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# Scarcity improves economic valuations when cognitively salient[1]

Ozan Isler[a,*], Onurcan Yilmaz[b], Uwe Dulleck[c,d,e,f]

[a] School of Economics, University of Queensland, St Lucia, Australia
[b] Department of Psychology, Kadir Has University, Istanbul, Turkey
[c] School of Economics and Finance, Queensland University of Technology, Brisbane, Australia
[d] Centre for Behavioural Economics, Society and Technology, Brisbane, Australia
[e] Crawford School of Public Policy, Australian National University, Canberra, Australia
[f] CESifo, Munich, Germany

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ABSTRACT

In an influential article, Shah et al. (2015) hypothesized that resource scarcity weakens the effect of irrelevant contextual factors on economic valuations. The hypothesis that "scarcity frames value" qualifies the applicability of standard theories of rational choice and suggests a revised psychological foundation. In support, Shah et al. showed that differences in the willingness to pay for a commodity depending on where it was purchased (a fancy hotel vs. a run-down store) and in the willingness to travel to receive a fixed discount depending on the size of the purchase (a cheap vs. an expensive computer) were smaller among those with low personal incomes. In a large-scale preregistered experiment ($N$ = 3,442), we tested whether scarcity framed value during the COVID-19 pandemic as well. The sample exhibited the canonical context effects overall. Consistent with the hypothesis, these effects tended to be smaller among those facing higher scarcity of personal income. Extending the original findings, economic valuations of low-income earners improved, particularly when scarcity was on the minds of the participants, as those with high financial and other resource scarcity concerns were less susceptible to the context effects. Our findings indicate that scarcity frames value, especially when it is cognitively salient, and emphasize the importance of considering contextual factors when attempting replications.



## 1. Introduction

Classic theories of rational choice conceive individuals as optimizing machines, with perpetual cost-benefit calculations based on stable perceptions of economic value immune from the influence of irrelevant contextual features (Robbins, 1932; Savage, 1954; Von Neumann & Morgenstern, 1944). The accumulated evidence on our natural cognitive limitations and bi-

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* Corresponding author
*E-mail address:* o.isler@uq.edu.au (O. Isler).

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ases has shown this mechanistic view of rationality to be inadequate (Simon, 1990; Tversky & Kahneman, 1974), motivating a paradigmatic shift towards psychologically realistic theories and experimental methods that culminated in modern behavioral economics (Kahneman & Tversky, 1979; Simon, 1955; Thaler, 2015).

It is now well-established that normatively irrelevant contextual features routinely affect inferences about economic value (Tversky & Kahneman, 1981). For example, in the beer-on-the-beach scenario, people systematically report higher willingness-to-pay (WTP) for the same bottle of beer that would be consumed at the same beach when it is purchased from a fancy hotel than when it is purchased from a run-down grocery store (Thaler, 1985). Likewise, in the so-called proportional thinking scenario, the willingness-to-travel (WTT) thirty minutes to receive a $50 discount predictably decreases with the original price of the discounted item, even though the distance to be traveled and the money to be saved remain constant (Tversky & Kahneman, 1981). These robust demonstrations of the context-dependency of economic value judgments have become canonical exhibits of how the classic view of *homo economicus* can systematically fail to predict actual human behavior.

On the other hand, recent research on the psychology of scarcity is beginning to paint a more nuanced picture regarding the validity of the standard theories of economic decision-making (for overviews of the literature, see Isler, 2020; Mullainathan & Shafir, 2013; Zhao & Tomm, 2018). In an influential article, Shah et al. (2015) hypothesized that "scarcity frames value", positing that resource scarcity improves economic valuations as they become less influenced by irrelevant contextual features. The article showed, across numerous studies, including original tests as well as several direct and conceptual self-replications, that people with tighter budgets were less biased by contextual factors in tasks such as the canonical beer-on-the-beach and proportional thinking scenarios described above. These results identified an important moderator—income scarcity—as regulating not only the influence of contextual features on the psychology of economic choice but also the applicability of the classic accounts of rational choice. Consistent with the idea that scarcity focuses attention on economic valuations, it has been shown elsewhere that the inducement of a scarcity mindset activates the neural networks underlying processes of economic valuation more so than the inducement of an abundance mindset (Huijsmans et al., 2019). Overall, these findings suggest that pressing resource needs increase the relevance of economic trade-offs and the efficient use of scarce resources.

Although the hypothesis that "scarcity frames value" is crucial for understanding the nature of decision-making, with significant implications for economics and beyond, independent attempts to replicate the findings of Shah et al. (2015) underlying this hypothesis have been rare. In the only published article with an independent test of Shah et al. (2015), O'Donnell et al. (2021) randomly chose one of the original studies in it—namely, Study 6 on the effects of time scarcity—and failed to replicate it. It is difficult to generalize the results of this failure to the overall findings of Shah et al. (2015) because of the random selection of Study 6. Previously, Camerer et al. (2018) had failed to replicate one of the earlier studies on the psychology of scarcity—one that introduced the idea that scarcity can lead to over-borrowing through cognitive fatigue (Shah et al., 2012). In response, Shah et al. (2018) argued that the failed replication attempt by Camerer et al. (2018) included a single, non-critical study of the original article and showed that, while the non-critical study is indeed difficult to replicate, the critical studies in this original article do successfully replicate (Shah et al., 2019).

These episodes show that independent replication projects can significantly benefit from communicating with the authors of the original study prior to data collection to receive their views on the suitability of the materials and any other features required for direct replication. The authors of the original study can help identify the studies in the original article critical for hypothesis testing. In addition, this communication provides an opportunity for the authors of the original study to voice (and even preregister) any concerns regarding potential confounds as well as contextual factors that can invalidate a replication attempt. Hence, we consulted the corresponding author (A. K. Shah) of Shah et al. (2015) and received continued constructive feedback on our study.

This feedback indicated that tests of the main hypothesis that "scarcity frames value" should be based on Study 1d and Study 2c, since they are the key studies in the original article. In these studies, 2,015 participants from the US were recruited online to complete the beer-on-the-beach and proportional thinking scenarios in counterbalanced order. The two studies are particularly insightful because they provide large-scale internal replications using a representative sample to demonstrate the moderation of context effects by personal income in two canonical tasks from the judgment-and-decision-making literature. Therefore, we planned to run high-powered independent tests of Study 1d and Study 2c in Shah et al. (2015).

