Burt and Knez investigated the "third-party effects" on trust in organizational behavior [29] They focused on social relations versus trust in a study of trust among managers in a high-tech firm by self-report surveys. As they demonstrated, gossip constitutes a valuable source of "second-hand" knowledge about others. However, as Kramer reviewed, " The effects of gossip on trust judgments are complex and not always in the service of rational assessment of others' trustworthiness" [30]. Also, the answers to the standard trust questionnaire are not correlated with the trusting behavior in the standard trust game [22, 31]. This implies that the self-report responses to do-you-trust type questions may not be consistent with actual behavior regarding trust.

2.3 Measuring Trust in Social Contexts

Humans are social animals, therefore trust should be considered in social context. Previous evidence shows that trust is a form of social intelligence [32]. However, few of the previous studies have focused on social connection between the paired partners when studying trust-based decisions. What have been missing in empirical measurement of trust were the social accounts of individual behavior.

As game theory and traditional economic assumptions failed to rationalize trusting behavior, social action should be considered as rational behavior. Previous research has introduced and manifested social utility in utility function curvature [33]. Other research

has estimated social utility functions in different contexts[34]. Extending the work on social utility, Loewenstein and Thompson had manipulated social relationship to examine interpersonal comparisons regarding the preferences for outcomes to self and others [35]. Although this study is not focused on trust, they incorporate social utility into account to study decision making in interpersonal contexts.

Past experiments using the standard trust game and the dictator game have over-simplified the conditions such that they neglect the social aspects in decision-making [3, 36]. Social perceptions of people who are involved in the decisions should not be decoupled from the measurements of utility while studying trust.

Trust-based decisions should be measured when games accommodate social strategic moves, by introducing a social context in the experimental models. The present research considers social perceptions to study trust, reciprocity, and risk preference. Further discussions are given in following chapters.

Chapter 3
Leveraging Social Perception to Study Trust

3.1 Scope

We leveraged social aspects to examine trust, reciprocity, and risk preferences. Trust has been defined in many ways across various disciplines [1-2]. In the present study, we focus on trust in regard of material exchanges. This is as opposed to nonmaterial things such as trust in knowledge exchange, morals, love, etc. As one of the most important social aspects in everyday exchanges, we considered "social perception" which is rooted in the network structure of social capitals to study trust-based decisions.

In this study, social perception refers to the perception of interpersonal relations. The fundamental dimensions underlying social perception is discussed in section 3.2. We focus on the impression formed from perceived social connections between people. This research addresses the questions: How do trust-based decisions vary with different strengths of social connections? How do they change with various social distances in social structure?

The influence of social perception on trust-based behaviors was examined in our experimental model. One of the biggest challenges is how to keep the anonymity of paired subjects while investigating behaviors based on actual social relations between them. Previous studies acquire the subjects' social relationships to one another by self reporting [22, 30]. However, such methods sacrifice anonymity and bring in factors that influence trusting behavior between paired subjects. Although other research keep the anonymity to ensure the credibility of experiment results, they have no means to incorporate social connections into account [3]. There exists a trade-off between retaining anonymity between the paired subjects and incorporating social reality.

To confront this challenge, we conducted our experiment with human subjects who were strangers. We incorporated their actual social network on Facebook and subjects were led to believe they were playing with a stranger with real social connections to them. We developed the relationship mining methods to categorize their social relationships to their real friends. Furthermore, we manipulated the relations between paired subjects to examine how social perceptions influence trusting behaviors.

In addition, we identified the effect on trust, risk preferences and reciprocity exclusively from social perceptions. Previous study has included subjects who were already friends or acquaintances [22]. As discussed earlier, these results may be influenced by prior knowledge of other perceived social attributes, such as the other party's social status, communities they belongs to, etc. These social factors were excluded from our study to prevent bias. We exclusively focused on the effect of social perception, regarding perceived social connections. To do this, we conducted the experiment with complete strangers and they were not allowed to meet each other during the entire experiment. The social distance between people in this study was characterized following the definitions of "degrees of separation" in social networks [37-38]. The social perceptions examined were perceptions of people who were in 2 or more degrees of separation. We assumed that on the basis of their first degree connections, people formed social perceptions of one another and hence influenced trust.

Leveraging actual social network to study trust between strangers also allows us to investigate interactions in the entry stage. It is common that when people first meet, they

introduce each other by referring to possible mutual friends. In business contexts, people tend to strengthen their bond by referring to their shared social connections among each other. However, does acknowledging mutual friends really strengthen social bond? Are people more trusting when there are perceived social connections? These questions were addressed by means of leveraging social perception to study trust.

3.2 Social Perception

Bourdieu first defined the concept of social capital as the following: "The aggregate of the actual or potential resources which are linked to possession of a durable network of more or less institutionalized relationships of mutual acquaintance or recognition" [39]. According to Bourdieu's definition, social capital consists of the following two decomposable elements: first, the social relationship itself that allows individuals to claim access to resources possessed by their associates; second, the amount and quality of those resources. On the basis of Bourdieu's definition, Portes concluded that "Transactions involving social capital tend to be characterized by unspecified obligations, uncertain time horizons, and the possible violation of reciprocity expectations" [40].

As several studies have pointed out, social capital facilitates individual's occupational attainment [41-43]. Other studies show that it improves companies' business operations [44-46]. Social capital is found to be significantly related to resource exchange and product innovation [47]. Most of the past studies have focused on the value created by social capital. However, few of them examine the potential risk of social capital or investigate the impact of social capital on trust.

Perceived social capital belonging to a person forms a certain impression of him/her. As the saying goes, "birds of a feather flock together." As the social perception is established, it serves as the basis for people to make assumptions to categorize others, predict behaviors, and make decisions thereafter. In this study, social perception refers to the perception of social capital that one possesses. The impression of that person can be shaped by the perceived connections on his or her social networks.

3.3 Assumptions and Predictions

We assumed that such social perceptions altered trust. Furthermore, we focused on the impression formed from perceived social connections between one another. These perceived social connections could be acquaintances, close friends, or enemies. Since there is no other information to rely upon, the influence of social perception on trust is even more effective in the entry stage interactions or between strangers.

How far can social perception be carried over through a social networks and influence trust? In everyday exchanges, a common strategy to get a good bargain is to leverage social connections as referrals. We assumed that social perception of whom one encountered with dominated the uncertainty where trust based upon. However, does social capital always motivate trust? Are there risks of having social capital?

We predicted social perception altered trust, risk preferences and reciprocity in two manners. First, we considered the social distance on a given social network. The social perception formed based upon one's social capital would have different strength of impact on trust according to the distance. The increase of trust should be proportional to the social distance.

In addition, social perception should be further considered polar. Positive (trustful) social perception induced stronger trusting behavior, while negative (distrustful) social perception damaged trust. Neutral social perception should lead to baseline behaviors, where observed trust should be in between those with trusting and distrusting perceptions.

Chapter 4
Relationship Mining

4.1 Purpose

The purpose of relationship mining is to categorize the social connections on a given social network. In order to investigate the impact of social perceptions on trust, reciprocity and risk preference, we manipulated social perceptions into different types and strengths. In this study, we considered social perceptions rooted in the network structure of social capitals. In other words, the impressions of one's first degree friends are projected onto strangers and hence form the perceptions of the strangers. Since the social perceptions are formed based upon the social capital one possesses, it is important to not only identify the social capital one has, but also categorize it according to trust.

We developed the relationship mining methods that categorize social relationships to one's first degree friends according to trust. The relationship mining results serve as the basis for manipulating social perceptions in various experimental treatments in the "Connected Strangers Experiment" (see section 6.3.3 for the experiment design).

In addition, the relationship mining allows us to incorporate actual social networks while keeping the anonymity of paired subjects in the experiment. To do this, the social relations of the social capital subjects have are genuine, while the social relations beyond 2 or more degrees of separation were manipulated to create various social perceptions in different experimental conditions. With the relationship mining methods, we categorized real-world social connections into trustful tie, distrustful tie, and neutral tie. By leveraging the actual social relationships, we manipulated social perceptions to investigate trust-based decisions.

4.2 Relationship Mining Methods

4.2.1 Social Ties Conditioned on Trust

This study scoped trust in terms of trust in monetary exchanges (Chapter 3). We categorized the relations of one's first degree social capitals regarding the same aspect of trust – monetary exchanges. Previous studies provided quantitative measurement of social ties [48-49]. Recent studies focused on predictive models that map virtual social networks to the strength of social ties by analyzing quantitative variables on social media sites [50-51]. The results may represent tie strength well, but the correlation of tie strength and trust are vaguely seen. In addition, the data collected from social media sites may provide an objective view for quantitative analysis of tie strength. However, such methods may not represent the actual level of trust a subject has.

In order to identify and categorize the social ties in terms of trust, we developed the relationship-mining survey. The survey questions are scenarios involving the subject and their actual friends. The survey questions for relationship mining are as follows:

1. **Will you lend $100 to** Thomas **if he asks?**
   - ☐ **Yes.**
   - ☐ **No.**

2. **Do you believe** Andrew **will return the $100 borrowed from you?**
   - ☐ **Yes.**

- ☐ **No.**
- ☐ **I'm not sure.**

3. **You have an urgent need of $100. Will you ask** Sophia **to lend you some money?**
   - ☐ **Yes.**
   - ☐ **No.**

4. Jessica **is in a rush and needs your help.....**
   Jessica **gives you $100 that her friend will come pick up from you within 30 minutes. However, no one shows up. You decide not to wait for the friend and keep the $100 in your wallet. On your way home, the $100 gets stolen! You will ...**
   - ☐ **say sorry to** Jessica **and may or may not return the entire $100.**
   - ☐ **pay back** Jessica **the full amount of money by all means.**
   - ☐ **think that $100 between you two is not a big deal. Either of you will cover it.**

We incorporated actual social networks of each subject on Facebook. To gain an adequate amount of information about one's social capital without introducing bias in the survey, forty friends were randomly picked and displayed in a random sequence. Each survey question is with regard to a friend, while the corresponding name, picture, social network, and further information of that friend are displayed along with the question on a web-based interface. Subjects' identities and their responses in the survey are kept secret. This method allows us to gather comprehensive information of one's social capital and keep their identity confidential. Also, the data collected is from the subjective view of each person, and would represent their impressions of each of their friends in terms of trust.

4.2.2 Algorithm for Categorizing Social Relationships

Based on the relationship mining results, the social connections between a person and his/her first degree friends were categorized into a trustful tie, a distrustful tie, or a neutral tie. We further differentiated trust regarding lending money and borrowing money.

Questions 1 and 2 in the relationship-mining survey are to indentify the lender's respect of trust, while questions 3 and 4 are with respect to the borrower. The algorithm for categorizing the social relationships is as follows:

For trust regarding lending,

If ((the answer to Q1 is "Yes") & (the answer to Q2 is "yes")) {

The relationship == trustful; }

else if ((the answer to Q1 is "No") & (the answer to Q2 is NOT "I'm not sure") {

The relationship == distrustful; }

else { The relationship == neutral; }

For trust regarding borrowing,

If ((the answer to Q3 is "Yes") & (the answer to Q4 is NOT "1")) {

The relationship == trustful; }

else if ((the answer to Q3 is "No") & (the answer to Q4 is "1")) {

The relationship == distrustful; }

else {The relationship == neutral; }

The relationship-mining survey incorporating actual social networks, in conjunction with the categorizing algorithm, allows us to identify a subject's social capital and to classify his/her social connections in terms of trust. The results serve as the basis for the Social Lending Game (Chapter 5) where a pair of strangers would participate as a borrower and a lender. The above algorithm of trust regarding borrowing is applied for a subject who participated as a borrower, and that of trust regarding lending is applied for a lender.

4.3 Manipulating Social Perception

Using the results from relationships mining, we generated the "Social Connection Graph" (Figure 1). The Social Connection Graph illustrates the social relations among strangers who participate as lender-borrower pairs in the social lending experiment.

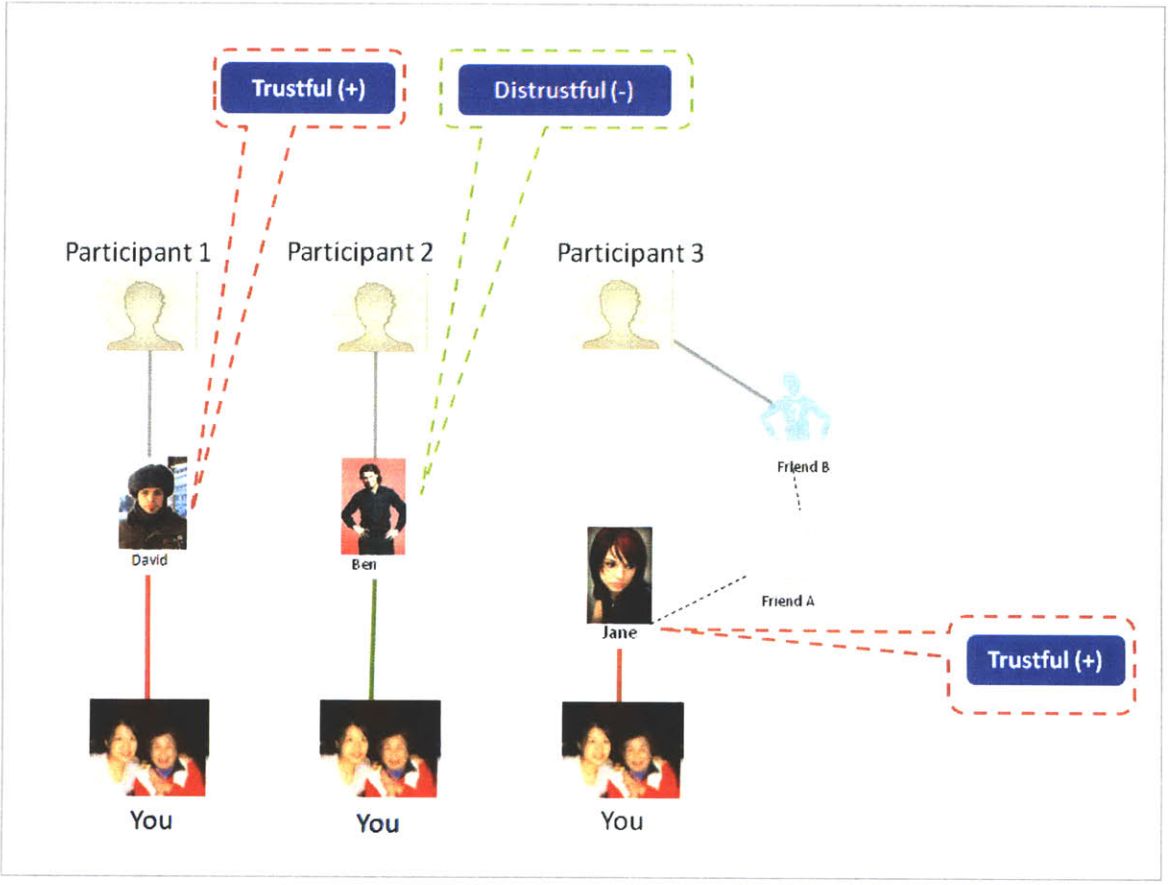

Figure 1. Types of social connections for generating the Social Connection Graph.

Three types of social connections are generated: the trustful connection, the distrustful connection, and no connection. As illustrated in Figure 1, for example, the subject and participant 1 had a common friend, David. Also, the degree of separation between the paired strangers was two. Since David was identified as a trustful friend according to the relationship mining results, David was a trustful connection between the subject and participant 1. Similarly, Ben connecting the subject and participant 2 had been categorized as a distrustful friend, and the degree of separation was two. This formed the

distrustful connection. If there is no connection between the two strangers, no mutual friend will be displayed.

In addition, various strengths of social connection are generated. As shown in Figure 1, participant 3 was four degrees away from the subject, and their mutual friend Jane had been categorized to be a trustful friend. The first degree friend is the basis when forming the social perception. To investigate the impact of strengths of social connections, as opposed to types of social connections, we considered only a trustful tie as the first degree connection when varying the strengths of social connection. Social connections of 3 degrees to 6 degrees of separation were generated, as displayed in Figure 2. The first degree friend is the social capital identified in the relationships mining, so only the first degree friend is listed on the Social Connection Graph. Other friends beyond first degree are displayed as anonymous, including the other participants.

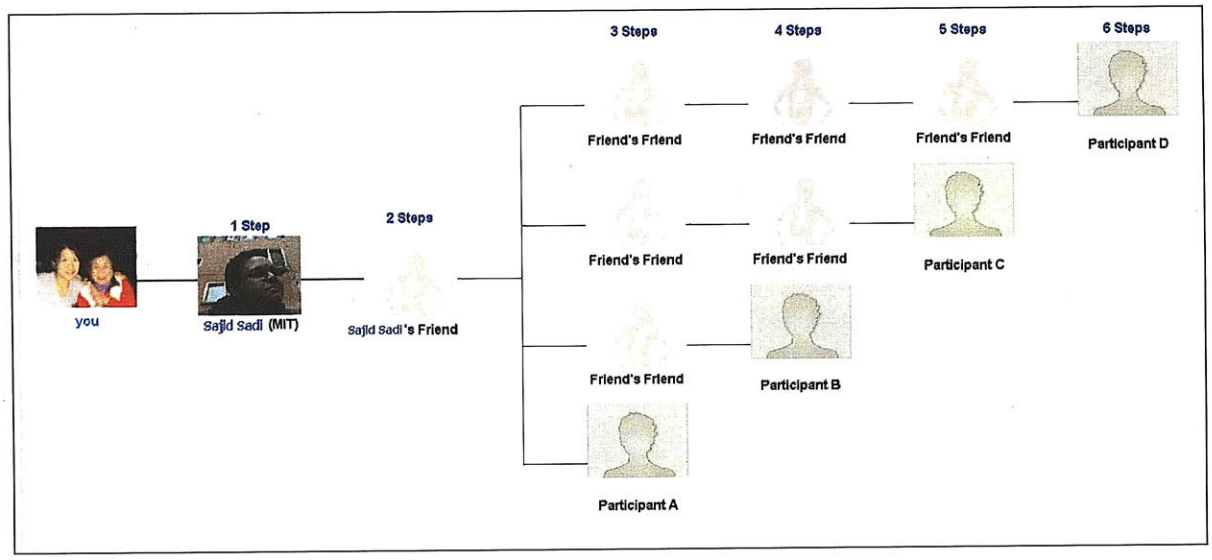

Figure 2. Different strengths of social connections in the Social Connection Graph.

By arranging a different first degree friend on the Social Connection Graph, different types of social connections between paired anonymous subjects can be arranged. By tuning the degrees of separation between the two subjects, the strengths of the social connection between them can be changed. The social perceptions one may have of the paired participant can be manipulated by arranging a specific Social Connection Graph, which served as the basis of different treatments in this experiment using the Social

Lending Game (see Chapter 6 and Figure 17).

Chapter 5
Social Lending Game

5.1 Purpose

The Social Lending Game is designed to model trust, reciprocity and risk preferences. By leveraging relationship mining using actual social network data (Chapter 4), the Social Lending Game serves as an experimental model which investigates the effect of social perceptions on trust-based decisions. In addition, the design decomposes decisions made by anonymously paired lenders/borrowers, to further examine self-other discrepancies in risk preference.

The experiment model of the Social Lending Game considers realistic social lending situations. Unlike empirical economics games, such as the standard trust game where the experimenter tripled the money between two players, the money sent from one subject in the Social Lending Game may be increased or may be gambled away due to the other subject's decisions [3]. The Social Lending Game with the investment task is a unique design that fundamentally distinguished the experimental model from empirical

experiment design. With which, the Social Lending Game models trust, risk-preferences, and reciprocity in an accurate sense, it also investigates the effect of social perceptions.

5.2 Social Lending Game Design

As an experimental model for testing the hypotheses, we considered the simplest social landing situation, where the financial transactions occur between one borrower and one lender.

Figure 3 depicts the game tree of the Social Lending Game. The borrower and the lender are paired up in the initial stage. Each of them is endowed with same amount of initial capital M_0. A unique endowment method was designed for the experiment in order to ensure subjects consciously regard the money as their own money (see section 6.2 for the endowment method.)

