

The Impact of an Epidemic: Experimental Evidence on Preference Stability from Wuhan[†]

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Are preferences stable, or are they potentially influenced by formative events and experiences? Questions of this type have troubled economists for decades (Stigler and Becker 1977). Preference stability underlies fundamental theories of decision-making. For example, Samuelson's (1937) proposition of utility as a discounted sum of rewards is based on the assumption that a rational agent's preferences are stationary.

We harness the exogenous shock of the COVID-19 outbreak to provide controlled evidence on the evolution of deep economic parameters, including trust, risk, and time preferences. Our study repeatedly applies incentivized decision tasks via the WeChat social media platform to a randomly selected sample of 396 student subjects in Wuhan, China, the first city to be devastated by the virus. The experiments were conducted from late January to early March of 2020. We compare behavioral measurements elicited during this period to those of a pre-epidemic baseline sample of 206 subjects recruited from the same population.

Our results suggest that the initial outbreak coupled with the lock-down of Wuhan City undermined trust and tempered the willingness of subjects to seek out unknown situations. The outbreak also led to a fall in risk aversion, and there is marginal evidence subjects exhibited

more present bias in the early stages of the crisis. Over the rest of the period, notwithstanding several interesting transitory effects, we observed measurements return to baseline levels with the following exceptions: trust was elevated in March relative to January, risk aversion remained significantly below its baseline level, and subjects became more averse to lying. The results suggest that perturbations in behavior and preferences from a public health crisis are sharp and can persist for at least several months.

I. Stability of Economic Preferences

Providing robust empirical evidence on the stability of economic preferences requires eliciting controlled behavioral measurements before and after an exogenous shock. By its nature, such a shock must be unanticipated, and thus researchers have relied heavily on natural experiments. When such natural experiments arise, one way scholars have addressed this question is by evaluating the impact of personal economic experiences on preferences. A seminal paper in this literature is Malmendier and Nagel (2011), who use data from between birth cohorts to show that stock market returns experienced are good predictors of risk tolerance.

A separate literature has emerged around the effect of natural disasters—such as floods, earthquakes, or hurricanes—on preferences.¹ Since natural disasters are by definition unanticipated, most prior studies of this type rely on measurements taken after the event between groups with differential exposure.² By contrast, behavioral measurements from our control group were elicited six months before the first reports of COVID-19 emerged, which offers a natural baseline for comparison.

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¹For a survey, see Chuang and Schechter (2015).

²A notable exception is Beine et al. (2020).

II. Experimental Context and Design

The experiments in this study were implemented using Ancademy, an online platform for social science experiments based on the open interface of WeChat (<https://www.ancademy.org/>). This platform facilitates experiments in which participation and payments are through (but not limited to) one's smartphone. In May 2019, we deployed a set of behavioral economics games and preference-elicitation tasks to a random sample of 206 student subjects at Wuhan University.³ The outbreak of COVID-19 at the turn of 2020 enabled us to conduct a fortuitous natural experiment. On January 23, the Chinese authorities imposed a strict lock-down of Wuhan city, followed shortly by lock-downs of other cities throughout Hubei province. By this time, many students at Wuhan University had returned home to celebrate the Lunar New Year, the beginning of which coincided with mass quarantine.⁴

Over the following six weeks, we monitored subjects' preferences and behavior in their place of quarantine. We conducted five separate waves of sampling between late January and early March (Table 1). Data for wave one were collected in the immediate aftermath of the lock-down. Waves two and three were implemented on either side of the February 7 well-publicized death of Dr. Li Wenliang, an ophthalmologist and alumnus of Wuhan University who was widely considered a hero for his early warnings of the COVID-19 outbreak (Green 2020). Waves four and five followed at two-week intervals thereafter. In each wave, we recruited a random sample of (approximately) 80 subjects from our subject population. To ensure comparability with the baseline, all subjects completed the experiment using a mobile device.

The decision-making tasks were designed to capture deep economic parameters of trust and trustworthiness, time, risk and ambiguity preferences, and lying propensity.

To measure trust and trustworthiness, we used first-mover amounts sent and second-mover amounts returned (as a proportion) in a standard

trust game.⁵ Subjects were randomly matched into pairs and to roles within a pair. First movers then decided how much of an ¥8 endowment to send to their match; the amount sent was tripled, and the second mover decided how much of the tripled amount to return. Any money not returned was kept by the second mover.