In our initial consultation, the corresponding author also raised concern that a direct replication of Shah et al. (2015) may be prevented or confounded by the significant impact of the COVID-19 pandemic on threat perceptions and norms of behavior. For example, the pandemic could heighten health threat concerns, which could be particularly acute among the poor. This could mute, add noise, or alter how income scarcity frames value in the COVID-19 context. Likewise, pandemic-related shifts in behavior (e.g., travelling, in-store shopping, socializing at the beach, etc.) could influence how participants interpret and react to the scenarios used in the study. We concurred that a substantial change in the decision context due to the COVID-19 pandemic could prevent a direct replication of the original study. Therefore, we postponed data collection for more than one calendar year, until March 2022, for the severity and unfamiliarity of the pandemic to subside. In addition, we measured COVID-19-related resource and health threat perceptions in the survey to check and account for the impact of the pandemic on perceptions and economic valuations. Because our control measures and exploratory analyses indicated a substantial influence of the COVID-19 context (see Sections 3.1 & 3.3), rather than a direct replication of Shah et al. (2015), we interpret our study as testing whether resource scarcity improves economic valuations in the context of the COVID-19 pandemic.

In Study 1d of Shah et al. (2015), which includes the beer-on-the-beach scenario, participants are randomly assigned to one of two conditions where the beer is bought either from "a fancy resort hotel" or "a small, run-down grocery store", and WTP for the beer is elicited in an open-ended question. In Study 2c of Shah et al. (2015), which uses the proportional thinking scenario, participants are randomly assigned to one of three conditions, where the original price of the discounted item is \$300, \$500 or \$1000, and WTT for a discount of \$50 is elicited in a binary-choice question. Study 1d and Study 2c successfully demonstrated the canonical context effects, whereby WTP for a beer was higher when it was bought from a fancy resort than when it was bought from a grocery store, and WTT increased as the original price of the discounted good decreased (i.e., as the proportional size of the discount increased). Crucially, in both studies by Shah et al. (2015), the differences in WTP and WTT across the experimental conditions were smaller among those with lower personal incomes. We tested the following two hypotheses, initially proposed by Shah et al. (2015), in the context of the COVID-19 pandemic:

$H_1$: In the beer-on-the-beach scenario, the difference in WTP for beer between the fancy resort and the grocery store conditions is smaller for participants with lower personal incomes.

$H_2$: In the proportional thinking scenario, the difference in WTT to receive a \$50 discount for a cheaper than for a more expensive computer is smaller for participants with lower personal incomes.

## 2. Method

The experiment includes tests of Study 1d and Study 2c in Shah et al. (2015) in the context of the COVID-19 pandemic. We obtained ethics approval from the Queensland University of Technology Human Research Ethics Committee and informed consent from every subject prior to participation. The experiment was preregistered at the Open Science Framework (OSF; https://osf.io/xuc9m). The experimental materials are available in the Supplementary Information, and the dataset and the analysis code are available at the OSF project site (https://osf.io/kdfjn/).

### 2.1. Power analysis

Because each participant would complete both scenarios, as in Shah et al. (2015), the sample size estimation could be based on the effect size of only one of them. Therefore, we used the scenario with the smaller effect size to estimate our sample size, which is the beer-on-the-beach scenario reported in Study 1d by Shah et al. (2015). The reported effect size of the interaction between income group (formed by the median-split of personal income) and decision context in a two-way ANOVA model was $\eta_p{}^2 = 0.003$. To detect an effect size of this magnitude with $\alpha = 0.05$ and $1 - \beta = 0.90$, we estimated using G*Power 3.1.9.2 that our sample should consist of at least 3,494 participants (Faul et al., 2009).

### 2.2. Participants

Study 1d and Study 2c by Shah et al. (2015) collected a representative online sample of US respondents from Survey Sampling International (renamed Dynata). To achieve a comparable analysis sample, we recruited US residents online and used pre-screening criteria to match the three key demographic features of the original studies (i.e., household income, household size, and participant gender). To do so, we recruited participants from Prolific (https://www.prolific.co/), which allows pre-screening of participants based on a previously completed demographic survey, including questions on household income ("What is your total household income per year, including all earners in your household [after tax] in USD?") and household size ("Including you, how many people live in your household?"). Participants were recruited to eight mutually exclusive subgroups defined by two household income brackets ("less than \$60,000" and "more than or equal to \$60,000"), two household size categories ("less than 3" and "3 or more"), and gender ("male" and "female"). For example, 56.8% of the sample analyzed in Studies 1d and 2c by Shah et al. (2015) reported household income levels of less than \$60,000. Among these participants, 52.9% reported living alone or with one other person. Among households with incomes less than \$60,000 and sizes less than 3, 52.3% were male—a subgroup consisting of 298 participants (15.7% of the overall analysis sample). Accordingly, we aimed to recruit 15.7% of our sample (i.e., 549 participants) to include males from households with annual incomes less than \$60,000 and a size of fewer than three people. Considering potential outliers, we aimed to recruit five additional participants for each subgroup. Hence, the target sample size for each subgroup (SG) was as follows: SG1) 554 (income $<$ \$60,000; household size $<$ 3; male); SG2) 506 (income $<$ \$60,000; household size $<$ 3; female); SG3) 353 (income $<$ \$60,000; household size $>$ 2; male); SG4) 591 (income $<$ \$60,000; household size $>$ 2; female); SG5) 329 (income $\geq$ \$60,000; household size $<$ 3; male); SG6) 265 (income $\geq$ \$60,000; household size $<$ 3; female); SG7) 449 (income $\geq$ \$60,000; household size $>$ 2; male); SG8) 488 (income $\geq$ \$60,000; household size $>$ 2; female). In addition, we restricted recruitment to English speakers who were 18 years or older at the time of the study and whose Prolific scores were at least 90 (to exclude those who consistently failed to complete studies or complied with the instructions). All subgroups except SG1 achieved their target sample sizes by the end of the preregistered five-day data collection period. Since gender is orthogonal to the original hypotheses, 42 observations missing in SG1 were filled by additional recruitment to SG2 prior to data analysis. Excluding 91 outliers on income and response quality (see section 2.4 for details), the analysis sample includes 3,442 unique and complete submissions ($M_{age} = 36.91$, $SD_{age} = 14.17$; 53.8% female). Participants earned a participation fee of \$0.50.