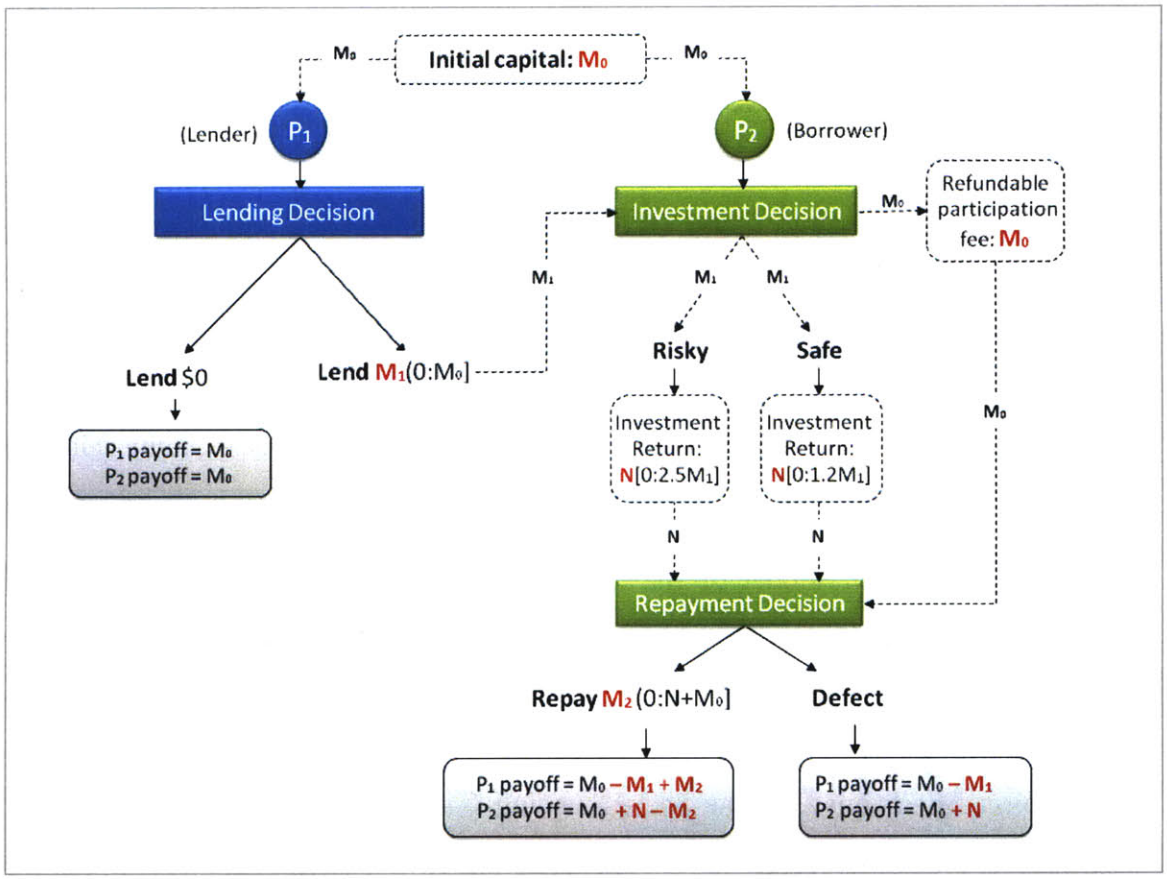

Figure 3. The game tree of the Social Lending Game.

The borrower and lender are not allowed to choose each other. They are paired up based on their social relationships on social networks. According to the relationship mining results, we identified their relationship regarding trust using actual social network data (Chapter 4). In the Social Lending Game, a borrower is paired up with a specific lender who is a stranger, but could be socially connected through their common friends (see Chapter 6 for further discussion on subject pairing.) The paired-up lender and borrower are not allowed to meet each other. This is to keep them as strangers during the game. Although they are strangers to each other, they are given the Social Connection Graph and corresponding information (Figure 17 and section 6.3.3), showing who their common friends are, and how far they could be linked to each other on their social network. In the experiment, the social connection information was given before and during their decisions.

The lender makes the lending decision, which is used to model trust as a function of social perception. The decisions made by the borrower include an investment decision and a repayment decision. The investment decision is to test the hypotheses of risk preferences. The repayment decision is to model reciprocity.

5.2.1 The Investment Task

As the most realistic social lending situation, the borrower is in need of money to remove his current deficit, while the lender may expect to increase her future utility from making the loan. In the Social Lending Game, we considered a borrower who needs money for making an investment. A great investment opportunity is provided, where a return better than the annual average return of stock market investments could be earned.

The investment simply consists of two options:

Investment option 1 is a high risk-high return investment.
Investment option 2 is a low risk-low return investment.

As the simplest investment situation, the borrower only has to pick one of the investment options, using the entire loan (M_1) given from the lender. The investment return (N) is calculated based on given winning possibilities. With investment option 1, there is a 50% risk to lose the entire loan (N=0), and a 50% chance to win 250% in return

($N=2.5M_1$). With investment option 2, the risk to lose the entire loan is 10% (N=0), with a 90% chance to gain 20% profit ($N=1.2M_1$).

Figure 4 is the screen illustrating the investment options for borrowers in the Social Lending Game. On the same screen, a borrower can see the Social Connection Graph showing the connection from them to the lender on social networks. Before they can start to make their investment choice, the borrower has to pay a "participation fee" in order to enter the investment. The reason for the participation fee arrangement is to model how people use the money of others. Would social perception change the risk-taking behavior? See section 5.2.2, "Spending Others' Money" for further discussion.

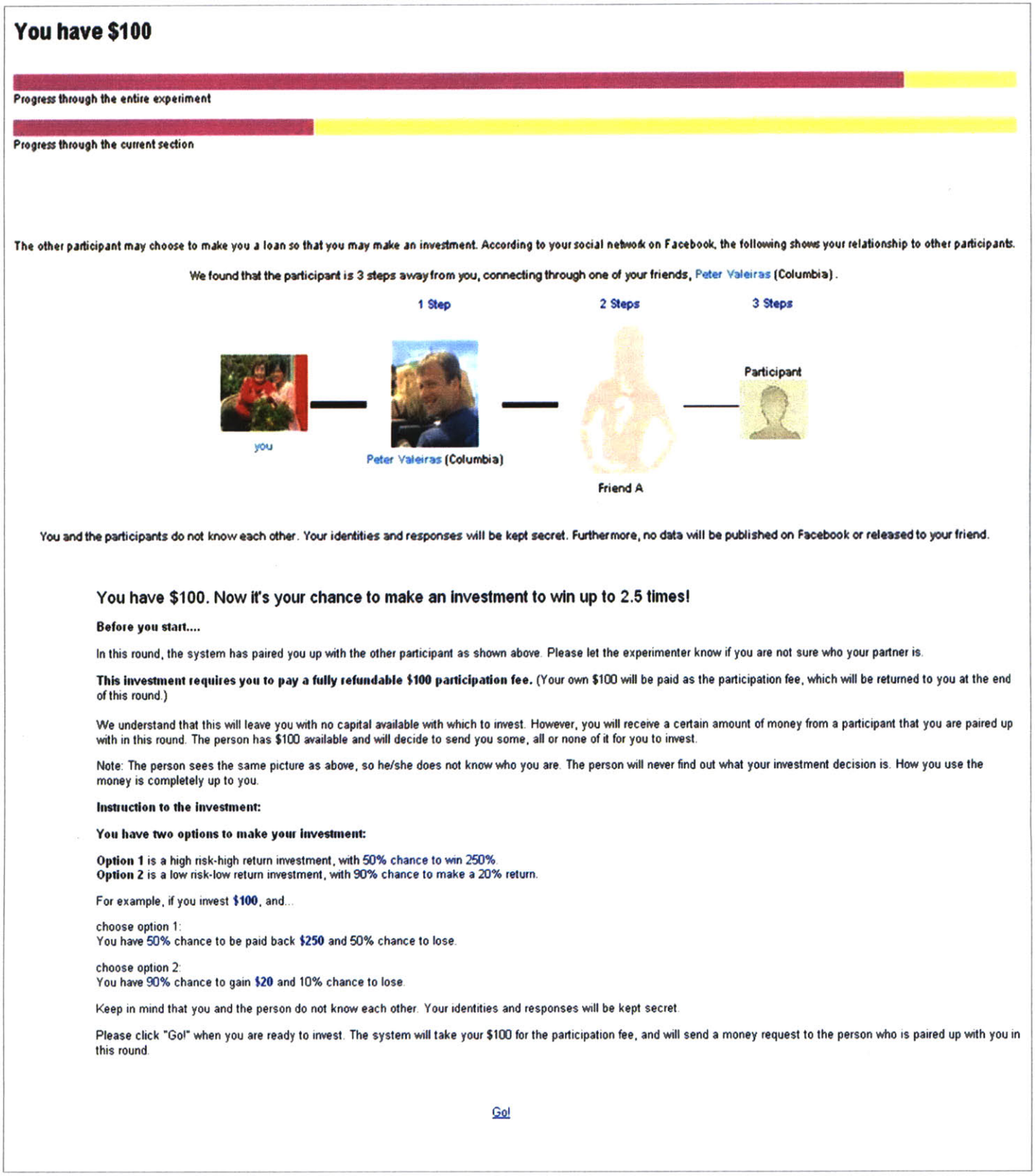

Figure 4. The investment task screen in the Social Lending Game.

5.2.2 Spending Others' Money

The borrower is given an initial capital M_0. However, we purposely put the borrower in the situation that they do not have enough money to invest, by doing the following:

In order to make the investment, the borrower is required to pay a fully refundable "participation fee" before they could continue. The participation fee costs the same amount as the initial capital M_0. In other words, the borrower's own capital is frozen until the end of the investment. At that time, the participation fee (M_0) is returned along with the investment principal and profit (N) (Figure 3). This leaves the borrower with no capital available with which to invest, and hence the borrower has to use money from a stranger to make the investment.

The reasons for charging the borrower the participation fee and leaving them with no money to invest are described as follows:

First, either investment option has a certain risk to lose the money (M_1) borrowed from the stranger. The fully refundable participation fee is in fact collateral that ensures the borrower to have the ability to pay back (Figure 3). Lenders are also aware of this before they make their lending decisions. The lender's screen reads "The borrower needs more capital to make an investment to earn up to 50%. Their own capital (M_0) is paid for a refundable participation fee, which will be returned to them with the investment profit. The borrower will use the money sent from you to make the investment." Thus, the investment risk would not influence the lender's decision. The lender's only risk is the borrower not repaying the loan. This makes the lender's decision rely on their understanding of the borrower, while the only information about the borrower is from the Social Connection Graph. When a lender makes the lending decision, they may only be influenced by the social perception of the borrower, but not by the investment risks or other factors.

Note that when the borrower is given the investment options, the participation fee is presented as a required fee to enter the investment. This provides them with a reason to request the loan from the lender. This setting is fundamentally different from the

empirical methods that the money receiver receives a set of free money for no reason. Further discussions about this are given in section 5.3.

The setting also clearly separates the other's money from the borrower's own money. As shown in Figure 4, terms or concepts such as "collateral" are avoided in the description about the participation fee, because collateral implies that the borrower has the obligation to pay back. We leave the repayment decision with the borrower at the end of the game when their own money (M_0) is returned. They are asked to payback using their own money, without being predefined as collateral. The purpose is to prevent mixing the borrower's own money with the lender's money. They use only money from others to invest. This allows us to investigate how people use someone else's money, as oppose to their own money.

5.2.3 Measuring Risk Preferences

The incentive to borrow is to make an investment profit. Using the loan from the lender, the experiment task is to model how people use money from others. How would the risk preference be different when the lender is a complete stranger, versus the case when the lender is a friend's friend?

To identify whether risk preferences are influenced by social perceptions, the Social Connection Graph is given on the investment option screen (Figure 4) and on the decision screen (Figure 5). The borrower is given only the following information:

1. The descriptions of the two investment options.
2. Through which friend the borrower can be linked to the lender.

We hypothesized that risk preferences can be influenced by social perception. Furthermore, we hypothesized that people tend to make riskier choices when the social connection was loose, i.e., when the lender is three steps or further, and when the connection is a distrustful tie (Chapter 4). On the other hand, we hypothesized that safer investment decisions would be made when using the money from connected strangers with a strong, trustful social tie.

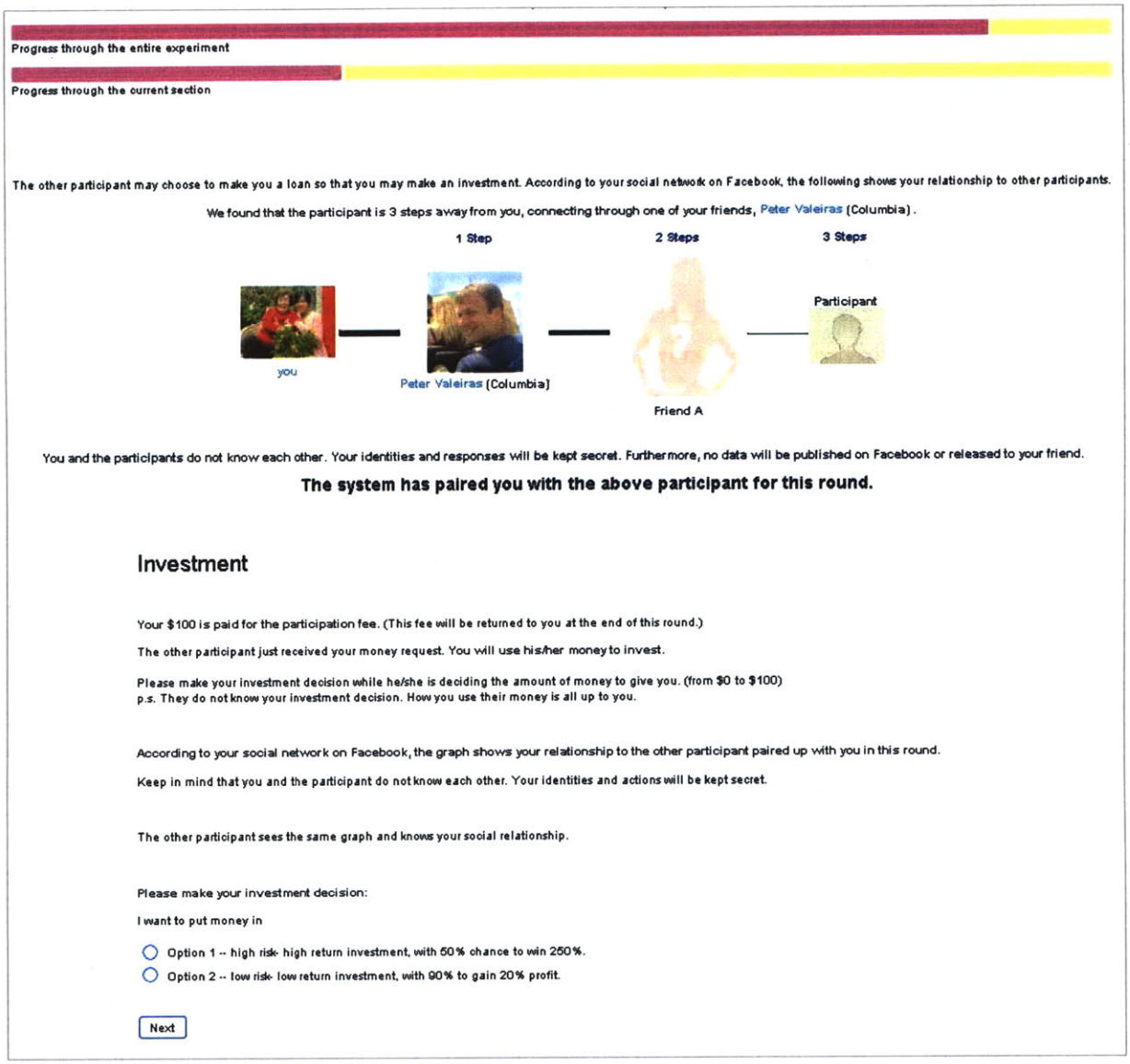

Figure 5. The decision screen for the investment, to model risk preferences using money from others, who can be socially connected as shown in the Social Connection Graph above the investment options. The borrower's own money (M_0) is locked by the participation fee.

We purposely arranged the expectation values for the two investment options to be close but different:

- **Option 1** is a high risk-high return investment, with a 50% to win 250%.
- **Option 2** is a low risk-low return investment, with a 90% chance to make a 20% return.

For example, if one invests $100, by choosing option 1, they have a 50% chance to be paid back $250 and a 50% chance to get $0. By choosing option 2, they have a 90% chance to be paid back $120 and a 10% chance to get $0.

People tend to be risk-averse [52-54]. If the two options had same expectation values, a risk-averse agent may regard option 2 superior to option 1. We arranged the expectation value of option 1 to be slightly better than option two, in order to compensate for this effect.

Note that no information about the loan amount (M_t) is given at this point. The investment decision is the borrower's discretion alone. However, the size of loan from the lender may signal trust, and may in turn change the borrower's decisions. To prevent such an influence, the borrower is asked to make the investment decision at the same time when the lender is sending the loan (Figure 5). This is to ensure that the investment decision is made regardless of the size of the loan.

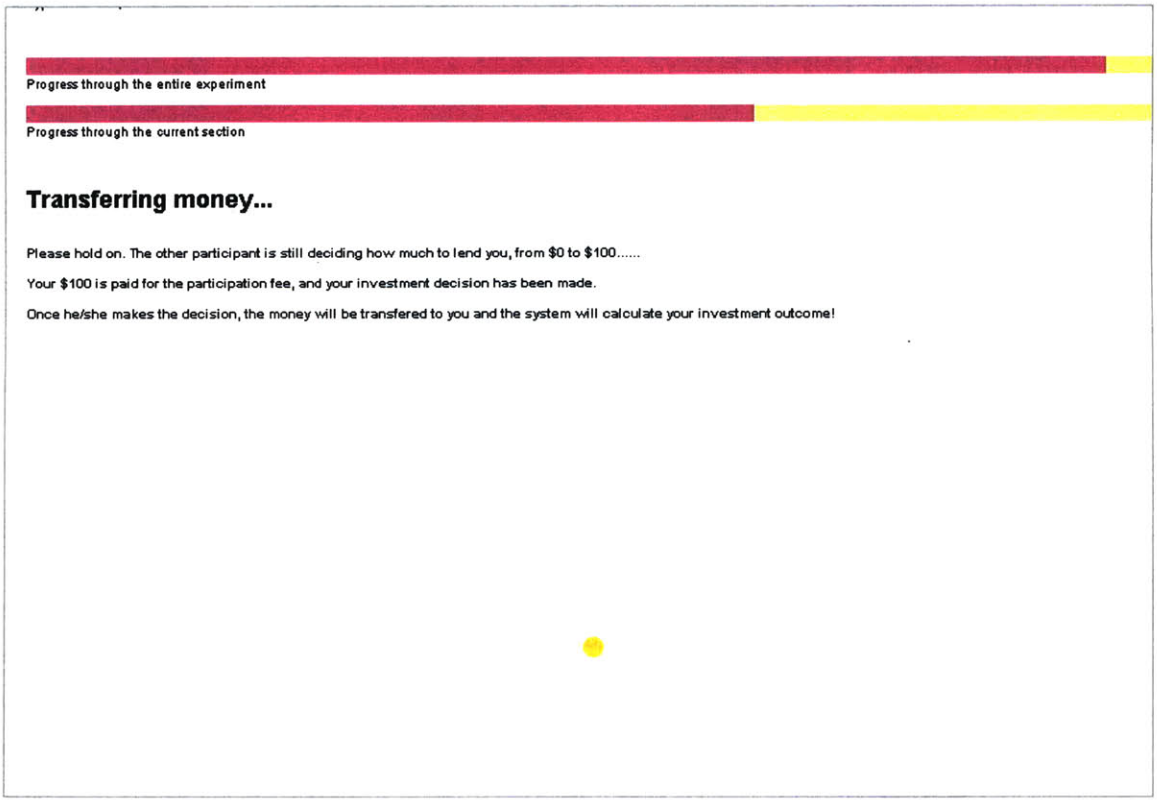

Figure 6. The transaction screen. The loan amount is not revealed until after the borrower makes their investment decision.

In addition, we arranged the transaction screen as shown in Figure 6. This way, the loan amount (M_1) from the lender is revealed only after the investment decision is made. The system requests the lender's decision through the Internet. The money from the lender is transferred to the borrower after this point, as shown in Figure 7. This further separates the borrower's own capital from the lender's, to measure how people spend money from others, and to model whether trust and reciprocity can be influenced by social perceptions.

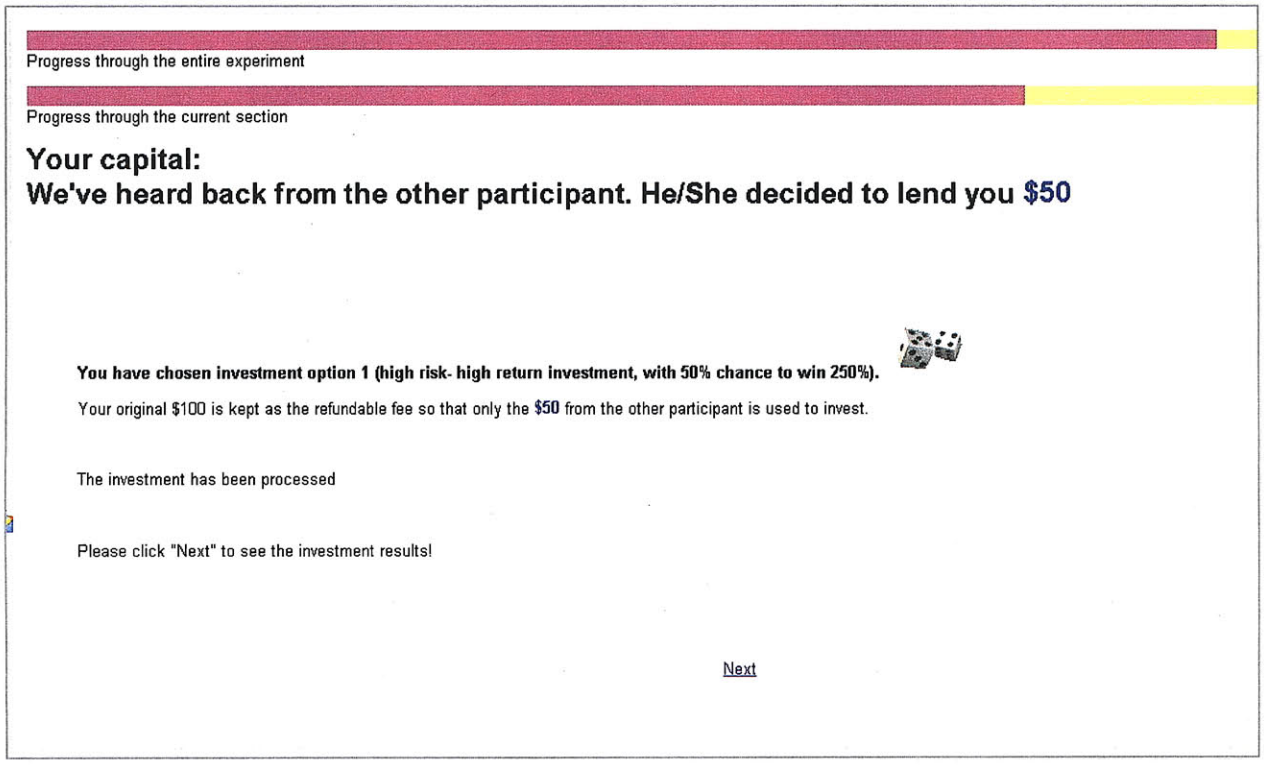

Figure 7. The loan-receiving screen. The money from the lender is kept separate from the borrower's own money.

