In Vino Veritas?

Communication Under Influence - An Experimental Study*

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Abstract

We report results from controlled laboratory experiments designed to identify a plausible channel through which alcohol drinking affects communication and transaction. In the game played in laboratory experiments, sellers who are privately informed about their asset's quality communicate and trade with potential buyers, after both parties drink their given alcoholic beverages. We investigate the effects of alcohol consumption by varying the alcohol contents in the assigned beverages across treatments. Our three primary findings are as follows. First, sellers under the influence of high alcohol contents lie significantly more than sellers who are not under the influence. Second, buyers under the influence of high alcohol contents make higher offers for the assets. Third, the public availability of information on alcohol contents does not change players' behavior significantly. These findings are qualitatively consistent with a model of communication with lying cost and naive receivers, and suggest that alcohol consumption has direct effects on lowering lying cost and degree of sophistication in interpreting received messages. We also find that our main results do not originate from alternative explanations such as other-regarding preferences, higher-order rationality, and risk-attitudes.

Keywords: Sender-Receiver Games, Communication Under Influence, Laboratory Experiments

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Round, round with the glass, boys, as fast as you can,
Since he who don't drink cannot be a true man.
For if truth is in wine, then 'tis all but a whim
To think a man's true when the wine's not in him.
Drink, drink, then, and hold it a maxim divine
That there's virtue in truth, and there's truth in good wine!

In Vino Veritas, Benjamin Cooke (1770s)

1 Introduction

Are people more truthful when they are under the influence of alcohol? The Latin phase "In vino veritas" (which translates into "in wine, truth") and the Chinese phase "After wine blurts truthful speech" illustrate a belief prevalent across ages and cultures that people under the influence of alcohol are more open to revealing their hidden thoughts. According to the Roman historian Tacitus (Tacitus, 1908), the Germanic peoples kept council at feasts because they believed that drinking prevented the participants from concealing opinions. In modern times, especially in countries such as China, Japan, Korea, and Russia, alcohol consumption is an integral part of business negotiations; major business decisions are, more often than not, made after the parties involved drink together. In her study of international business culture, Meyer (2014) states that across East Asia, doing a substantial amount of drinking with customers and collaborators is a standard step. In these cultures, it is believed that drinking provides an opportunity to let one's hair down and express the real thoughts.

In this paper, we use laboratory experiments to investigate whether alcohol consumption makes people more truthful, thus facilitating negotiations plagued with information asymmetry. We adopt the lemons market environment considered by Forsythe, Lundholm, and Rietz (1999): a seller who is privately informed about her asset type sends a cheap-talk message (Crawford and Sobel, 1982) to a buyer who in turn makes a price offer for the asset. Although transferring the asset to the buyer is Pareto-efficient and feasible, information asymmetry prevents efficient trade from materializing (Akerlof, 1970). Assuming perfect rationality of players, the unique equilibrium of the game has no information transmitted in the communication stage, and no trade for all but the lowest-type assets.

To investigate the channels through which drinking systematically affects the outcome in the lemons market under study, we develop a simple behavioral model in which the seller has a lying cost and the buyer may be credulous. Specifically, the seller suffers a lying cost whenever she sends a message different from the true type of the asset she is holding, and a fraction of credulous buyers takes the sellers' messages at face value. The model predicts that when the

lying cost is sufficiently low and/or the fraction of credulous buyers is sufficiently high, partial information transmission is possible. Moreover, the lower the lying cost and the higher the fraction of credulous buyers, the more likely the seller would inflate their asset type. These predictions are in line with the findings of Forsythe et al. (1999) that sellers often exaggerate their asset's quality and some buyers are deceived, resulting in a gain to sellers at the expense of buyers compared with the theoretical prediction described above.

Based on the simple model with seller's lying cost and receiver's credulity, we hypothesize that drinking may influence players' behavior through two different channels. The first one is a *direct* channel according to which drinking changes a seller's lying cost and a buyer's degree of credulity. The second one is an indirect channel, via players' *beliefs*. On one hand, alcohol consumption could lead a seller to believe that the buyers are more credulous, thus increasing her expected payoff of inflating her asset type. On the other hand, alcohol may make a buyer believe that sellers are more truthful (as the folk wisdom goes), and thus more willing to make a high price offer following a favorable message. Whether sellers are more truthful and whether buyers are willing to make higher offers after drinking depend on the direction and the relative strength of these effects, and is thus an empirical inquiry.

To investigate the effect of alcohol on communication and trading, we ask our subjects to drink a cup of alcoholic beverage at the beginning of the experiment. There are two types of beverages: high-alcohol-content (11% alcohol-by-volume) and low-alcohol-content (1% alcohol-by-volume). By varying the alcoholic contents of the drinks given to subjects who play the role of sellers and buyers, as well as the information about the alcoholic drinks given, we are able to study the effects of alcohol on communication and trading behaviors, as well as the possible channels through which the effects take place.

Our main experimental findings are as follows. First, sellers under the influence of high alcohol contents lie significantly more than sellers who are not under the influence. Second, when buyers are under the influence of higher alcohol contents, they tend to make higher offers for the assets. Third, public availability of information on alcohol contents does not change players' behavior significantly. Taken together, these findings suggest that alcohol consumption directly lowers peoples' lying cost and raises their degree of credulity, leading sellers to make more lies and buyers to make higher offers. The indirect channel via beliefs plays an insignificant role in how alcohol consumption affects players' behaviors.

Whereas the second finding above is in accord with the intuition that alcohol lowers peoples' ability in extracting information from received messages (see, for example, Steele and Josephs (1990)), the finding that people under the influence are more likely to lie runs counter to the conventional wisdom that alcohol makes people more truthful. One possible explanation for this finding is that alcohol intoxication weakens one's inhibitory restraint over immoral and im-

proper behaviors (see, for example, Steele and Southwick (1985), Denton and Krebs (1990), and MacDonald et al. (1995)), so subjects who are under influence could behave less honestly. However, caution must be exercised in extrapolating our experimental result to real-world business negotiations. First, due to concerns about alcohol's effect on health risks, the volume of alcoholic beverages given to the subjects in our experiments was quite small compared to real-world business settings. Second, communication and negotiation in business meetings can be a lot more complicated than the simple experimental games we studied.[1] Nonetheless, our result casts doubt over the conventional wisdom about alcohol's effect, especially when only a mild amount is consumed.

There are a few other conceivable channels through which alcohol consumption affects behaviors. First, it is not difficult to imagine that drinking may affect an individual's degree of bounded rationality. As presented by Crawford (2003), lying and deception can take place when players in communication games are not fully rational. Second, individuals' attitude toward risk may be influenced by drinking. Third, drinking may affect individuals' social preferences.

To test if the alternative channels discussed above are the primary sources of the experimental results we obtained, we designed three additional stages that followed the ten rounds of communication-trading game in the experiments. First, we let subjects play the 2/3-beauty contest (which we refer to as the guessing game)[2] to obtain a simple but reasonable measure of the average degree of bounded rationality of our subjects. We find that there is no significant difference between the average number choices between subjects given high-alcohol-content drinks and those given low-alcohol-content drinks. Second, we asked our subjects to play the dictator game (Kahneman, Knetsch, and Thaler, 1986) to obtain a reasonable measure of their social preference. We find that there is no significant difference between the average split proposals offered by subjects under the influence of high alcohol contents and those offered by subjects under no such influence in any treatment. Third, we elicited individuals' risk attitudes and found no systematic evidence that drinking influences their risk tolerance. This finding is in line with previous literature on alcohols' effects on risk preferences (Corazzini, Filippin, and Vanin, 2015).

The rest of the paper is organized as follows. Related literature is discussed below. Section 2 presents the theoretical environment of the lemon market with strategic information transmission, describes a model of sellers' lying costs and buyers' credulity, and shows that partial communication may be possible in equilibrium. Experimental design, hypotheses, and procedure are discussed in Section 3. We report our experimental findings in Section 4. Section 5 concludes.

[1] For example, information transmission can occur through verifiable disclosure or costly signaling; and negotiation may involve multiple stages of offers and counter-offers.

[2] See, e.g., Stahl and Wilson (1994, 1995) and Nagel (1995).

1.1 Related Literature

The effect of alcohol intoxication on individuals' cognitive abilities and decision-making has been studied extensively in the psychology literature. According to the survey by Steele and Josephs (1990), alcohol intoxication impairs ones' information processing ability. It restricts the range of cues that one can perceive in a situation, and reduces our ability to process and extract meaning from the cues and information perceived. This effect is in line with the hypothesis that in our experiments, buyers under the influence of alcohol are less likely to correctly update their beliefs on the sellers' asset type based on the messages received, and thus more likely to take the messages at their face value. Steele and Southwick (1985) show that alcohol intoxication weakens ones' inhibitory control, thus more likely to engage in behaviors with negative consequences. Abernathy et al. (2010) survey possible neuro-mechanisms through which alcohol affects decision-making.

There is a relatively small economic literature on alcohol consumption and its immediate effects. Corazzini et al. (2015) study individual decision-making using laboratory experiments and find that subjects under influence are less patient and less generous, but there is no effect on risk preference. Au and Zhang (2016) find that subjects under influence are more willing to collaborate despite an adverse selection problem. Schweitzer and Gomberg (2001) study the effect of alcohol consumption on structuring a hypothetical offer for a job candidate, and find that subjects under influence use more aggressive tactics and make more mistakes. The long-term effect of alcohol consumption has been studied more extensively, especially in the labor economics literature. Empirical studies have identified a positive relationship between moderate alcohol consumption and earnings. Bray (2005) shows that the effect arises because moderate alcohol consumption improves the return to education and work experience, thus human capital accumulation. Other studies attribute the relationship to the positive impact of moderate alcohol consumption on physical health (MacDonald and Shields, 2001), mental health (Peele and Brodsky, 2000), and social network development (Ziebarth and Grabka, 2009). Furthermore, there are a couple of theoretical studies related to alcohol consumption, building on the assumption that people are more likely to reveal their private type after drinking. Haucap and Herr (2014) propose a signaling model and identify a separating equilibrium in which only high-productivity agents engage in social drinking, and positive assortative matching arises in the subsequent social-interaction stage. Finkle and Shin (2014) suggest that a principal can reduce the agent's information rent by compelling the agent to drink excessively.

The communication game we study belong to the literature of cheap talk pioneered by Crawford and Sobel (1982). A number of theoretical studies in this literature incorporate senders' lying-aversion and receivers' credulity in order to explain the over-communication phenomenon frequently documented in the experimental literature (e.g., Dickhaut et al. (1995), Blume et al.

(2001), Cai and Wang (2006) and Wang et al. (2010)). Assuming an unbounded message space, Kartik et al. (2007) identifies a fully-separating equilibrium in which senders' messages are inflated and credulous receivers are deceived. Kartik (2009) considers a bounded message space and shows that there is always pooling at the highest messages. Chen (2011) assumes that a fraction of senders are truthful and finds that in the limit as the behavioral types vanishes, only top messages are sent and the equilibrium converges to the most informative equilibrium in Crawford and Sobel (1982). In this paper, we adopt their modelling approach to our communication-trading game to study the channel through which alcohol consumption affects the behaviors of sellers (senders) and buyers (receivers).

2 Theoretical Environment

Our theory and experiment are based on the model of strategic information transmission in a lemon market considered by Forsythe et al. (1999). The game is played between a (female) seller and a (male) buyer. Each seller is endowed with an asset, whereas each buyer is endowed with some money. The asset held by the seller can be one of the following three possible types: *high*, *medium*, or *low*. The asset's type is drawn from a uniform distribution, that is, $\Pr(\theta) = \frac{1}{3}$ for all asset type $\theta \in \{h, m, l\}$. Asymmetric information is modelled by having the realized type revealed only to the seller but not to the buyer. Every player prefers a higher-type asset to a lower-type asset, and the buyer values the asset more than the seller regardless of the asset's type. Let b_θ and s_θ be the asset's value to the buyer and to the seller respectively. In these notations, $b_h > b_m > b_l$, $s_h > s_m > s_l$, and $b_\theta > s_\theta$ for all θ.

Bargaining is modelled as the buyer making a take-it-or-leave-it offer to the seller. The set of possible price offers is restricted to $\{p_h, p_m, p_l\}$ with the following properties: (i) $p_h > p_m > p_l$, (ii) $b_\theta > p_\theta > s_\theta$ for all θ, and (iii) $p_h > \frac{1}{3}(b_h + b_m + b_l)$. The second property ensures that a Pareto-improving trade is always feasible. The third property ensures that it is suboptimal for the buyer to offer a price p_h under the prior belief. After receiving the offer, the seller can decide either to accept or reject it. If she accepts, trade takes place, and she sells the asset to the buyer at the offered price. If she rejects it, trade does not take place and the players keep their respective endowments.