### 2.3. Materials and procedure

Our study closely followed the materials and procedures of Shah et al. (2015). As in the original article, after receiving informed consent, each participant completed the beer-on-the-beach scenario (Study 1d in Shah et al., 2015) and the proportional thinking scenario (Study 2c in Shah et al., 2015) in random order. Participants then completed a demographic survey to measure personal income, followed by three questionnaires on financial concerns, COVID-19 health and resource scarcity threat perceptions, and financial literacy.

#### 2.3.1. The beer-on-the-beach scenario

The question in this task, originally used in Thaler (1985), asked participants, "What price do you tell him?" after the description, "You are lying on the beach on a hot day. All you have to drink is ice water. For the last hour you have been thinking about how much you would enjoy a nice cold bottle of your favorite brand of beer. A companion gets up to go make a phone call and offers to bring back a beer from the only nearby place where beer is sold ([…]). He says that the beer might be expensive and so asks how much you are willing to pay for the beer. He says that he will buy the beer if it costs as much or less than the price you state. But if it costs more than the price you state he will not buy it. You trust your friend, and there is no possibility of bargaining with the bartender." Participants were randomly assigned to one of two conditions where, in place of the square brackets above, it was written that the beer is sold either at "a fancy resort hotel" or "a small, run-down grocery store". An open-ended numerical response was elicited.

#### 2.3.2. The proportional thinking scenario

The question in this task, adapted by Shah et al. (2015) from Tversky and Kahneman (1981) and the original version used by Thaler (1980), asked participants whether they would be willing to travel to a distant store to buy a discounted computer, with the description "Imagine that you go to the store to buy a tablet computer that costs […]. The clerk informs you that a store thirty minutes away sells the same tablet computer for $50 less. Would you go to the other store to buy the tablet computer or would you buy it at the current store?" Participants were randomly assigned to one of three conditions where the cost of the computer was described, in place of the square brackets above, as either "$300", "$500" or "$1000". Participants chose their answers from one of two options ("I would buy it at the current store." or "I would travel to the other store to buy it.").

#### 2.3.3. Personal income

Shah et al. (2015) found that personal income moderates the context effects. As in the original article, two questions were used to estimate personal income: household size ("Including you, how many people live in your household?") and annual household income ("What is your total household income per year, including all earners in your household [after tax] in USD?"). The information for estimating personal income (household income and size) was collected twice: (1) initially measured by Prolific and used for quota sampling in our study (see Section 2.2), and (2) measured a second time in the demographic survey of the current study to have updated values for these variables (together with the same questions on gender, age, ethnicity, and education used in the original study). As preregistered, all analyses using personal income are based on the updated values of household income and size. Median annual household incomes were equivalent ($MD$ = $55,000), and mean household sizes were similar between the original ($M$ = 2.76) and the replication study ($M$ = 2.73). Personal income was calculated by taking the midpoint of the income bin selected by the participant ($150,000 for the highest, open-ended, bin) and dividing it by the square root of household size. This measure is based on the equivalence transformation used by the OECD (2008), which takes into account economies of scale in household needs (i.e., decreasing rate of increase in needs with each additional household member).

#### 2.3.4. COVID-19 threat perceptions

To explore the influence of the COVID-19 pandemic on threat perceptions and economic valuations, two questions, one on resource scarcity and another on health threat perceptions, were asked in random order using scales ranging from 0 ("Not at all") to 100 ("Very much"):

> "In this study, you considered two scenarios where you were asked how much you are willing to pay for a bottle of beer and whether you are willing to travel to a distant store to buy a discounted tablet computer. While completing these two scenarios, (1) to what extent did scarcity of material resources (such as lack of goods and services) or scarcity of financial resources (such as inadequate income or savings) due to the COVID-19 pandemic come to your mind, and (2) to what extent did risks to your personal health due to the COVID-19 pandemic come to your mind?".

The average of ratings on these two questions gives the COVID-19 threat perceptions score ($M$ = 17.33, $SD$ = 22.62, Cronbach $\alpha$ = .72), but we explore the resource scarcity threat and the health threat components separately as well.

#### 2.3.5. Financial concerns

Using a scale ranging from 1 ("Strongly disagree") to 7 ("Strongly agree"), the financial concerns scale included four questions about financial stress that were taken from Kim and Garman (2003) and a fifth question that was about financial preparedness: (1) "I am satisfied with my present financial situation" (reverse coded), (2) "My income is enough for me to

meet my monthly living expenses" (reverse coded), (3) "I worry about how much money I owe," (4) "I am satisfied with the amount of money that I am saving and investing for retirement" (reverse coded), and (5) "I am financially unprepared for negative life-events such as severe sickness, serious injury or long-term unemployment." The sum of ratings on the five questions gives the financial concerns score ($M = 20.95$, $SD = 7.80$, Cronbach $\alpha = .86$). A sixth item was added as an attention check: (6) "This is an attention check. Please choose "Strongly agree" as a condition of successful completion."

#### 2.3.6. Financial literacy

Various aspects of financial literacy were measured with the financial literacy test taken from Isler et al. (2022). The test includes five multiple choice questions about annual and compound interest, inflation, risk diversification, and loans: (1) "Suppose you had $100 in a savings account without bank fees and the interest rate was 2% per year. How much would you have in the account after 1 year?" (Correct answer: $102), (2) "Imagine that the interest rate on your savings account was 1% per year and inflation was 2% per year. After 1 year, how much would you be able to buy with the money in this account?" (Less than today), (3) "'An investment with a high return is likely to be high risk.' Is this statement true or false?" (True), (4) "Suppose you had $200 in a savings account without bank fees and the interest rate was 10% per year. How much would you have in the account after 2 years?" (More than $240), (5) "Suppose you need to loan $1000 from your bank. You have the option to repay the loan in either 2 or 3 years. Suppose that the interest rate is the same in either option. Which of the following is correct?" (The monthly repayments will be lower, and the total interest paid will be higher for the 3-year loan). The total number of correct answers on the test gives the financial literacy score ($M = 3.55$, $SD = 1.33$, Cronbach $\alpha = .58$).