5.2.4 Measuring Trust, with Respect to Social Perception

The lender decides whether they want to pass any of their endowment (M_0) to the borrower. The lender's decision screen is shown in Figure 8, where a Social Connection Graph is displayed to show the social connection between the lender and the borrower. The content of the Social Connection Graph is based on the relationship mining results and experiment treatment. See Chapter 4 and section 6.3.3 for further descriptions. In this

example, the lender's friend Aaron knew the borrower. The borrower and the lender were strangers and were not allowed to meet during the experiment.

Figure 8. The decision screen for lending, to model influences of social perceptions on trust.

The decision screen shows the lender the following:

1. Through which friend the borrower can be linked to the lender.

2. The borrower is in need of money to make an investment, wherein the borrower has the chance to gain up to 2.5 times in return. The borrower will use the money from the lender to invest.
3. Even if the borrower lost in the investment, they still had the initial endowment (M_0).
4. The borrower may share the profit with the lender or may not return the full amount of the loan.

The lender can either transfer any amount M_1 ($0< M_1 \leq M_0$) or can decide not to lend any money to the borrower. Any amount not transferred to the borrower is kept by the lender. If the lender decides not to lend, they will keep the entire M_0, and the borrower receives no loan for the investment, which terminates the game. The borrower's payoff is also M_0 (Figure 3). If the lender lends M_1, and the borrower repays M_2, the lender's payoff will be $M_0 - M_1 + M_2$. The lending decision investigates how social perception motivates trust, which was measured by the amount lent (M_1).

The incentive to lend is the potential share of profit from the borrower. Even if the borrower loses the investment, they still have the ability (their own money) to pay back full amount. The risk of lending is that the borrower decides not to pay back the loan. Also, the borrower's investment decision is never revealed to the lender. The lending decision is the lender's discretion, whether to trust the borrower. The amount (M_1) is sent to the borrower without adjustment (Figure 3). Differing from the trust game, no extra capital is provided by the experimenter during the transaction. Comparing with the empirical experiment, this game design further reflects trust. See section 5.3 for further discussions.

5.2.5 Measuring Reciprocity, with Respect to Social Perception

Reciprocity is measured from the borrower's repayment decision. This happens when the investment outcome is revealed. The investment return (N) is delivered to the borrower. At the same time, the participation fee (M_0) is refunded (Figure 3).

If the borrower loses in the investment (N=0), they also loses the money from the lender (M_1). The total money they have is their initial endowment M_0. In other words, they lose a stranger's money. Will they use their own money to pay back?

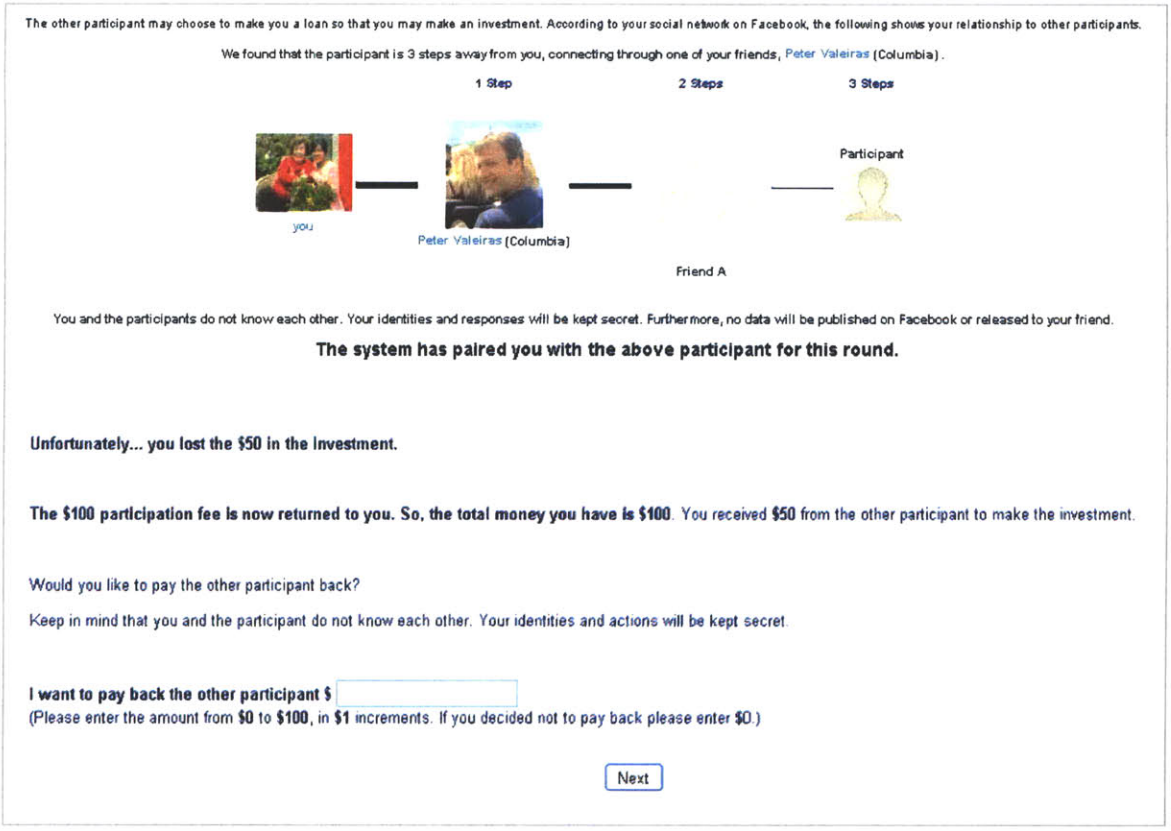

Figure 9. The repayment screen.

Figure 9 shows the repayment decision screen. The Social Connection Graph and corresponding information are displayed on the same screen. In this example, the investment is not successful (N=0), such that the borrower loses all the money from the lender (M_1=\$50). The total amount of money the borrower has at this point is the refunded participation fee (M_0 = \$100). The borrower could choose not to pay back by entering \$0, or by paying back some or all of their capital. The amount entered is pre-calculated in a pop-up window before the borrower confirms this decision (Figure 10). In this example, the borrower tries to payback \$50 (M_2) to the lender. The borrower is considered trustworthy by paying back the full amount (M_1=M_2=\$50). If the borrower confirms paying back this amount, they will suffer a loss (M_2=\$50) and leave the game with the remaining \$50. The lender will get the full amount of the loan paid back and leave the game with their entire endowment \$100 (M_0). The borrower may change their mind based on the pre-calculation results. If the borrower maximizes their own utility, they will defect by

keeping their own $100 and leave the game. Therefore, the lender loses $50, and the borrower is considered not trustworthy.

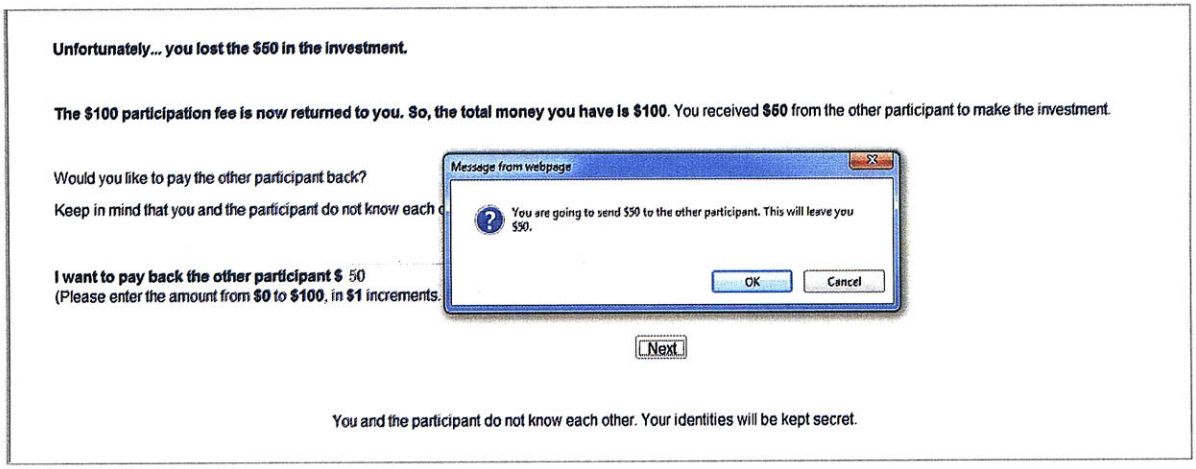

Figure 10. The repayment preview screen, which clearly informs the borrower their balance if the repayment decision is made. No money will be transferred to the lender before their final decision is confirmed.

The investment could be successful. If the borrower wins in the investment (N>0), the total investment return will be the money sent from the lender (M_1) plus the investment profit. They also keep their own money returned from the investment participation fee (M_0). In this situation, would they share their profit with the lender?

The repayment decision screen and preview screen are the same as Figure 9 and Figure 10, except for the amounts. The Social Connection Graph and corresponding information are displayed to show the connection between the borrower and the lender.

The repayment decision measures reciprocity, when the investment is successful. If the borrower shares the profit with the lender ($M_2 > M_1$), we consider the borrower as reciprocal.

5.3 Comparing with Previous Economics Games

In the standard trust game, the money sent from player 1 is always tripled by the experimenters and then transferred to player 2. Thus, player 2 receives 200% extra for free for sure. Player 1 is aware of this happening, and will expect to share the free money. The

capital is not increased out of any player's effort, but automatically increases to three times for no reason. Since the expansion of the capital is given for free, subjects may not regard the tripled money as valuable as three times of the actual amount. Consequently, the decision-making behavior deviates toward a tendency of giving money away more easily. We termed such tendency the "free money effect."

Player 2 receives the money and is asked to decide whether to send any amount of it back to player 1. Knowing that two-thirds of the money is given for free, it does not hurt returning money back and sharing the free portion with player 1. Similar concerns around the "free money effect" are interpreted by Fehr as follows: "In a trust game, for example, a Proposer [player 1] receives an amount of money x from the experimenter, and then can send between zero and x to the Responder [player 2]. The experimenter then triples the amount sent, which we term y, so that the Responder has 3y. The Responder is then free to return anything between zero and 3y to the Proposer. It turns out that many Proposers send money and that many Responders give back some money. Moreover, there is frequently a positive correlation between y and the amount sent back at the individual as well as at the aggregate level" [5].

As for player 1 in the standard trust game, bearing in mind any money sent is tripled for free for sure, their incentive to send money is for the share of the free money rather than trust. Thus, the money sent from player 1, and the amount returned by player 2 may not actually measure trust and reciprocity as the trust game claimed.

In the Social Lending Game, we designed the borrower's investment task. This investment decision task is the core element in the experiment model that allows the Social Lending Game to reflect trust and reciprocity. First, the money sent from the lender may be increased to up to 2.5 times, but this is from the borrower's action. Gaining profit in the investment is from the borrower's effort. It takes all their initial capital M_0 in order to make the investment. Also, it takes their decision to potentially increase the capital. No free money effect is introduced by the experimenter.

Furthermore, in the Social Lending Game, the money sent from the lender may be diminished out of the borrower's action. If the entire amount of money sent from the

lender is lost, will the borrower still repay the lender? Will this be influenced by the social connection between them?

Anticipating this, and without the "free money effect", the lender's gauge relies on the social perception of the paired borrower. This repayment decision, especially when suffering a loss from their own action (as oppose to receiving free money for no reason) measures reciprocity. Social factors are also taken into account in the measurement of trust and reciprocity in the present game design. Comparing with the standard trust game, the design of the Social Lending Game, with the investment task and the refundable participation fee, can more accurately reflect trust and reciprocity.

Chapter 6
Experiment Procedure

6.1 Experimental Design Overview

We designed a behavioral experiment with different treatments to test the hypotheses around trust-based decisions and the influences by social perceptions. The experiment was conducted in several rooms located at the MIT Behavioral Research Lab. We conducted the study with human subjects. They were seated in separate rooms with doors closed. Subjects who were paired up in the same experiment were not allowed to meet each other before, during or after the experiment.

6.1.1 Experiment Components

The experiment consisted of the following components:

Phase 1:

1a. The relationship-mining survey.

1b. The "Complete Stranger Experiment".

Phase 2:

2a. The "Connected Stranger Experiment".

2b. The Review Questionnaire.

For phase 1a, we designed the relationship-mining survey and interfaced it with actual social network on Facebook. Through our experiment system, subjects were able to view information about their friends in real time. They answered a set of questions in different scenarios involving their friends. Phase 1b consisted of one round of the Social Lending Game where subjects were randomly paired up with a complete stranger.

Phase 2a consisted of seven rounds of the Social Lending Game. Each round was a separate experimental treatment, and was completely independent. A subject was paired up with seven different strangers to participate in each of the seven rounds. Phase 2b was a questionnaire that probed subjects' decision-making strategy and reviewed their experience. It was not presented unless they completed all other phases.

The experiment procedure is illustrated in Figure 11. The entire process of phase 1 and phase 2 took around 30 minutes each. Phase 1 and phase 2 were separated by at least seven days. After completing phase 1, subjects were required to complete a demographic survey (see Appendix C) Also, they were asked to fill out a participation payment form, no payment was made until the end of phase 2. All the money endowed in the experiment was in chips, and the amount could be increased or decreased based on their decisions. We developed a unique endowment method, described in section 6.2.

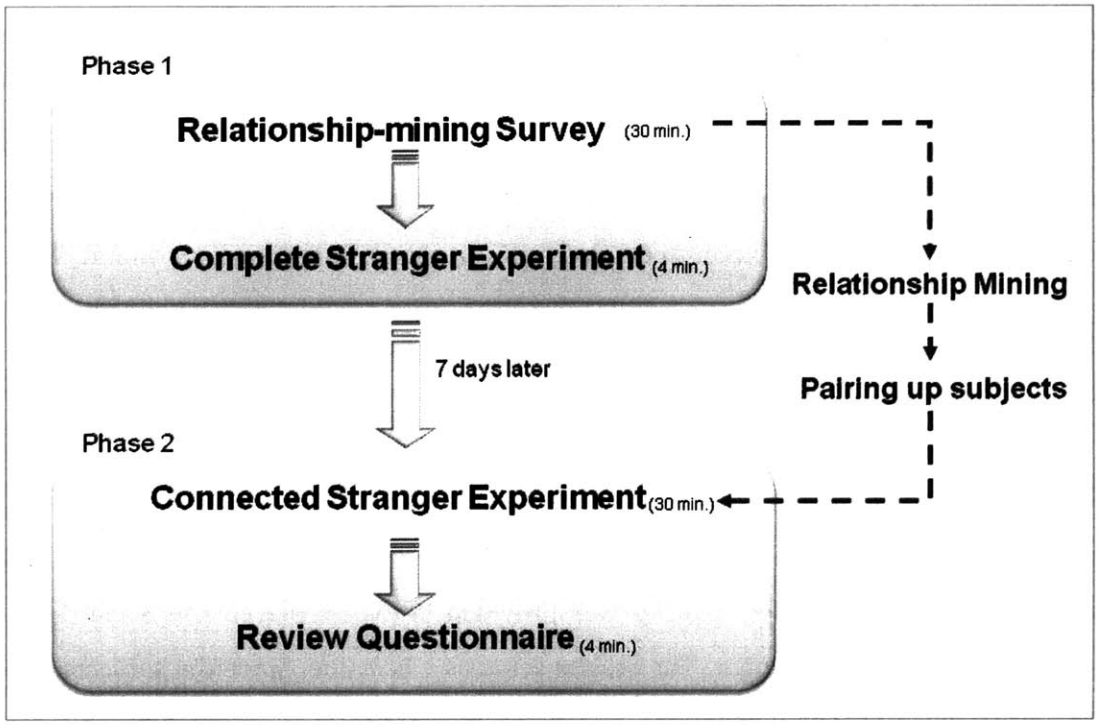

Figure 11. The experiment procedure.

6.1.2 Social Network in Sequential Experiments

We developed a system and interface for behavior experiments involving social networks (see section 6.6 and Chapter 4). In experiment phase 1 and phase 2a, subjects were required to use their real Facebook identities to log in to Facebook through our experiment's interface. This allows actual social networks to be displayed on the experiment's interface in real time. In addition, the use of actual social network data along with subject's behavior recorded in the experiment, allow us to conduct the relationship mining (Chapter 4).

The basis of the treatments in experiment phase 2a is the Social Connection Graph. It was constructed according to the results from the relationship mining using the data from the relationship-mining survey. In other words, the content of experiment phase 2a relied upon phase 1a. They both were based on the relationship mining results from actual social network data.

The Social Connection Graphs, such as Figure 17, Figure 18 and Figure 19, illustrated the social relationship between two subjects who were paired up in the game.

We manipulated the graph by replacing the pictures and changing degrees of separation. To change the types of social ties, we changed the first degree friends on the graph by replacing a trustful friend with a distrustful friend. The trustful or distrustful relationships were categorized from the relationship mining. Seven types of Social Connection Graphs were created for the seven treatments in the Connected Strangers Experiment (Section 6.3.3).

6.1.3 Pretest-Posttest Design Combining with Repeated Measures

Our experiment can be seen as a Pretest-posttest experiment design combined with repeated measures [55-56]. The Complete Stranger Experiment (phase 1b) is the pre-treatment measure. In the Complete Stranger Experiment, no information about social connections or subject pairing was provided. Subjects played the Social Lending Game with a complete stranger. The results serve as a baseline. Since the subjects are the same for all levels of the independent variable(s), they are their own controls.

The post-treatment measurements are the Connected Stranger Experiments. They consisted of seven treatments, which were conducted in seven different rounds of the Social Lending Game. This can be seen as a repeated measurement (within subjects) design. The treatments are described in section 6.3.3. Counterbalancing is a common strategy to address carryover effects in such repeated measurement design [56-58]. We randomized the sequence of the seven treatments. Furthermore, we arranged pre-experiment surveys prior to each round of the game. The pre-experiment surveys served as interferences to further prevent carryover noises. Also, pre-experiment surveys were also designed as part of our unique endowment method (see section 6.2) so that subjects earned a new set of capital for each round. This further removed the carryover effects.

We arranged a period of at least seven days between the pre- and post-treatment measures, for the following reasons:

1. Pairing up subjects for the seven treatment groups, based on relationship mining results.

At the end of phase 1, the experimenters assisted subjects to schedule phase 2 to be some time seven days or later than phase 1. Subjects were told that "We have a pool of participants who also ran the same tasks, using their real Facebook identity. According to the data, the system will find seven appropriate partners for you. You will be paired up with them to run seven independent tasks in phase 2 at the time scheduled. Usually it takes seven days for us to pair you up with them and schedule all seven people to the same time. If the system can't find seven good matches for you or if some of them cannot make it at that time, we may reschedule you to a later time." Subjects did not see the Social Connection Graph until then. The actual pairing up method was described in section 6.5.

2. Providing interference that made it hard to recall phase 1 tasks.

In phase 1, the relationship-mining survey included questions regarding trust, in the aspect of financial transactions, between friends (see section 6.3.1). The results of the relationship-mining survey were used for construct the Social Connection Graph, which formed the major content of the experiment treatments in the Connected Stranger Experiment (see section 6.1.2). Thus, if the experiment treatments had been presented right after the relationship-mining survey, the subjects might be able to infer the experiment's purpose from the questions they just answered. To prevent this, we had arranged interference questions at the end of the relationship-mining survey and avoided related wordings. In addition, subjects were not allowed to perform phase 2 until seven days after phase 1.

6.1.4 Standardizing Experiment Procedure

We standardized the experiment procedure to avoid any factors that may be induced to the experiment by experimenters. For example, Levitt and List observed in the trust game that scrutiny by the experimenter distorted subjects' behavior [13]. Different from the standard trust game, subjects made decisions, and delivered and received monetary rewards through computers. We also standardized all the instructions of every phase of the experiment, as listed in Appendix B and Appendix D. Experimenters did not give subjects instructions or chat with subjects. Subjects were seated in a closed room, and were not allowed to chat with the experimenter or with other participants during the entire experiment.

6.2 Endowment

We developed an endowment method for behavior economics experiments. In most of the behavioral economics studies, subjects are given money for free in the beginning of the experiments. The money might not work as a effective endowment since people may not treat the free money the same as their own money. In addition, knowing the actual amount before the experiments may change their behavior, especially when the experiment involves decisions about money. An alternative is to give subjects chips without revealing the exchange rate. However, the free chips given in the beginning of the experiments may be an even less effective endowment than free money. People may not take them seriously and hence bias the experiment results.

In our study, subjects were not given money or chips for free. They were required to perform tasks to earn money in chips, and use their earnings to lend, borrow, invest, and make repayments in the Social Lending Game. They were asked to answer survey questions. By answering each question, they earned a certain amount of chips. The amount they earned while doing the survey questions was clearly displayed (Figure 12). When they gathered $100 in chips, they gained the opportunity to enter one round of the Social Lending Game (Figure 13).