After the seller learning the asset's type but before the buyer making an offer, the seller can send a cheap-talk message to the buyer. The set of feasible messages is $M = \{$"High", "Medium", "Low", "Not reveal"$\}$. Each message is costless to both players, and the seller is not obliged to send a message that coincides with the asset's type.

The timeline is as follows. The seller privately learns the type of the asset and sends a message to the buyer. After seeing the message (but not the asset type), the buyer makes one of the

following offer: p_l, p_m, or p_h. After receiving the offer, the seller decides whether to accept or reject the offer. If the offer is accepted, transaction takes place: asset and money change hand as stated in the offer. Otherwise, no transaction takes place: no asset and money change hand.

The Bayesian Nash equilibrium of the game described above can be solved by backward induction. In the last stage, the seller holding asset of type θ would accept the price offer p if and only if $p > s_\theta$. Taking this acceptance rule into account, the buyer would evaluate the asset conditional on his offer being accepted and choose a price $p \in \{p_h, p_m, p_l\}$ that maximizes $E[b_\theta | p > s_\theta] - p$. It is clear that the seller's message plays no role in these computations, so the message should be disregarded by the buyer altogether. Consequently, the seller would be indifferent between any of the messages, and the only equilibrium outcome in the communication stage is babbling. The following proposition summarizes the discussion above; a formal proof is omitted as it is trivial.

Proposition 1 (Babbling Prediction)**.** *In the unique Bayesian Nash equilibrium outcome, 1) the seller's message does not depend on the type of asset, and 2) the buyer's price offer does not depend on the messages received.*

2.1 A Model with Lying Cost and Credulity

In this subsection, we discuss a simple model, à la Chen (2011), Kartik et al. (2007), and Kartik (2009), in which partial information transmission could arise as an equilibrium outcome. In the model, a fraction of buyers are not as skeptical as required in Bayesian Nash equilibrium, making it profitable to deceive this group of buyers by over-reporting the asset type. However, because of a lying cost, over-reporting may not be always optimal. The purpose of such a model is to help develop hypotheses on how alcohol consumption could potentially affect communication and trading in the game we study. Therefore, instead of pursuing the most general characterization of equilibria with lying cost and credulous receivers, we make a number of assumptions to keep the model as simple and tractable as possible.

The game is identical to that of the previous subsection, except that some players are assumed to have different payoff functions. Specifically, we assume that each seller has a lying cost λ; she has to bear this cost whenever her report differs from her true asset type.[3] There are two types of buyers: sophisticated and naive. A naive buyer takes the seller's message at face value, whereas a sophisticated buyer understands the sellers' incentives and updates his belief accordingly. Moreover, a sophisticated buyer is assumed to adopt the most pessimistic belief about the asset type following off-path messages. The fraction of naive buyers is denoted by $\chi^* \in [0, 1]$. Finally, we impose the following assumptions on parameters.

[3] That is, the lying cost is constant regardless of how she lies.

Assumption 1.

(a) $p_m < s_h$ and $p_l < s_m$.

(b) $\max\left\{\frac{1}{2}(b_m + b_l) - p_m, \frac{1}{2}(b_h + b_l) - p_h\right\} < \frac{1}{2}(b_l - p_l)$.

Assumption 1(a) states that for $\theta \in \{h, m\}$, it is necessary to offer p_θ in order for a θ-type seller to sell his asset. Assumption 1(b) ensures that a sophisticated buyer is willing to offer only p_l either if he believes that the asset has equal chances of being type-l and type-m, or if it has equal chances of being type-l and type-h. It is straightforward to check that these assumptions on parameters hold in our experimental implementation.

Recall a seller's reporting strategy is a mapping from the set of asset types $\{h, m, l\}$ to the message space M. Denote a seller's belief about the fraction of naive buyers by χ. Given a belief χ, we say a seller's reporting strategy σ is *consistent* if it is optimal for the seller, given that the buyer plays a best-response to σ. Note that a consistent reporting strategy is an equilibrium strategy if the seller's belief χ coincides with the actual fraction χ^* of naive buyers. To allow for the possibility that one's belief system is influenced by external factors (such as alcohol consumption and information about trading partner's beverages), the notion of consistent strategy allows the seller's belief χ to differ from the true fraction χ^*.

The following two observations are immediate. First, as $p_m < s_h$, a h-type seller would always report "High" because any other message necessarily gives her a negative payoff (due to the lying cost). Second, a m-type and a l-type seller only lie by reporting "High", if they decide to lie at all. The reason is that a "High" message allows them to get a strictly more favorable offer from the naive buyers, and a weakly more favorable offer from the sophisticated buyers (as a h-type seller always reports "High").

Using the observations above, the proposition below characterizes the seller's consistent reporting strategy for all combinations of λ and χ.

Proposition 2. *The seller's consistent reporting strategy depends on (λ, χ) as follows.*

(i) If $\lambda \geq p_h - p_l$, then all types of seller report truthfully.

(ii) If $\lambda \in [\chi(p_h - p_l), p_h - p_l]$, then only l-type seller lies with a positive probability.[4]

(iii) If $\lambda \in (\chi(p_h - p_m), \chi(p_h - p_l)]$, then only l-type seller lies (with certainty).

(iv) If $\lambda \in [\chi(p_h - s_m) - (p_m - s_m), \chi(p_h - p_m)]$, there are two consistent strategies:

(a) only l-type seller lies (with certainty);

[4] The probability is constant at $\frac{1}{5}$ under our parameter configurations (described in the next section).

(b) both l-type and m-type lie (with certainty).

(v) If $\lambda < \chi(p_h - s_m) - (p_m - s_m)$, then both l-type and m-type sellers lie (with certainty).

The proof of the proposition is presented in Appendix A. The proposition states that a lower values of λ and a higher value of χ are associated with more lying. This result is intuitive. When a seller decides whether to lie or not, she tradeoffs the constant lying cost against the benefit of soliciting a favorable offer from the naive buyers. A low lying cost and a large proportion of naive buyers therefore favor lying.

Recall a buyer's strategy is a mapping from the received messages to price offers. A naive buyer simply offers p_θ after receiving message θ. A sophisticated buyer forms belief about the seller's reporting strategy, using his belief about the seller's lying cost, denoted by δ, as well as his (second-order) belief about the seller's belief on the fraction of naive buyers, denoted by q. We require the sophisticated buyers to play an offer strategy consistent with his belief (δ, q). Specifically, given his belief (δ, q), a sophisticated buyer uses Proposition 2 to deduce the seller's unique consistent reporting strategy and play a best response to it. Note that a consistent offer strategy is an equilibrium strategy if the sophisticated buyer's beliefs are correct, i.e., $\delta = \lambda$ and $q = \chi^*$. Similar to the discussion of the seller's reporting strategy, the notion of a consistent offer strategy allows the buyer to entertain beliefs different from the truth (i.e., $\delta \neq \lambda$ and $q \neq \chi^*$), in order to incorporate the possibility that the buyer's belief system is influenced by external factors we studied in the experiments.

Corollary 1. *The sophisticated buyer's consistent offer strategy depends on (δ, q) as follows.*

(i) If $\delta \geq p_h - p_l$, then the buyer completely believes the seller's messages.

(ii) If $\delta \in (q(p_h - s_m) - (p_m - s_m), p_h - p_l)$, then the buyer partially discounts the seller's messages.

(iii) If $\delta \leq q(p_h - s_m) - (p_m - s_m)$, then the buyer completely discards the seller's messages.

The corollary predicts that the sophisticated buyer puts more trust on the seller's messages if he believes that she has a high lying cost and that she believes the fraction of naive buyers is small.

3 Experimental Design, Hypotheses, and Procedure

3.1 Design and Hypotheses

In our experiment implementation, we adopt the following parameters (in units of experiment points): The buyer is initially endowed with 400 experiment points. With these parameters, it

Buyer's value			Seller's value			Price offer		
b_h	b_m	b_l	s_h	s_m	s_l	p_h	p_m	p_l
750	450	250	450	200	0	650	400	150

Table 1: Experimental Parameters

can be shown that there is a unique Bayesian Nash equilibrium outcome in the bargaining stage: the buyer offers p_l, and the seller accepts if and only if the asset is low-type.

In our experiments, subjects are given and asked to consume their alcoholic drinks at the beginning of the experiment. There are two types of drinks: high-alcohol-content (11% alcohol-by-volume) and low-alcohol-content (1% alcohol-by-volume). We are primarily interested in how alcohol consumption affects people's communication and trading behaviors. Also, knowledge of the alcohol content consumed by the trading partner can potentially change players' belief about their truthfulness and consequently their decisions. We thus have two experimental variables in our experimental design. The first experimental variable is the alcohol content of each party. All possible combinations result in our four primary treatments as presented in Table 2(a). For instance, Treatment *LL* has both buyers and sellers consuming the low-alcohol-content drinks.

		Buyer	
	Alcohol Content	Low (1%)	High (11%)
Seller	Low (1%)	*LL*	*LH*
	High (11%)	*HL*	*HH*

(a) Four Main Treatments

		Buyer	
	Alcohol Content	Low (1%)	High (11%)
Seller	Low (1%)	N/A	*LH-I*
	High (11%)	*HL-I*	N/A

(b) Two Information Treatments

Table 2: Experimental Treatments

Our second experimental variable is whether or not a player is *informed* about the alcohol contents consumed by the players. In our four main treatments, subjects are informed of neither the alcohol content of their drinks nor that of their trading partners' drinks. In the two additional information treatments, *HL-I* and *LH-I* as presented in Table 2(b), in contrast, subjects are informed about both the alcohol content of their drinks and that of their trading partners' drinks.

We now discuss our hypotheses. As mentioned in the introduction, the conventional wisdom seems to suggest that people are more truthful after alcohol consumption. Therefore, our first hypothesis is that alcohol consumption makes the sellers more truthful in their reporting of asset type. There are two possible channels through which alcohol influence sellers' reporting behavior. The direct channel is that alcohol consumption raises the sellers' lying cost λ, whereas the indirect channel is that it lowers their beliefs χ about the fraction of naive buyers. According to Proposition 2, an increase in λ and/or a decrease in χ would weakly shrink the set of seller types who lie and/or induce less intensive lying.

Hypothesis 1 (Null Hypothesis on the Effect of Drinking on Sellers' Messages)**.** *Sellers under the influence of alcohol are more prone to truthful reporting.*

On the other hand, alcohol consumption has been shown to lower peoples' inhibitory control over inappropriate and immoral behaviors (see, for example, Steele and Southwick (1985), Denton and Krebs (1990), and MacDonald et al. (1995)). Therefore, an alternative hypothesis is that sellers become less morally restrained in truthfully reporting their asset type, leading to more lying. This can be modelled as a reduction in lying cost λ. Similar to the null hypothesis above, it is also possible that alcohol consumption affects sellers' belief about the likelihood that the buyer is naive. According to Proposition 2, a decrease in λ and/or an increase in χ can lead to less truthful messages by the senders. Thus, we have the following alternative hypothesis regarding the effect of drinking on sellers' messages.

Hypothesis 2 (Alternative Hypothesis on the Effect of Drinking on Sellers' Messages)**.** *Sellers under the influence of alcohol make less truthful reporting.*

Hypotheses 1 and 2 can be tested by comparing the reporting strategies of sellers in Treatments *HH* and *HL* against Treatments *LH* and *LL*.

Regarding the effect of alcohol consumption on buyers' behavior, we hypothesize that alcohol consumption makes buyers follow the sellers' messages more closely. There are again two channels through which this effect can occur. First, alcohol consumption can directly increase the naivety of the buyers, i.e., χ^* goes up. Second, it may increase buyers' estimate of the sellers' lying cost q, thus indirectly inducing more trust on sellers' messages. These two effects together generate the following hypothesis.

Hypothesis 3 (Null Hypothesis on the Effect of Drinking on Buyers' Offers)**.** *Buyers under the influence of alcohol are more prone to taking the sellers' messages at face value.*

Hypothesis 3 can be tested by comparing the offer strategies of buyers in Treatments *HH* and *LH* against Treatments *HL* and *LL* respectively.