### 2.4. Analysis plan

#### 2.4.1. Excluding outliers

Shah et al. (2015) excluded outliers on income and response quality by omitting participants with personal incomes less than $2,050 or WTPs larger than $20 from tests of Study 1d and 2c. Considering the cumulative inflation of 19% in the US for the period 2014-2022 between the original study and ours, we excluded 91 participants with personal incomes less than $2,440 or WTPs larger than $24 from all analyses.[1]

#### 2.4.2. Control measures

We measured COVID-19 resource scarcity and health threat perceptions and compared them across the low- and high-income groups to check whether the COVID-19 pandemic resulted in a decision-making context that is significantly different than Shah et al. (2015). In addition, we planned for two controls to check whether our sample is representative in exhibiting the commonly observed effects of decision context in the two scenarios: (1) a significant effect of decision context in the beer-on-the-beach scenario, such that WTP for beer from the resort hotel is higher than for beer from the grocery store, thereby replicating the commonly observed differences in "transaction utility" (Thaler, 1985), and (2) a significant effect of decision context in the proportional thinking scenario, such that WTT to receive a $50 discount is more likely for a cheaper than for a more expensive computer, thereby replicating the commonly observed "proportional thinking" effect (Thaler, 1980).

#### 2.4.3. Hypothesis Testing

Using the same approach as in Shah et al. (2015), we planned to test each hypothesis twice, once comparing lower- vs. higher-income groups defined by the median-split of personal income ($MD = 38{,}013$) and a second time using the continuous log-transformed personal income variable (to control for the expected positive skew in the distribution of this variable). For $H_1$, we planned to test for the interaction between personal income and decision context in two-way ANOVAs on WTP. For $H_2$, we planned to test for the interaction between personal income and decision context using Wald tests in binary logistic regressions on WTT. We preregistered that, together with the canonical context effects tested as part of the control measures, statistically significant interaction effects indicating that the differences in WTP and WTT increase with personal income would be interpreted as providing evidence for $H_1$ and $H_2$.

#### 2.4.4. Exploratory analysis

We preregistered additional analyses to explore the potential moderators of the predicted context effects. We expected greater financial concerns, COVID-19 scarcity and health threat perceptions, and financial literacy to decrease the influence of decision context.

[1] Although the criteria for determining outliers were not documented in the preregistration, their exclusion allows consistency with the analyses in the original article. Neither the inclusion of outliers nor the exclusion of those who fail the attention check question changes any of the preregistered control measures or hypothesis test results, but the effect sizes tend to be larger without the outliers (see Supplementary Information).

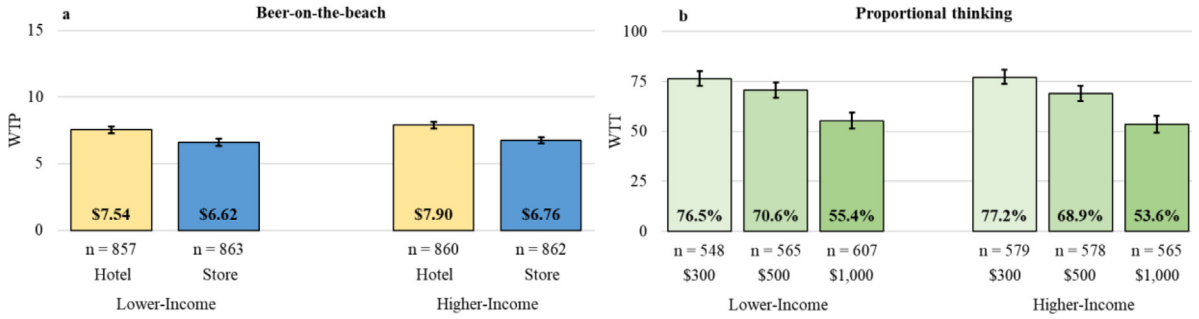


**Fig. 1.** **(a)** Willingness to pay (WTP) in the beer-on-the-beach scenario and **(b)** willingness to travel (WTT) in the proportional thinking scenario across the experimental conditions compared between lower- and higher-income groups found by splitting the analysis sample (excluding outliers) at the median personal income. Error bars indicate 95% confidence intervals.

## 3. Results

### *3.1. Control measures*

The COVID-19 threat perception measures indicated that the pandemic presents a substantially different decision context than that of Shah et al. (2015). Nevertheless, our analysis sample exhibited the canonical effects of context on economic valuations in both scenarios.

#### *3.1.1. COVID-19 threat perceptions*

The low-income participants expressed consistently higher threat perceptions ($M$ = 19.94 vs. 14.71; $t(3440) = 6.82$, $p < .001$, $d = 0.23$) than the high-income participants both overall as well as when considering health ($M$ = 14.34 vs. 11.30; $t(3440) = 3.94$, $p < .001$, $d = 0.13$) and resource scarcity threat perceptions separately ($M$ = 25.54 vs. 18.12; $t(3440) = 7.78$, $p < .001$, $d = 0.27$).

#### *3.1.2. The beer-on-the-beach scenario*

WTP for beer was on average $1.03 higher if bought from a resort hotel ($M$ = 7.72, 95% CI = [7.54, 7.90]) than if bought from a grocery store (6.69 [6.51, 6.88]). This difference is statistically significant (two-sample $t$-test: $t(3440) = 7.90$, $p < .001$, $d = 0.27$) and nearly the same as the difference found in Study 1d of Shah et al. (2015) ($6.50 for the hotel and $5.62 for the store) after adjusting for the cumulative inflation of 19% (i.e., $1.02).