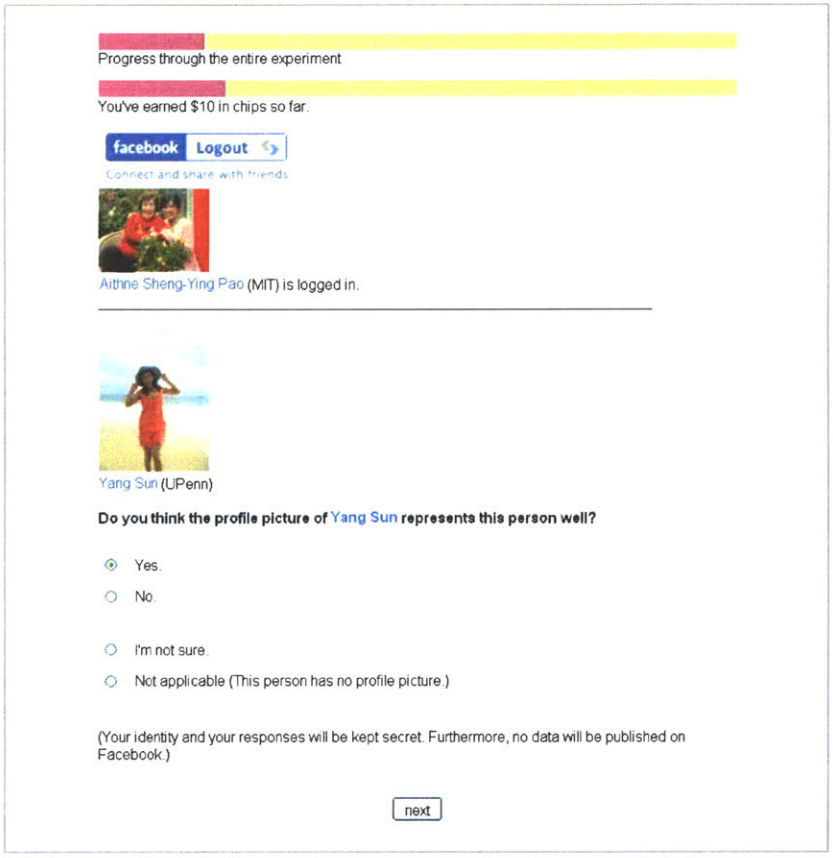

Figure 12. The endowment procedure. Instead of endowing subjects with free money, subjects earn capital by doing the pre-experimental survey. The amount of money they eared is displayed on the top of the screen next to the progress bar.

Each subject, either in the role of a lender or a borrower, was endowed with the same amount of chips this way. They were told that at the end of the study, the chips were exchanged for real money at a fixed exchange rate. The exchange rate was 80 chips to US $1, and was not revealed until they finished all rounds of the game.

In addition, no information about the exact amount of participation payment was clearly given beforehand. They were also told that they may use their earning to win more from the game, or may lose their money to the other participant paired up with them in the game. Although the money was in chips, they may take it more seriously than other endowment methods empirically used in behavioral economics experiments.

Figure 13. The endowment screen. When subjects gathered $100 in chips by finishing the pre-experiment survey, they gained the opportunity to enter one round of the Social Lending Game.

6.3 Experiment Design

6.3.1 The Relationship-mining Survey

In phase 1, subjects were asked to answer a set of questions about their friends. They first logged in to our experiment's system that connected with Facebook. This allowed them to see a set of scenario questions about them and their Facebook friends. Each friend's name and picture were displayed along with the question (Figure 14). No data was published on Facebook. Their identity and all their responses in the relationship-mining survey were kept secret. Their answers to these questions were collected for relationship mining.

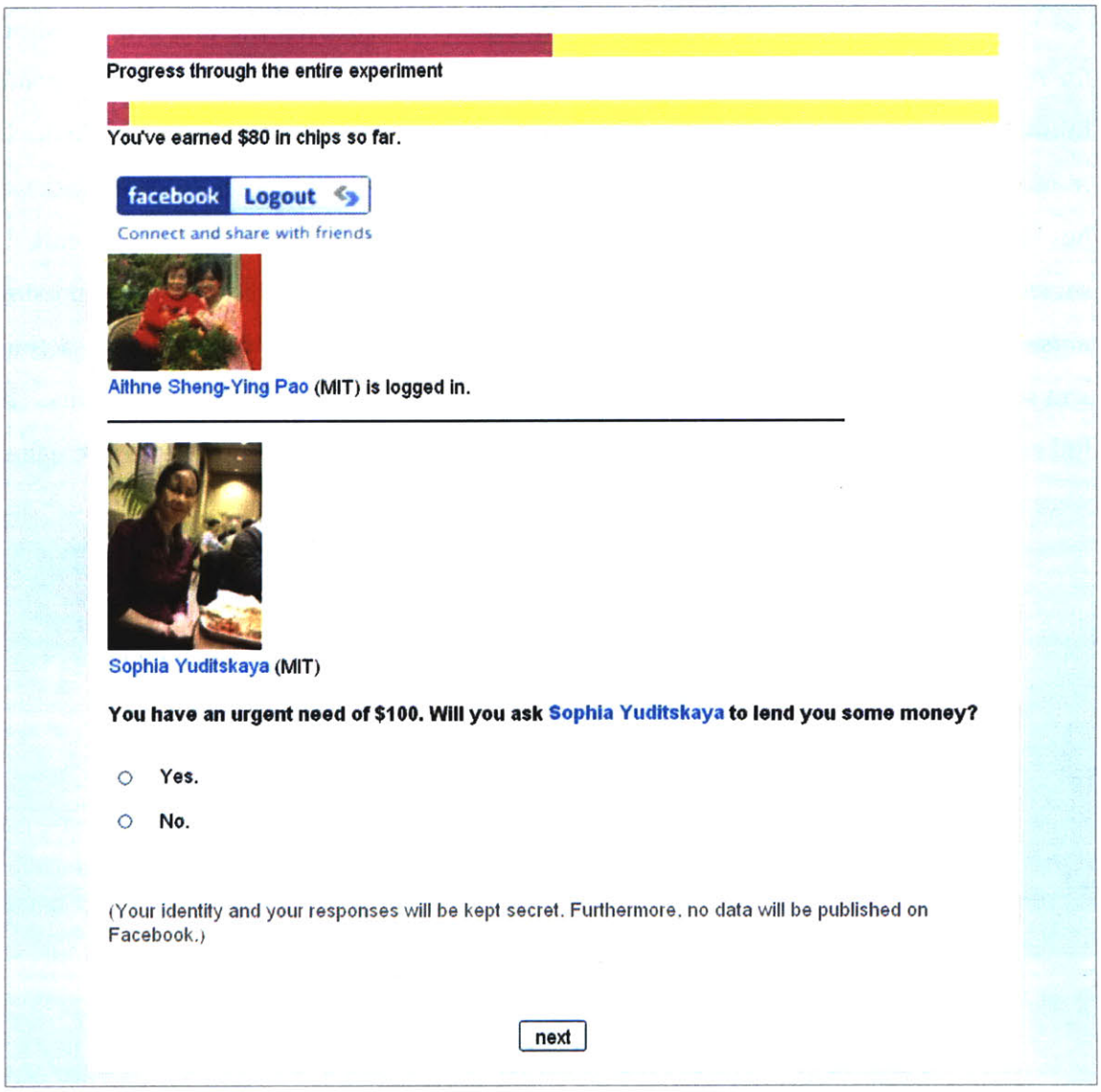

Figure 14. The relationship-mining survey, for mining trusting relationship between friends, whose pictures and names were displayed with the scenario questions.

The purpose of phase 1, the relationship-mining survey, is to find out whether it is a trustful relationship, a distrustful relationship, or a neutral one, between a subject and each of their Facebook friends. However, in the representation for subjects in the experiment, we avoided using words such as trust, trustworthiness, distrust, relationship, friendship, rating, etc. They only saw the name "part 1" instead of relationship-mining survey (See Appendix B). This was to avoid any possible implication or framing effect.

Also, we arranged two interference questions followed by the four real questions for relationship mining (section 4.2). The interference questions, unlike the relationship mining questions, have nothing to do with trust or trustworthiness regarding financial transaction. The interference questions serve as retroactive interference, and the data was not taken into account for relationship mining. This interference makes it difficult for subjects to recall the survey or to figure out the purpose of it. This design reduces possible noise when subjects did the tasks in the rest of experiments regarding loan transactions and social networks. The dummy questions were arranged as the last two questions. The full set of questions in the relationship-mining survey is listed as follows (note: the names were replaced by actual friend's full names of each subject's):

1. **Will you lend $100 to** Thomas **if he asks?**
   - ☐ **Yes.**
   - ☐ **No.**

2. **Do you believe** Andrew **will return the $100 borrowed from you?**
   - ☐ **Yes.**
   - ☐ **No.**
   - ☐ **I'm not sure.**

3. **You have an urgent need of $100. Will you ask** Sophia **to lend you some money?**
   - ☐ **Yes.**
   - ☐ **No.**

4. Jessica **is in a rush and needs your help.....**
   Jessica **gives you $100 that her friend will come pick up from you within 30 minutes. However, no one shows up. You decide not to wait for the**

friend and keep the $100 in your wallet. On your way home, the $100 gets stolen! You will ...

- ☐ **say sorry to** Jessica **and may or may not return the entire $100.**
- ☐ **pay back** Jessica **the full amount of money by all means.**
- ☐ **think that $100 between you two is not a big deal. Either of you will cover it.**

5. **Do you have** Emily's **phone number?**
   - ☐ **Yes.**
   - ☐ **No.**
   - ☐ **I'm not sure.**

6. **Do you think the profile picture of** David **represents this person well?_**
   - ☐ **Yes.**
   - ☐ **No.**
   - ☐ **I'm not sure.**
   - ☐ **Not applicable (This person has no profile picture.)**

The questions were presented in the sequence listed above. Our experiment system randomly sampled forty friends of each subject. Each question was repeated forty times, with the name and corresponding information replaced with one of the forty friends. After finishing one question with forty friends, a subject saw the next question with the same forty friends. The order of friends displayed with each question was in a different random sequence. This method provides consistency within the phase 1 experiment. This allows each subject to easily go through each question regarding multiple friends. It also allows the phase 1 experiment to be completed within 25 minutes and provides sufficient data for relationship mining (Chapter 4) and for experiments phase 2 and 3.

The other purpose of phase 1, the relationship-mining survey, is to endow subjects with capital to play the Social Lending Game in phase 2 and 3. The endowment method is described in section 6.2. By answering each question in the relationship-mining survey,

they got $1 in chips. At the end of the relationship-mining survey, they were endowed with $200 in chips.

6.3.2 The Complete Stranger Experiment

The Complete Stranger Experiment consisted of a single round of the Social Lending Game (see Chapter 5). In which, two subjects were randomly assigned to be the lender and the borrower. They were seated in separate rooms, without knowing who each other was, and were not allowed to meet each other. Subjects used the $100 in chips to play this round, right after they finished the relationship-mining survey (Figure 15).

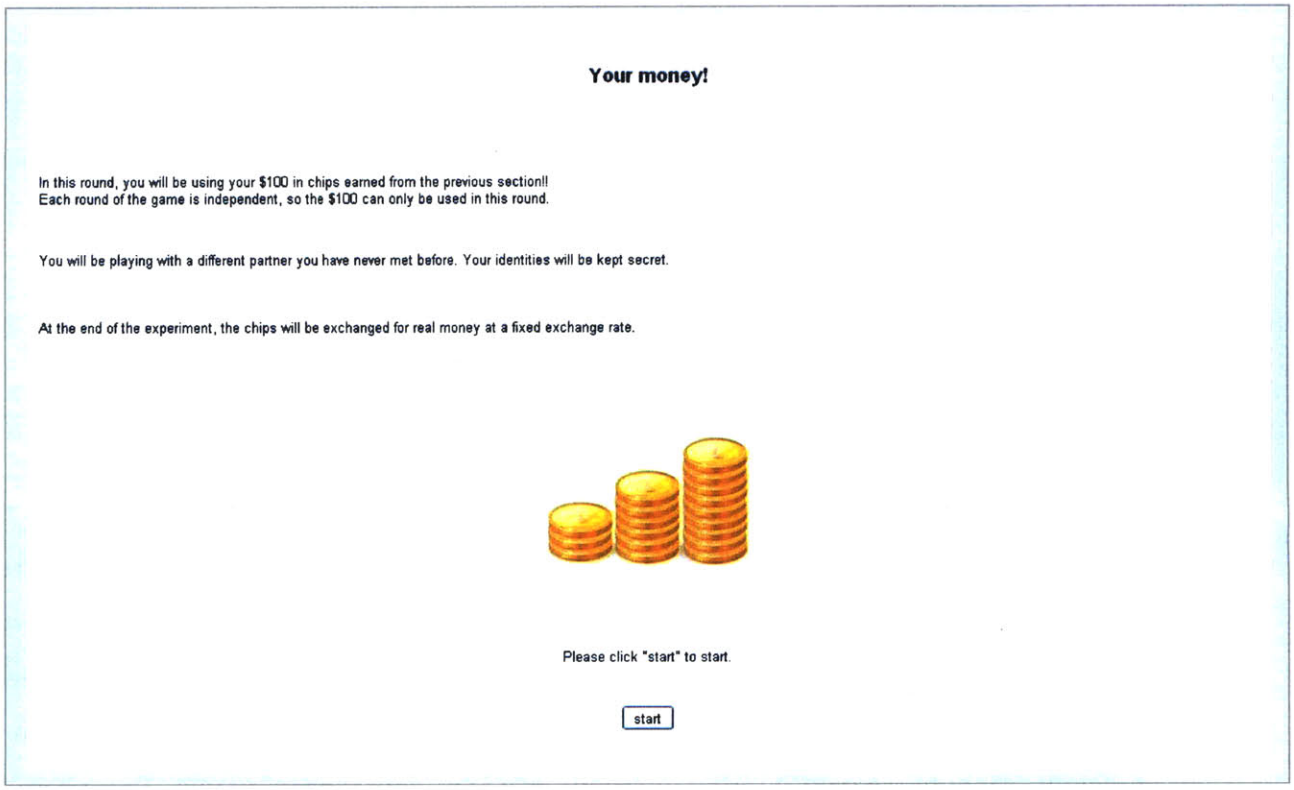

Figure 15. The initialization of the Social Lending Game.

The two subjects paired up in this phase were complete strangers. The lender was asked to decide how much money they would like to lend to a complete stranger to make an investment. At the same time, the borrower had a great investment opportunity. The borrower's own $100 was paid as the refundable participation fee for the investment,

which would be reimbursed along with the investment return. The borrower made the investment decision, using the money from a complete stranger.

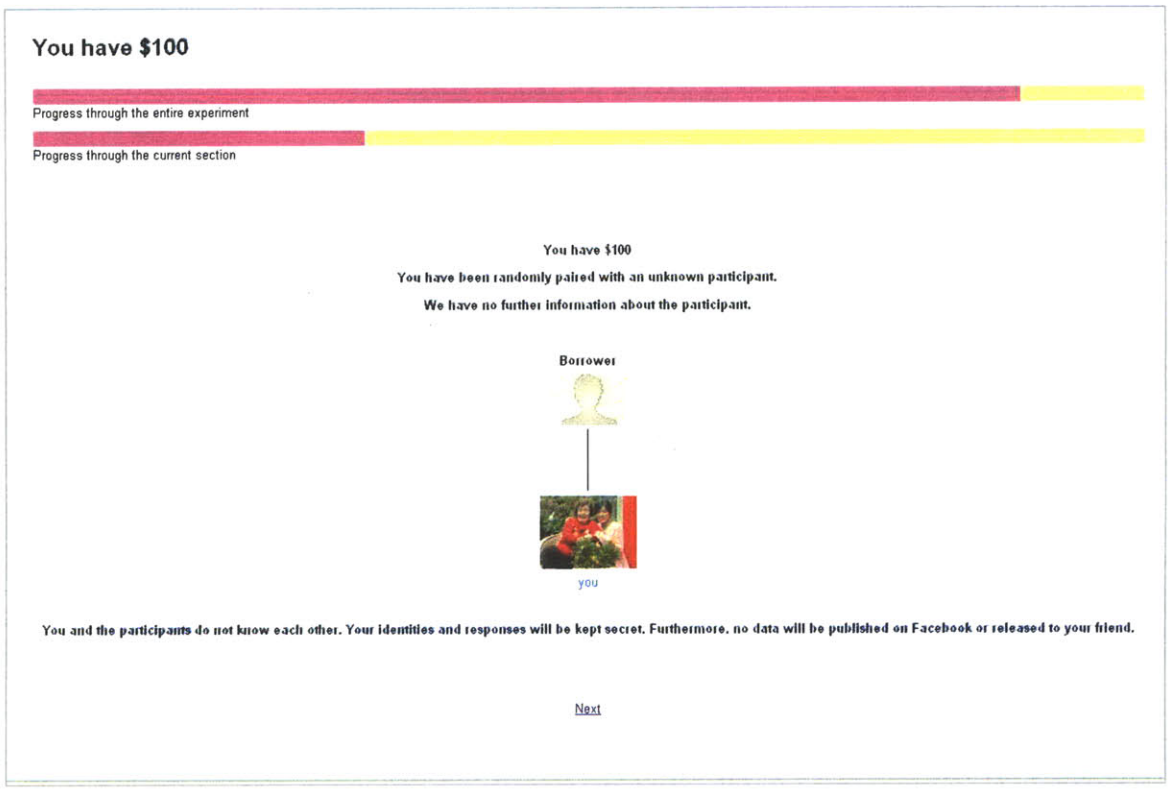

Figure 16. The Complete Stranger Experiment, where no information about the paired stranger was given.

No information about how the lender and the borrower were socially connected was provided in this phase. Also, we avoided using any words regarding social networks, social connections, or social relationships in the experiment (Figure 16). This was the first round they played the Social Lending Game. This phase serves as the control treatment, which provided the baseline of people's behavior in the Social Lending Game, for comparison with the experimental treatments. See section 6.3.3 for further discussion.

6.3.3 The Connected Stranger Experiment

Different from the Complete Stranger Experiment, the Connected Stranger Experiment provided information about how two subjects were socially connected, when they were paired up to be the lender and the borrower. Figure 17 shows one example of the Social Connection Graph given to subjects in the Connected Stranger Experiment. In this

example, the borrower was connected to the lender through a friend Peter. The graph also showed that the lender was three steps away from the borrower, i.e., 3 degrees of separation on their social networks.

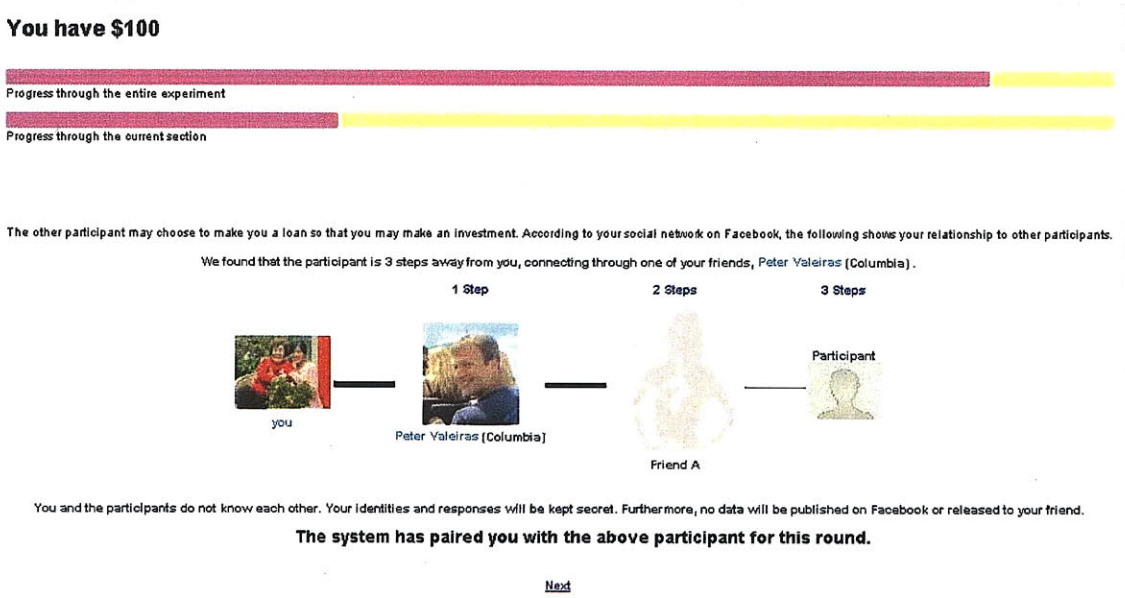

Figure 17. The Social Connection Graph in the Connected Strangers Experiment. This example shows a 3-degree separation treatment.

In addition to the graph, the subjects read:

"According to your social network on Facebook, the following shows your relationship to other participants:

We found that the participant is 3 steps away from you, connecting through one of your friends, Peter Valeiras (Columbia).

You and the other participant do not know each other. Your identities and responses will be kept secret. Furthermore, no data will be published on Facebook or released to your friend."

The Social Connection Graph and the corresponding information about the subjects' social connections were displayed on all screens in the Connected Stranger Experiment. Except for the Social Connection Graph, the experiment settings in various

treatments stayed the same. Two subjects who were paired up for the same round were seated in separate rooms and were not allowed to meet each other before, during, or after the experiment. They were strangers to each other, but were given the information of how they were socially connected.

The Connected Stranger Experiment consisted of seven experimental treatments, described as follows:

Positive tie treatment: The borrower and the lender were 2 degrees separated from each other. They were socially connected through a friend. We arranged a friend who was categorized as having a trustful relationship with the subject according to the relationship mining results. However, no information was given to the subjects that this friend was categorized to be a trustful friend.