In the hypotheses above, both a direct and an indirect channel could be at work to deliver the hypothesized effects. We are interested in determining which channel plays a more important role in shaping traders' behaviors. Consider first alcohol's effect on sellers' reporting behaviour. If the indirect channel of beliefs plays a more prominent role, we would expect that factors that directly affect sellers' beliefs would have a significant impact on their reporting strategies. In particular, it is plausible that sellers hold the belief that buyers are more likely to be naive when they are under the influence of alcohol (as in Hypothesis 3). Therefore, if sellers are *informed* that buyers are under the influence, they have a higher value of χ and find it more profitable to inflate their messages (recall Proposition 2).

Hypothesis 4 (Null Hypothesis on the Effect of Information on Sellers' Messages)**.** *If a seller is informed that the buyer is under the influence of alcohol, she is more likely to lie.*

Hypothesis 4 can be tested as follows. It is natural to expect that in the main (no-information) treatments, subjects assume that the other side are given the same beverage, and thus they infer the level of intoxication of the trading partners by introspection. Therefore, comparing Treatment *HL* and Treatment *HL-I*, Hypothesis 4 predicts that sellers lie more in Treatment *HL*. Similarly, comparing Treatment *LH* and Treatment *LH-I*, it predicts that sellers lie more in Treatment *LH-I*.

Next consider alcohol's effect on buyers' offer behaviour. Again if the indirect channel of beliefs play a prominent role in shaping buyers' offer behaviour, we would expect that factors that directly affect their beliefs would have a significant impact on the offers they make. In particular, it is plausible that buyers have the perception that people are more truthful under the influence of alcohol (as the conventional wisdom goes). This implies an increase in δ, and according to Corollary 1, they are willing to put more trust on sellers' messages. Consequently, we hypothesize that if a buyer is informed the seller is intoxicated, he is willing to make more generous offers following each message.

Hypothesis 5 (Null Hypothesis on the Effect of Information on Buyers' Offers)**.** *If a buyer is informed that the seller is under the influence of alcohol, he is more likely to make higher price offer.*

Similar to Hypothesis 4 above, Hypothesis 5 can be tested by comparing treatments that differ in the information on alcohol content offered to subjects. It predicts that buyers follow sellers' messages more closely in Treatment *HL-I* than in Treatment *HL*. Similarly, they follow sellers' messages more closely in Treatment *LH* than in Treatment *LH-I*.

3.2 Experimental Procedure

Our experiment was conducted at Nanyang Technological University (Singapore) in English and Southwestern University of Finance and Economics (China) in Mandarin Chinese.[5] A total of 312 subjects who were above 21 years old (at the time of the experiment) with no prior experience in these experiments were recruited from the undergraduate/graduate population of these two universities to participate in 18 experimental sessions, three per each treatment.[6,7] A between-subjects design was used, and each session involved 14-20 subjects making decisions in 7-10 pairs. The experiment was programmed and conducted using z-Tree (Fischbacher, 2007).

We illustrate the instructions for Treatment *HL-I*. The experiment consisted of four stages. Upon arrival at the lab, subjects were instructed to sit at separate computer terminals. Each was given a copy of the experimental instructions for stage 1 at the beginning of a session and was told that the instructions for stages 2-4 would be provided on the screen before each of those stages (see Appendix A). Instructions for the stage 1 were read aloud and supplemented by slide illustrations. We then asked subjects to drink one cup of alcoholic beverage (~200ml) in 6 minutes. There were two types of beverage: high alcohol content (about 11%) and low alcohol content (about 1%). We randomly selected half of the subjects to drink each type of beverage.

Stage 1 - Communication Game: At the beginning of this stage, those participants who had drunk the high-alcohol-content beverage were assigned to the role of Member A, and those participants who had drunk the low-alcohol-content beverage were assigned to the role of Member B. The roles were fixed throughout this stage of the experiment. Subjects were randomly paired in each round and played 10 rounds of decision making.

In each round, Member A was endowed with an asset K, whereas Member B was endowed with 400 experimental points. The asset K could be low, medium, or high type. At the beginning of each round, the computer randomly selected, with equal chances, the type of the asset, which was revealed only to Member A. Member A then chose what message about the type of the asset to send to Member B among four available messages: "High", "Medium", "Low", and "Not Reveal." After observing the message from Member A, Member B made an offer to buy the asset K among three available offers: 150 Points, 400 Points, and 650 Points. Member A then decided whether to accept or reject the offer. If Member A rejected the offer from Member B, then Member A retained the asset K and no transaction took place. Otherwise, Member

[5] Appendix A presents the English version of the experimental instructions that were used to conduct experiments in Nanyang Technological University. The authors translated the Chinese text of the instructions used in Southwestern University of Finance and Economics.

[6] All information treatments and one session for each of the main treatments were conducted at Nanyang Technological University. Two sessions for each of the information treatments were conducted at Southwestern University of Finance and Economics. The total number of participants were 160 in Singapore and 152 in China.

[7] We recruited only subjects aged 21 or above, and in our recruitment messages, we explicitly stated that the experiment involved a mild to moderate amount of alcohol consumption.

A transferred the asset K to Member B, and Member B paid the offered amount of points to Member A. If Member A at the end of a stage held the asset with low, medium, and high type, then the asset will be translated into 0 point, 200 points, and 450 points, respectively. If Member B instead held the asset with low, medium, and high type, then the asset will be translated into 250 points, 450 points, and 750 points, respectively.

Before starting the actual rounds, subjects were given a comprehension quiz and a practice round. For the payment from the stage 1, one round was randomly selected at the end of the experiment.

Stage 2 - Dictator Game: At the beginning of this stage, one-half of the participants were randomly assigned the role of Member C, and the other half the role of Member D. The role assignment was independent of that of stage 1. This stage only had 1 round of decision-making. Member C and Member D were randomly paired, and Member C made a split (only with integers) of 100 points as "[_____] points for me and [_____] points for Member D". The split made by Member C was revealed to Member D, and 100 points were divided accordingly. Member D thus had no decision to make.

Stage 3 - Guessing Game: In this stage, each subject simultaneously and independently chose an integer number between 0 and 100 inclusively. The computer then calculated the average of the numbers chosen by all subjects. The participant whose number choice was closest to the 2/3 of the average was declared the winner, and awarded 100 points. In the case of a tie, the prize of 100 points was shared equally among the joint winners.

Stage 4 - Risk-attitude Elicitation: In this stage, we presented a table with 12 rows for each subject where each row contained a decision between two options. The first option was to receive 100 points with certainty. The second option was a lottery between 140 points and 60 points. The chance to have 140 points in the second option was strictly increasing in the row number. We randomly selected one of the 12 rows and paid according to the choice made by a subject.

After all stages were concluded but before we paid the subjects, we tested their blood alcohol contents using the *BACTRACK S80* breathalyzers. We suggested subjects to leave the lab only if their blood alcohol contents fell below the legal limit for driving - 0.02% in China and 0.08% in Singapore.

The final cash payment to each subject was the sum of his/her earnings from all four stages, plus a show-up fee. For the sessions conducted in Singapore, we offered a show-up payment of SGD5, and used an exchange rate of 35 points = 1 SGD. For the sessions conducted in China, we offered a show-up payment of CNY10, and used an exchange rate of 10 points = 1 CNY. The average payments were SGD21.7 (≈ USD16.3) in Singapore with the payment range of [SGD10, SGD40], and CNY65.03 (≈ USD10.27) in China with the payment range of

[CNY20.08, CNY128.16].[8] The sessions lasted for 80 minutes on average, including 15 minutes for experimental instructions, 6 minutes for waiting time after alcohol consumption, 40 minutes for one practice round followed by ten official rounds of communication-trading games, the rest of stages 2-4 and the breath test.

4 Experimental Results

In this section, we report our experimental results. In the Section 4.1, we report treatment-level data aggregated across all three sessions and all ten rounds of the communication-trading game.[9] We provide evidence that sellers' messages are informative and buyers' offers are dependent on the messages received. We further present glimpses of some treatment effects regarding the role of higher alcohol contents and the role of publicly available information about the alcohol contents. We then report the treatment-level data from the Guessing Game, Dictator Game, and Risk-attitude Elicitation in Section 4.2, and show that the overall behaviors observed do not vary across treatments. This result suggests that the observed treatment effects in the communication game cannot be attributed to the potential influence of alcohol on individual's bounded-rationality, degree of other-regarding preferences, and risk-attitudes. All statistical analyses and regression results will be presented in Section 4.3.

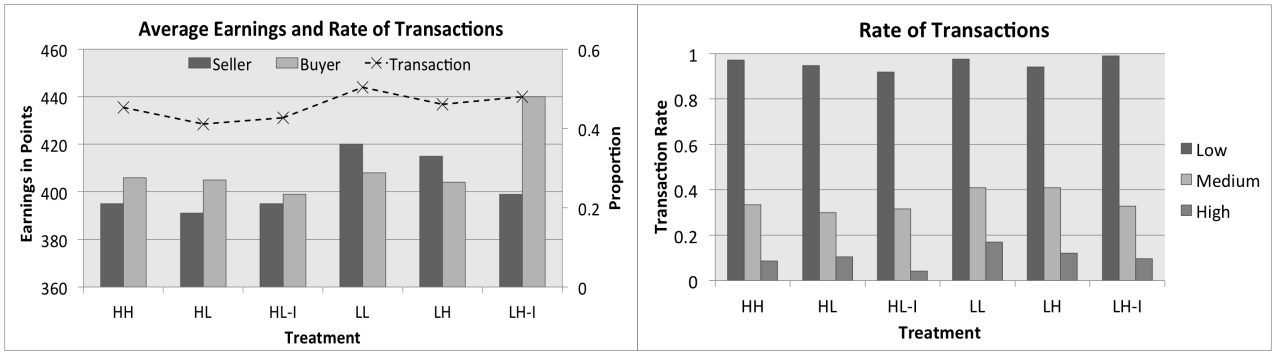
4.1 Communication-Trading Game

Figure 1(a) reports the average earning and the average rate of transactions for each treatment aggregated across all three sessions and all ten rounds of decision-making. Two observations are immediately apparent. First, in all treatments, the average earnings of the sellers (390-420 points) are substantially higher than the theoretical prediction of 267 points. The same observation is valid for the buyers even if the difference is of smaller magnitudes (reported average value of 433.3 points vs. theoretical prediction of 410 points). Second, the average transaction rates observed in the lab (> 41%) are consistently and substantially higher than the theoretical prediction of 33%.

According to Proposition 1, the lemon market nature of our communication-trading game

[8] A typical meal (including a cup of tea or soft drink) in the university canteens in Nanyang Technological University and Southwestern University of Finance and Economics costs SGD6 (≈ USD4.5) and CNY10 (≈ USD1.58), respectively. Thus, the difference in the average payments between the two places is a reflection of the difference in purchasing power across the two countries.

[9] In reporting the aggregate level data, we pooled the data from two different countries. Even if we are aware of the fact that average alcohol consumptions and social norms associated with drinking in China and Singapore are not the same, the country does not affect the treatment effects if there exists any. In our regression analysis reported in the later subjections, we controlled for the country effects.



(a) Average Earnings and Rate of Transactions (b) Rate of Transactions | Asset Type

Figure 1: Experimental Outcomes

generates the prediction of adverse selection and market failure, i.e., transactions only occur when the asset type is low. Figure 1(b) presents a sharp contrast. First, in line with the theoretical prediction, the transaction rate is close to 100% when the asset type is low. When the asset type is medium, however, the average transaction rate is between 30% and 41%, which are substantially higher than the theoretical prediction of 0%. Even when the asset type is high, the rate is strictly positive (> 4%) in all treatments and sometimes reaches 17% (in Treatment *LL*). This higher transaction rates observed in all treatments are the main source of the higher earnings reported in Figure 1(a) and contribute more to increase the earnings of the sellers than to increase the earnings of the buyers.[10] These results are summarized as follows:

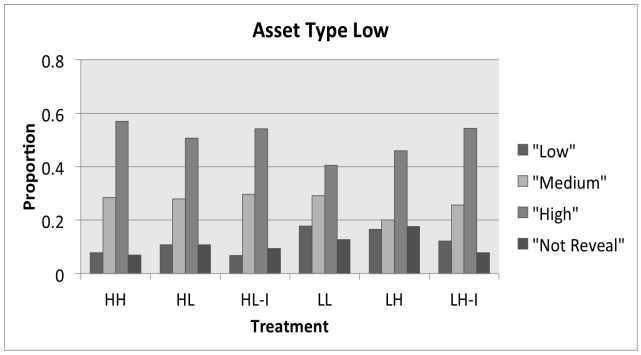
Observation 1. *Observed transaction rates and average earnings in the laboratory are substantially higher than the predicted levels of the unique babbling equilibrium outcome.*

Two additional results are worth reporting. First, both sellers' and buyers' payoffs are consistently lower in the treatments in which the sellers are under the influence of higher alcohol content (Treatments *HH*, *HL*, and *HL-I*) than in the treatments in which they are under no such control (Treatments *LL*, *LH*, and *LH-I*). One can identify the same finding from the transaction rates reported in Figure 1(b). Second, the public information about the asymmetry of the alcohol contents between sellers and buyers help the players under the influence of high alcohol contents increase their earnings. The average earning of the buyers is 14 points higher than that of the sellers in Treatment *HL*, but the difference becomes only 4 points in Treatment *HL-I*. The average earning of the buyers is 11 points lower than that of the sellers in Treatment *LH*, but the ranking is reversed with a substantial margin of 41 points in Treatment *LH-I*.