#### *3.1.3. The proportional thinking scenario*

WTT to receive a $50 discount decreased by an overall 22.3 percentage points (pp) as the original price of the discounted item increased: 76.8% [74.3, 79.3] for the $300 computer, 69.7% [67.0, 72.4] for the $500 computer, and 54.5% [51.6, 57.4] for $1,000 the computer. These differences are statistically significant (Pearson's chi-square test: $\chi^2(2, n = 3442) = 135.47$, $p < 0.001$) and larger than the overall 17.6% difference found in Study 2c of Shah et al. (2015) (70.9% for the $300 computer, 68.2% for the $500 computer, and 53.3% for the $1,000 computer).

### *3.2. Hypothesis tests*

Although the trends were in the predicted directions, the preregistered statistical tests showed no clear evidence for either of the hypotheses that scarcity frames value during the COVID-19 pandemic. Fig. 1a displays the average WTP in the beer-on-the-beach scenario, and Fig. 1b displays the WTT rates in the proportional thinking scenario across the income groups and the experimental conditions.

#### *3.2.1. The beer-on-the-beach scenario*

As in the original study, higher-income participants' willingness to pay for beer from the hotel (7.90 [7.66, 8.14]) was higher than for beer from the store (6.76 [6.53, 7.00]), $t(1720) = 6.54$, $p < .001$, $d = 0.32$. Unlike the original study, lower-income participants also showed higher WTP for beer from the hotel (7.54 [7.29, 7.79]) than for beer from the store (6.62 [6.33, 6.90]), $t(1718) = 4.74$, $p = .019$, $d = 0.23$. While the estimated effect size was smaller for the lower-income participants than for the higher-income participants, failing to support $H_1$, the interaction between income group and context was not significant, $F(1, 3438) = 0.69$, $p = .408$, $\eta_p^2 < .001$. The interaction remained insignificant when personal income was treated continuously, $F(1, 3438) = 1.02$, $p = .313$, $\eta_p^2 < .001$.

*3.2.2. The proportional thinking scenario*

The willingness to travel to receive a $50 discount decreased as the original price of the discounted item increased for both the higher-income ($\chi^2(2, n = 1722) = 73.39$, $p < 0.001$) and the lower-income participants ($\chi^2(2, n = 1720) = 62.85$, $p < 0.001$). Specifically, WTT rates were 77.2% [73.6, 80.6], 68.9% [64.9, 72.6], and 53.6% [49.4, 57.8] among higher-income participants and 76.5% [72.7, 80.0], 70.6% [66.7, 74.3], and 55.4% [51.3, 59.4] among lower-income participants when the price of the computer was $300, $500, and $1,000. While the overall difference in WTP was smaller for the lower-income participants (21.1 pp) than for the higher-income participants (23.6 pp), failing to support $H_2$, the interaction between personal income and context was not significant either when comparing income groups split at the median (Wald-tests: $\chi^2(1, n = 3442) = 0.28$, $p = 0.596$) or when treating income as continuous ($\chi^2(1, n = 3442) = 2.49$, $p = 0.114$).

*3.3. Exploratory analysis*

Fig 1. above is suggestive of trends in the expected direction (i.e., weaker context effect among the lower income group), but these differences were not enough to reach statistical significance. Extending the original hypothesis, we explored whether resource scarcity needs to be cognitively salient for it to improve economic valuations. For this, we estimated modified versions of the statistical models used in hypothesis testing by replacing the personal income variable with the relevant perception measure (i.e., the potential moderator) and tested for the interaction between it and the decision context. We then studied the moderation effect of these perception measures separately among the lower-income and the higher-income groups as defined by median personal income.

*3.3.1. Perceived resource scarcity*

To explore the moderating role of how scarcity is perceived, we used the financial concerns score and the COVID-19 scarcity and health threat perceptions score. The two perception measures were positively correlated ($r = .15$, $p < .001$). These analyses revealed that the effect of decision context weakened with increased scarcity perceptions (see Fig. 2a-b), and this effect tended to be stronger among the lower-income participants.

In the beer-on-the-beach scenario, the effect of context on WTP was larger among those with below-median than those with above-median financial concerns ($d = 0.35$ vs. 0.19; interaction: $F(1, 3438) = 4.27$, $p = .039$, $\eta_p^2 = .001$) and threat perceptions ($d = 0.38$ vs. 0.17; $F(1, 3438) = 7.63$, $p = .006$, $\eta_p^2 = .002$). The influence of financial concerns was stronger among the lower-income ($d = 0.38$ vs. 0.16; $F(1, 1716) = 3.44$, $p = .064$, $\eta_p^2 = .002$ [$F(1, 1716) = 5.95$, $p = .015$, $\eta_p^2 = .003$ when financial concerns are continuous]) than among the higher-income group ($d = 0.34$ vs. 0.26; $F(1, 1718) = 0.72$, $p = .395$, $\eta_p^2 < .001$) and the moderating role of threat perceptions was stronger among the lower-income ($d = 0.38$ vs. 0.12; $F(1, 1716) = 5.84$, $p = .016$, $\eta_p^2 = .003$) than among the higher-income group ($d = 0.38$ vs. 0.24; $F(1, 1718) = 1.98$, $p = .156$, $\eta_p^2 < .001$).

Similarly, in the proportional thinking scenario, the effect of context on WTT was significantly larger among those with below-median than those with above-median threat perceptions ($\chi^2 = 109.01$ vs. 36.31; $\chi^2(1, n = 3442) = 8.95$, $p = .003$). The influence of threat perceptions was stronger among the lower-income ($\chi^2 = 49.52$ vs. 19.53; $\chi^2(1, n = 1720) = 5.39$, $p = .020$) than among the higher-income group ($\chi^2 = 59.71$ vs. 18.15; $\chi^2(1, n = 1722) = 3.43$, $p = .064$). While the comparison of participants with above- and below-median financial concerns showed a similar trend ($\chi^2 = 89.86$ vs. 50.03), this difference was not statistically significant ($\chi^2(1, n = 3442) = 2.09$, $p = .148$).

To focus on the low-income group, where the influence of perceptions on economic valuations was most visible, we considered the two components of our COVID-19 threat perceptions measure separately (i.e., resource scarcity threat and health threat). In the beer-on-the-beach scenario, we found significant improvement in economic valuations by resource scarcity threat perceptions ($F(1, 1716) = 4.70$, $p = .030$, $\eta_p^2 = .003$) but not by health threat perceptions ($F(1, 1716) = 2.72$, $p = .099$, $\eta_p^2 = .002$). In the proportional thinking scenario, both perception measures showed a positive influence on economic valuations (resource scarcity threat perceptions: $\chi^2(1, n = 1720) = 7.82$, $p = .005$; health threat perceptions: $\chi^2(1, n = 1720) = 5.21$, $p = .023$).

