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The impact of language on decision-making:

Auction winners are less cursed in a foreign language[☆]

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Abstract: As foreign language use becomes more commonplace in the globalized market, we ask whether using a foreign language systematically impacts financial decisions. We conducted a lab experiment in Beijing, China, with 357 native Mandarin Chinese speakers who know English as a foreign language. We ran a series of sealed-bid, common value auctions, where winning bidders often pay more than the object is worth and hence suffer from the "winner's curse." Here we show that using a foreign language reduces the winner's curse, as winning bidders were less likely to overbid for the object. When using a native tongue, bidders adopted a naïve strategy, while with a foreign language they got closer to the Nash equilibrium bid. However, as bidders received feedback on others' bidding behavior across consecutive auctions, bidding across the language treatments converged to the naïve bid. These results suggest that the language through which individuals make bidding decisions can have influential effects on financial decision making in market settings.

JEL Codes: D44, D91, C92

Keywords: Bilingualism; Decision making; Auctions

Declarations of interest: None.

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Main Text

1. Introduction

In a globalized and multilingual economy, language can impact economic decisions. For example, research has found that processing information through a certain language can activate cultural norms, beliefs, and preferences associated with that language which can shape economic decision making (see Clist, 2022, for a review). Additionally, others have found that subtle language manipulations, such as dropping pronouns, can impact self-distancing and subsequent economic decisions (Chen and He, 2021; He, 2017; He, Li, and Yan, 2021). Here, we investigate a novel, additional hypothesis underexplored in economics regarding "the foreign language effect," which examines the influence of using a native or foreign language on how individuals process information and make decisions. To do so, we examine how native or foreign language use influences economic decision-making in market settings, utilizing auctions as a well-studied context directly relevant to market behavior. In principle, if the same information is communicated, then the language should have no impact on the final decision. Alternatively, using a foreign language might worsen performance because it takes more effort to comprehend, decreasing the likelihood that bidders will make a well-reasoned choice (Volk, Köhler, & Pudelko, 2014). Contrary to these possibilities, we show that bidding using a foreign language could be beneficial.

Research on the "foreign language effect" has revealed that receiving information through a foreign as compared to native language can change how individuals think and make decisions (see review, Hadjichristidis, Geipel, Keysar, 2019, or Hayakawa et al., 2016). Cognitively, these effects have been explained through a dual process theory of reasoning (Evans & Stanovich, 2013; Sloman, 1996). Under this model, individuals have two distinct reasoning processes, one which leads to quick, intuitive, and emotionally driven judgments (System 1) and another process that leads to slower but more deliberative outcomes (System 2). Using a foreign language reduces the salience of the more emotionally driven, intuitive judgments of System 1 leading to better decisions when intuition may lead someone astray (Hadjichristidis, Geipel, & Surian, 2017; Hayakawa et al., 2017) and may also induce less risk aversion (for a review see Circi, Gatti, Russo, & Vecchi, 2021 though also see Hayakawa et al., 2019 and Li, 2017 which did not find an effect of language on risk preferences). In this paper, we extend this foreign language effect work, which has largely focused on moral choice, risky choice, and judgements, by examining for the first time financial decisions in a common market setting. We hypothesize that because default

behavior does not always produce the best outcomes in this setting, using a foreign language may aid individuals in making better financial choices.

We used sealed bid, second price common value auctions, where the target object has the same value for all bidders in the auction (common value), and the highest bidder wins the object but pays the second highest bid (second price). This type of auction is an ideal setting to test our hypothesis for two reasons. First, auctions are a popular means by which to buy and sell trillions of dollars of financial and real assets / goods, and hence behavior in auctions is a fundamental determinant of economic outcomes (Kagel & Levin, 2011). Second, while optimal bidding behavior in this type of auction can be determined by calculating the risk neutral Nash equilibrium (RNNE) bid, people often deviate from this optimal bid in both laboratory experiments and the real world (Wilson, 1977). Specifically, winning bidders in these auctions often pay more than the object is worth (Thaler, 1988). This "winner's curse" is now one of the most well-known behavioral anomalies in market settings.