To elicit time preference, subjects made a series of nine pairwise choices between ¥100 today or ¥100(1 + i) 1 month later, where the interest rate i increased uniformly from 0 to 0.24. The switching point carries information about a subject's discount rate r , which we use to calculate her annualized rate of patience as $G = (1/1 + r)^{12}$.⁶

To elicit preference toward risk and ambiguity, we presented subjects with a list of nine pairwise choices between a lottery and a sure amount of money. The lottery prizes were fixed across pairs: a chance to win ¥3 or ¥9. For the risk (ambiguity) task, the probability of winning each amount was 50 percent (unknown). The sure amount increased uniformly from ¥3 to ¥9. We use the switching point in each task to calculate risk and ambiguity aversion as an ordinal variable increasing in a subject's aversion.

To measure lying propensity, subjects were asked to privately choose an integer at random from zero to nine, add it to the last number of their student ID, and record the digit. The system then randomly generated a number in the same interval, and subjects had to report whether the two numbers matched. If they matched (unobserved by the experimenter), subjects earned ¥5, else zero. The extent of lying is inferred from the difference between the reported matching rate and the expected rate of 10 percent.

Subjects completed all tasks sequentially with no feedback until all tasks were completed. Subjects were paid according to the outcome of each task, earning an average of ¥65.68. Payments were made via the WeChat pay facility. If the payoff-relevant date for a task was in

⁵The Trust game was only implemented in one half of sessions; in the other sessions, it was replaced with the Ultimatum game (not reported here). This was to prevent behavioral spillover effects between tasks.

⁶Raw switching points are in the online Appendix along with a second measure of time preference elicited between two future dates. For all elicitations, those subjects who never switch are assigned a switching point of 10, and we exclude those who switch more than once.

³This was part of a separate project examining how the experimental interface affects decision-making.

⁴Media outlets at the time were dubbing this the largest quarantine in human history; see, for example, Kang (2020).

TABLE 1—EXPERIMENTAL WAVES AND DESCRIPTIVE STATISTICS OF THE MAIN OUTCOME VARIABLES

	Baseline	Wave 1	Wave 2	Wave 3	Wave 4	Wave 5
Trust	3.39	1.75	4.95	3.6	3.66	4.42
[0, 8]	(2.59)	(1.80)	(2.48)	(2.44)	(2.73)	(2.59)
Trustworthiness	0.27	0.22	0.33	0.23	0.38	0.34
[0, 1]	(0.21)	(0.23)	(0.20)	(0.20)	(0.23)	(0.21)
Patience	0.43	0.39	0.37	0.46	0.4	0.38
[0, 1]	(0.27)	(0.25)	(0.28)	(0.28)	(0.26)	(0.28)
Risk aversion	6.55	6.33	6.08	6.74	6.29	6.05
{1,2,...,10}	(1.13)	(0.86)	(1.47)	(1.18)	(1.42)	(1.58)
Ambiguity aversion	6.51	6.85	7.07	6.82	6.59	6.53
{1,2,...,10}	(1.33)	(1.40)	(1.46)	(1.75)	(1.55)	(1.55)
Lying propensity	0.66	0.65	0.62	0.66	0.6	0.51
{0,1}	(0.47)	(0.48)	(0.49)	(0.48)	(0.49)	(0.50)
Dates of sampling	May 2019	Jan. 24/26	Feb. 4/6	Feb. 7/8	Feb. 21/22	Mar. 6/7
Observations	206	80	78	80	78	80

Notes: Values are mean (standard deviation). Two-tailed Wilcoxon rank-sum tests of equal means versus baseline, except for lying propensity, which is based on Fisher's exact test. Lying propensity has an expected rate of 0.10.

the future, payment was received on the future date. Sessions lasted about 45 minutes. No subject participated in more than one session.

III. Results

A. Trust and Trustworthiness

As shown in Table 1, first-mover amounts sent in the trust game were significantly lower in wave one relative to the baseline ($p = 0.02$). This was driven by a mass of subjects keeping their full endowment. Trust recovered sharply in wave two ($p < 0.01$) and then remained significantly above the wave-one level.⁷ There is some evidence of a short-term fall in amounts sent between waves two and three ($p = 0.098$). There were few systematic differences in second-mover returns after adjusting for the amount received.