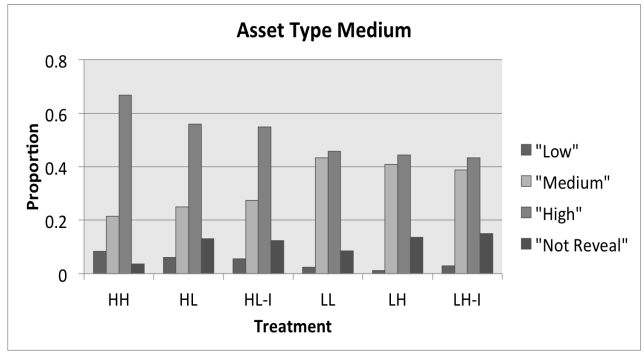
Observation 2. *The average earnings of sellers and buyers, as well as the average transaction rates, are consistently lower when the sellers are under the influence of high alcohol contents than*

[10]The sellers could make two different types of mistakes. The first type is to accept an offer that they should not, and the second type is to reject an offer that they should accept. In our data, the sellers made very few mistakes (< 3%) of the first type and no mistake of the second type.

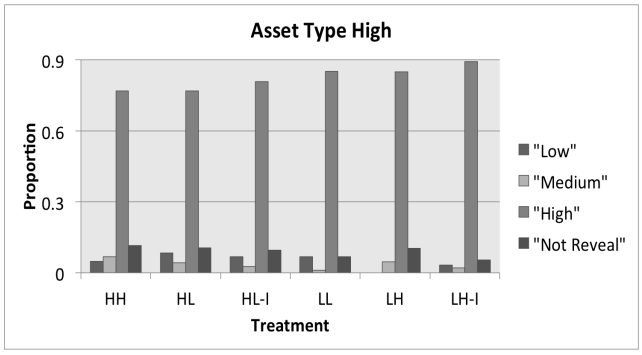
when they are under no influence. The public availability of information about the asymmetry between the alcohol contents of sellers' and buyers' drinks increases the average earnings of the players who are under the influence of high alcohol contents.



(a) Asset Type Low



(b) Asset Type Medium



(c) Asset Type High

Figure 2: Frequencies of Messages Conditional On Asset Type

We now report the sellers' and the buyers' behaviors separately. Figure 2 presents sellers' messages conditional on asset types, aggregated across all ten rounds of all three sessions. The first three treatments in each bar-chart are those with the sellers under the influence of high alcohol contents while the last three treatments are those with the sellers under the influence of low alcohol contents. A few observations emerge. First, the proportion of message "High" is highest in all treatments, and the proportion of message "Low" is almost always the lowest. Second, the message "Not Reveal" is not frequently used (on average 10%) and never reaches 18%. Third, it is evident that, inconsistent with the babbling prediction, the messages are informative. Figure 2(c) reports that when the asset type is High, the proportion of message "High" is consistently over 77% and sometimes reaches 89% (in Treatment *LH-I*). The proportion decreases to 43%-67% when the asset type is Medium (Figure 2(b)) and to 40%-57% when the asset type is Low (Figure 2(a)). The message "Medium" is rarely sent when the asset type is High (<6%) but is used significantly more frequently when the asset type is Medium (21%-43%). When the asset type is Medium, in particular, there is almost no difference between the

proportions of message "High" and that of message "Medium" in Treatments *LL*, *LH* and *LH-I* (on average 44% vs. 41%). When the asset type is Low, a non-negligible proportion of sellers (7%-18%) send the message "Low".

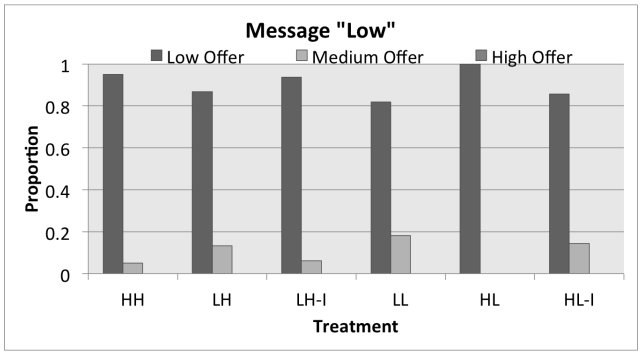
The messages become more informative when the sellers are *not* under the influence of high alcohol contents. When the asset type is Medium, the proportions of message "Medium" in the three treatments with the sellers under the influence of high alcohol contents are substantially lower than those in the three other treatments (on average 25% vs. 41%), and the proportion of message "High" in the three treatments with the sellers under the influence are substantially higher than those in the three other treatments (on average 58% vs. 44%). Similarly, when the asset type is Low, the proportion of sellers sending the message "Low" is consistently lower when the sellers are under the influence of high alcohol content than when they are not (7%-11% vs. 12%-18%). When the asset type is High, the proportion of sellers sending message "High" is 77%-81% when the sellers are under the influence of high alcohol contents while the proportion is substantially higher (85%-89%) when the sellers are not. These observations are in line with our Hypothesis 2 that sellers under the influence of alcohol make less truthful reporting. Summarizing these results, we establish the following observation.

Observation 3. *Observed messages in the laboratory are informative. However, the messages become less informative when the sellers are under the influence of high alcohol contents than when they are not under such influence.*

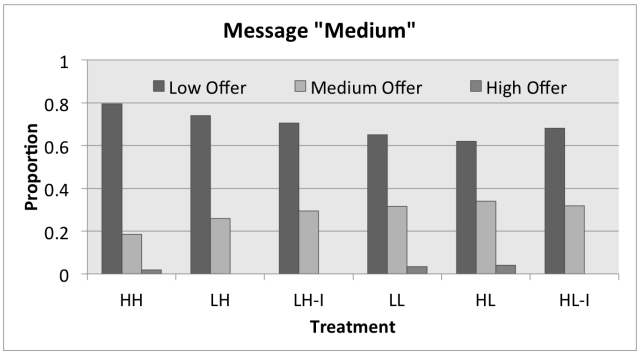
We now consider the effect of the public availability of information about the alcohol contents. The proportions of message "High" conditional on the asset type being Low and the asset type being High are slightly higher in Treatment *HL-I* than in Treatment *HL*. However, the public availability of information does not change the overall shape of the sellers' message choices when they are under the influence of high alcohol contents. On the other hand, when the buyers are under the influence, the proportions of message "High" conditional on the asset type being Low and the asset type being High are more substantially higher. But again, the overall shape of the sellers' message choices does not vary with the availability of information. This observation is inconsistent with our Hypothesis 4 that sellers lie more when she is informed that the buyer is under the influence of alcohol.

Observation 4. *The sellers' choices of messages do not vary depending on whether the information about the alcohol contents is publicly available or not.*

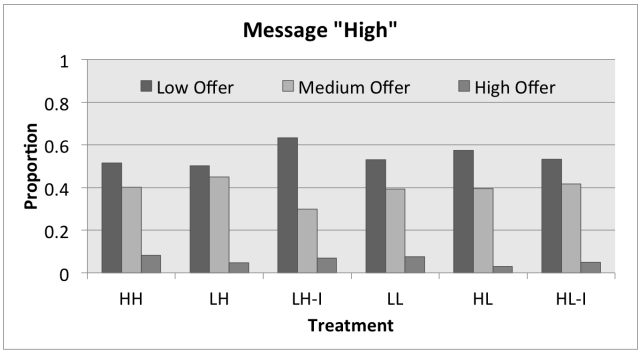
Figure 3 presents buyers' offers conditional on the messages received, aggregated across all ten rounds of all three sessions. The first three treatments in each bar-chart are those with the buyers under the influence of higher alcohol contents, and the last three treatments are those with the buyers under the influence of low alcohol contents. It is immediately clear that buyers'



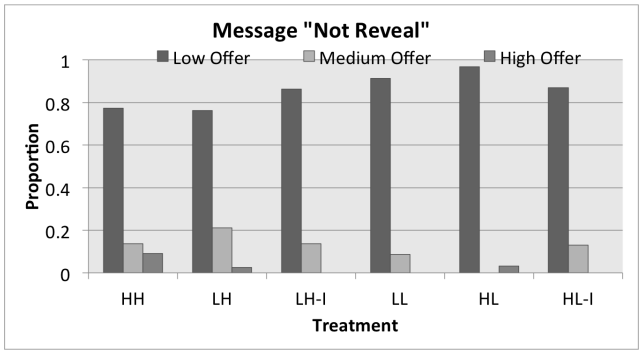
(a) Message "Low" (7%)



(b) Message "Medium" (21%)



(c) Message "High" (62%)



(d) Message "Not Reveal" (10%)

Figure 3: Frequencies of Offers Conditional On Messages

offers, to a large extent, depend on the messages they received. The proportions of Low offers are highest conditional on the message "Low" (86%-100%) while the proportions are lowest when the messages are "High" (50%-65%). The proportions of Medium offers are consistently higher when the messages are either "Medium" (19%-34%) or "High" (30%-45%) than when the messages are "Low" (0%-18%). The proportions of High offers are 0% when the received messages are "Low" and almost always 0% when the messages are "Medium" while the proportions become strictly positive (3%-8%) in all treatments when the received messages are "High".

The effect of alcohol on the buyers' offers depends on the messages they received. For example, the proportions of Medium offers conditional on the message "Medium" are consistently lower when the buyers are under the influence (19%-29%) than when they are not (32%-34%). The proportions of Low offers conditional on the message "Not Reveal" are consistently lower when the buyers are under the influence (76%-86%) than when they are not (87%-97%). However, it is appropriate to pay more attention to the contingency that the message "High" is received, which covers 62% of the data. In this case, in line with our Hypothesis 3, the proportions of Low (High) offers in Treatment *HL* are 57.5% (3.0%), substantially higher (lower) than 51.5% (8.3%) in Treatment *HH*. Similarly, upon receiving the message "High", the proportions of Low

(Medium) offers are 53.1% (39.3%) in Treatment *LL*, substantially higher (lower) than 50.3% (45%) in Treatment *LH*. These observations show that buyers under the influence of high alcohol contents make higher offers on average.

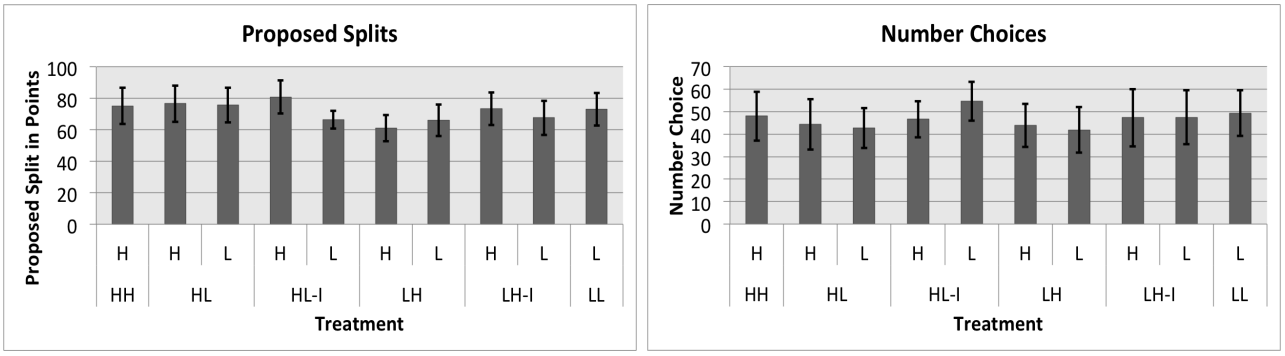
Observation 5. *Observed offers by buyers in the laboratory depend on the messages they received. Conditional on receiving message "High", buyers who are under the influence make the Low offer less frequently than those who are not under the influence.*

The effect of information about the alcohol contents on the buyers' offer choices seems to be insignificant. Upon receiving a message "High", the proportion of High offers does not vary significantly between Treatment *HL-I* and Treatment *HL*. Similarly, the proportion of High offers does not vary significantly between Treatment *LH-I* and Treatment *LH*. These observations are not supportive of our Hypothesis 5.