To test whether using a native or foreign language impacts bidders' overbidding in a common value auction we conducted a laboratory experiment in Beijing, China. We recruited native Mandarin Chinese speakers who knew English as a foreign language, and randomly assigned them to participate entirely in either Mandarin Chinese or in English in groups of either 6 or 12 participants. Participants placed bids across ten auctions over different jars with a random proportion of 200 1 RMB and 0.1 RMB coins. So that participants could estimate the total value of the jar, each participant received a different private sample of ten coins randomly drawn with replacement from the jar each round prior to bidding. Once all bids were collected, participants were then shown the highest bid, second highest bid, jar value, and their own earnings before proceeding to the next auction.

Across the auctions, we examined two factors as our main variables of interest. First, we examined the effect of language on participants' bids. We compared the bidding strategies of individual bidders to both the predicted naïve bid, defined here as placing a bid equal to the expected value of the jar conditional on the bidder's information, and the optimal RNNE bid. Second, we examined the prevalence of winner's curse, defined here as how often winners paid more than the true value of the jar. We also explored whether two other factors may differentially influence bidding decisions across language treatments: number of bidders in an auction and response to feedback across auction rounds. Research has found that as the number of bidders in an auction increases so does the rate of overbidding, even though the optimal behavior is to bid more conservatively as group size increases (Campbell, Kagel, & Levin, 1986; Thaler, 1988). Because participants were randomly assigned to groups of either 6 or 12 participants, we examine how language influences bidding decisions when bidders are differentially susceptible to overbidding. We also explored how bidding behavior changed as participants received feedback

across auctions. While some studies have shown that experience and feedback improve bidding behavior and reduce susceptibility to winner's curse (Kagel & Richard, 2001; Lind & Plott, 1991), others found limited or no effects of feedback or experience on bidding behavior (Ball, Bazerman, & Carroll, 1991; Foreman & Murnighan, 1996; Grosskopf, Bereby-Meyer, & Bazerman, 2007). By including feedback across auctions, we could both explore the impact of feedback more broadly as well as see if participants differentially responded to feedback across language treatments.

2. Methods

Participants were 357 Renmin University students in Beijing, China. All were native Mandarin Chinese speakers who knew English as a second language. To ensure that subjects knew sufficient English, all participants completed a basic reading comprehension task prior to signing up. To keep the level of English language proficiency constant, 7 subjects were excluded after identifying themselves as English majors in the post-experiment questionnaire, leaving a final sample of 350 subjects. The target sample size of 350 participants (or ~88 per cell) was selected to reliably capture a small to medium sized effect typically found in the foreign language effect literature, assuming $\alpha = 0.05$, $1 - \beta = 0.80$, and a "small" MDE of approximately 1/5 standard deviations (Circi, Gatti, Russo, & Vecchi, 2021). Subjects were paid a show up fee of 50 RMB (~7.30 USD) for their participation in the hour-long session, with potential additional pay depending on their performance.

We conducted a total of 40 sessions of either 6 or 12 participants, half in Mandarin Chinese and half in English. To ensure language immersion, all experimental materials, instructions, and communication during the session were in the assigned language. For consistency, all spoken instructions were played via a recording of a bilingual Mandarin-English speaker in the assigned language. Furthermore, materials were presented and responses were collected via the computer program z-Tree (Fischbacher, 2007), allowing the experimenters to view auction responses in real-time as subjects submitted their bids. The experimental scripts and materials are included in the Online Appendix, and the experiment is approved by the University of Chicago IRB (Protocol ID H11209).

As subjects entered the session, they received a subject ID and waited quietly. Once all subjects arrived, the experimenter began the session, which consisted of the common value auctions as well as three other unrelated economic decision-making games collected for separate projects (see Online Appendix for details on these games, which included a beauty contest game, Monty Hall game, and a series of questions inquiring how long subjects would be willing to work to earn different prizes), followed by a series of short evaluation questions at the end of the experiment. The common value auctions were randomly conducted either as the first or the third game in the series of the games to control for possible order effects.

The common value auction task consisted of ten sealed-bid, second price common value auctions, in which participants bid to win a jar of coins. At the beginning of the task, participants were told they would be bidding on a jar containing a total of 200 coins comprised of a random proportion of 1 RMB and 0.1 RMB coins. The number of 1 RMB coins in a given jar was determined by drawing a random number from 1 to 199; hence the value of the jar ranged from a minimum of 20.90 RMB or 3.04 USD to a maximum of 199.10 RMB or 28.98 USD (199 coins of 0.1 RMB and one coin of 1 RMB versus one coin of 0.1 RMB and 199 coins of 1 RMB).