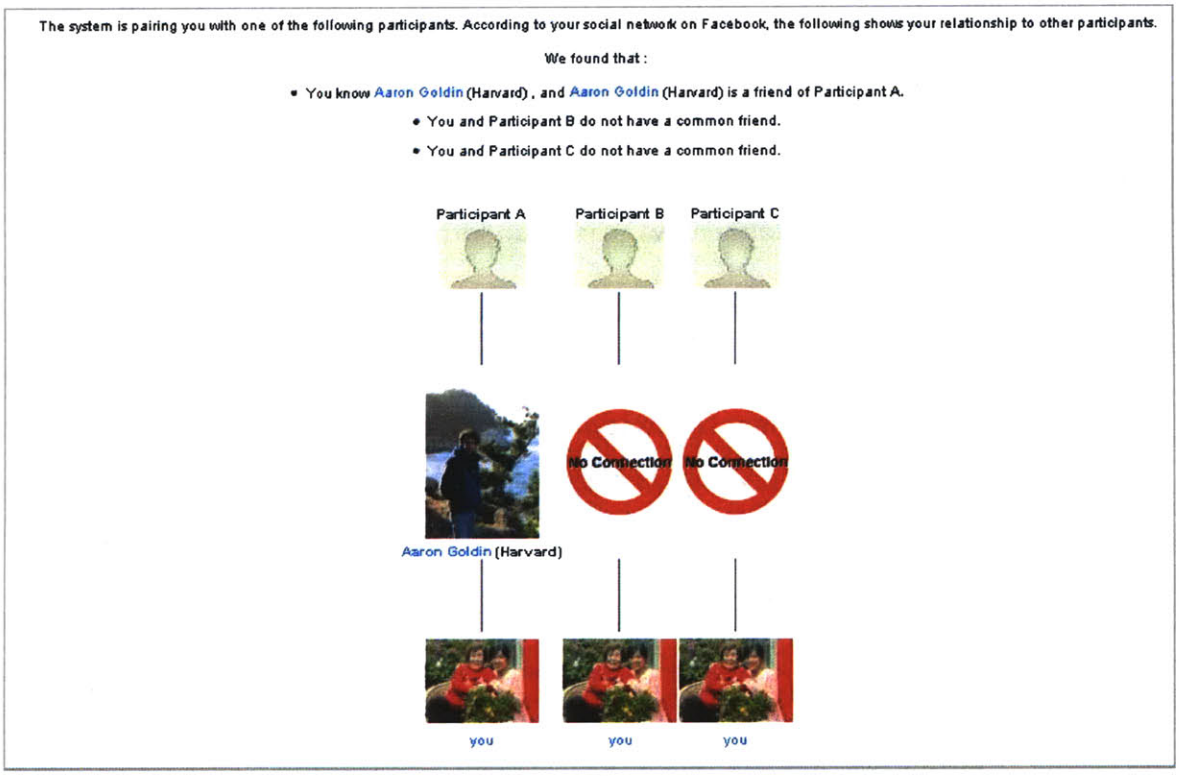

Figure 18. The positive tie treatment screen.

The treatment screen is shown in Figure 18. The subject was told that the system found that they and Participant A shared the common friend, Aaron. They and other

participants shared no friends. The subject was paired up with Participant A in the Social Lending Game.

Negative tie treatment: The borrower and the lender were 2 degrees separate from each other. They were socially connected through a friend who was categorized as having a distrustful relationship with the subject according to the relationship mining results. No information was given to the subjects that this friend was categorized to be a distrustful friend. The distrustful connection treatment screen and corresponding information was the same as the trustful connection treatment screen (Figure 18) but with a different friend.

Unconnected stranger treatment: The borrower and the lender had no common friend. They were socially unconnected. Different from the setting in the Complete Stranger Experiment, where it had nothing to do with social connection (the control treatment, see section 6.3.2), the unconnected stranger treatment here provided the information that the subjects had been identified to share common friends with other participants in the study. The social connection information was also provided, even though the subject in this treatment was paired up with an unconnected one.

Throughout the unconnected stranger treatment, information as shown in Figure 19 was displayed. The subject was aware that there were three other participants in the study. The Social Connection Graph showed that the subject was paired up with Participant C, who shared no common friend with the subject. The same graph also showed two other participants who were connected to the subject through their friends.

According to the relationship mining results, we arranged two trustful friends as the two friends shown in the unconnected stranger treatment. No information was given to the subjects that these friends were categorized to be trustful friends. It looked as if they were coincidently put on the same screen, for showing that the system found common friends between them and the other participants.

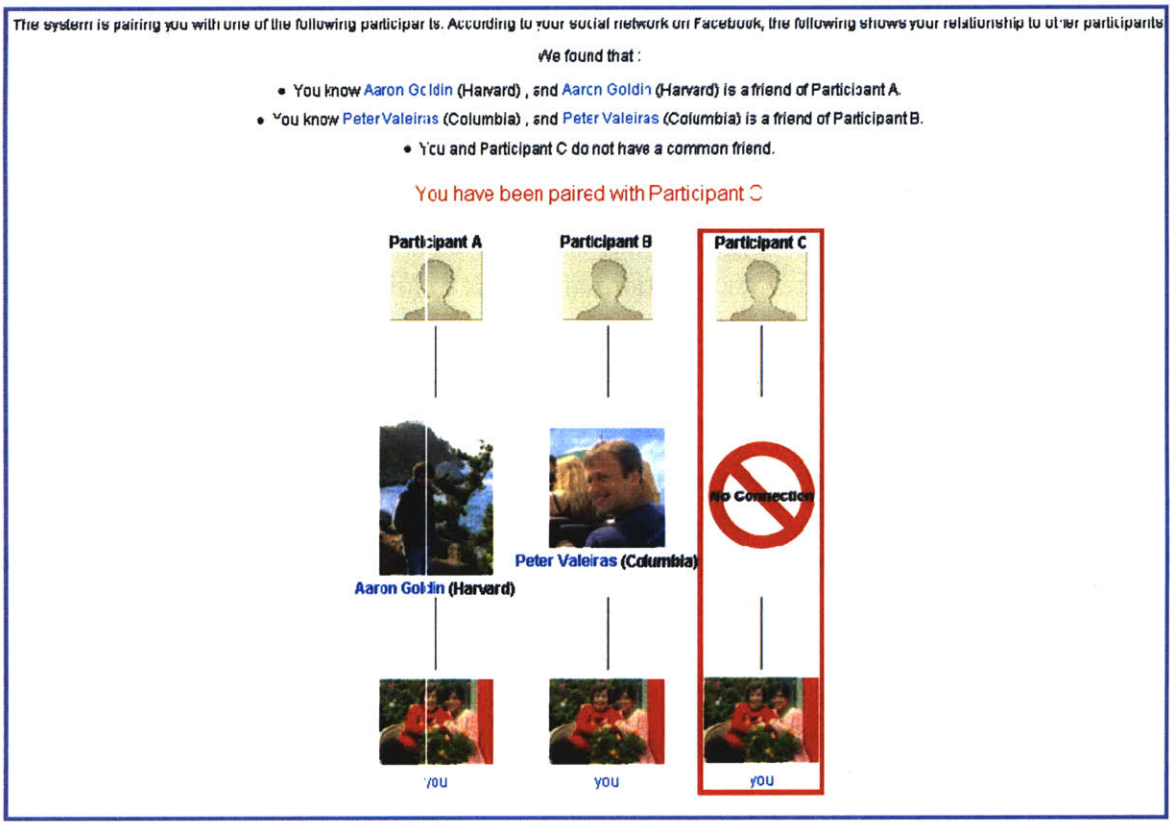

Figure 19. The unconnected stranger treatment.

3-degree separation treatment: The social distance between the borrower and the lender was 3 degrees of separation. They were socially connected through a friend. We arranged a friend who was categorized as having a trustful relationship with the subject according to our relationship mining results. However, no information was given for the subjects that this friend was categorized to be a trustful friend. The treatment screen is shown in Figure 17.

4-degree separation treatment: Same setting as in the 3-degree separation treatment, except for the borrower and the lender were 4 steps away.

5-degree separation treatment: Same setting as in the 3-degree separation treatment, except for the borrower and the lender were 5 steps away.

6-degree separation treatment: Same setting as in the 3-degree separation treatment, except for the borrower and the lender were 6 steps away.

In order to compare the Connected Strangers Experiment results with the Complete Strangers Experiment results (the baseline), subjects were required to play the same role in phase 2 and phase 3 experiments (see Appendix D).

6.3.4 The review questionnaire

The purpose of the review questionnaire is the following:

1. To find out the decision making strategy.
2. To investigate their experiences interacting with the game interface.
3. To collect information in order to rule out data that may be noisy or biased.

The review questionnaire was only carried out after the experiments were completed, but before the participation payment was made. The questions for subjects participated as a lender are slightly different from those for a borrower. The review questionnaire is listed in Appendix E.

6.4 Subject Recruitment

Subjects who were qualified for the experiment had to meet the following criteria: (1) they must be age 18 or older; (2) they must have an active Facebook with their real identity; (3) they must have logged in Facebook within the past 6 months using the real identity; (4) they have at least 50 Facebook friends (see Appendix A and G)

Subjects were recruited from a variety of sources. The major source was the Sona System, a web-based human subject pool management, hosted by MIT Behavior Research Lab[2]. Other electronic advertisements were posted on Facebook and Craigslist Boston[3]. Physical advertisements were posted on public bulletin boards, around Cambridge and Boston (see Appendix G for subjects recruiting advertisement). The experiment ran with human subjects was under COUHES approval (see Appendix F).

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[2] The SONA systems in MIT Behavior Research Lab, http://mitbrl.sona-systems.com/

[3] Craigslist Boston, http://boston.craigslist.org/

6.5 Subjects Pairing

Subjects were not allowed to invite friends to sign up in the same session or to participate in the same round. This was to prevent any bias caused by prior knowledge of the other party, such as appearance, gender, or acquaintance from past interactions. Subjects could only know about the other party from information given in the experiment.

In the Complete Stranger Experiment (experiment phase 1), subjects were randomly paired up to play the role of the borrower and the lender. A borrower and a lender might have met each other before the experiment, or might have invited each other to participate together without telling the experimenters. To further prevent the pre-experiment acquaintance bias, we scheduled multiple subjects for the same session and seated them in separate rooms with doors closed. They were paired up with a randomly chosen other. Subjects were told that they were paired up with a stranger, but no information about the stranger was given. The information and identity about who was paired up with whom was never revealed.

The same settings were applied to the Connected Stranger Experiment (experiment phase 2) except for subjects pairing. Subjects played seven rounds of the Social Lending Game. Each round was an experimental treatment, where they were told that they were paired up with a different partner who was socially connected to them in a different way (see 6.3.3). In fact, they were all randomly paired up with seven other participants, regardless of the actual social connection. The only pairing criterion was the borrower/lender roles had to be consistent with those in the Complete Stranger Experiment run seven days earlier, i.e., a lender was paired up with the seven random subjects who had played as borrowers in phase 1 and vice versa. They were seated in separate rooms with doors closed for the whole time. The Social Connection Graph (such as in Figure 17) provided subjects with the information of the paired partner, which was the only information given about the pairing relationship. No real identity or real social connection information was revealed.

At the end of phase 1, each subject was told that the system would take some time to arrange a group of seven people to pair up with him/her for the phase 2 experiment.

They were also told that "the system will look for seven people who passed certain criteria to be your partners in the phase 2 study." Forty-eight hours before the time a subject were scheduled for phase 2, a message was sent to the subject, as shown in Figure 20:

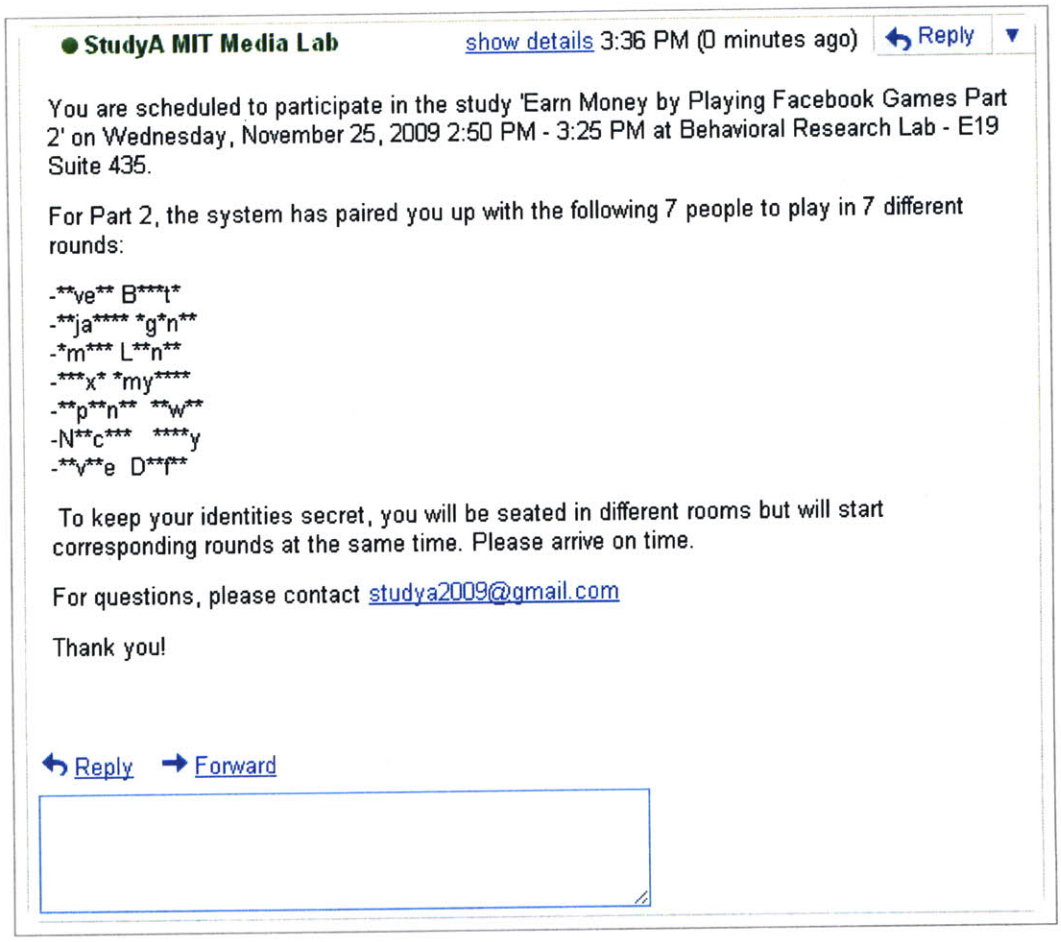

Figure 20. The pairing-up message before the Connected Stranger Experiment.

We sent this message to make subjects think the system had paired them up with seven people based on certain criteria. This made subjects believe that they played with seven other people in real time during the Connected Stranger Experiment. Also, this may strengthen the authenticity of the Social Connection Graph and corresponding information given in the Connected Stranger Experiment (see Figure 17 and section 6.3.3). In fact, the names in the message were not real names of the paired participants. Our system randomly paired up borrowers with lenders. In practical implementation of the

experiment, our system allows subjects in a pair to show up at different time. The design and implementation of the experiment system is described in Chapter 7.

6.6 Social Identity and Confidentiality

Subjects were first given a five-digit unique number as the experiment ID. With the ID, they logged in to our experiment system. We incorporated actual social network data from Facebook to our experiment system (see Chapter 7). Through our experiment's interface, they logged in to Facebook with their real Facebook identity, with which, the actual social network data can be captured and displayed in the experiment. No data was published on Facebook. The responses from each subject were only corresponded with the experiment ID, where no real identity was recorded with the experiment data. For further details see Appendix F.

Chapter 7
System Design

7.1 System Overview

The experiment system is implemented as a web-based platform with an interactive interface[4], which allows more than one subject to participate. The experiment system includes a main server that handles the experiment platform and receives each subject's decisions, pairs up subjects from different rooms in real time, and handles corresponding responses to subjects. Virtual money is used in the game. The system keeps track of each subject's capital in different rounds of the game. In addition, the experiment system integrates actual social networks, which allows us to carry out relationship mining and to examine trust in the social context.

7.2 Integrating Actual Social Networks

We chose Facebook for this experiment because it has been the largest social network dataset with the largest number of users to date. Also, Facebook users use their

[4] Our experiment system was located at http://486a.media.mit.edu/cgi-bin/ML/start.pl

real identities. This allows us to conduct our experiment by leveraging actual social networks. We developed a stand-alone experiment server, which uses Facebook Connect[5] to have our server communicate with Facebook in real time.

Subjects log in to the experiment server with a subject ID, which is to keep their identity secret during the experiment. At the same time, they log in to Facebook with their real identity (Figure 21). Once subjects log in, our experiment server gathers data from Facebook and displays information about their friends as part of the experiment contents. Each subject's friends, including their names, pictures, networks, etc can be directly viewed with the experiment questions or within the Social Connection Graph. The hyperlinks to their friends' pages are provided, so the subjects can review their friends during the experiment. This realizes the relationship mining using actual social networks in real time, and allows the Social Connection Graph to be displayed with the subjects' actual first degree friends.

[5] The Facebook Connect http://developers.facebook.com/blog/post/108; http://developers.facebook.com/

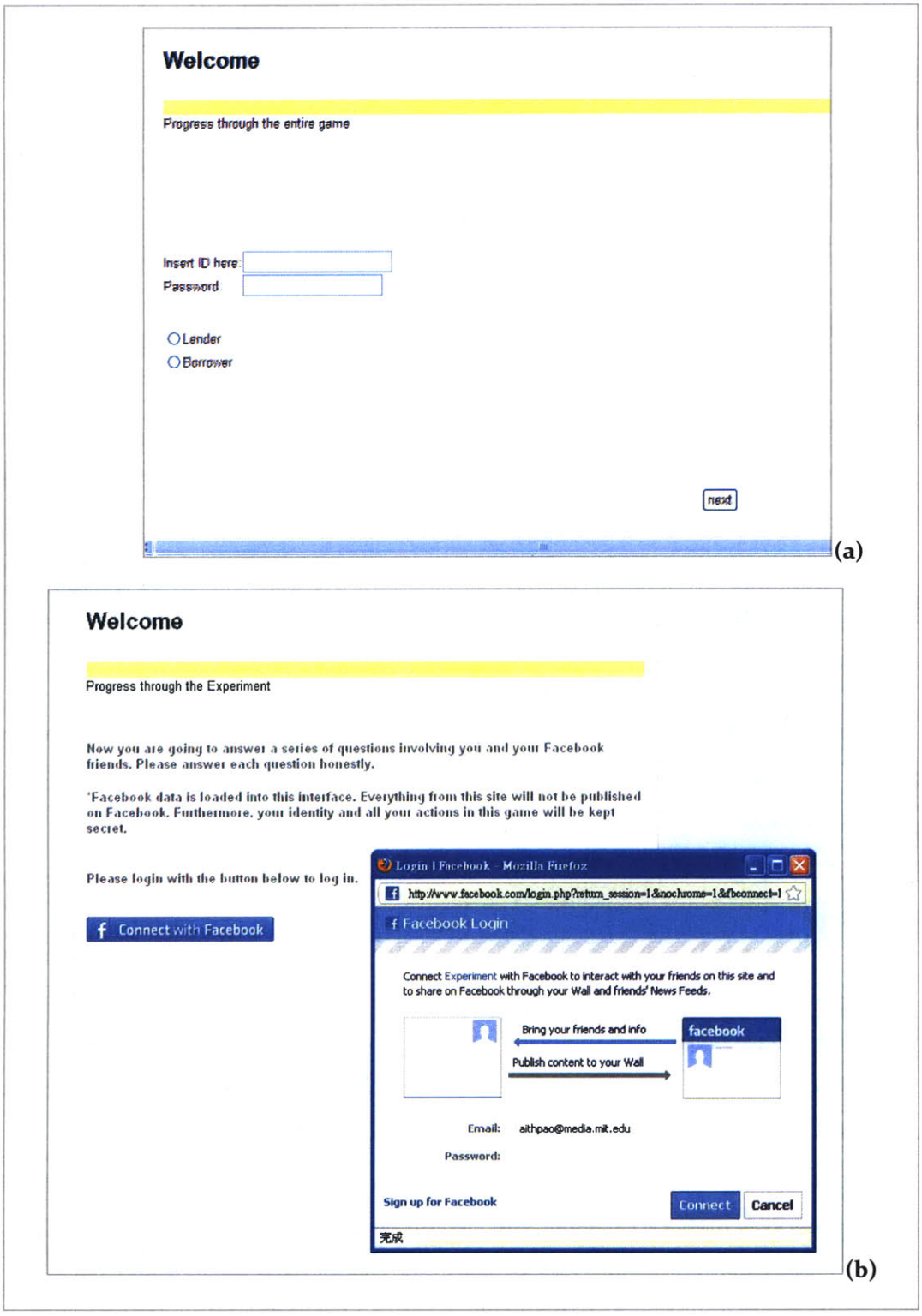

Figure 21. After subjects log in to the experiment server with a subject ID (a), the experiment system connects with Facebook using their real social identity (b).

7.3 Interface Design for Behavioral Study

All that subjects knew about each other in the experiment was the social connection information. Because this was the only information we provided, one concern was it may force subjects to use this information. This is a common consideration with similar games. The way we prevented this is by the following:

First, no terms relevant to social connections or social preferences appear in the description of the game interface or on the Social Connection Graph; nor do they appear on the consent form (Appendix F) or the subject recruitment Ads (Appendix E). Also, in the game interface, the information about the subjects' social connections is presented in such a way to let them know that "your identities are kept secret", and to let them know that "we have paired you up with a subject." In the interface of the experiment, subjects perceive it as playing a Facebook game, where they can fluidly review friends' Facebook pictures and links while they were making their decisions.