Observation 6. *The public availability of information about alcohol contents does not alter buyers' offer behaviors.*

4.2 Dictator Game, Guessing Game, and Risk Attitude

Is it possible that the treatment effects reported in the previous subsection are direct consequences of the influence of alcohol on individual's other-regarding preference, degree of bounded rationality, and attitudes toward risk? In this subsection, we report the aggregate-level data from Dictator Game, Guessing Game, and belief elicitations, which show that these factors do not play a significant role in shaping individuals' behaviors.



(a) Proposed Splits in Dictator Game (b) Number Choices in Guessing Game

Note: The error bars indicate 1 standard deviation.

Figure 4: Experimental Outcomes - Dictator Game and Guessing Game

Dictator Game: Figure 4(a) reports the average split proposal observed in the Dictator Game for each drinking category (H: High alcohol contents; L: Low alcohol contents) in each treatment.

There is no systematic evidence that drinking affects the split proposals in this game. For example, the average proposal from individuals under the influence of high alcohol contents is only insignificantly higher than that from those who are not under the influence in Treatments *HL-I* and *LH-I*. Moreover, the ranking is reversed in Treatment *LH*. The average split proposals are essentially the same between Treatment *HH* and Treatment *LL*. For almost all treatments, the non-parametric Mann-Whitney tests reveal that, we cannot reject the null hypothesis that, within a treatment, the split proposals made by participants under the influence of high alcohol contents are the same as those made by participants under no such influence (with the lowest p-value = 0.4880).[11] One marginal case is Treatment *HL-I* in which the null hypothesis is rejected with p-value 0.09. Similarly, regarding the between-treatment comparison, we cannot reject the null hypothesis that the split proposals observed in Treatment *LL* are the same as the split proposals observed in Treatment *HH* (Mann-Whitney test, p-value = 0.8721).[12]

Guessing Game: Figure 4(b) reports the average number choices observed in the Guessing Game for each drinking category in each treatment. Again, there is no systematic evidence that drinking influences the number choices. The average number choices from individuals under the influence of high alcohol contents seem to be slightly higher than that from those who are not under the influence in Treatments *HL*, *LH* and *LH-I*. However, the differences are neither substantial in magnitudes nor statistically significant. Moreover, the ranking becomes reversed in Treatment *HL-I*. The average number choices are essentially the same in Treatment *HH* and in Treatment *LL*. Confirming this observation, the non-parametric Mann-Whitney tests show that we cannot reject the null hypothesis that, within a treatment, the number choices made by participants under the influence of high alcohol contents are the same as those made by participants under no such influence in all treatments with no exception (the lowest p-value = 0.1019). Regarding the between-treatment comparison, we again cannot reject the null hypothesis that the number choices observed in Treatment *LL* are the same as those observed in Treatment *HH* (Mann-Whitney test, p-value = 0.9483).

Risk-attitude: Figure 5 reports the result from the elicitation of participants' risk attitudes. There seem substantial variations in the empirical distributions of risk-attitudes across treatments. However, no evidence is found that drinking systematically influences individuals' attitudes toward risk.[13] On one hand, the between-treatment comparison reveals that the proportions of risk-averse individuals are smaller in Treatment *HH* than in Treatment *LL* (54% vs. 64%). Similarly, the within-treatment comparison shows that the proportion of risk-averse

[11] All Mann-Whitney tests reported in this section are two-sided.

[12] On the other hand, Corazzini et al. (2015) find lab evidence for a negative relationship between the blood alcohol concentration and the amount of money donated to NGOs.

[13] This result is consistent with the finding from Corazzini et al. (2015) who experimentally investigate the causal effects of alcohol consumption on risk preferences, time perception and altruism. They do not find any effect of alcohol in depleting subjects' risk tolerance.

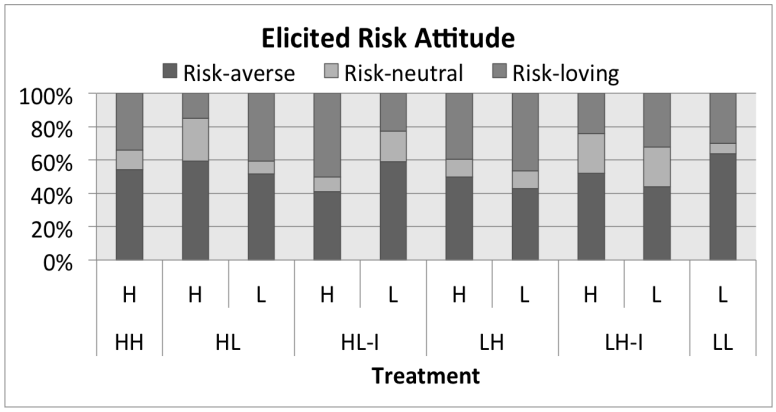


Figure 5: Experimental Outcomes - Risk Attitudes

individuals among those under the influence of high alcohol contents is smaller than the proportion of risk-averse individuals among those under no such influence in Treatment *HL-I* (41% vs. 59%). On the other hand, all other within-treatment comparisons show that the proportion of risk-averse individuals among those under the influence of high alcohol contents is larger than the proportion of risk-averse individuals among those under no such influence in Treatment *HL-I*. The Mann-Whitney test, conducted with the average proportions of risk-averse individuals for each drinking category in each treatment as an independent observation, reveals that we cannot reject the null hypothesis that the proportion of risk-averse individuals among those who are under the influence of high alcohol contents is the same as that among the individuals who are not under the influence (p-value = 0.9168). Similarly, we cannot reject the null hypothesis that the proportion of risk-loving individuals among those who are under the influence of high alcohol contents is the same as that among the individuals who are not under the influence (p-value = 0.9168).

4.3 Estimating Treatment Effects

In this subsection, we report results from regression analyses that estimate the treatment effects in the communication-trading game, controlling for a multitude of factors such as measures of subjects' social preference, degree of bounded rationality, and risk attitudes elicited, as well as the period effect. In Section 4.3.1, we analyze how alcohol consumption affects sellers' reporting behavior. In Section 4.3.2, we analyze alcohol's effects on buyers' offers, which reveal how they interpret the sellers' messages they receive. Section 4.3.3 studies how alcohol consumption affects transaction and hence market efficiency. Finally, Section 4.3.4 looks at whether the public availability of information about the alcoholic contents of assigned beverages affect communication behaviors and transaction outcomes. Broadly speaking, we find that our regression results corroborate observations discussed in the previous two subsections.

4.3.1 Impact of alcohol consumption on sellers' reporting behaviors

Table 3 shows the estimated treatment effects with Treatment *LL* as the baseline (i.e., the omitted group). In all specifications, sellers in both Treatments *HH* and *HL* who are under influence lie significantly and substantially more (around 10% or 15%) than those in Treatment *LL*. In contrast, there is no difference between Treatments *LL* and *LH* where the buyers are under influence. In all specifications, all the control variables including period dummies, country fixed effects, measures of social preferences and higher-order rationality have no significant impact on the estimated treatment effects. It appears that 1) participants in China lie significantly less than participants in Singapore and 2) the social preference measure is positively related to lies of sellers.

Table 4: **Pairwise Comparisons**

	(1) Baseline *LL*	(2) Baseline *LH*	(3) Baseline *LL*	(4) Baseline *HL*
Treatment *HL*	0.108**			
	(0.0464)			
Treatment *HH*		0.193***		0.0521
		(0.0429)		(0.0439)
Treatment *LH*			-0.0357	
			(0.0458)	
Participants in China	-0.00206	-0.185***	-0.153***	-0.0498
	(0.0505)	(0.0461)	(0.0504)	(0.0470)
Period = 2	-0.0774	0.00788	-0.00900	-0.0548
	(0.103)	(0.0932)	(0.102)	(0.0963)
Period = 3	0.0531	-0.0941	-0.00217	-0.0413
	(0.102)	(0.0993)	(0.107)	(0.0972)
Period = 4	0.0169	-0.0383	-0.0360	0.0156
	(0.103)	(0.0962)	(0.103)	(0.0982)
Period = 5	-0.00498	-0.0868	-0.0509	-0.0501
	(0.107)	(0.0961)	(0.104)	(0.0999)
Period = 6	-0.0942	-0.181*	-0.104	-0.176*
	(0.103)	(0.0950)	(0.103)	(0.0972)
Period = 7	-0.0257	0.108	-0.000984	0.0802
	(0.103)	(0.0930)	(0.103)	(0.0954)
Period = 8	-0.0617	-0.0918	-0.0516	-0.101
	(0.105)	(0.0976)	(0.106)	(0.0980)
Period = 9	0.0844	-0.0977	-0.0352	0.0145
	(0.104)	(0.0947)	(0.103)	(0.0979)
Period = 10	0.0859	0.0115	0.0433	0.0511
	(0.101)	(0.0970)	(0.103)	(0.0953)
Constant	0.452***	0.589***	0.582***	0.616***
	(0.0853)	(0.0771)	(0.0868)	(0.0773)
Observations	466	510	469	507
R-squared	0.026	0.088	0.027	0.026

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; In all specifications, period 1 is the dummy variable omitted as the baseline period.

Table 3: **Treatment Effect of Alcohol on Seller's Lying**

	(1) Baseline	(2) More Controls	(3) Period Dummies	(4) Last 5 Periods	(5) Preference Controls
Treatment *LH*	-0.0320	-0.0344	-0.0343	-0.0729	-0.0320
	(0.0459)	(0.0455)	(0.0456)	(0.0643)	(0.0460)
Treatment *HL*	0.107**	0.105**	0.105**	0.0777	0.0928*
	(0.0462)	(0.0464)	(0.0465)	(0.0655)	(0.0480)
Treatment *HH*	0.155***	0.154***	0.157***	0.154**	0.147***
	(0.0446)	(0.0445)	(0.0443)	(0.0617)	(0.0444)
Participants in China		-0.0987***	-0.0986***	-0.0999**	-0.107***
		(0.0343)	(0.0343)	(0.0487)	(0.0353)
Period		0.00249			
		(0.00545)			
Period = 2			-0.0330		-0.0344
			(0.0698)		(0.0694)
Period = 3			-0.0229		-0.0278
			(0.0713)		(0.0706)
Period = 4			-0.0108		-0.0113
			(0.0704)		(0.0706)
Period = 5			-0.0512		-0.0565
			(0.0714)		(0.0711)
Period = 6			-0.141**		-0.142**
			(0.0701)		(0.0695)
Period = 7			0.0404	0.182***	0.0385
			(0.0698)	(0.0695)	(0.0685)
Period = 8			-0.0805	0.0589	-0.0790
			(0.0717)	(0.0716)	(0.0712)
Period = 9			-0.00962	0.131*	-0.0111
			(0.0704)	(0.0702)	(0.0698)
Period = 10			0.0475	0.189***	0.0462
			(0.0696)	(0.0697)	(0.0692)
Social Preference					0.00162***
					(0.000454)
Higher-order Rationality					-0.000423
					(0.00103)
Risk Averse					-0.0345
					(0.0479)
Risk Love					0.00393
					(0.0508)
Constant	0.449***	0.506***	0.544***	0.421***	0.490***
	(0.0331)	(0.0510)	(0.0626)	(0.0723)	(0.0792)
Observations	976	976	976	486	976
R-squared	0.024	0.032	0.043	0.058	0.059

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; The baseline treatment is *LL* in which both sellers and buyers drink the beverage with lower-alcohol-contents; In columns (3) and (5), period 1 is omitted as the reference group; in column (4), period 6 is omitted as the reference group.

For robustness, we conduct two pairwise comparisons, one between Treatments *LL* and *HL*, and the other between Treatments *LH* and *HH*. These comparisons allow us to fully identify the effect of alcohol consumption on sellers' reporting behaviors, given the alcohol contents of buyer's beverages. The estimated results are presented in Table 4 where each column has a distinct baseline treatment as specified in the first row of the table. Columns (1) and (2) of Table 4 reveal that sellers lie more under the influence of higher alcohol contents, fixing the alcohol content of buyers' drinks at low and high respectively. However, columns (3) and (4) of the same table show that changing only the alcohol content of buyers' drinks has no effect on sellers' lying behavior. We thus establish the following result:

Result 1. *Sellers under the influence of higher alcohol contents are less truthful than those under no such influence.*

We also analyze sellers' reporting behavior according to different asset types randomly drawn at the beginning of the game. The estimation results are presented in Table 5. Sellers under the influence of high alcohol content lie more for all asset types; interestingly, the proportion of lying is the highest when the asset type is middle. One explanation is the seller might feel more guilty to lie when the asset type is the lowest. The second part of Table 5 shows that subjects are less likely to send the message "Not reveal" when they are under the influence of alcohol.