To estimate the value of the jar, at the beginning of each auction bidders were given a private signal of the jar value: a sample of ten coins drawn randomly with replacement from the jar. Each bidder received a different, random proportion of 0.1 and 1 RMB coins in their 10-coin sample. After receiving their sample, bidders were shown a thirty second countdown to submit a bid, although bidders could still submit their bid after the timer hit zero. Once all bids were submitted, participants' screens displayed the highest bid, the second highest bid, the true value of the jar, and their own earnings. For the winner, the earnings were the value of the jar minus the second highest bid; for all other participants the displayed earnings were 0.

Participants were informed about how the jar value was calculated and how samples were drawn prior to the start of the first auction. Furthermore, to ensure that they understood the task, participants in both language treatments first completed a practice auction and were given the opportunity to ask questions in the designated language before the first auction. All participants completed ten consecutive auctions. For the final, tenth auction participants were asked additional questions after entering their bid for that auction but prior to receiving the auction feedback. These questions probed participants' bidding strategies, asking them if they thought other bidders had a higher signal, their current guess of the value of the jar, as well as their guess of the value of the jar assuming that they had the highest signal or if they and another individual both had the highest signal.

At the end of the experiment, one of the auctions was randomly selected and subjects received their earnings from that auction. If the winner of the selected auction lost money in that auction, the money was subtracted from the show up fee up to the base pay of 30 RMB or 4.36 USD.

3. Results and Discussion

We first assessed whether bidders believed the jar value was randomly determined during each auction round. If bidders believed the jar value was non-randomly determined, this would make it impossible to distinguish between true overbidding compared to bidding with the expectation that the jar must have a certain proportion of high value coins. To test this, after the tenth auction participants were asked to estimate the value of the jar. We found no evidence that bidders thought

the jar value was not randomly determined, as their estimate did not differ from the actual expected jar value at a given signal value *(t*=0.29, *p*=0.774; see Figure A3.1). This demonstrates that subjects assumed that the jar's value was randomly determined before making a bidding decision and that on average subjects were capable of calculating well-calibrated estimates.

We continue by first reporting the results of the first auction. Then we report the results for the remaining auctions in which knowing the outcome of previous auctions may have influenced bidding decisions. To control the false discovery rate (FDR) and account for multiple comparisons, *p*-values were adjusted using the Benjamini-Hochberg method. Furthermore, throughout this paper, all bids are winsorized at the 5% and 95% levels within each signal value to avoid extreme bids. The non-winsorized results are similar and are shown in Online Appendix A4.

3.1. Effect of language on participants' bids

We first compared how closely individual bids followed the predicted naïve bid and the RNNE bid across language treatments at a given signal value. The naïve bid is defined as placing a bid equal to the expected value of the jar conditional on the bidder's signal, and the RNNE bid is the theoretically-optimal bid, predicting that bidders should shade their bids downward to avoid the winner's curse (see Online Appendix A1 for the equations, given the bidder's signal). In this paper, overbidding is defined relative to the RNNE bid which assumes subjects are risk neutral.

In the first auction bidders in a foreign language were consistently less naïve than those in the native language treatment (see Figure 1 for subjects' bids). As shown in Figure 2a, bidders in the native language treatment bid below the naïve bid in the first round by an average of 4.76 RMB (*t*=2.24, *p*=0.044), and bidders in the foreign language treatment bid below the naïve bid by an average of 20.23 RMB (*t*=7.11, *p*<0.001). The foreign language bidders bid significantly further away from the naïve bid compared to the native language bidders (MD=15.47 RMB, $SD_{foreign}$=37.53, SD_{native}=28.13, SD_{all}=33.99, *t*=4.37, *p*<0.001), showing that they were bidding more strategically. This strategic approach is also shown in Figure 2b that plots the bids in relation to the RNNE bid. Here bidders in the native language treatment bid significantly above the RNNE bid by an average of 16.05 RMB (*t*=7.04, *p*<0.001). In contrast, bidders in the foreign language treatment did not deviate from the RNNE bid (- overbid to RNNE by 1.20 RMB, *t*=0.39, *p*=0.853). Hence, individual bids placed in the native language treatment were significantly farther above the

RNNE bid than bids placed in the foreign language treatment (*MD* =14.85 RMB, $SD_{foreign}$=40.54, SD_{native}=30.24, SD_{all}=36.45, *t*=3.89, *p*<0.001).