The interface is also designed in the way that the Social Connection Graph is embedded in the decision screens. No special emphasis is put on the Social Connection Graph. No sound or no graphical effects are built with the interface. We picked the same background color and simple layout to prevent potential bias from the experiment environment.

In addition, the experiment's interface can be simply run on any browser. We incorporated several features in the experiment's interface design to ensure the quality of the data. These features include a decision preview window, go-back prevention, and a progress bar for endowment. The decision preview window is a pop-up window for subjects to reconfirm their decisions before they are finally made. Considering the experiment involves monetary calculations, we provide the preview window to make sure the data collected represent their actual decisions. The go-back prevention then prevents subjects from visiting previous choices and modifying them. The progress bar not only displays the progress throughout the experiment but also indicates the amount of virtual money they accumulate in the Social Lending Game. This keeps reminding the subjects

how much money they own, which serves as a unique endowment methods (see section 6.2).

Chapter 8
Results

There were 372 people from around the greater Boston area signed up to the study, of which, there were 158 participated. 135 people completed all phases of the study, of which, 45 played the role as a lender and 90 as a borrower. The data collected from each subject was normalized based on the maximum amount and minimum amount of money they sent. We analyzed the lending decision, the investment decision, and the repayment decision of the subject. The results and discussions regarding trust, risk preferences and reciprocity in terms of the influence of social perceptions are described as followed.

8.1 Influence of Social Perceptions on Trust

Trust was measured by the amount of money sent by the lender to the borrower in the Social Lending Game. The lender was aware that the borrower used the loan to invest. The borrower may have shared the investment profit with the lender, if they decided to. If the borrower lost the investment, they still had the ability to pay back the loan, although they can choose not to do so. The lender's decision was based on the anticipation of

whether the borrower would decide to pay back the loan or to share the profit. The amount lent indicated how much the lender trusted the borrower.

The lender's anticipation relied only on the social perceptions of the paired borrower. Although they were strangers, they perceived how they were socially connected through the Social Connection Graph and corresponding information. Seven types of social perceptions were formed by the seven experimental treatments: "positive tie treatment", "negative tie treatment", "unconnected stranger treatment", "3-degree separation treatment", "4-degree separation treatment", "5-degree separation treatment", and "6-degree separation treatment" (see section 6.3.3). The question asked was: will trust be influenced by the perceived social connections between the two parties?

We analyzed the loan amount in each of the seven treatments to examine how social perceptions influence trust. Section 8.1.1 compares the results from "positive tie treatment" and "negative tie treatment." Comparing with the baseline, it shows the difference between the impacts of negative social perceptions and positive social perceptions on trust. Section 8.1.2 compares the results with those from "unconnected stranger treatment." Our results provide a different view from previous studies, which concluded that people trust strangers [3, 22]. The experiments results led to a possible model of trust between strangers. Section 8.1.3 describes whether the strength of social perceptions influences trust.

8.1.1 Negative Social Perceptions Undermined Trust

We compared the results from "positive tie treatment" and "negative tie treatment" from the Connected Stranger Experiment. The level of trust under the negative tie treatment was 35% lower than that under the positive tie treatment (Figure 22). A paired t-test showed that significantly lower trust was observed in the negative tie treatment than the positive tie treatment (p=0.04). Note that in the negative tie treatment, the lender was aware that they and the borrower were connected through a mutual friend, whom the lender did not trust. However, whether the connection was a trustful or distrustful relationship between the borrower and the mutual friend was unknown to the lender. This result shows the following: A negative social perception was formed and projected onto a stranger only if the stranger knew a person whom the subject did not trust. Such negative

perceptions significantly diminished trust in that stranger. In other words, people can be distrusted simply by being perceived to know a distrustful person.

This observation suggested the following hypotheses: a positive social perception should also be formed and projected onto a stranger if the stranger was a trustful friend's friend. Furthermore, such positive perceptions should induce trust. However, although slightly more trust was observed than the baseline behavior, the difference was insignificant (Figure 22, p=0.87). People did not trust more when there was a positive connection existing between strangers. In other words, a negative connection undermined cooperative behavior between strangers, but a positive connection did not help.

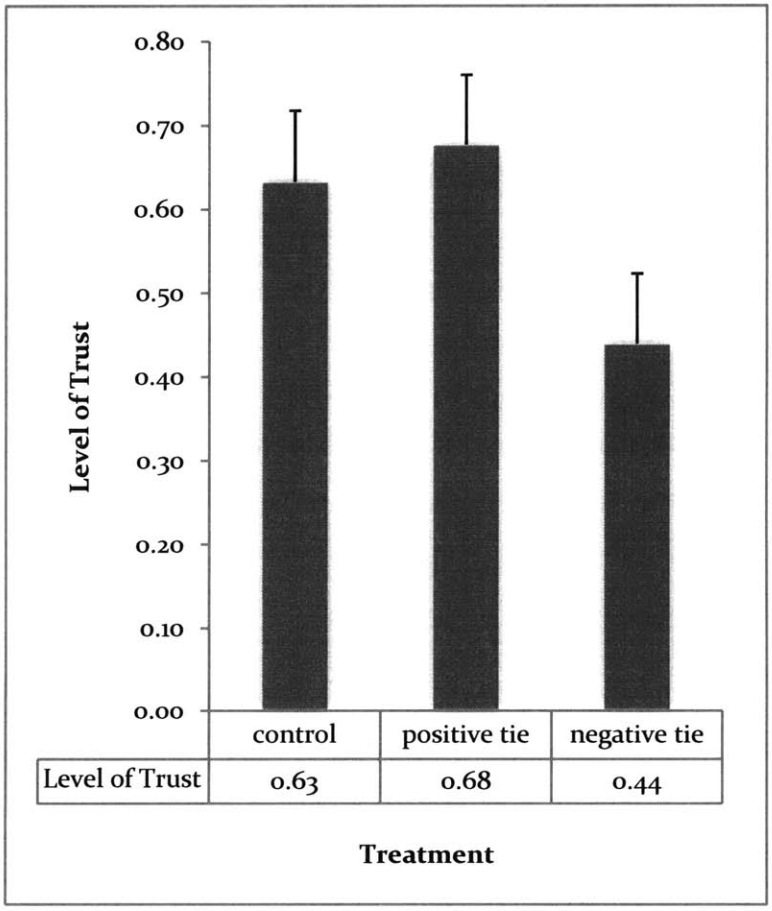

Figure 22. Comparison of positive tie treatment and negative tie treatment.

Our results show that having positive social connections did not significantly increase trust when comparing with the control group. The control group was consistent

with the setting in the standard trust game, where complete strangers were paired up and no social connection-related information was given. With the results of the standard trust game, previous studies concluded that people trust strangers, but, at the same time, they raised the question why people do so [3, 22]. Does it mean that people trust strangers as much as friends' friends? The following analysis addressed this question.

8.1.2 Model of Trust between Strangers

Literature concluded that people trust strangers [3, 22]. Our results suggest a different view. We compared the results of the complete stranger experiment (control), with that of the unconnected stranger treatment. Recall the settings for the control and unconnected stranger treatment (section 6.3.2 and 6.3.3). In the control setting, the lender and the borrower were complete strangers. Throughout the entire experiment, there was no information or implication about social connections. The control setting was consistent with empirical studies using the standard trust game [3, 22]. In the unconnected stranger treatment, the lender was given the Social Connection Graph showing their relationships to three other strangers, who participated as the borrower and were seated in separate rooms (Figure 19). The lender was paired up with one of them whom they shared no mutual friends with, while the lender was aware that the other two participants knew the lender's friends in real life. In both the "unconnected stranger" and the control settings, the borrowers were both strangers who shared no common friends with the lender. If people trusted strangers, as previous studies concluded, same level of trust should have been observed in both settings.

However, as shown in Figure 23, we observed significantly lower levels of trust in the unconnected stranger treatment than in the complete stranger experiment (p = 0.01). We concluded that people do not trust strangers. If this is true, why do people trust strangers in empirical studies and in our complete stranger setting?

We compared the results with connected strangers, i.e., friends' friends. Trust observed between "unconnected strangers" was 51% lower than the strangers who had a trustful common friend (i.e., positive tie treatment). The results are shown in Figure 23. The unconnected stranger treatment and the positive tie treatment differed significantly (p=0.001) according to a paired t-test between. As for the complete strangers, no

significant difference in trust was observed from the positive tie treatment (p=0.87). The results show that people trust complete strangers as much as friends' friends, but they distrust unconnected strangers.

We also compared the results with the negative tie treatment (i.e., the strangers who had a distrustful common friend). Although trust was 27% weaker in unconnected strangers than in negative tie treatment, the difference was not significant (p=0.21). However, people trust complete strangers 30% more than negative tied strangers (p=0.10), and 48% more than the unconnected strangers (p = 0.01). The results show that people distrust unconnected strangers as much as a betrayer's friends. No connection does not mean neutral.

Our findings suggested that people considered complete strangers to be connected strangers. In the Complete Stranger Experiment, as well as in empirical studies, the possibility that the subjects have common friends with the paired anonymous counterpart was not excluded. These experiments settings simply ignore the fact that humans are social animals and strangers are potentially connected. When there was no further information about their social relationships, people supposed they were potentially connected and showed trust as if they were trustfully tied, even though they were complete strangers.

On the contrary, the "unconnected stranger" treatment excluded such possibility. In the unconnected stranger treatment, we modeled the real world situations where multiple strangers existed, among whom, some were friends' friends while others were strangers with no mutual friends. Under this condition, the behavior which measured truthfully represented trust between strangers. Our results show that trust was significantly weaker between unconnected strangers than the baseline behavior. People did not really trust strangers, especially when they were told that they were unconnected to the strangers.

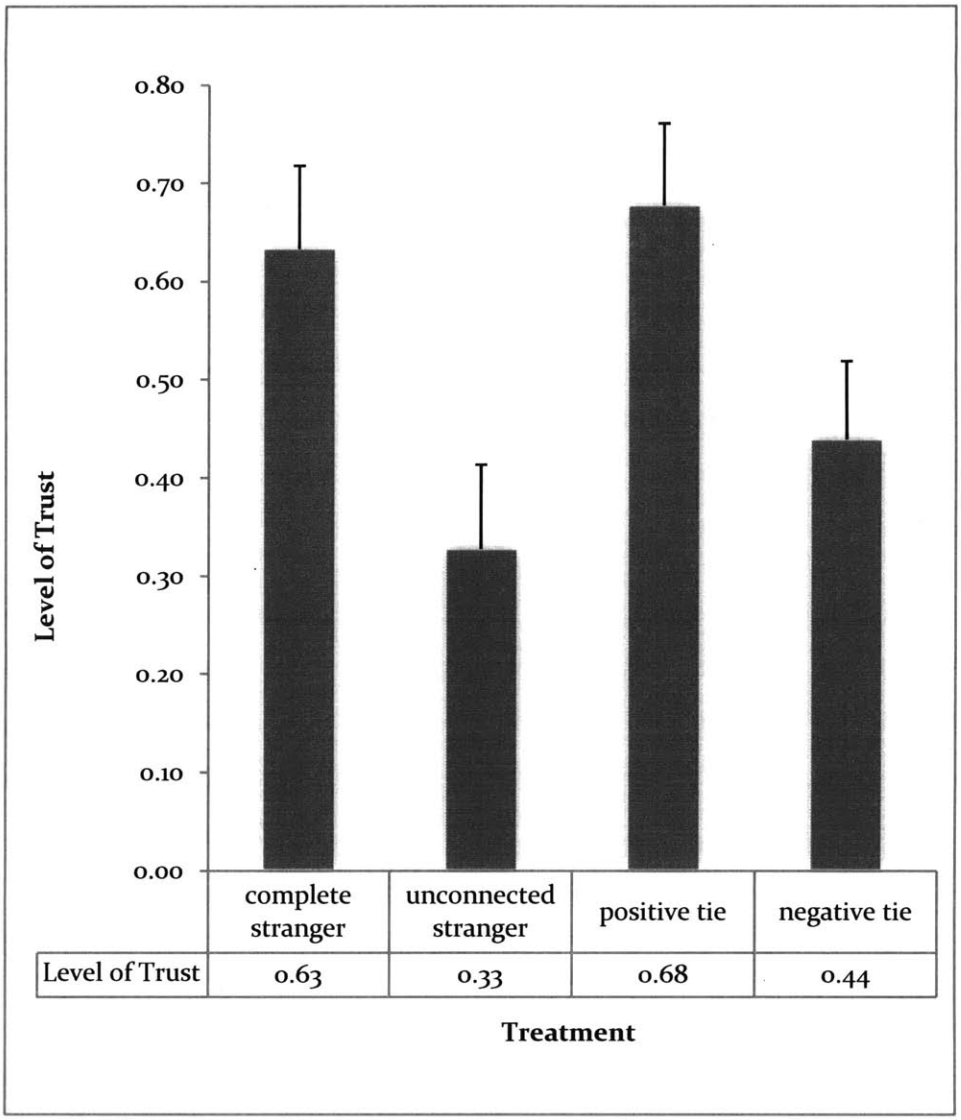

Figure 23. Comparing trust between unconnected strangers, connected strangers (positive tie and negative tie) and complete strangers (control).

Based on the results, we addressed the question that was raised earlier: Do people trust friend's friends as much as strangers? Is a positive social connection useless when it comes to trust? Our data showed that having a positive social tie motivated significantly stronger trust than no social tie. However, people presumed they were potentially connected to a stranger. If no information was provided, people regarded a stranger as a friend's friend and hence signal trust to the stranger.

Our experiments results represent a possible model of trust between strangers in real world: people presupposed they were connected and place trust, unless they perceived that they were unconnected. When there existed connected strangers, people distrusted complete strangers and trusted connected ones instead. In other words, people trusted strangers unless they were provided with better options – the connected strangers.

The results reflect the problems in empirical experiment design. In empirical studies, subjects encounter only one anonymous counterpart. They perceive that there were no other options. In the real world, people are surrounded by strangers but are aware of the possibility that a stranger may be a friend's friend. Thus, even though subjects were told that their paired partner in the experiment was a stranger, they behaved as if that was a connected stranger. Consequently, trust between strangers in these experiments is shown to be higher than expected. Such experiments settings ignored the social aspects of human behavior and may not truthfully measure trust in strangers. Instead, it represented the baseline behavior that people are trusting with insufficient information.

8.1.3 Trust along Social Distance

We further asked how trust-based decisions vary with different strengths of social perceptions. The strength of social perceptions was a function of social distance. Social distance is usually measured in degrees of separation. A direct friend is considered as one degree of separation. A friend's friend is two degrees away, and so on. As the simplest linear model, we considered trust decreased when social distance increased.

We compared the results from 2 degrees to 6 degrees of separation. Figure 24 shows the change of trust versus social distance. The results reject the hypothesis that trust decreased linearly with social distance. Instead, the results suggest that there was a social threshold of trust at 2 degrees of separation. When strangers were connected within 2 degrees, i.e., when the strangers were friends' friends, the level of trust was 2.19 times higher than unconnected stranger. However, when the social distance was 3 degrees, the level of trust dropped 53%. Beyond, 2 degrees of separation, although the strength of trust was slightly higher than trust between unconnected strangers, the difference was not significant.

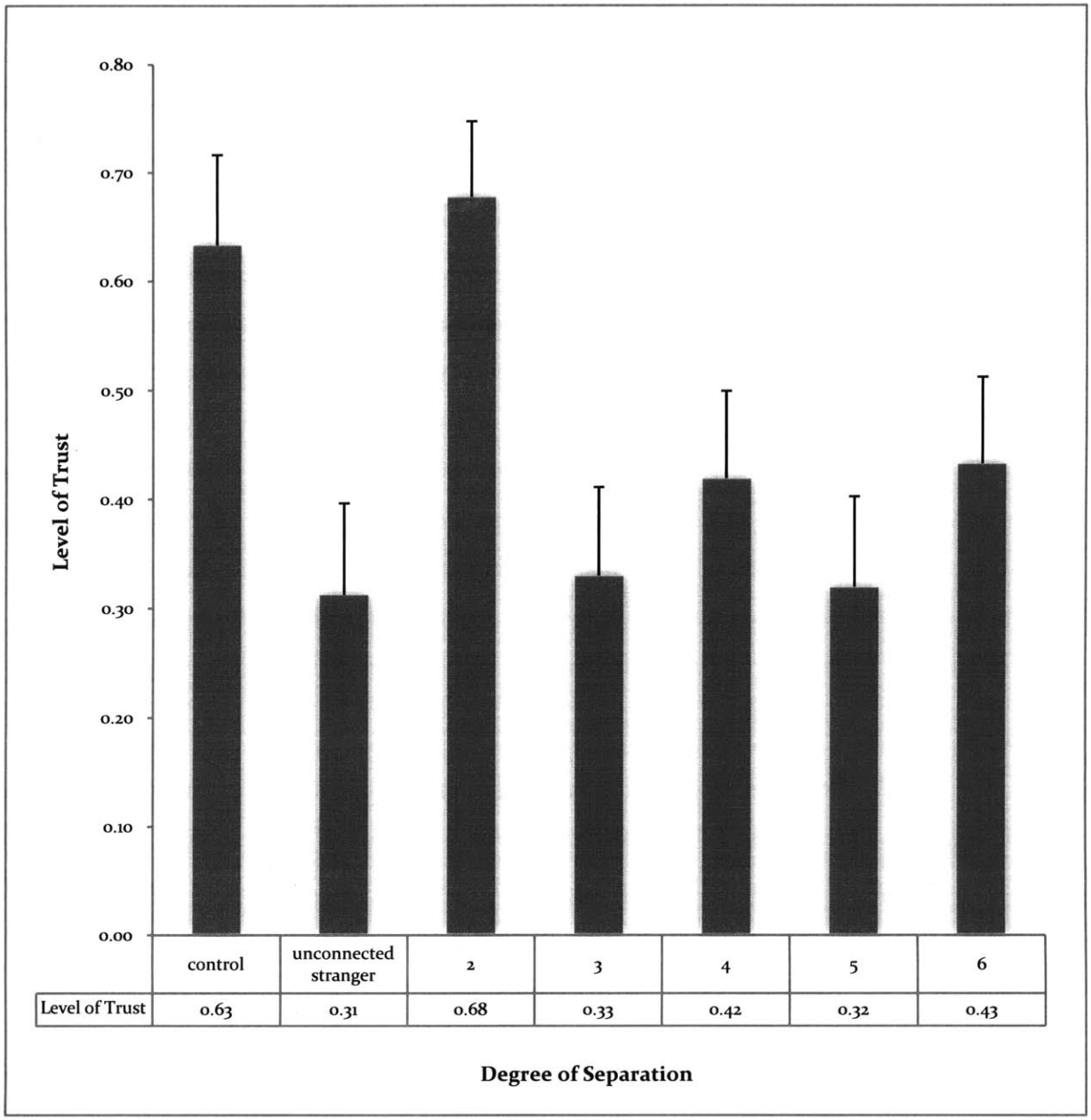

Figure 24. Trust versus social distance.

Comparing with the control (complete strangers), this finding supported the above model of trust between strangers (section 8.1.2) and further inferred that people presumed complete strangers to be potentially connected in 2 degrees of separation. In other words, people regarded complete strangers the same as friends' friends and trusted them. However, when provided with information showing that the strangers were beyond 2 degrees separation, people considered them as unconnected and distrusted them.

8.2 Influence of Social Perception on Risk Preference

Risk preferences were measured by the investment decisions the borrowers made (See Chapter 5 and Figure 3). The Connected Stranger Experiments allowed us to investigate whether social perceptions influence risk preference using others' money. Recall that the borrowers were given two investment options. Option one was a high risk-high return investment and option two was a low risk-low return option. The risk preference measurement was based on the investment options in a range between 1 and 2.

Table 1 shows risk preference across different treatments. The baseline risk preference was 1.41, where 1 indexed extremely risk-seeking and 2 meant extremely safe. It was measured in the Complete Stranger Experiment (control), where no further information about social connections between the borrower and lender pair was provided.

	control	unconnected stranger	positive tie	negative tie	degree=3	degree=4	degree=5	degree=6
Risk Preference	**1.41**	**1.35**	**1.24**	**1.3**	**1.33**	**1.3**	**1.3**	**1.27**
***p* value**		**0.552**	**0.048**	**0.208**	**0.374**	**0.208**	**0.144**	**0.101**

Table 1. Risk preference across different treatments (1: extremely risk-seeking, 2: extremely safe). The p values listed are paired t-tests between each treatment and the baseline measured in the complete stranger experiment (control).

The risk preference index under the positive tie treatment was 1.24. When comparing with the baseline (risk preference index = 1.35), the results show that people made riskier decisions when using the money from a stranger with a positive tie (i.e., the stranger was perceived to be a trustful friend's friend). A paired t-test between the positive tied treatment and the baseline showed significant difference (p= 0.048). When using money from a negatively tied stranger, an unconnected stranger, as well as from strangers

whose connections were beyond 2 degrees of separation, people tended to make only slightly riskier decisions but the change was insignificant.

We looked for other possible factors that dominated the investment decisions. We analyzed 180 data points across different experiment days during the entire experiment period, from November 2009 to March 2010. We found that weather had a strong impact on investment decisions (Table 2). People made significantly riskier decisions on sunny days than on raining days.

	sunny days	raining days
Risk Preference	**1.28**	**1.44**
***p* value**		**0.027**

Table 2 Risk preference and weather.