Table 5: **Sellers' Lying Behavior by Asset Types**

	Baseline: Treatment *LL*			Baseline: Treatment *LH*		
Lie given asset type	Low	Medium	High	Low	Medium	High
Treatment *HL*	0.0835	0.186**	0.0558			
	(0.0630)	(0.0755)	(0.0491)			
Treatment *HH*				0.116**	0.251***	0.0784*
				(0.0560)	(0.0741)	(0.0420)
Constant	0.797***	0.526***	0.0854***	0.800***	0.526***	0.0521**
	(0.0488)	(0.0576)	(0.0310)	(0.0481)	(0.0576)	(0.0228)
Observations	136	163	167	165	157	188
R-squared	0.013	0.037	0.008	0.028	0.070	0.019
	Baseline: Treatment *LL*			Baseline: Treatment *LH*		
Message "Not Reveal" given asset type	Low	Medium	High	Low	Medium	High
Treatment *HL*	-0.0199	0.0457	0.0371			
	(0.0520)	(0.0457)	(0.0416)			
Treatment *HL*				-0.108**	-0.101**	0.0126
				(0.0486)	(0.0421)	(0.0431)
Constant	0.127***	0.0843***	0.0682**	0.176***	0.136***	0.103***
	(0.0377)	(0.0307)	(0.0270)	(0.0416)	(0.0368)	(0.0295)
Observations	154	183	183	187	172	211
R-squared	0.001	0.005	0.004	0.028	0.032	0.000

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; SH and BH refer to sellers and buyers drink high-alcohol beverage respectively; In all specifications, the same set of control variables are used as in previous tables, including period dummies; all those variables have no significant effects on the findings.

In sum, our experimental results support Hypothesis 2. This finding casts doubts over the conventional wisdom that alcohol consumption makes ones more truthful may not be applicable, at least for the mild level of intoxication we induce the subjects.

4.3.2 Impact of alcohol consumption on buyers' offers

In this subsection, we analyze how buyers' offers are affected by alcohol consumption. Table 6 reports results of regression with the dependent variable being the offers buyers make (1 for low offer; 2 for medium offer; and 3 for high offer). Column (5) of Table 6 shows that, given that

sellers are under the influence, buyers make higher offers when they are under the influence of high alcohol contents than when they are not.[14] In contrast, Column (4) of Table 6 presents that, given that sellers are not under the influence, buyers' offers are not significantly different whether they are under the influence of high or low alcohol contents. Column (2) and (3) show, as expected, that the alcohol content of the sellers' drink have no statistically significant effect on buyers' offers.

Table 6: **Treatment Effect of Alcohol on Buyers Offers (Value)**

	(1) Baseline *LL*	(2) Baseline *LL*	(3) Baseline *LH*	(4) Baseline *LL*	(5) Baseline *HL*
Treatment *LH*	-0.00264			-0.00310	
	(0.0503)			(0.0507)	
Treatment *HL*	-0.0636	-0.0657			
	(0.0504)	(0.0503)			
Treatment *HH*	0.0195		0.0209		0.0832*
	(0.0522)		(0.0486)		(0.0491)
Participants in China	0.105***	-0.0227	0.216***	0.0941*	0.116**
	(0.0377)	(0.0567)	(0.0496)	(0.0544)	(0.0526)
Period = 2	-0.0642	-0.0385	-0.0877	-0.113	-0.0179
	(0.0771)	(0.112)	(0.108)	(0.111)	(0.108)
Period = 3	-0.00917	-0.0577	0.0351	-0.0566	0.0357
	(0.0788)	(0.113)	(0.112)	(0.114)	(0.110)
Period = 4	-0.0734	-0.0962	-0.0526	-0.113	-0.0357
	(0.0799)	(0.111)	(0.115)	(0.110)	(0.116)
Period = 5	0	0	0	0.0189	-0.0179
	(0.0823)	(0.122)	(0.112)	(0.118)	(0.115)
Period = 6	-0.0550	-0.0769	-0.0351	-0.0755	-0.0357
	(0.0788)	(0.115)	(0.110)	(0.114)	(0.110)
Period = 7	-0.0183	-0.0192	-0.0175	-0.0377	-0
	(0.0827)	(0.115)	(0.119)	(0.119)	(0.116)
Period = 8	-0.119	-0.0769	-0.158	-0.0943	-0.143
	(0.0791)	(0.121)	(0.104)	(0.120)	(0.105)
Period = 9	-0.0917	-0.0385	-0.140	-0.0943	-0.0893
	(0.0788)	(0.112)	(0.110)	(0.111)	(0.113)
Period = 10	-0.0642	-0.0385	-0.0877	-0.0566	-0.0714
	(0.0802)	(0.115)	(0.113)	(0.115)	(0.113)
Constant	1.406***	1.493***	1.333***	1.427***	1.323***
	(0.0737)	(0.0992)	(0.0905)	(0.101)	(0.0901)
Observations	1,090	520	570	530	560
R-squared	0.014	0.007	0.040	0.011	0.020

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; SH and BH refer to sellers and buyers drink high-alcohol beverage respectively; In all specifications, the same set of control variables are used as in previous tables, including period dummies; all those variables have no significant effects on the findings.

[14]The finding that buyers made higher offers under the influence of alcohol is consistent with Au and Zhang (2016). They find that, after drinking, people become less sensitive to the information content of others' message or action.

Table 7: **Treatment Effect of Alcohol on Buyers Offers (Choice)**

	(1)	(2)	(3)	(4)	(5)	(6)
Offer Choice	2 (vs 1)	2 (vs 1)	3 (vs 1)	3 (vs 1)	3 (vs 2)	3 (vs 2)
Baseline Treatment	LL	HL	LL	HL	LL	HL
Treatment *LH*	-0.0119		-0.0378		-0.0565	
	(0.0602)		(0.0581)		(0.0587)	
Treatment *HH*		0.0488		0.0972**		0.121**
		(0.0551)		(0.0459)		(0.0571)
China	0.0192	0.138**	0.0104	0.0462	-0.0171	-0.0591
	(0.0627)	(0.0579)	(0.0553)	(0.0469)	(0.0611)	(0.0773)
Social Preference	-0.00287***	2.18e-05	-4.26e-05	9.30e-05	0.00118	0.000442
	(0.000822)	(0.000709)	(0.000720)	(0.000587)	(0.00101)	(0.000830)
Higher-order Rationality	-0.00624***	0.00149	-0.00149	-0.000635	0.00212	-0.000479
	(0.00152)	(0.00190)	(0.000922)	(0.00148)	(0.00204)	(0.00168)
Risk Averse	-0.238**	0.164**	0.102*	-0.0133	0.161**	-0.148
	(0.116)	(0.0722)	(0.0573)	(0.0584)	(0.0648)	(0.133)
Risk Loving	-0.324***	0.296***	0.118**	0.0753	0.220***	-0.119
	(0.122)	(0.0813)	(0.0582)	(0.0752)	(0.0808)	(0.145)
Constant	1.062***	0.0572	0.164	-0.0342	-0.0199	0.153
	(0.178)	(0.135)	(0.184)	(0.0831)	(0.184)	(0.168)
Observations	295	340	181	217	152	165
R-squared	0.111	0.086	0.049	0.075	0.084	0.094

Notes: Dependent variable is dummies of offer choice, e.g., 2(1) refers to the choice of offer 2 over offer 1. Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; SH and BH refer to sellers and buyers drink high-alcohol beverage respectively; In all specifications, the same set of control variables are used as in previous tables, including period dummies; all those variables have no significant effects on the findings.

In the regressions reported in Table 7, we restrict our attention to the buyers' offer behavior following a "High" message by the senders. This analysis is relevant because, as mentioned in Section 4.1, about 62% of messages in the whole sample are "High". Note also that the dependent variables are dummy variables indicating the buyers' offer choices. Columns (4) and (6) indicate that buyers are significantly more likely to make high offers (relative to medium and low offers respectively) when they are under the influence of alcohol than when they are not. This finding is consistent with that of Table 6. In sum, we have the following result:

Result 2. *Given that sellers are under the influence of alcohol, buyers make higher offers when they are under the influence of high alcohol content then when they are not.*

This result provides partial support to Hypothesis 3 that buyers are more prone to taking sellers' messages at face value when they are under alcohol's influence.

4.3.3 Consequence of alcohol consumption on market outcomes

Given the finding that sellers under the influence of high alcohol contents tend to be less truthful, one may naturally expect that deals are made less frequently when sellers are under the influence. This expectation turns out to be true as can be seen in the comparison between treatments *HL* and *LL* presented in Column (2) of Table 8.

Table 8: **Treatment Effect on Transaction Rates**

	(1) Baseline *LL*	(2) Baseline *LL*	(3) Baseline *LH*	(4) Baseline *LL*	(5) Baseline *HL*
Treatment *LH*	-0.0430			-0.0438	
	(0.0434)			(0.0435)	
Treatment *HL*	-0.0928**	-0.0942**			
	(0.0435)	(0.0435)			
Treatment *HH*	-0.0348		0.00729		0.0582
	(0.0431)		(0.0418)		(0.0420)
Participants in China	0.00801	-0.0828*	0.0867*	-0.0113	0.0262
	(0.0327)	(0.0476)	(0.0448)	(0.0473)	(0.0452)
Period = 2	-0.101	-0.154	-0.0526	-0.0377	-0.161*
	(0.0672)	(0.0956)	(0.0945)	(0.0975)	(0.0933)
Period = 3	-0.0550	-0.0769	-0.0351	-0.0755	-0.0357
	(0.0683)	(0.0994)	(0.0945)	(0.0983)	(0.0961)
Period = 4	-0.165**	-0.173*	-0.158*	-0.189**	-0.143
	(0.0670)	(0.0968)	(0.0929)	(0.0959)	(0.0947)
Period = 5	-0.101	-0.154	-0.0526	-0.0755	-0.125
	(0.0678)	(0.0978)	(0.0940)	(0.0982)	(0.0947)
Period = 6	-0.110	-0.0962	-0.123	-0.0943	-0.125
	(0.0680)	(0.0988)	(0.0941)	(0.0980)	(0.0957)
Period = 7	0.0183	-0.0385	0.0702	0.0566	-0.0179
	(0.0675)	(0.0968)	(0.0931)	(0.0968)	(0.0951)
Period = 8	-0.128*	-0.173*	-0.0877	-0.170*	-0.0893
	(0.0675)	(0.0958)	(0.0944)	(0.0963)	(0.0952)
Period = 9	-0.0275	0.0192	-0.0702	0	-0.0536
	(0.0678)	(0.0961)	(0.0942)	(0.0972)	(0.0959)
Period = 10	-0.138**	-0.173*	-0.105	-0.0755	-0.196**
	(0.0670)	(0.0954)	(0.0934)	(0.0976)	(0.0927)
Constant	0.579***	0.666***	0.463***	0.578***	0.487***
	(0.0601)	(0.0791)	(0.0761)	(0.0802)	(0.0779)
Observations	1,090	520	570	530	560
R-squared	0.018	0.035	0.022	0.023	0.020

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; In columns (3)-(5), period dummies are omitted if the estimates are insignificant.

Table 9: **Treatment Effect on Transaction Rates Controlling for Asset Types**

	(1) Baseline LL	(2) Baseline LL	(3) Baseline LL	(4) Baseline LH	(5) Baseline LL	(6) Baseline HL
Treatment *LH*	-0.0430	-0.0282			-0.0289	
	(0.0434)	(0.0323)			(0.0325)	
Treatment *HL*	-0.0928**	-0.0701**	-0.0712**			
	(0.0435)	(0.0321)	(0.0321)			
Treatment *HH*	-0.0348	-0.0543*		-0.0271		0.0124
	(0.0431)	(0.0302)		(0.0289)		(0.0291)
Asset Type 2		-0.594***	-0.602***	-0.574***	-0.547***	-0.641***
		(0.0280)	(0.0396)	(0.0403)	(0.0415)	(0.0381)
Asset Type 3		-0.838***	-0.820***	-0.858***	-0.810***	-0.863***
		(0.0199)	(0.0305)	(0.0263)	(0.0303)	(0.0262)
China	0.00801	0.00933	-0.0800**	0.0905***	-0.00899	0.0293
	(0.0327)	(0.0249)	(0.0377)	(0.0332)	(0.0379)	(0.0323)
Constant	0.579***	1.048***	1.104***	0.976***	1.050***	0.970***
	(0.0601)	(0.0470)	(0.0671)	(0.0525)	(0.0665)	(0.0552)
Observations	1,090	1,090	520	570	530	560
R-sqared	0.018	0.504	0.482	0.537	0.464	0.546

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. In all specifications, the same set of control variables are used as in previous tables, including period dummies; all those variables have no significant effects on the findings.