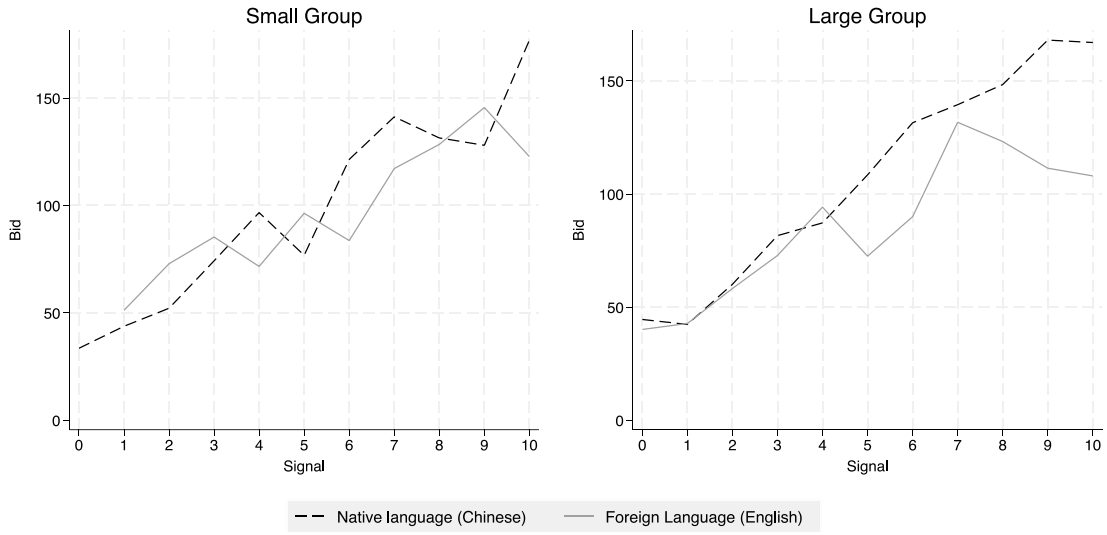

Figure 1. Actual bids by language treatment and group sizes in the first auction. The signal value was the number of 1 RMB coins drawn in the bidder's 10-coin sample.

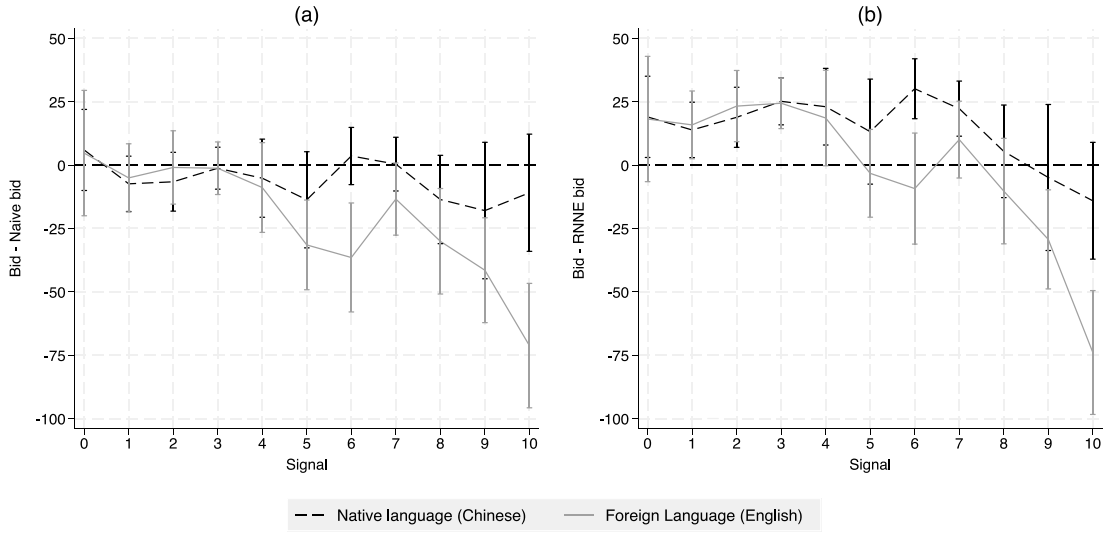

Figure 2. Difference between individuals' bids and the Naïve (a) and RNNE (b) bid by language treatment in the first auction. Vertical bars are 95% confidence intervals.