To gain individual-level insight, we conduct a Tobit regression of amounts sent on a categorical variable for the experimental waves, a dummy for being in Wuhan during 2020, and demographic control variables. There is evidence of a gender effect: the coefficient estimate on the female dummy is positive and highly significant ($p < 0.01$). The estimate on the Wuhan

dummy, however, is negative and more than offsets the gender effect ($p < 0.01$). The fitted values from this analysis are presented in Figure 1 for all subjects (black squares), subjects based in Wuhan (orange circles), and subjects based outside of Wuhan (blue triangles). We observe lower trust among Wuhan-based subjects, although this is based on a small sample size.

B. Time, Risk, Ambiguity, and Lying Propensity

The average annualized rate of patience in our baseline sample is 0.43. This rate decreased to 0.37 in wave two, and the difference is marginally significant ($p = 0.09$). Again, there was a fluctuation between waves two and three, in which subjects temporarily placed greater value on the future ($p = 0.09$). Our measure of time preference ended the 2020 sampling period where it began.

Risk aversion was significantly lower in waves one and two than in the baseline (respectively, $p = 0.06$ and $p < 0.01$). The downward trend was interrupted in wave three with a pronounced spike upward ($p < 0.01$). By wave five, risk aversion was back below the baseline level ($p < 0.01$). Ambiguity aversion was significantly elevated in waves one, two, and three (respectively, $p = 0.02$, $p < 0.01$, and $p < 0.01$). This bias did not persist. By wave five, ambiguity aversion was significantly below the wave-two level ($p = 0.02$). While the

⁷Detailed results of all statistical analyses in this section are contained in the online Appendix.