Result 3. *Given that buyers are not under the influence of alcohol, the transaction rate is lower when sellers are under the influence than when sellers are not.*

Column (3) of Table 8 presents a comparison between Treatments *HH* and *LH*, and shows that such difference disappears when buyers are also under the influence of high alcohol contents. One reason is that as reported in Result 2 above, intoxicated buyers tend to make higher offers, thus partially offsetting negative effect of sellers' untruthful behaviors on transaction rates. Note, however, that this effect on its own is not strong enough to generate a systematic difference in transaction rates, as shown by the comparisons presented in Columns (4) and (5) of Table 8. Finally, we check the robustness of these findings by controlling for the asset types in Table 9, and obtain similar results.

4.3.4 Impact of information on communication outcome

In this subsection, we investigate the effect of making public the information about the alcohol contents of the assigned beverages on the communication and transaction outcomes. Table 10 considers the effect of revealing information about alcohol contents of the assigned beverages when sellers are given low-alcohol-content drinks and buyers are given high-alcohol-content drinks. Table 11 considers the effect of information revelation when sellers are given high-alcohol-

content drinks and buyers are given low-alcohol-content drinks. We do not find any significant treatment effect of information revelation on sellers' lying, buyers' offers, or transaction rates.

Table 10: **Comparison between Treatment LH-I and LH**

	(1) lie	(2) lie	(3) offer	(4) offer	(5) deal	(6) deal
Treatment *LH-I*	-0.105	-0.0832	0.0560	0.0391	0.0911	0.0885
	(0.0658)	(0.0704)	(0.0622)	(0.0646)	(0.0602)	(0.0624)
Period = 2		0.216*		-0.0882	0.294**	0.294**
		(0.128)		(0.132)	(0.117)	(0.116)
Period = 3		0.170		-0.176	0.235**	0.235**
		(0.131)		(0.123)	(0.117)	(0.117)
Period = 4		0.0221		-0.118	0	0
		(0.125)		(0.132)	(0.112)	(0.110)
Period = 5		0.152		-0.0294	0.235**	0.235**
		(0.129)		(0.131)	(0.117)	(0.118)
Period = 6		0.0879		0.0294	0.118	0.118
		(0.130)		(0.147)	(0.116)	(0.115)
Period = 7		0.163		0	0.147	0.147
		(0.127)		(0.137)	(0.117)	(0.116)
Period = 8		-0.0879		-0.0294	0.147	0.147
		(0.133)		(0.139)	(0.117)	(0.118)
Period = 9		0.120		-0.0882	0.147	0.147
		(0.129)		(0.141)	(0.117)	(0.115)
Period = 10		0.134		0.0882	0.294**	0.294**
		(0.126)		(0.145)	(0.116)	(0.117)
Social Preference		-0.000817		-0.00351***		-0.000589
		(0.000864)		(0.000958)		(0.000843)
HIgher-order Rationality		-0.00147		-0.00542***		0.00199
		(0.00180)		(0.00144)		(0.00175)
Risk Aversion		-0.0579		-0.0936		0.0691
		(0.0784)		(0.0878)		(0.0743)
Risk Loving		-0.00203		-0.0589		0.0333
		(0.0783)		(0.0999)		(0.0724)
Constant	0.579***	0.558***	1.300***	1.724***	0.227**	0.180
	(0.0568)	(0.131)	(0.0509)	(0.145)	(0.0895)	(0.122)
Observations	304	304	340	340	340	340
R-squared	0.008	0.043	0.002	0.106	0.047	0.054

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

The baseline treatment is *LL* or L that is both sellers and buyers, or only sellers drink lower-alcohol beverage.

Table 11: **Comparison between Treatment HL-I and HL**

	(1) lie	(2) lie	(3) offer	(4) offer	(5) deal	(6) deal
Treatment *HL-I*	0.0536	0.0595	0.0261	0.119	0.00227	-0.0125
	(0.0678)	(0.0891)	(0.0708)	(0.0826)	(0.0643)	(0.0845)
Period = 2		-0.0693		-0.167	-0.267**	-0.267**
		(0.131)		(0.147)	(0.124)	(0.123)
Period = 3		-0.0641		-0.200	-0.0667	-0.0667
		(0.129)		(0.157)	(0.131)	(0.130)
Period = 4		0.125		-0.133	-0.0667	-0.0667
		(0.130)		(0.150)	(0.131)	(0.133)
Period = 5		-0.0877		-0.267*	-0.133	-0.133
		(0.130)		(0.149)	(0.130)	(0.130)
Period = 6		-0.00837		-0.400***	-0.0667	-0.0667
		(0.136)		(0.133)	(0.131)	(0.132)
Period = 7		-0.164		-0.167	-0.100	-0.100
		(0.134)		(0.142)	(0.131)	(0.134)
Period = 8		-0.226*		-0.300**	-0.200	-0.200
		(0.134)		(0.144)	(0.128)	(0.129)
Period = 9		0.0508		-0.167	-0.0667	-0.0667
		(0.133)		(0.148)	(0.131)	(0.128)
Period = 10		0.0595		-0.133	-0.100	-0.100
		(0.129)		(0.140)	(0.131)	(0.127)
Social Preference		0.00162*		0.00102		0.00115
		(0.000903)		(0.000952)		(0.000880)
Higher-order Rationality		0.000164		-0.00114		-0.00151
		(0.00227)		(0.00271)		(0.00219)
Risk Aversion		0.105		0.363***		0.0948
		(0.0880)		(0.0731)		(0.0848)
Risk Loving		-0.0410		0.503***		-0.0133
		(0.103)		(0.0865)		(0.0965)
Constant	0.520***	0.436***	1.387***	1.129***	0.532***	0.472***
	(0.0579)	(0.123)	(0.0601)	(0.141)	(0.104)	(0.124)
Observations	272	272	300	300	300	300
R-squared	0.002	0.070	0.000	0.125	0.022	0.037

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

The baseline treatment is *LL* or L that is both sellers and buyers, or only sellers drink lower-alcohol beverage.

Result 4. *Public availability of information about the alcohol contents of assigned beverages has no significant effect on communication and transaction outcomes.*

In light of the findings discussed above, Hypothesis 4 and 5 are not supported. As the availability of information has a direct impact on affect subjects' beliefs about the sellers' tendency to lie, as well as their beliefs about the buyers' degree of naivety in interpreting received messages, the finding implies that variation in subjects' beliefs does not play a significant role in determining their reporting and offer strategies. Recall that Hypothesis 2 and 3, which are supported by evidence reported in Result 1 and 2 respectively, can be driven by a direct channel (via changes

in lying cost and degree of naivety respectively) and an indirect channel (via changes in beliefs about trading partner's lying cost and degree of naivety respectively). Result 4 therefore suggests that the direct channel is likely to be the main driving force for the results, as variation in subjects' beliefs are insignificant in shaping their behaviors.

5 Concluding Remarks

In this paper, we experimentally investigate the effect of alcohol consumption in an otherwise-standard communication-trading game. Contrary to the folk wisdom, alcohol consumption lead to less truthful communication in our experiments. Moreover, subjects under alcohol's influence are willing to make higher offers, indicating that they are less adept at extracting information content from received messages. We find that these results are mainly driven by the direct channel that alcohol consumption lowers ones' lying cost and degree of sophistication in message interpretation.

There are a number of caveats in interpreting our findings. First, our subjects' level of alcohol intoxication is quite mild (even in the high-alcohol-content treatment) compared to that in actual business settings. It is conceivable that peoples' behavior can be quite different at a (much) higher level of intoxication. Second, the communication game we studied is one of cheap-talk, whereas in real-world settings, communication often involves disclosing verifiable information. As discussed in Section 4.3.1, we find evidence that subjects are less likely to choose "Not reveal" when they are under alcohol's influence. This suggests that alcohol consumption could facilitate communication by increasing peoples' disclosure of (verifiable) information. Testing the validity of this conjecture is an interesting avenue for future study. Finally, we adopt a very simple design in modelling trading by having the buyer making a take-it-or-leave-it offers. Real-world business negotiations could involve more complicated bargaining protocols in which players could, for example, make promises, bluffs, and threats. Our study is silent on alcohol's effects on the implementability and profitability of sophisticated bargaining tactics, which constitute another interesting avenue for future research.

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A Proof of Proposition 2

Proof of Proposition 2: Following the remark prior to the proposition statement, a seller either tells the truth or lies by reporting "High". Thus, there are only four possible consistent reporting strategies:

1. all types report truthfully
2. only l-type seller lies
3. only m-type lies
4. both l- and m-types lie

In our subsequent analysis, we normalize the sellers' payoff with no trade to zero. Note also that under the assumption that buyers assign the most pessimistic belief to off-path messages, a l-type seller's payoff of reporting "Low" is always $p_l - s_l$.

Case 1: All types report truthfully If all types of sellers report truthfully, then both the naive and sophisticated buyers fully believe in the message sent. The respective expected payoff of a m- type and a l-type seller depends on message as follows:

$$\Pi_l(r) = \begin{cases} p_l - s_l & \text{if } r = \text{Low} \\ p_h - s_l - \lambda & \text{if } r = \text{High} \end{cases} \text{ and } \Pi_m(r) = \begin{cases} p_m - s_m & \text{if } r = \text{Medium} \\ p_h - s_m - \lambda & \text{if } r = \text{High} \end{cases}. \tag{1}$$

Both types of seller find it optimal to report truthfully if and only if $\lambda \geq p_h - p_l$. Therefore, truthful reporting is a consistent strategy if and only if $\lambda \geq p_h - p_l$.

Case 2: Only l-type seller lies Suppose m-type seller reports truthfully, but l-type seller lies with probability $\beta \in (0, 1]$. Then the sophisticated buyer offers p_m upon receiving message "Medium". A "High" message may come from a l-type or a h-type seller, and the sophisticated buyer's payoff of offering p_h and p_l are respectively $\frac{1}{1+\beta}b_h + \frac{\beta}{1+\beta}b_l - p_h$ and $\frac{\beta}{1+\beta}(b_l - p_l)$. If $\beta < \frac{b_h - p_h}{p_h - p_l}$, then offering p_h is strictly optimal; if $\beta > \frac{b_h - p_h}{p_h - p_l}$, then offering p_l is strictly optimal. If $\beta = \frac{b_h - p_h}{p_h - p_l}$, then he is indifferent between p_h and p_l. Note that by Assumption (ii), the cutoff $\frac{b_h - p_h}{p_h - p_l}$ is strictly within $(0, 1)$.

If $\beta < \frac{b_h - p_h}{p_h - p_l}$, the respective expected payoff of a m- type and a l-type seller coincide with that in (1). Therefore, the reporting strategy under consideration is consistent if and only if $p_h - p_m \leq \lambda = p_h - p_l$.

Suppose next that $\beta > \frac{b_h - p_h}{p_h - p_l}$. Then a l-type seller's payoff of lying is $\chi(p_h - s_l) + (1-\chi)(p_l - s_l) - \lambda$, whereas the payoff of m-type seller is

$$\Pi_m(r) = \begin{cases} p_m - s_m & \text{if } r = \text{Medium} \\ \chi(p_h - s_m) - \lambda & \text{if } r = \text{High} \end{cases}.$$

Only l-type finds it profitable to lie if and only if $\lambda \in [\chi(p_h - s_m) - (p_m - s_m), \chi(p_h - p_l)]$. Moreover, if $\beta < 1$, then it is necessary that $\lambda = \chi(p_h - p_l)$.

Finally, if $\beta = \frac{b_h - p_h}{p_h - p_l}$, then the buyer is indifferent between offering p_h and p_l. Denote his probability of offering p_h by α. The l-type seller's payoff of lying is thus $\chi(p_h - s_l) + (1-\chi)[(1-\alpha)(p_l - s_l) + \alpha(p_h - s_l)] - \lambda$. The payoff of m-type seller is

$$\Pi_m(r) = \begin{cases} p_m - s_m & \text{if } r = \text{Medium} \\ \chi(p_h - s_m) + (1-\chi)\alpha(p_h - s_m) - \lambda & \text{if } r = \text{High} \end{cases}.$$

A l-type seller is willing to randomize between lying and truth-telling if and only if $\alpha = \frac{1}{1-\chi}\left(\frac{\lambda}{p_h - p_l} - \chi\right)$. At this α, it is straightforward that m-type seller finds truth-telling optimal. Moreover, $\alpha \in (0,1)$ if and only if $\lambda \in (\chi(p_h - p_l), p_h - p_l)$.