Next, we examined individual bids as a function of group size (12 or 6 participants). In the first auction, native language treatment bidders in the large group overbid more than those in the small group (t=4.15, p<0.001), replicating prior results that larger auction groups exacerbate overbidding. In contrast, there were no differences in overbidding between the large and small groups in the foreign language treatment (t=0.15, p=0.883). Overbidding was nonexistent in the large and the small group alike in the foreign language treatment (see Figure A3.2).

In the subsequent auctions the impact of language treatment on individual bidding decisions largely disappears. Subjects in both the native and foreign language treatments bid naïvely (Native: t=0.52, p=0.783, Foreign: t=0.29, p=0.853; see Figure 3). Furthermore, while there were still differences in individual bids between language treatments across group sizes (F(1,3146)=7.90, p=0.010), both individuals in the native and foreign language treatments bid significantly above the RNNE in both the small group (Native: t=8.56, p<0.001, Foreign: t=*10.*32, p<0.001) and large group (Native: t=25.85, p<0.001, Foreign: t=17.78, p<0.001).

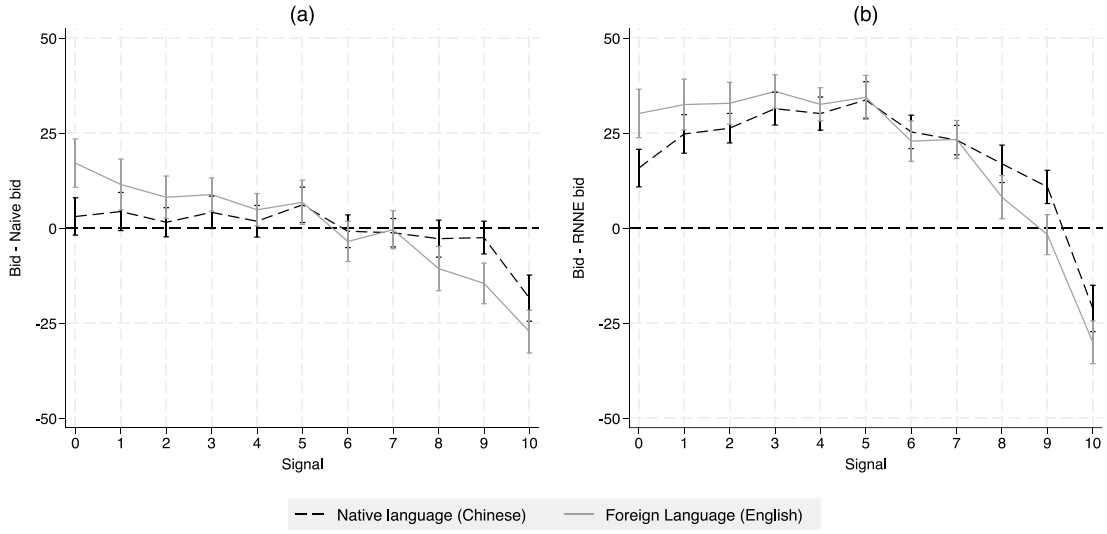

Figure 3. Difference between individuals' bids and the Naïve (a) and RNNE (b) bid by language treatment in auctions 2 – 10. Vertical bars are 95% confidence intervals.

3.2. Market outcomes: Winner's curse and winners' profit

Next, we examined market outcomes, focusing on the winners' profits. As predicted, language affected the likelihood of experiencing winner's curse. In the first auction, winner's curse was more prevalent in the native language treatment (95.00%) than in the foreign language treatment (68.42%; χ^2=4.67, p=0.045). This resulted in winners in the foreign language treatment losing

20.31% less in normalized profits, although this difference was statistically non-significant (*t*=1.45; *p*=0.215).