*3.3.2. Financial literacy*

Additional exploratory analysis revealed that the effect of decision context increased with financial literacy (see Fig. 2c), which occurred particularly among the lower-income participants. Overall, the context effects were larger among those with above-median than those with below-median financial literacy in both the beer-on-the-beach ($d = 0.44$ vs. 0.09; $F(1, 3438) = 19.03$, $p < .001$, $\eta_p^2 = .006$) and the proportional thinking scenarios ($\chi^2 = 109.22$ vs. 32.81; $\chi^2(1, n = 3442) = 7.10$, $p = .008$). These differences were more pronounced among the lower-income group (beer-on-the-beach: $d = 0.50$ vs. 0.03; $F(1, 1716) = 18.91$, $p < .001$, $\eta_p^2 = .011$; proportional thinking: $\chi^2 = 48.95$ vs. 18.14; $\chi^2(1, n = 1720) = 5.11$, $p = .024$) than among the higher-income group (beer-on-the-beach: $d = 0.39$ vs. 0.20; $F(1, 1718) = 2.24$, $p = .134$, $\eta_p^2 = .001$; proportional thinking: $\chi^2 = 50.50$ vs. 14.97; $\chi^2(1, n = 1722) = 2.01$, $p = .157$).

## 4. Discussion

We tested whether scarcity framed value during the COVID-19 pandemic. Although context effects tended to decrease with the scarcity of personal income as in the original studies of Shah et al. (2015), our hypothesis tests failed to find clear

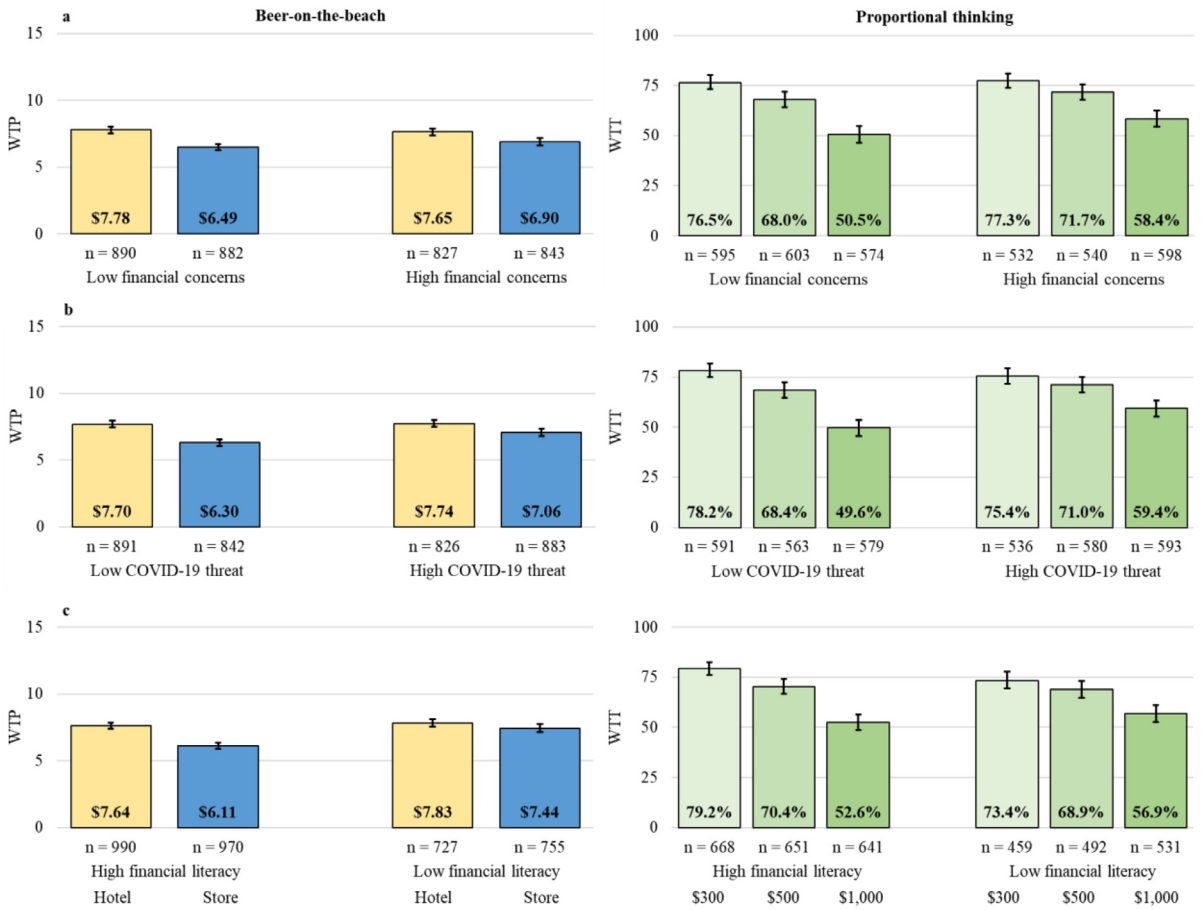


**Fig. 2.** Willingness to pay (WTP) in the beer-on-the-beach scenario (left panels) and willingness to travel (WTT) in the proportional thinking scenario (right panels) across the experimental conditions compared between low and high groups found by splitting the sample at the medians of **(a)** financial concerns scores, **(b)** COVID-19 scarcity and health threat perceptions scores, and **(c)** financial literacy scores in the analysis sample excluding outliers. Error bars indicate 95% confidence intervals.

statistical evidence that resource scarcity, as operationalized by personal income, improved economic valuations amidst the pandemic. However, our preregistered exploratory tests revealed that context effects were weaker when scarcity was cognitively salient. Specifically, participants with higher financial concerns and COVID-19-related resource scarcity threat perceptions made better economic valuations, especially if they were in the low-income group. These results not only confirm but also extend the original hypothesis by showing that scarcity frames value in particular when it is cognitively salient.