In order to exclude the weather factor, we looked further at the investment decisions on the same day to examine the influence of social perception on risk preference. Table 3 shows the results on a sunny day. A within-subject comparison between the unconnected stranger treatment and other treatments was made. Interestingly, much riskier decisions were made when in the positive tie treatment. The risk preference factor in the positive tie treatment (1.13) was significantly lower than that (1.38) in the unconnected stranger treatment (p=0.05). The results in other treatments show no significant difference. This finding was consistent with the previous results, which suggest that people made riskier decision if and only if the encountered counterpart was a trustful friend's friend.

	unconnected stranger	positive tie	negative tie	degree=3	degree=4	degree=5	degree=6
Risk Preference	1.38	1.13	1.25	1.31	1.25	1.38	1.25
***p* value**		0.05	0.46	0.72	0.46	1.00	0.46

Table 3. Comparing risk preference across different social perception treatments on a sunny day.

8.3 Influence of Social Perceptions on Reciprocity

Reciprocity was measured from the payback decisions in the situation where the borrowers lost the lender's money and had to use their own money for the repayment. In the Social Lending Game, the borrowers use all the money from the lender to make an investment. The borrower's own money was paid for a participation fee and was refunded at the end of the investment. If the borrower lost the investment, all the money from the lender was gone (see Chapter 5 and Figure 3). In this situation, the amount paid back indicated reciprocity. We investigated whether social perceptions influenced reciprocating behavior.

We compared the defect rate across different experiment treatments in the situation when the borrower lost the investment. The defect rate was calculated by the percentage of people who paid back $0. The results show that negatively connected strangers defected twice as much as the baseline, while the defect rate between positively connected strangers was similar to baseline (Figure 25). Unconnected strangers defected 54% more than the baseline. As for strangers who were connected in more than two degrees of separation, no significant difference in defect rate was observed.

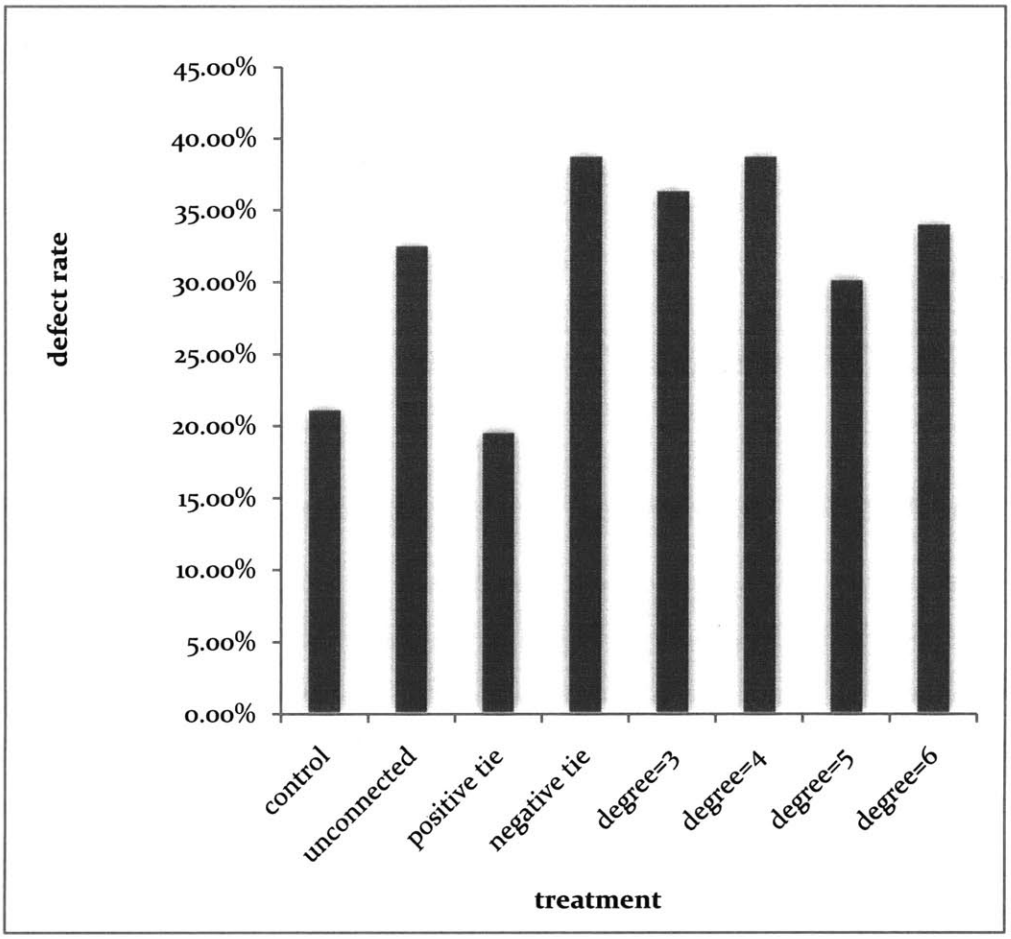

Figure 25. Defect rate across experiment treatments in the condition when losing the investment.

When the borrowers won the investment, we focused on whether they shared the profit with the lender, by which we investigated whether social perception had an impact on reciprocity. We compared the unconnected stranger treatment and the positive tie treatment. We plotted the unconnected stranger lender-borrower pairs as green dots and the positive tied stranger pairs as red triangles (Figure 26). The red line and green line correspondingly represent the linear trends of these two treatments. The black solid line indicates repaying exactly the loan amount. The black dashed line indicates the amount where the borrower split the investment profit evenly with the lender, in addition to returning the full amount of loan. Data points closer towards the up-left corner indicate more reciprocal, while those data points under the 100% repayment line represent non-reciprocal.

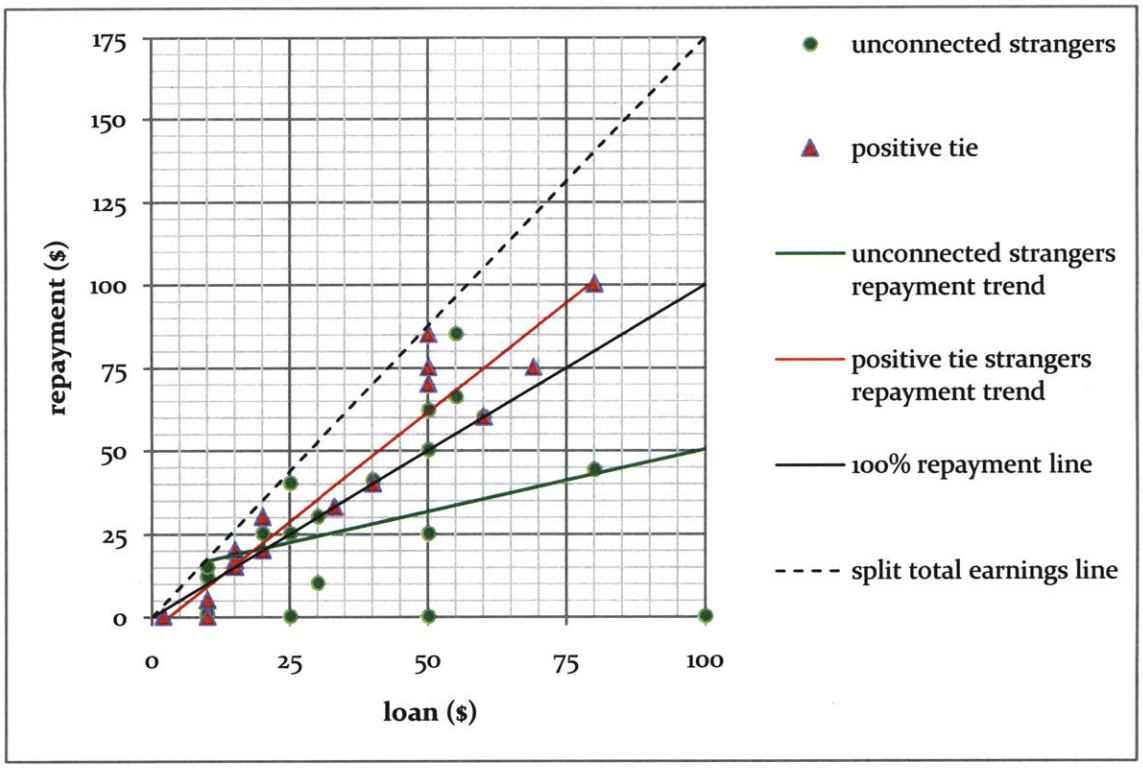

Figure 26. The distribution of repayment vs. loan.

The results show that 87% of the borrowers paid back the full amount of loan in the positive tied treatment. Among them, 39% shared the investment profit with the anonymously paired lender. In the unconnected stranger treatment, the defect rate was higher. There were 45% of the borrowers did not pay back the full amount. Among them, 50% completely defected. The sharing behaviors were observed in the other experiment treatments and there was no significant difference.

Previous studies using the standard trust game show that people reciprocate and split the earnings evenly [3, 22]. However, in our experiment, no one split their profit with the paired stranger. The borrowers shared 21% of the investment profit on average. The maximum portion shared was 33%. This result suggests that the empirical experiment design may have the "free money effect" that motivated the subjects to be fair, while the real reciprocating behavior may be biased.

Chapter 9
Conclusions and Future Work

We identified an experimental procedure where trust can be measured in social contexts. This study presented the relationship mining methods that categorize social connections into trustful tie, distrustful tie, and neutral tie. We manipulated the types and strengths of social connections to form perceptions of strangers in a monetary exchange. Using the Social Lending Game, we incorporated real-world social relationships to investigate whether social perception influenced trust, risk preference and reciprocity. The game design, along with the results, reflects problems in empirical experiments around trust measurement. The results also led to a possible model of trust between strangers in real world.

In summary, the experiment's results draw the following conclusions. First, people trust strangers as much as if they were friends' friends. In contrast, people distrust strangers when they are told the strangers have no friends in common with them, or when the presence of connected strangers is perceived. The results may infer the following: people presuppose strangers as connected within two degrees of separation and trust them. Hence, knowing that someone is a friend's friend does not actively increase trust.

Although having a positive connection does not motivate trust, it serves as a prevention mechanism from being distrusted. Further results indicate that no connection does not mean neutral. When provided with information showing that a stranger was not any friend's friend (an unconnected stranger), people distrust the stranger as much a betrayer's friend. Given this, no information about a stranger makes people trust more than having some reference to signify a stranger is a stranger; although they are both strangers and a rational person should trust them equally.

Negative social perception strongly undermines cooperative behavior. In other words, people can be distrusted simply by being perceived to know a distrustful person. Note that the stranger could be a close friend to the distrustful person, or could also have a negative relationship with that distrustful person. Such information may further change the perception and influence trust. Trust is a guiding behavioral instinct, while social perceptions are a major factor that altered trust. This research provides evidence that trust in strangers can be manipulated. Implications for future applications include leveraging social perception to influence trust-based decisions.

The same influence of social perception on trusting behavior was found to be on reciprocating behavior. People reciprocate with complete strangers as if they were a friend's friend. Between unconnected strangers, or strangers beyond two degrees of separations, people tend to focus on self interest and choose to betray. This further supports the possible model of trust-based decisions between strangers: people presuppose that strangers are connected through a trustful friend and place reciprocity, even though a rational person should consider all strangers as unconnected and reciprocate the same.

The reciprocity measurement in our experiment's design reflects potential factors that may bias the reciprocating behavior in empirical studies [3, 22]. We identified the "free money effect" with experimental evidence. The results also address similar concerns in literature [5]. The experiment's design in this study may provide a more accurate way to examine trust and reciprocity.

Furthermore, the Social Lending Game allows us to investigate risk preference. The results reveal that people use money from strangers differently depending on the social connections. With positive connected strangers (friend's friend), people tend to make riskier decisions. At the same time, if they lose money from the stranger, higher level of reciprocity exist between positive connected strangers. Unlike the model of trust and reciprocity between strangers, people do not regard complete strangers the same as positively connected ones and risk their money. Risky choices are more likely to be made with positive connected strangers. This opens new directions for future research determining how risk preferences and trust may intertwine, with respect of social aspects.

Our results also suggest that weather could be a predictor of risk preferences. Sunshine arouses risk-taking propensity. On rainy days, people are more risk-averse. This result is inconsistent with a previous study which implies that good weather is associated with investors being less willing to tolerate risk [59]. They correlated good mood with good weather conditions and indicated that "The better is [sic.] the investors' mood, the more risk averse they are." Various previous studies have documented relations between weather conditions and real-life investment returns [60-63]. To date, however, there has not been a complementary analysis between weather and risk preferences. Our findings, in conjunction with the methods in this study, suggest that it may be valuable to explore how weather or other social proxies affect trust and risk-taking.

A rational person should act the same way with different strangers, and the decisions made should make no difference between one stranger versus another. In this research, we demonstrated that the perception of a stranger can be manipulated by little information about social connections. A decision maker's gauge relies on the social perceptions of the other party and the social perceptions altered trust, risk-preference, and reciprocity. We concluded that people maximize their utility from both material consumption and social anticipation. An agent who is considered irrational by empirical economics or game-theoretic views may actually be socially rational.

The methods in this study shed light on further research investigating social perceptions and trust-based behaviors. Measurement of trust, as well as reciprocity, should be considered under social contexts. The results from this study can be applied to

everyday exchanges ranging from entry-stage interactions to decisions in the virtual world. The findings may serve as basis of future research on leveraging social networks to reinvestigate utility theory, trust-based decisions and risk-taking behaviors.

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Appendix

Appendix A
Subject Prescreening

Before you start....

- Is your age above 18?
- Do you have an active Facebook account with your real identity?
- Do you have more than 50 Facebook friends?
- Have you logged in Facebook within the past 6 months using your real identity?

If you answer "No" to any of the above questions, please tell the researchers!

If your answers to all of the above questions are yes, please read the following documents.

The documents include an instruction and a consent form. Please read them carefully and sign on the last page of the consent form.

If you have any questions before you sign, please feel free to ask the researchers.

After you sign the consent form, please do NOT leave your seat in order to keep yours and other participants' identities secret.

Please do NOT use the computer before the researchers enter the room.

When all participants are ready to start, the researchers will come to your room, collect the form and assist you to log in.

Appendix B
Instruction for Experiments Phase 1

Facebook Study Instruction for Part 1:

The Facebook study has two parts. Today you are doing Part 1. After 7 days or longer, you will come back and play Part 2.

You will be paired up with different people who are strangers to you to participate in each round. You and your partners in each round are seated in separate rooms. The door will be closed during the entire study. To keep everyone's identity and responses secret, please do NOT leave your room without further instructions given by the researchers.

Your payment of participating in the study will be made after you finish part 2. The total amount of payment is decided by your decisions and your partners' decisions.

In today's part, you will first see a set of questions involving you and your Facebook friends. NO data will be published on Facebook. Your answers to these questions will only be used to help the researchers to pair you up with good matches for you to play in Part 2. Your identity and all your responses will be kept secret. Your Facebook friends have no way to know anything about this study unless you tell them.

When you answer the questions, you will earn money in chips, which will be your money to play the game with your partners. The chips will be exchanged to real money at the end of part 2. You may win more money from your partner. It is also possible that you may lose your money to your partner.

IMPORTANT: If you do not see the pictures of your Facebook friends while completing Part 1, please lightly knock on the door and we will come to assist you.

Today we have paired you up with one partner. You will use the money to play in one round. After you read the instruction and sign the consent form, the experimenter will come and assist you to start.

Good luck!

Appendix C
Demographics Survey

1.Are you Male or Female?

- ◦ Male
- ◦ Female

2.What is your age? (please enter your age) ⌜_____

3.What is your own yearly income?

- ◦ Less than $20,000
- ◦ $20,000 - $34,999
- ◦ $35,000 - $ 49,999
- ◦ $50,000 - $ 74,999
- ◦ $75,000 - $99,999
- ◦ $100,000 or more

Appendix D
Instruction for Experiments Phase 2

Facebook Study Instruction for Part 2:

Before you start, please turn off your cell phone.

==========

The Facebook study has two parts. Today you are doing Part 2.

According to your answers to the questions in Part 1, the system has matched you with other participants who also completed Part 1. The system has paired you up with 7 participants for today's study. You will be playing with each of them in 7 different rounds.

You and your partners in each round are seated in separate rooms. The door will be closed during the entire study. To keep everyone's identity and responses secret, please do NOT leave your room or do NOT open the door without further instructions given by the researchers.

==========

Last time at the end of Part 1, you still have $100 in chips left. This $100 will be used in the first round. After that, you will have a chance to get another $100 in chips for the 2nd round and so on. In other words, you will have a new set of $100 in chips before a new round starts.

Your payment of participating in the study will be made after you finish Part 2. The total amount of payment is decided by your decisions and your partners' decisions. The exchange rate is fixed will be revealed at the end. The payment will be made in cash or cash voucher.

Please note that each round is independent. Your payment in each round is only decided by the actions of you and your partner in that round. The money you gain or lose in one round is completely not related to the previous or next round. Even if you win a lot in one round, you are not allowed to use it in the next round. Similarly, if you lose money in one round, you are not able to make it up in the next round. You will be doing the task with a new partner and in a new setting in the new round.

==========

NO data will be published on Facebook. Your identity and all your responses will be kept secret. Your Facebook friends have no way to know anything about this study.

IMPORTANT: If you do not see the pictures of your Facebook friends while completing Part 1, please lightly knock on the door and we will come to assist you.

In each round, the screen will display a graph indicating who your partner is. If you do not understand any part of the instructions, or if you are not sure about who you are paired up with, please knock on the door and let us know before you continue to the next step!

==========

There may be a short period of waiting time between each round. It is for the system to connect you to your partner in the next round, and to wait until everyone is ready. Please be patient and do not leave the room.

==========

You may win more money from your partner. It is also possible that you may lose your money to your partner.

Good luck!

Appendix E
Review Questionnaire

Follow-up

* Required

What's your SONA ID? *

Are you familiar with the trust game? *

- ◯ I'm an expert of the trust game, related economics games, and game theory
- ◯ I understand how the trust game works but not the game theory or economics assumptions.
- ◯ I heard about it but not too familiar.
- ◯ I have never heard about it.

Do you understand the graphs showing how you are connected to the other participants through your friends? *

- ◯ no
- ◯ yes

(If no) what may cause the confusion?
(What do you not understand about the graphs?)

Do you think the instruction of the game is easy to usnderstand? *

- ◯ Yes, it's clear.
- ◯ No, it is confusing at some point.

(If no) What do you think is confusing?

Were you aware that you might lose your money because borrowers might not return it? *

- ◯ Yes, I thought about this but not from the instructions
- ◯ Yes, I found this from the instructions
- ◯ No, I was not aware of this because the instruction is not clear.

What made you decide the amount of money that you sent to other participants in each round? *

you can choose more than one answer if any of the following fits.

- ☐ No particular reason. I decided the amount of money quite randomly.
- ☐ I decided the amount based on who were the friends that could link me to the borrowers.
- ☐ I decided based on how many steps the borrowers could be connected to me.
- ☐ I tried to predict whether the borrowers would return me money. Based on that I decided how much to lend.
- ☐ Other:

When you made your decisions, did you take into acount that the borrowers might not return you the full amount you lent? *

- ◯ yes
- ◯ only in a certain rounds
- ◯ no

In regards to the last question, when did you think the borrowers might not return the full amount? *

(If you answered no to the last question, please go to the next question)

- ☐ I took this into account when I played after a few rounds. I didn't realize this in the first few rounds.
- ☐ I took this into account only in the first few rounds. I didn't feel safe in the beginning but I worried about this less after played it for a while.
- ☐ I took this into account when the borrowers are connected to me through a friend I don't like
- ☐ I took this into account when the borrowers are too many steps away from me.
- ☐ Other:

Why did you still send money to the borrowers if you thought that they might not return it?

(if you sent $0 to all the other participants, please go to the next question.)

Why did you decide not to send money to the borrowers?
(if you did not send $0 to the other participants, please go to the next question.)

During the game (not after the game), do you believe you played with different participants? *

- ◯ Yes, I believe I was playing with a different person in each round.
- ◯ No, I think I was playing with the same person.
- ◯ No, I believe I was playing with a computer, not a real person.

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Follow-up B

* Required

What's your SONA ID? *

Are you familiar with the trust game? *

- ◯ I'm an expert of the trust game, related economics games, and game theory
- ◯ I understand how the trust game works but not the game theory or economics assumptions.
- ◯ I heard about it but not too familiar.
- ◯ I have never heard about it.

Do you understand the graphs showing how you are connected to the other participants through your friends? *

- ◯ no
- ◯ yes

(If no) what may cause the confusion?
(What do you not understand about the graphs?)

Do you think the instructions for the game are easy to understand? *

- ◯ Yes, it's clear.
- ◯ No, it is confusing at some point.

(If no) What do you think is confusing?

In each round when you were asked to make an investment decision between a risky option and a safe option, how did you decide? *

- ◯ No particular reason. I randomly picked one of them.
- ◯ Based on whom I was playing with.
- ◯ Other:

(If you choose "Based on whom I was playing with.") Which of the following is close to your strategy?

- ☐ I tend to choose the safer investment option if I am playing with someone who is my good friend's friend.
- ☐ I tend to choose the risky investment option if I am playing with someone who is my good friend's friend.
- ☐ I tend to choose the safer investment option if I am playing with someone who is more steps away from me.
- ☐ I tend to choose the risky investment option if I am playing with someone who is more steps away from me.
- ☐ Other:

When you won in the investments, did you share any portion of the investment profits with the other participants? *

- ◯ Yes, I have.
- ◯ No, I have not.

Why did you decide to share (or not to share) the investment profits with the other participants? *

When you lost in the investments, did you still return the money to the other participants? *

- ◯ Yes, I did
- ◯ No, I did not.
- ◯ I did in some rounds but not always.

Why did you decide to pay back (or not to pay back) when you lost in the investment? *

How did you decide the final amount of money that you sent back to the other participants? *
(Feel free to choose more than one answer if any of the following fits.)