In the subsequent auctions, there was no difference in the rate of the winner's curse across language treatments. Specifically, while winners in the native language treatment maintained approximately the same rate of winner's curse (84.30%), winners in the foreign language treatment became just as likely to suffer from winner's curse (85.20%; χ^2=0.06, *p*=0.841). Therefore, while rates of the winner's curse were reduced in the first auction, the foreign language effect disappeared in the later auctions as participants received feedback (see Table A3.1).

3.3. Explaining bidding strategies across language treatments

Here, we investigated why foreign language bidders behaved more like native language users in consecutive auctions. One explanation we addressed given prior literature on the foreign language effect and risk preferences (for a meta-analysis, see Circi, Gatti, Russo, & Vecchi, 2021) is that language treatment influenced risk preferences, however we did not find support for this mechanism (see Online Appendix A2). Another possible explanation for why bidders changed their behavior over time is that they may have responded to the feedback after each auction and adjusted their bidding accordingly in the subsequent rounds to converge on a similar bidding strategy across language treatments. This is consistent with most participants (>94%) saying they used information from the prior round when making a bidding decision. We consider how winners' overbidding in the preceding round may lead other subjects to increase their bids in the next auction until average bids converge with naïve bidding. We then show that such convergence to a naïve bid results in faster decisions. We use the "cursed equilibrium" to explain the underlying mechanism of this bidding pattern (Eyster & Rabin, 2005).

As discussed by Thaler (1988), one of the difficulties of overcoming the winner's curse is that a bidder who adopts an RNNE strategy is unlikely to win if the other bidders overbid relative to the RNNE. Hence, when bidders see the high bids by the highest and second highest bidders, they might conclude that to win subsequent auctions, they have to raise their bids, leading to higher rates of overbidding. To examine this proposed account, we use Eyster & Rabin's (2005) cursed equilibrium framework (for the full theoretical model, see Online Appendix A1). Here subjects decide their bids under the assumption that, with some positive probability, other players are bidding non-strategically. This assumption is defined as the level of cursedness, $\chi \in [0,1]$. For example, when $\chi = 1$, a subject is certain that others' bids are non-strategic. In this case, their optimal bidding strategy is the expectation of the common value conditional on their own signal only. Thus, the optimal bid with $\chi = 1$ is equivalent to the naïve bidding strategy, which is the level that the average bid converges to in our data. In summary, we suggest that the foreign language participants who bid closer to the RNNE in the first auction conclude over time that others are

bidding non-strategically. Hence, they increase their bids, and as a result the winners of the auctions become increasingly cursed.

We find this relationship between the winning bid in an auction and the behavior of other bidders in subsequent auctions. Using the cursed equilibrium equation, we can recover each subject's empirical level of cursedness (χ). We find that cursedness increases more after the winner of the previous auction overbid compared to the actual value of the jar (53.0%) than when the winner did not overbid (39.8%; t=2.6, p=0.023). We then used the Arellano-Bond estimator to assess how the deviation of the winner's bid from the expected cursed-equilibrium bid in auction t-1 affects others' levels of cursedness χ_t in the next auction t. We find again that the more a winner's bid deviates from the optimal bid under the cursed equilibrium framework in the previous auction, the higher the increase in subjects' levels of cursedness in the subsequent auction (see Table 1). This shows that subjects adjust their bidding strategies after each auction by considering the behavior of the previous winners. This adjustment results in the increasing average bid across auctions and therefore it may lead to the convergence to the naïve bid in the foreign language treatment. Furthermore, the effect of feedback is robust to accounting for language proficiency (see Online Appendix A5).

VARIABLES	(1) Arellano–Bond estimator	(2) Arellano–Bond estimator
Subject's previous level of cursedness (χ_{t-1})	0.110	0.108
	(0.0544)	(0.0531)
Deviation of winner's bid from the expected cursed equilibrium (Z_{t-1})	0.871*	1.003*
	(0.262)	(0.350)
Foreign Language $\times Z_{t-1}$		-0.298
		(0.491)
Observations	2,071	2,071
Number of ID	349	349

Robust standard errors in parentheses
*** p<0.001, ** p<0.01, * p<0.05

Table 1. Effect of the deviation from the expected cursed-equilibrium of winners' bids in the previous auction (Z_{t-1}) on other subjects' levels of cursedness (χ_t) in the subsequent auction. Robust standard errors were clustered by session.