In sum, if $\lambda \in [\chi(p_h - p_l), p_h - p_l]$, then it is a consistent strategy for l-type seller to randomize between "High" and "Low", and m-type seller to report truthfully. If $\lambda \in [\chi(p_h - s_m) - (p_m - s_m), \chi(p_h - p_l)]$, then it is a consistent strategy for l-type seller to lie with certainty, and for m-type seller to report truthfully.

Case 3: Only m-type seller lies Suppose l-type seller reports truthfully, but m-type seller lies with probability $\beta \in (0,1]$. Then the sophisticated buyer offers p_l upon message "Low". A "High" message may come from a m-type or a h-type seller, and the sophisticated buyer's payoff of offering p_h and p_m are respectively $\frac{1}{1+\beta}b_h + \frac{\beta}{1+\beta}b_m - p_h$ and $\frac{\beta}{1+\beta}(b_m - p_m)$. If $\beta < \frac{b_h - p_h}{p_h - p_m}$, then offering p_h is strictly optimal; if $\beta > \frac{b_h - p_h}{p_h - p_m}$, then offering p_l is strictly optimal. If $\beta = \frac{b_h - p_h}{p_h - p_m}$, then he is indifferent between p_h and p_m. Note that by Assumption (ii), the cutoff $\frac{b_h - p_h}{p_h - p_m}$ is strictly within $(0,1)$.

If $\beta < \frac{b_h - p_h}{p_h - p_m}$, the respective expected payoff (increases) of a m- type and a l-type seller coincide with that in (1). Therefore, the reporting strategy under consideration is consistent if and only if $p_h - p_l \le \lambda \le p_h - p_m$, which is impossible as $p_m > p_l$.

Next suppose $\beta > \frac{b_h - p_h}{p_h - p_m}$. Then a l-type seller's payoff of lying is $\chi(p_h - s_l) + (1-\chi)(p_m - s_l) -$

λ. The payoff of a m-type seller is

$$\Pi_m(r) = \begin{cases} p_m - s_m & \text{if } r = \text{Medium} \\ \chi(p_h - s_m) + (1-\chi)(p_m - s_m) - \lambda & \text{if } r = \text{High} \end{cases}.$$

Only m-type finds it profitable to lie if and only if $\chi p_h + (1-\chi) p_m - p_l \leq \lambda \leq \chi(p_h - p_m)$. But this is again impossible as $p_m > p_l$.

Finally, suppose $\beta = \frac{b_h - p_h}{p_h - p_m}$. The sophisticated buyer is indifferent between p_h and p_m. Denote his probability of offering p_h by α. Then a l-type seller's payoff of lying is $\chi(p_h - s_l) + (1-\chi)[\alpha(p_h - s_l) + (1-\alpha)(p_m - s_l)] - \lambda$. The payoff of m-type seller is

$$\Pi_m(r) = \begin{cases} p_m - s_m & \text{if } r = \text{Medium} \\ \chi(p_h - s_m) + (1-\chi)[\alpha(p_h - s_m) + (1-\alpha)(p_m - s_m)] - \lambda & \text{if } r = \text{High} \end{cases}.$$

A m-type seller is willing to randomize between lying and truth-telling if and only if $\alpha = \frac{1}{1-\chi}\left(\frac{\lambda}{p_h - p_m} - \chi\right)$. However, at this α, the l-type seller finds it strictly optimal to lie too, a contradiction.

In sum, there is no consistent reporting strategy in which only m-type seller lies.

Case 4: Both l- and m-types lie Following an argument similar to the case above, if a m-type seller finds it optimal to lie, then a l-type seller would find it strictly optimal to lie. Although a "High" message may come from any type of seller, because of Assumption (ii), the sophisticated buyer offers p_l, regardless of the proportion of lying m-type seller. Suppose first that a m-type seller randomizes between "High" and "Medium", then the respective expected payoff of a m- type and a l-type seller depends on message as follows:

$$\Pi_l(r) = \begin{cases} p_l - s_l & \text{if } r = \text{Low} \\ \chi(p_h - s_l) + (1-\chi)(p_l - s_l) - \lambda & \text{if } r = \text{High} \end{cases} \quad \text{and}$$

$$\Pi_m(r) = \begin{cases} p_m - s_m & \text{if } r = \text{Medium} \\ \chi(p_h - s_m) - \lambda & \text{if } r = \text{High} \end{cases}.$$

The strategy under consideration is consistent if and only if $\lambda = \chi(p_h - s_m) - (p_m - s_m)$.

Next suppose a m-type seller lies with certainty. Then the message "Medium" is off-path and the expected payoff (increases) of a m- type seller depends on message as follows:

$$\Pi_m(r) = \begin{cases} \chi(p_m - s_m) & \text{if } r = \text{Medium} \\ \chi(p_h - s_m) - \lambda & \text{if } r = \text{High} \end{cases}.$$

A m-type seller finds it optimal to lie if and only if $\lambda \leq \chi\,(p_h - p_m)$.

In sum, if $\lambda \leq \chi\,(p_h - p_m)$, then it is a consistent strategy for both l-type seller and m-type seller to lie with certainty. Q.E.D.

B Appendix: Experimental Instructions - *HL-I*

Instructions

Welcome to the experiment. In the following two hours or less, you will participate in 4 stages of economics decision-making experiment. Please read the instructions below carefully; the cash payment you will receive at the end of the experiment depends on how you make your decisions according to these instructions. Communication of any kinds with any other participants will not be allowed.

Today's experiments consist of FOUR stages. The final cash payment will be the sum of your earnings from the four stages, translated into SGD as the exchange rate of 35 points = 1 SGD, plus a show-up payment of 5 SGD for arriving to the experiment on time and participating.

As part of this study, we will first ask you to drink one cup of alcoholic beverage (~200ml) in 6 minutes. There are two types of beverage: high alcohol content (about 11%), and low alcohol content (about 1%). We will randomly select half of you to drink each type of beverage. Then, we will proceed to the experiment. The following is the instruction for the first stage. After you participate in the first stage, further instructions will be given to you via your computer screen.

STAGE 1

At the beginning of this stage, those participants who have drunk the high-alcohol-content beverage will be assigned the role of Member A, and those participants who have drunk the low-alcohol-content beverage will be assigned the role of Member B. Your role will remain fixed throughout this stage of the experiment.

This stage consists of 10 rounds of decision-making. In each round, one Member A and one Member B will be randomly and anonymously paired to form a group, with a total of 10 groups. You will not be told the identity of the participant you are matched with, nor will that participant be told your identity – even after the end of the experiment.

For the payment from this stage, one round will be randomly selected at the end of the experiment. Every participant will be paid based on their actions and the actions of their randomly counterpart in the selected game. Any of the games could be the game selected. Therefore, you should treat each game like it will be the one determining your payment.

Your Decision in Each Round

In each round, Member A is endowed with **an asset K**, whereas Member B is endowed with **400 points**. The asset K can be low, medium, or high type. At the beginning of each round, the computer randomly selects, with equal chances, the type of the asset K, which will be revealed only to Member A.

After observing the type of the asset, Member A chooses what message about the type of asset to send to Member B. Four messages are available:

"High" / "Medium" / "Low" / "Not Reveal."

It is not part of instruction that you need to tell the truth.

After receiving the message sent by Member A, Member B makes an offer (in points) to buy the asset K from Member

A. Three offers are available:

150 Points / 400 Points / 650 Points.

Member A then decides whether to accept or reject the offer.

Your Earnings in Each Round

Your earning in each round depends on i) the actual type of asset K, ii) the offer made by Member B, and iii) whether Member A accepts or rejects the offer.

1. If Member A rejects the offer from Member B, then Member A will retain the asset K and no transaction will take place.
2. If Member A accepts the offer from Member B, the transaction will take place: Member A will transfer the asset K to Member B, and Member B will pay the offered amount of points to Member A.

At the end of each round, the asset K will be transferred into points according to the following table:

[**Table 1: Value of Asset K (in points)**]

Asset K's Actual Type	If Member A Holds Asset K	If Member B Holds Asset K
Low	0	250
Medium	200	450
High	450	750

For example,

1. Suppose that Member A accepts the offer of 650 points from Member B. It turns out that the actual type of asset K is Medium. Then,
   Member A's Earning = Payment Transfer from Member B = 650 points
   Member B's Earning = Initial Endowment – Payment + Value of Asset K
   = 400 – 650 + 450 = 200 points.
2. Suppose that Member A rejects the offer of 400 points from Member B. It turns out that the actual type of asset K is medium. Then,
   Member A's Earning = Value of Asset K = 200 points
   Member B's Earning = Initial Endowment = 400 points.

Information Feedback

At the end of each round, you will be informed about (i) the message sent by Member A, (ii) the offer made by Member B, (iii) the accept/reject decision by Member A, (iv) the actual type of asset K, and (v) your earning in points.

Practice Rounds

We will provide you with one practice round. At the beginning of the practice round, you will be randomly assigned the role of either Member A or Member B. Your role in the official rounds will be the same as that in the practice round. Once the practice round is over, the computer will tell you "The official rounds begin now!"

Administration

Your decisions and your monetary payment will be kept confidential. Upon finishing the experiment, you will receive your cash payment. You will be asked to sign your name to acknowledge your receipt of the payment. You are then free to leave.

If you have any question, please raise your hand now. We will answer your question individually. If there is no question, we will proceed to the practice round now.

QUIZ

1. Suppose that Member A accepts the offer of 150 points from Member B. It turns out that the actual type of asset K is High. Calculate each member's earning. (Please use the information in **Table 1**.)

   Member A's Earning = _____

   Member B's Earning = _____

2. Suppose that Member A rejects the offer of 150 points from Member B. It turns out that the actual type of asset K is High. Calculate each member's earning. (Please use the information in **Table 1**.)

   Member A's Earning = _____

   Member B's Earning = _____

3. Suppose that Member A accepts the offer of 650 points from Member B. It turns out that the actual type of asset K is Low. Calculate each member's earning. (Please use the information in **Table 1**.)

   Member A's Earning = _____

   Member B's Earning = _____

STAGE 2

At the beginning of this stage, one half of the participants will be randomly assigned the role of Member C, and the other half the role of Member D. Your role will remain fixed throughout this stage of the experiment.

This stage only has 1 round of decision-making. At the beginning, one Member C and one Member D will be randomly and anonymously paired to form a group. You will not be told the identity of the participant you are matched with, nor will that participant be told your identity – even after the end of the experiment.

In each group, Member C makes a split (only with integers) of 100 points as

"_____Points for me and _____Points for Member D."

The split made by Member C is revealed to Member D, and 100 points are divided accordingly. Member D thus has no decision to make. At the end of the stage, the following message will be displayed:

"Member C receives _____ Points and Member D receives _____Points."

STAGE 3

In this stage, each participant simultaneously and independently chooses an integer number between 0 and 100 inclusively. The computer will then calculate the average of the numbers chosen by all participants. The participant whose number choice is closest to the 2/3 of the average will be declared the winner, and awarded 100 points. In the case of tie, the prize of 100 points will be shared equally among the joint winners.

At the beginning of this stage, the computer displays the following message:

Please input an integer number between 0 and 100 (inclusively).

You can input any number between 0 and 100. After all participants have entered their numbers, the computer will do the calculation and decide the winner(s). At the end of this stage, you will receive a message of the following form:

The winning number: W / Your number choice: N / Award given to you: P

STAGE 4

In this stage, you will be asked to make a series of choices. How much you receive in this stage will depend partly on **chance** and partly on the **choices** you make. The decision problems are not designed to test you. What we want to know is what choices you would make in them.

For each line in the table that will be shown to you on the screen, please state whether you prefer option A or option B. Notice that there are a total of **12 rows** in the table but just one row will be randomly selected for payment. **You do not know which line will be paid when you make your choices. Hence you should pay attention to the choice you make in every line.** After you have completed all your choices, the computer will randomly generate a number, which determines which line is going to be paid.

Your earnings for the selected line depend on which option you chose: If you chose option A in that line, you will receive 100 points. If you chose option B in that line, you will receive either 140 points or 60 points. To determine your earnings in the case you chose option B, there would be a second random draw. The computer will randomly determine if your payoff is 140 points or 60 points, with the chances stated in Option B.

You earnings from this stage will be revealed at the end of the study after you have completed **a short questionnaire** that will be shown to you on your computer screen.