- [ ] No particular reason. I decided the amount of money quite randomly.
- [ ] I decided the amount based on who were the friends that could link me to the lenders.
- [ ] I decided based on how many steps the lenders could be connected to me.
- [ ] I decided based on my investment outcome.
- [ ] I decided based on the amount of money sent from the lenders.
- [ ] Other:

Were you aware that you could maximize your profit if you choose not to return the money from the other participant? *
(Were you aware during the process when you played, not now)

- ◯ No, I was not aware of this.
- ◯ Yes, I found this from the instructions
- ◯ Yes, I thought about this but not from the instructions.

(If yes..) You were aware that you could maximize your profit by not returning the money to the other participant. Does it influence your repayment decision?

- ◯ No, I still payback the full amount or more.
- ◯ Yes, I think it is smart to pay back less and I did.
- ◯ I'm not sure. I just paid back as I felt like.

(If you selected "yes" or "I'm not sure" in the previous question....) You were aware that you can maximize your profit by not paying back, why did you still pay back?

Submit

Appendix F
COUHES Approval & Consent Form

	Massachusetts Institute of Technology Committee on the Use of Humans as Experimental Subjects	Application # (assigned by COUHES)	
		Date	

APPLICATION FOR APPROVAL TO USE HUMANS AS EXPERIMENTAL SUBJECTS (STANDARD FORM)

*Please answer every question. Positive answers should be amplified with details. You must mark N/A where the question does not pertain to your application. Any incomplete application will be rejected and returned for completion. A **completed CHECKLIST FOR STANDARD APPLICATION FORM must accompany this application.***

I. BASIC INFORMATION

1. Title of Study	
How Perception of Social Connection Influences Trust Behavior and Personal Decision	
2. Principal Investigator	
Name: Deb Roy	Building and Room #: E15-483
Title: Professor of Media Arts and Sciences; Director of Center for Future Banking	Email: dkroy@media.mit.edu
Department: Media Lab	Phone:

3. Study Personnel

All key personnel[1] **including the PI** *must be listed below, with a brief statement of qualifications and study role(s).*
***Important Note:** all key personnel are required to complete Human Subject training before work begins on the project.*

Investigators and other personnel [and institution(s)]:	*Qualifications: Describe briefly*	*Study role(s): (Check box to the right if person will be obtaining consent.)*	
Deb Roy	**Faculty**	**Principal investigator**	☐
Sheng-Ying (Aithne) Pao	**Graduate student**	**Associate Investigator**	☐
Peter Rigano **Jorge Simosa** **Wendy Cheang**	**Undergraduate student**	**UROP**	☐

4. Collaborating Institutions. *If you are collaborating with another institution(s) then you must obtain approval from that institution's institutional review board, and forward copies of the approval to COUHES)*

[1] MIT key personnel all individuals who contribute in a substantive way to the execution and monitoring of the study at or on behalf of MIT or affiliated institutions. Typically, these individuals have doctoral or other professional degrees, although other individuals may be included. In particular, investigators and staff involved in obtaining informed consent are considered key personnel.

5. Location of Research. *If at MIT please indicate where on campus. If you plan to use the facilities of the Clinical Research Center you will need to obtain the approval of the CRC Advisory Committee. You may use this form for simultaneous submission to the CRC Advisory Committee.*

Behavioral Research Lab

6. Funding. *If the research is funded by an outside sponsor, please enclose one copy of the research proposal with your application. A draft of the research proposal is acceptable.*

A. Type of funding:	**B. Source of funding**
☐ Contract/Grant ☐ Subcontract ☐ Departmental ☐ Gift ☐ Other: ☐ No Funding Have funds been awarded? ☐ Yes ☐ Pending ☐ No *Award #, if known*	☐ Federal Government ☐ Other Gov. (e.g. State, local) ☐ Industry ☐ Other Private ☐ Departmental Funds ☐ Other: **Specify name of source designated above:**

C. If Contract of Grant

Name of Contract or Grant:	Contract or Grant Title:
Contract or Grant Number:	OSP#:

7. Human Subjects Training. *All study* personnel **MUST** *take and pass a training course on human subjects research. MIT has a web-based course that can be accessed from the main menu of the COUHES web site. COUHES may accept proof of training from some other institutions. List the names of all study personnel and indicate if they have taken a human subjects training course.*

Sheng-Ying (Aithne) Pao - completed
Peter Rigano - completed
Jorge Simosa - completed
Wendy Cheang- completed
Deb Roy - completed

8. Anticipated Dates of Research

Start Date: Jun. 20, 2009	Completion Date: Jun. 20, 2010

II. STUDY INFORMATION

1. Purpose of Study. *Please provide a concise statement of the background, nature and reasons for the proposed study. Use non-technical language that can be understood by non-scientist members of COUHES.*

This is a pilot study to examine how social connection and the perception of social network influences trust and decision making. We aim to understand how trust between participants who do not know each other is influenced by the factors of how they perceive each other, based on the social information about people who connect them, and how this social perception in turn influences their trust behavior and personal decisions.

2. Study Protocol. *For **biomedical, engineering and related research**, please provide an outline of the actual experiments to be performed. Where applicable, provide a detailed description of the experimental devices or procedures to be used, detailed information on the exact dosages of drugs or chemicals to be used, total quantity of blood samples to be used, and descriptions of special diets.*

*For applications in the **social sciences, management and other non-biomedical disciplines** please provide a detailed description of your proposed study. Where applicable, include copies of any*

questionnaires or standardized tests you plan to incorporate into your study. If your study involves interviews please submit an outline indicating the types of questions you will include.

You should provide sufficient information for effective review by non-scientist members of COUHES. Define all abbreviations and use simple words. Unless justification is provided this part of the application must not exceed 5 pages.

Attaching sections of a grant application is not an acceptable substitute.

Subjects who are qualified for this experiment would be people who connect and interact with other people on social networking websites such as Facebook.

On the first day, they will first provide the information about their social network on the networking website, given their consent. They will be required to finish a social relation survey on a computer to specify and rate their relationships to people they are connected to, from which three categories of relationship will be identified. The three categories are possitive relatonship, negative relationship, and neutral relationship. People they trust and care a lot about are categorized into positive relationship. People they avoid or distrust are categorized into negative relationship. People they do not care about are categorized into neutral relationship. The information will be used to construct a half-genuine social connection map of how they connect to the other subject they do not know. One day after, they will participate in a "two-way trust game", in which the social connection map will be displayed before they play.

The experiment will include two settings. In the first setting, we will pair up subjects randomly, under the only condition that they do not know each other directly. Each pair of subjects will first be endowed with $10 and play the "p2p lending game" against each other. In the game, player 1 (lender) is required to decide the amount of money send to Player 2. Player 2 is required to use the money borrowed from player one to make an investment decision from two options. The investment outcome decides the total amount of money that Player 2 will have. After that, Player 2 decides the amount of money return to Player 1.

Their names will be encrypted, so they do not know who they are playing the game with. We'll also send them a list of names before they come and make sure they do not know the people on the list. They will play the game with people they do not know, and the only information they have about the other person is how they are connected in their social network. To do this, we mine their social network based on the results of the social relation survey. Before they play the game, they will see the social connection map. The map illustrates their relationship to the other player, such as who their common friend is, or they do not have common friends. Their common friends on the map will be names and pictures picked from one of the three categories of relationship we mined from the survey results.

In the second setting of the experimient, subjects will play a card-guessing game. In this game they will see three cards facing down, and they are told that one of the cards is a joker (or a specific card) -- the target card. The player who can guess the right card will win 50 points, the other would gain nothing. If both of them guess it right, they will share the 50 points. If both of them guess it wrong, both gain nothing. Before they make a guess, each of them is presented with one of the cards other than the target card, but none

of them know which one is the targt card, or which card has been presented to the other player. The only thing each player knows is the card they've seen is not the target card. Next, they are required to guess which one is the target card, and other person can choose to agree or disagree. They can choose to cooperate with the other player by telling the truth, or choose to preventing the other player from sharing the prize by telling a lie. They will see the social connection maps as mentioned above before playing the game.

Subjects are told that they are playing with the other subjects and that the map shows how theya are socially connected, but for conducting and controlling the treatment in the experiments, we may have computers play the role of the other participant, playing the game against the subjects. After the game, they will be clearly informed that whether they play with computers and that the social connection map is half-genuine. If they play with a human, we will not reveal who they play the game with, and will not reveal their real connections.

For each subject, $10 payment for the survey is ensured, but the total amount of payment will be decided by their performance in the games they play.

They will have to finish a short questionnaire about their experience during the game and about demographics. Through their behavior and their self-report questionnaires, to investigate the strategy they take in the game and to see whether their behaviour is influenced by factors other than social connections.

3. Drugs and Devices. *If the study involves the administration of an investigational drug that is not approved by the Food and Drug Administration (FDA) for the use outlined in the protocol, then the principal investigator (or sponsor) must obtain an Investigational New Drug (IND) number from the FDA. If the study involves the use of an approved drug in an unapproved way the investigator (or sponsor) must submit an application for an IND number. Please attach a copy of the IND approval (new drug), or application (new use.).*
If the study involves the use of an investigational medical device and COUHES determines the device poses significant risk to human subjects , the investigator (or sponsor) must obtain an Investigational Device and Equipment (IDE) number from the FDA.

Will drugs or biological agents requiring an IND be used? YES☐ NO☒
If yes, please provide details:

Will an investigational medical device be used? YES☐ NO☒
If yes, please provide details:

4. Radiation *If the study uses radiation or radioactive materials it may also have to be approved by the Committee on Radiation Exposure to Human Subjects (COREHS). COUHES will determine if you need COREHS approval.*

Will radiation or radioactive materials be used? YES☐ NO☒
If yes, please provide details:

5. Diets

Will special diets be used? YES☐ NO☒
If yes, please provide details:

III. HUMAN SUBJECTS

1. Subjects	
A. Estimated number: 100	**B. Age(s): 18 or older**

C. Inclusion/exclusion criteria

i. What are the criteria for inclusion or exclusion?

Subjects have to be connected and interact with other people on social networking websites such as Facebook.

ii. Are any inclusion or exclusion criteria based on age, gender, or race/ethnic origin? *If so, please explain and justify*

no

D. Please explain the inclusion of any vulnerable population (e.g. children, cognitively impaired persons, non-English speakers, MIT students), and why that population is being studied.

2. Subject recruitment *Identification and recruitment of subjects must be ethically and legally acceptable and free of coercion. Describe below what methods will be used to identify and recruit subjects*

Subjects will be recruited through a variety of standard techniques. We may post notices to internal M.I.T. subject recruitment lists, and announce the study on appropriate Internet discussion groups.

Please attach a copy of any advertisements/ notices and letters to potential subjects

3. Subject compensation *Payment must be reasonable in relation to the time and trouble associated with participating in the study. It cannot constitute an undue inducement to participate*

Describe all plans to pay subjects in cash or other form of payment (i.e. gift certificate)

cash

Will subjects be reimbursed for travel and expenses?

no additional reimbusement

4. Potential risks. *A risk is a potential harm that a reasonable person would consider important in deciding whether to participate in research. Risks can be categorized as physical, psychological, sociological, economic and legal, and include pain, stress, invasion of privacy, embarrassment or exposure of sensitive or confidential data. All potential risks and discomforts must be minimized to the greatest extent possible by using e.g. appropriate monitoring, safety devices and withdrawal of a subject if there is evidence of a specific adverse event.*

What are the risks / discomforts associated with each intervention or procedure in the study?

There is no significant physical or psychological risk to participation.

What procedures will be in place to prevent / minimize potential risks or discomfort?

5. Potential benefits

What potential benefits may subjects receive from participating in the study?

They will receive cash payment, and will potentially learn more about their social network and their decision-making process.

What potential benefits can society expect from the study?

This study will help the science and society to deeper understand human decision making process and the influenced by social network.

6. Data collection, storage, and confidentiality

How will data be collected?

Data will be collected from subjects' input on computers.

Is there audio or videotaping? YES ☐ **NO** ☒ ***Explain the procedures you plan to follow.***

Will data be associated with personal identifiers or will it be coded?
Personal identifiers ☐ **Coded** ☒ ***Explain the procedures you plan to follow.***

Where will the data be stored and how will it be secured?
All the personal information, research data, and related records will be stored in an encrypted file to prevent access by unauthorized personnel. Only the results of analysis for this study will be reported.
What will happen to the data when the study is completed?
Subjects' personal information will not be reported in any form and will be destroyed following analysis.
Can data acquired in the study affect a subject's relationship with other individuals (e.g. employee-supervisor, patient –physician, student-teacher, family relationships)?
No.

7. Deception *Investigators must not exclude information from a subject that a reasonable person would want to know in deciding whether to participate in a study.*

Will information about the research purpose and design be withheld from subjects?
YES ☒ **NO** ☐ ***If so, explain and justify.***
The research purpose and design will be withheld to prevent any potential influence on their behavior about trust and decision making. Once the experiment is done, they will be clearly informed about the research purpose and design. Please see study protocal for details.

8. Adverse effects. *Serious or unexpected adverse reactions or injuries must be reported to COUHES within 48 hours. Other adverse events should be reported within 10 working days.*

What follow-up efforts will be made to detect any harm to subjects and how will COUHES be kept informed?
no follow-up

9. Informed consent. *Documented informed consent must be obtained from all participants in studies that involve human subjects. You must use the templates available on the COUHES web-site to prepare these forms. Draft informed consent forms must be returned with this application. Under certain circumstances COUHES may waive the requirement for informed consent.*

Attach informed consent forms with this application.

10. The HIPAA Privacy Rule. *If your study involves disclosing identifiable health information about a subject outside of M.I.T., then you must conform to the HIPAA Privacy Rule and complete the questions below. Please refer to the HIPAA section, and to the definitions of protected health information, de-identified data and limited data set on the COUHES web-site.*

Do you plan to use or disclose identifiable health information outside M.I.T.?
YES ☐ **NO** ☒
If YES, then the subject must complete an Authorization for Release of Protected Health Information Form. Please attach a copy of this draft form. You must use the template available on the COUHES web-site.

Alternatively, COUHES may grant a Waiver of Authorization if the disclosure meets criteria outlined on the COUHES web-site.

Are you requesting a Waiver of Authorization?
YES ☐ **NO** ☐
If YES, explain and justify.

Will the health information you plan to use or disclose be de-identified?
YES ☐ NO☐

Will you be using or disclosing a limited data set?
YES ☐ NO☐

If YES, then COUHES will send you a formal data use agreement that you must complete in order for your application to be approved

IV. INVESTIGATOR'S ASSURANCE

I certify the information provided in this application is complete and correct

I understand that I have ultimate responsibility for the conduct of the study, the ethical performance of the project, the protection of the rights and welfare of human subjects, and strict adherence to any stipulations imposed by COUHES

I agree to comply with all MIT policies, as well all federal, state and local laws on the protection of human subjects in research, including:

- **ensuring all study personnel satisfactorily complete human subjects training**
- **performing the study according to the approved protocol**
- **implementing no changes in the approved study without COUHES approval**
- **obtaining informed consent from subjects using only the currently approved consent form**
- **protecting identifiable health information in accord with the HIPAA Privacy Rule**
- **promptly reporting significant or untoward adverse effects**

Signature of Principal Investigator _____ **Date** _____

Print Full Name and Title _____

Signature of Department Head _____ **Date** _____

Print Full Name and Title _____

Please return 3 hard copies of this application (1 with original signatures) to the COUHES office E25-143b.

CONSENT TO PARTICIPATE IN

NON-BIOMEDICAL RESEARCH

Decisions of Networking Website Users.

You are asked to participate in a research study conducted by *Sheng-Ying Pao (M.S.), Peter Rigano, Jorge Simosa, Wendy Cheang and Deb Roy (Ph.D.)*, from the Media Lab at the Massachusetts Institute of Technology (M.I.T.). The *results will be contributed to thesis in the Media Lab.* You were selected as a possible participant in this study because You *(1) are a Facebook user and (2) allow us to incorporate your social network data on Facebook for the study.* You should read the information below, and ask questions about anything you do not understand, before deciding whether or not to participate.

- **PARTICIPATION AND WITHDRAWAL**

Your participation in this study is completely voluntary and you are free to choose whether to be in it or not. If you choose to be in this study, you may subsequently withdraw from it at any time without penalty or consequences of any kind. The investigator may withdraw you from this research if circumstances arise which warrant doing so.

If the information you provided about your social relationship is not true or the number of connections you have on the website is not enough for the study, your participation may be terminated by the investigator without regard to your consent.

- **PURPOSE OF THE STUDY**

This study is to analyze social interaction and personal decision-making.

- **PROCEDURES**

If you volunteer to participate in this study, we would ask you to do the following things:

You will be required to finish a survey on a computer involving your Facebook friends. You will be playing a game on a computer with another subject who you have never met before, followed by a questionnaire about demographics.

The total length of this study will be about 60 minutes, about 30 minutes for Part 1 and about 30 minutes for Part 2. You will play the game in MIT Behavioral Research Lab on a computer.

- **POTENTIAL RISKS AND DISCOMFORTS**

There is no significant physical or psychological risk to participation

- **POTENTIAL BENEFITS**

This study will help the science and society to deeper understand social interaction and human decision making.

- **PAYMENT FOR PARTICIPATION**

Your total payment is based on your performance in the experiment. You will earn dollars in chips and use the chips when you play. You could gain more or less chips based on your decisions and performance. Chips will be exchanged into cash at the end of Part 2. Payment will be made after you finish both part 1 and Part 2.

- **CONFIDENTIALITY**

Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission or as required by law.

Your personal information, reactions in the experiment, and related records will be stored in an encrypted file to prevent access by unauthorized personnel. Only the results of analysis for this study will be reported. Your information and responses in the experiment will not be reported in any form and will be destroyed following analysis.

- **IDENTIFICATION OF INVESTIGATORS**

If you have any questions or concerns about the research, please feel free to contact the Facebook Experiment Team [(617) 715-4435, studya@mit.edu]

- **EMERGENCY CARE AND COMPENSATION FOR INJURY**

If you feel you have suffered an injury, which may include emotional trauma, as a result of participating in this study, please contact the person in charge of the study as soon as possible.

In the event you suffer such an injury, M.I.T. may provide itself, or arrange for the provision of, emergency transport or medical treatment, including emergency treatment and follow-up care, as needed, or reimbursement for such medical services. M.I.T. does not provide any other form of compensation for injury. In any case, neither the offer to provide medical assistance, nor the actual provision of medical services shall be considered an admission of fault or acceptance of liability. Questions regarding this policy may be directed to MIT's Insurance Office, (617) 253-2823. Your insurance carrier may be billed for the cost of emergency transport or medical treatment, if such services are determined not to be directly related to your participation in this study.

• **RIGHTS OF RESEARCH SUBJECTS**

You are not waiving any legal claims, rights or remedies because of your participation in this research study. If you feel you have been treated unfairly, or you have questions regarding your rights as a research subject, you may contact the Chairman of the Committee on the Use of Humans as Experimental Subjects, M.I.T., Room E25-143B, 77 Massachusetts Ave, Cambridge, MA 02139, phone 1-617-253 6787.

SIGNATURE OF RESEARCH SUBJECT OR LEGAL REPRESENTATIVE

I understand the procedures described above. My questions have been answered to my satisfaction, and I agree to participate in this study. I have been given a copy of this form.

_____

Name of Subject

_____

Name of Legal Representative (if applicable)

_____ _____

Signature of Subject or Legal Representative Date

SIGNATURE OF INVESTIGATOR

In my judgment the subject is voluntarily and knowingly giving informed consent and possesses the legal capacity to give informed consent to participate in this research study.

_____ _____

Signature of Investigator Date

MIT Committee On the Use of Humans as Experimental Subjects

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
77 Massachusetts Avenue
Cambridge, Massachusetts 02139
Building E 25-143B
(617) 253-6787

To:	Deb Roy E15-488
From:	Leigh Firn, Chair COUHES
Date:	06/22/2009
Committee Action:	**Expedited Approval**
COUHES Protocol #:	0905003236
Study Title:	How Perception of Social Connection Influences Trust Behavior and Personal Decision
Expiration Date:	06/21/2010

The above-referenced protocol was approved following expedited review by the Committee on the Use of Humans as Experimental Subjects (COUHES).

If the research involves collaboration with another institution then the research cannot commence until COUHES receives written notification of approval from the collaborating institution's IRB.

It is the Principal Investigator's responsibility to obtain review and continued approval before the expiration date. You may not continue any research activity beyond the expiration date without approval by COUHES. Failure to renew your study before the expiration date will result in termination of the study and suspension of related research grants.

Adverse Events: Any serious or unexpected adverse event must be reported to COUHES within 48 hours. All other adverse events should be reported in writing within 10 working days.

Amendments: Any changes to the protocol that impact human subjects, including changes in experimental design, equipment, personnel or funding, must be approved by COUHES before they can be initiated.

Prospecitve new study personnel must, where applicable, complete training in human subjects research and in the HIPAA Privacy Rule before participating in the study.

COUHES should be notified when your study is completed. You must maintain a research file for at least 3 years after completion of the study. This file should include all correspondence with COUHES, original signed consent forms, and study data.

Appendix G
Subject Recruiting Advertisement

Play a FACEBOOK Game and Earn Money!

Are you 18+ years old?
Do you have:

1) a Facebook account?
2) more than 50 Facebook friends?

If so…

Congratulations!

You qualify to take part in this study.

Earn money while playing an online game against other players.

–The experiment takes place on two different days.
–Each part will take about 35 minutes.
–Your payment is based on your performance in the game.

Contact studya2009@gmail.com or sign up at http://web.mit.edu/brl/

Facebook users: Come Play a Game!
Email: studya2009@gmail.com
Or sign up at http://web.mit.edu/brl/