Finally, as Figure 4 shows, bidders in both language treatments bid faster as the auctions progressed, converging in time spent across auction rounds. The foreign language bidders are a lot slower in the first auction (*MD*=10.32s, $SD_{foreign}$=25.60, SD_{native}=23.28, SD_{all}=24.97, t=3.95, p<0.001), which corresponds to them also behaving a lot less cursed and bidding closer to the RNNE. Then as these foreign language bidders converge with the naïve bidding of the native language bidders and become more and more cursed across auctions, their speed of placing bids also converges to the speed of the native language bidders. It is well-known that reflective, strategic

decisions are slower than more intuitive or “gut” feeling decisions (Schouten & Bekker, 1967; Wickelgren, 1977). Therefore, the transition of bidders in a foreign language from strategic bidding in the first auction to bidding more and more naïvely in later auctions may reflect an increasing reliance on quick, intuitive choices.

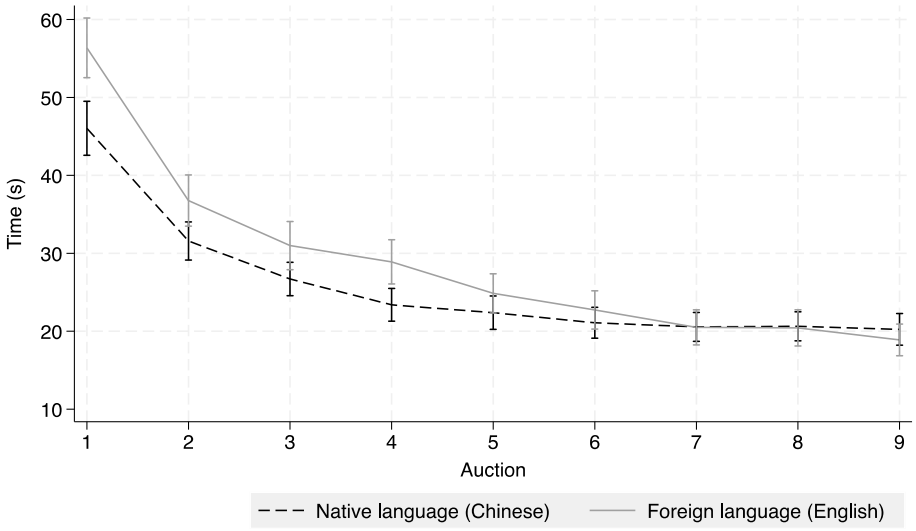

Figure 4. Time to place a bid as a function of language treatment across auctions. Auction 10 is excluded as there were additional questions. Vertical bars are 95% confidence intervals.

4. Conclusions

As predicted, we found that bidders using a foreign language were initially less likely to overbid and suffer the winner’s curse. However, this foreign language effect was reduced by feedback across auctions and bidders in both language treatments started bidding more naïvely. We found that such convergence was driven by seeing overbidding by winners in previous auctions. As bidders observed that some winners were overbidding, they might have raised their bids to win. This led them to place more naïve bids, which in turn increased overbidding and the rate of the winner’s curse across auction rounds. The more they converged to the naïve bid, the faster they submitted their bids, reflecting that they transitioned away from a slower, strategic approach and to a faster, emotional one.

While these findings are consistent with our hypothesis, an important contribution would be to extend these findings to other language pairings and cultural contexts. By doing so, future research can examine the extent to which language may prime cultural norms (Akkermans et al., 2010; Alempaki et al., 2021; Clist & Hong, 2023; Clist & Verschoor, 2017; Gargalianou et al.,

2017; Lambarraa & Riener, 2015; Li, 2017; see Clist, 2022, for a review), which given the current design cannot be ruled out as a possible contributing factor to the effect.

While it may seem intuitive that the nature of bidding would be a function of information, not the language through which it is communicated, bidders make different bidding decisions when operating in their native or foreign language. By taking the “nativeness” out of the language but keeping the information the same, we show that overbidding is indeed exacerbated by the language we most naturally employ. These results have important implications for financial decision-making not only in auctions but more broadly in market settings when individuals are responding to information communicated through either their native or foreign language.

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