### *4.1. Implications*

The concept of scarcity is foundational to modern economic science, often defined as the study of the efficient use of scarce resources (Robbins, 1932). Despite the close theoretical link between resource scarcity and economic theory, the psychology of scarcity remains relatively neglected in economics. However, an emerging literature in behavioral and psychological sciences shows that resource scarcity can profoundly affect decision-making by creating a "scarcity mindset" (Isler, 2020; Mullainathan & Shafir, 2013).

On the one hand, resource scarcity can worsen financial decision-making by taxing cognitive resources (Mani et al., 2013), for example, increasing overborrowing among the poor due to attentional neglect about future outcomes (Shah et al., 2012). On the other hand, scarcity can increase the efficiency of resource use by allowing a focus on current and more pressing needs. For example, scarcity can focus the mind on how to make ends meet, thereby decreasing the influence of normatively irrelevant contextual features (Shah et al., 2015). Hence, the accuracy of rational choice theories in describing actual human behavior depends on their ability to incorporate these contrasting effects of scarcity on the psychology of value.

In this study, we focused on the latter, efficiency-improving effects of resource scarcity. Shah et al. (2015) showed that lower-income participants tend to form more stable economic valuations across normatively irrelevant variations in the

decision contexts of the beer-on-the-beach and proportional thinking scenarios compared with higher-income participants, for example, offering more consistent prices for a beer bought from a fancy resort hotel than a beer bought from a run-down grocery store. Although our comparisons of high- vs. low-income participants revealed trends generally in the same direction as the original findings, the effect sizes were smaller and not statistically significant.

However, our preregistered exploratory analyses revealed that rather than merely the objective features of resource scarcity, such as personal income, it is the cognitively salient aspects of resource scarcity at the moment of decision-making that frame value. At first, this might seem like a straightforward result: the effect of resource scarcity on individual behavior must involve the perception of this scarcity. However, similar levels of actual resource scarcity can be perceived very differently at the moment of decision-making, which can influence openness to context effects. A similar finding is reported by Isler et al. (2020) regarding the difference between objective and subjective health threats: hospital patients categorized by medical experts as being at high-risk of influenza-related illnesses were more likely to get vaccinated, but only if they perceived themselves to be at high-risk. The cognitively salient aspects of the decision-making context will vary across studies. In the present study, susceptibility to context effects was significantly weaker among those with higher financial concerns and COVID-19-related scarcity and health threat perceptions. In this sense, our study supports and extends the original hypothesis by introducing a critical contextual moderator (i.e., perceptions of resource scarcity) in framing value.

This contribution highlights how replication studies can benefit from corresponding with the authors of the original study prior to data collection. Their feedback not only allowed us to identify the studies in the original article critical for hypothesis testing but also allowed them to voice and, in a sense, preregister their concerns regarding the potential influence of the COVID-19 pandemic. Indeed, despite waiting until the late stages of the pandemic (March 2022) for data collection, COVID-19-related resource scarcity and health threat perceptions influenced participants' openness to the influence of context effects in important ways.

Relatedly, we also recommend consideration of potentially significant contextual differences between the original and the replication studies prior to data collection so that these features of the decision context can be measured and taken into account (e.g., via relevant survey measures and statistical tests). Changes in threat perceptions (e.g., due to pandemics, wars, economic crises) can significantly affect human behavior (Van Bavel et al., 2020). These perception measures can also provide new insights into replication attempts, as they did in our case.

Our preregistered exploratory analyses also suggested a moderating role for financial literacy, but its direction was opposite to our initial expectations. Because financial literacy is associated with cognitive reflection and avoidance of errors in financial decisions (Isler et al., 2022), we predicted that economic valuations would be more consistent among those with higher financial literacy, but the observed association was negative. In any case, such surface associations can be misleading because other, more influential, moderators could be driving the results *despite* increases in financial literacy. In particular, financial literacy was positively associated with personal income ($r = .23$, $p < .001$) and negatively associated with financial concerns ($r = -.15$, $p < .001$) and COVID-19 threat perceptions ($r = -.15$, $p < .001$). Likewise, this finding is compatible with the argument that, although most well-established cognitive biases (e.g., confirmation bias, base-rate neglect, etc.) increase with spontaneous decisions, in some situations (e.g., experience formed with regular and accurate feedback), heuristics can improve performance (Gigerenzer, 2008; Isler & Yilmaz, 2019). It can be that those low on financial literacy rely on heuristics that allow higher consistency across contexts—a possibility that can be further examined.

### *4.2. Limitations and Future Directions*

The present study, like the original studies of Shah et al. (2015), is limited by its correlational design, which prevents clear causal inference. Despite its important implications for the science of economics, causal tests of the hypothesis that scarcity frames value have been lacking (for an exception regarding the effects of time scarcity, see Study 6 in Shah et al., 2015). Future studies should experimentally test this hypothesis by manipulating resource scarcity or, as our novel findings suggest, by manipulating its cognitive saliency. Similarly, the cross-cultural stability of this effect remains relatively unknown. The original studies as well as ours are restricted to Western, educated, industrialized, rich and democratic (i.e., WEIRD) samples (Henrich et al., 2010), and replications in different cultural contexts are needed before making generalizations about the underlying hypothesis.

### *4.3. Conclusion*

The hypothesis that scarcity frames value is critical for economics and other behavioral sciences. While a standard approach has been to posit that individual perceptions of economic value are stable, Shah et al. (2015) showed that resource scarcity can affect economic valuations. Our findings further qualify this boundary condition by suggesting that scarcity frames value, in particular, when it is cognitively salient. Future research on this hypothesis can help reconcile some of the inconsistencies between the normative predictions of rational choice theories and actual human behavior.

## Declaration of Competing Interest

none

## Data availability

The experimental materials are available in the Supplementary Information, and the dataset and the analysis code are available at the OSF project site (https://osf.io/kdfjn/).

## Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jebo.2023.02.019.