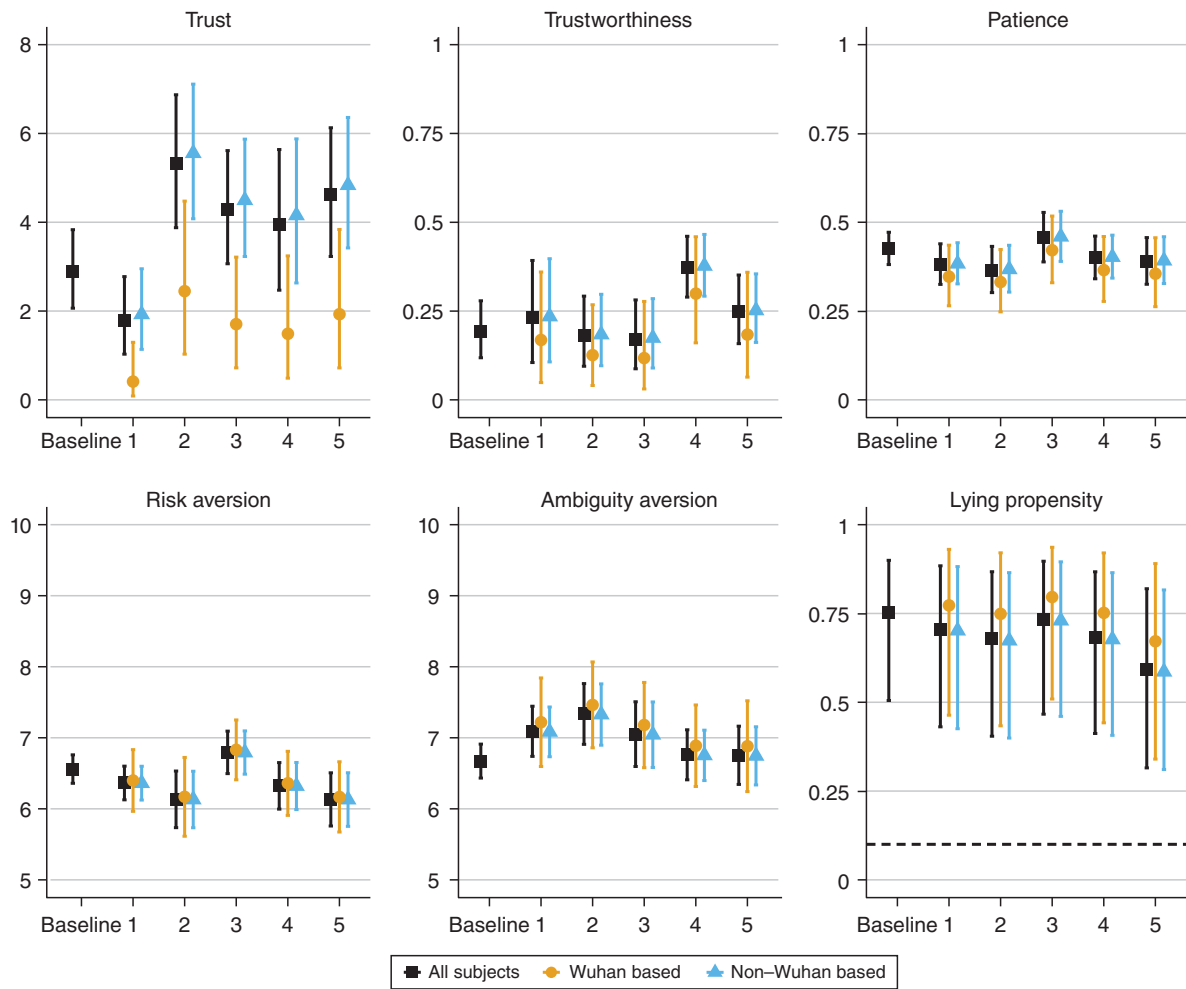


FIGURE 1. FITTED VALUES OF THE MAIN OUTCOME VARIABLES BY EXPERIMENTAL WAVE

Notes: Fitted values are for all subjects (black squares), subjects based in Wuhan (orange circles), and subjects based outside of Wuhan (blue triangles), from censored regressions of the outcome on indicators for the experimental wave relative to the baseline and controls. Whiskers indicate 95 percent confidence intervals based on robust standard errors. The dashed line in the lying propensity panel indicates the expected rate of lying propensity given our design.

distribution of switching points in the baseline appears to exhibit two modes, the aftermath of the COVID-19 outbreak shifted the lower mode to the right, creating a unimodal distribution.

Across all waves, reported matching rates are significantly above the expected rate given perfect truth telling. There is no systematic difference in lying propensity between the baseline and wave-one samples ($p = 0.89$). There is evidence that subjects became more averse to lying as the crisis unfolded. In wave five, 51 percent of subjects reported a match, significantly below the baseline frequency of 66 percent ($p = 0.03$).

Similar behavioral trends can be found in Figure 1 and are robust to controlling for observed covariates. Wuhan-based subjects were more impatient and averse to risk and ambiguity, although these differences are not significant at the 10 percent level.

IV. Discussion and Conclusion

The results from the decision-making tasks suggest that preferences are liable to be influenced by formative events and experiences. The COVID-19 outbreak in China initially undermined subjects' trust, but this is followed by a

sustained period of greater trust in others. There is precedent for this: Cassar, Healy, and von Kessler (2017) observed a similar phenomenon after the 2004 tsunami in Thailand.

We observe differential responses in the domains of risk and ambiguity. Whereas subjects were more risk tolerant after the crisis, they were less willing to seek out unknown situations. While such a divergence has previously been observed in response to a change in deterrence policies (Cavatorta and Groom 2020), we are not aware of such a pattern being identified in response to a natural catastrophe. In the COVID-19 context, it is plausible that individuals were cautious in the face of uncertainty (such as taking preventative measures to avoid catching the virus) but after contracting the virus were willing to take significant risks to avoid the worst outcome (death).

Our finding of decreased risk aversion contrasts with related evidence on risk taking in financial markets (Li et al. 2020). The advantage of a natural experiment is to enable a separation between changes in risk-return ratios and underlying risk preference.

Finally, we observe a sharp discontinuity in elicited measures of trust, patience, and risk aversion before and after the death of Dr. Wenliang, an event that appeared to resonate in the collective conscious of ordinary Chinese citizens.

Differential selection into the baseline and post-COVID-19 samples is clearly a potential confound in our design, and so we remain cautious in any causal interpretation. Nevertheless, the marked short-term fluctuations between our 2020 waves suggest that the time between measurements is an important factor to consider when making inferences as to the impact of natural events on preferences.

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