## References


Camerer, C.F., Dreber, A., Holzmeister, F., Ho, T.H., Huber, J., Johannesson, M., Kirchler, M., Nave, G., Nosek, B.A., Pfeiffer, T., Altmejd, A., Buttrick, N., Chan, T., Chen, Y., Forsell, E., Gampa, A., Heikensten, E., Hummer, L., Imai, T., … Wu, H., 2018. Evaluating the replicability of social science experiments in Nature and Science between 2010 and 2015. Nat Hum Behav 2 (9), 637–644. doi:10.1038/s41562-018-0399-z.

Faul, F., Erdfelder, E., Buchner, A., Lang, A., 2009. Statistical power analyses using G* Power 3.1: Tests for correlation and regression analyses. Behavior Research Methods 41, 1149–1160.

Gigerenzer, G., 2008. Why heuristics work. Perspectives on Psychological Science 3, 20–29.

Henrich, J., Heine, S.J., Norenzayan, A., 2010. Most people are not WEIRD. Nature doi:10.1038/466029a.

Huijsmans, I., Ma, I., Micheli, L., Civai, C., Stallen, M., Sanfey, A.G., 2019. A scarcity mindset alters neural processing underlying consumer decision making. Proc Natl Acad Sci U S A 116 (24), 11699–11704. doi:10.1073/pnas.1818572116.

Isler, O, 2020. Resource Scarcity. In: Shackelford, T.K., Weekes-Shackelford, V.A. (Eds.), Encyclopedia of Evolutionary Psychological Science. Springer International Publishing, pp. 1–3. doi:10.1007/978-3-319-16999-6_1585-1.

Isler, O., Isler, B., Kopsacheilis, O., Ferguson, E., 2020. Limits of the social-benefit motive among high-risk patients: a field experiment on influenza vaccination behaviour. BMC Public Health 20 (1), 1–9.

Isler, O., Rojas, A., Dulleck, U., 2022. Easy to shove, difficult to show: Effect of educative and default nudges on financial self-management. Journal of Behavioral and Experimental Finance 34. doi:10.1016/j.jbef.2022.100639.

Isler, O., Yilmaz, O., 2019. Intuition and deliberation in morality and cooperation: an overview of the literature. In: Liebowitz, J. (Ed.), Developing informed intuition for decision-making. Taylor & Francis, pp. 101–113.

Kahneman, D., Tversky, A., 1979. Prospect Theory: An Analysis of Decision under Risk. Econometrica 47, 263–291. doi:10.2307/1914185.

Kim, J., Garman, E.T., 2003. Financial stress and absenteeism: An empirically derived research model. Financial Counseling and Planning 14 (1), 1–12.

Mani, A., Mullainathan, S., Shafir, E., Zhao, J., 2013. Poverty impedes cognitive function. Science 341 (6149), 976–980.

Mullainathan, S., Shafir, E., 2013. Scarcity: Why having too little means so much. Time Books.

O'Donnell, M., Dev, A.S., Antonoplis, S., Baum, S.M., Benedetti, A.H., Brown, N.D., Carrillo, B., Choi, A.L., Connor, P., Donnelly, K., Ellwood-Lowe, M.E., Foushee, R., Jansen, R., Jarvis, S.N., Lundell-Creagh, R., Ocampo, J.M., Okafor, G.N., Azad, Z.R., Rosenblum, M., Nelson, L.D., 2021. Empirical audit and review and an assessment of evidentiary value in research on the psychological consequences of scarcity. In: Proceedings of the national academy of sciences, 118 doi:10.1073/pnas.2103313118.

OECD, 2008. Growing unequal?: Income distribution and poverty in OECD countries Paris, France.

Robbins, L., 1932. An essay on the nature and significance of economic science. Macmillan.

Savage, L.J., 1954. The foundations of statistics. Wiley.

Shah, A.K., Mullainathan, S., Shafir, E., 2012. Some consequences of having too little. Science 338, 682–685. https://science.sciencemag.org/content/338/6107/682.long.

Shah, A.K., Mullainathan, S., Shafir, E., 2018. An opportunity for self-replication. Nat Hum Behav 2 (9), 603. doi:10.1038/s41562-018-0405-5.

Shah, A.K., Mullainathan, S., Shafir, E, 2019. An exercise in self-replication: Replicating Shah, Mullainathan, and Shafir (2012). Journal of Economic Psychology 75. doi:10.1016/j.joep.2018.12.001.

Shah, A.K., Shafir, E., Mullainathan, S., 2015. Scarcity frames value. Psychol Sci 26 (4), 402–412. doi:10.1177/0956797614563958.

Simon, H.A., 1955. A behavioral model of rational choice. The quarterly journal of economics 69, 99–118.

Simon, H.A., 1990. Invariants of human behavior. Annual review of psychology 41 (1), 1–20.

Thaler, R.H., 1980. Toward a positive theory of consumer choice. Journal of Economic Behavior & Organization 1 (1), 39–60. doi:10.1016/0167-2681(80)90051-7.

Thaler, R.H., 1985. Mental Accounting and Consumer Choice. Marketing Science 4 (3), 199–214. doi:10.1287/mksc.4.3.199.

Thaler, R.H., 2015. Misbehaving: The making of behavioral economics. WW Norton & Company.

Tversky, A., Kahneman, D., 1974. Judgment under Uncertainty: Heuristics and Biases. Science 185.

Tversky, A., Kahneman, D., 1981. The framing of decisions and the psychology of choice. Science 211, 453–458.

Van Bavel, J.J., Baicker, K., Boggio, P.S., Capraro, V., Cichocka, A., Cikara, M., Crockett, M.J., Crum, A.J., Douglas, K.M., Druckman, J.N., Drury, J., Dube, O., Ellemers, N., Finkel, E.J., Fowler, J.H., Gelfand, M., Han, S., Haslam, S.A., Jetten, J., … Willer, R., 2020. Using social and behavioural science to support COVID-19 pandemic response. Nature Human Behaviour doi:10.1038/s41562-020-0884-z.

Von Neumann, J., Morgenstern, O., 1944. Theory of games and economic behavior. Princeton University Press.

Zhao, J., Tomm, B.M., 2018. Psychological Responses to Scarcity. Oxford Research Encyclopedia of Psychology doi:10.1093/acrefore/9780190236557.013.41.