

Working Papers RESEARCH DEPARTMENT

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ISSN: 1962-5361

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DOI: https://doi.org/ 10.21799/frbp.wp.2022.27

Scarcity and Intertemporal Choice

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Abstract

Scarcity is a ubiquitous experience, and existing evidence largely suggests that people become more myopic when they feel their resources are scarce. Importantly, evidence for this proposition comes primarily from contexts in which scarcity threatens needs that require resources imminently. The current work examines instances in which scarcity threatens needs along a broader time horizon. Archival data from the Federal Reserve Bank of Philadelphia's Consumer Finance Institute and five pre-registered studies (N = 7,728) show that the time horizon of threatened needs is an important determinant of scarcity's effect on intertemporal choice. Studies 1 and 2 measure perceptions of scarcity and demonstrate that scarcity's effect on intertemporal choice is moderated by the time horizon of people's needs. Study 3 experimentally manipulates perceptions of scarcity and demonstrates a polarizing effect of scarcity on intertemporal choice. When scarcity threatens needs with shorter time horizons, scarcity increases choices of smaller, sooner outcomes; however, this effect attenuates and sometimes reverses when scarcity threatens needs with longer time horizons. Studies 4-6 examine process evidence and find that the effect of scarcity on intertemporal choice is driven at least in part by differences in the perceived relative marginal utility of intertemporal choice options, rather than other factors such as a general change in time preference. Our findings suggest that scarcity does not inherently lead to myopic decisions and contribute to the ongoing debate regarding how and why scarcity influences intertemporal choice.

Keywords: scarcity, myopia, intertemporal choice, financial decision-making, economic psychology *JEL Classifications*: D11, D15, D91, G51

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Nearly everyone is acquainted with feelings of scarcity (Matthaei, 1984). Scarcity is a relative concept that refers to the subjective perception that resources are insufficient for one's needs or wants (e.g., Raiklin and Uyar, 1996). It is argued that scarcity "exists simply because it is human nature for people to want more than they have" (Ruffin and Gregory, 1993, p. 3). Individuals can experience a sense of scarcity because they feel they cannot afford basic necessities that require resources imminently or because they feel their finances are insufficient for desired expenses that are less imminent such as education costs, sustaining their lifestyle, or even retirement (Raiklin and Uyar, 1996; Rossi, 2019). Thus, any individual can experience scarcity so long as they perceive their resources as insufficient for their needs. In the current work, we examine whether and how the needs threatened by scarcity impact responses to scarcity.

Prior research suggests that scarcity evokes a general mindset that can influence a range of consequential outcomes (Mullainathan and Shafir, 2013). One such outcome is intertemporal choice, which has meaningful consequences for well-being (e.g., saving for retirement, incurring high-interest debt, adopting crash diets). Existing evidence largely suggests that when people feel their resources are scarce, they make decisions that favor shorter-term outcomes over longerterm outcomes. Some evidence used to support a relationship between scarcity and intertemporal choice comes from work on the effects of household income or poverty (e.g., Carvalho, 2010; Haushofer and Fehr, 2014; Lawrance, 1991; Tanaka, Camerer, and Nguyen, 2010). Although factors other than scarcity differ across household income and poverty levels (e.g., societal differences, education) and may contribute to findings in these contexts, evidence for a causal relationship between scarcity and intertemporal choice has been established using experimental manipulations that isolate the role of scarcity (e.g., Gneezy, Imas, and Jaroszewicz, 2020; Jachimowicz et al., 2017; Moeini-Jazani, Albalooshi, and Seljeseth, 2019; Shah, Mullainathan, and Shafir, 2012, 2019). The prevailing view resulting from this line of work is that perceptions of scarcity induce impulsive, impatient, myopic behavior — the implication being that diverse experiences of scarcity are alike and lead to homogeneous changes in preferences. In the current work, we question whether all experiences of scarcity are the same.

Existing research on scarcity has primarily examined circumstances in which resource scarcity threatens current, imminent needs. While these circumstances may be common, we underscore that scarcity can threaten needs that exist along a broader time horizon, ranging from needs that require resources immediately to those that can be met with resources in the future. Yet, whether and how scarcity affects intertemporal choices when threatened needs have longer time horizons remains an open question because (1) there are seemingly no systematic investigations into the role of the time horizon of needs threatened by scarcity, and (2) existing literature provides competing predictions about how scarcity affects intertemporal choice when the time horizon of threatened needs is longer.

Across an analysis of archival data and five additional preregistered studies, we find that the time horizon of the needs threatened by scarce resources is an important determinant of scarcity's effect on intertemporal choice. When scarcity threatens needs with shorter time horizons, we replicate previous research demonstrating that scarcity increases choices of smaller, sooner outcomes that can help serve those needs. However, when scarcity threatens needs that exist further along the time horizon, individuals facing scarcity are not necessarily more likely to choose smaller, sooner outcomes (versus larger, later outcomes) compared with those not facing scarcity. Indeed, in some contexts, they choose larger, later outcomes over smaller, sooner outcomes. These results suggest that the time horizon of threatened needs is critical to understanding the effect of scarcity on intertemporal choice. More broadly, the current work suggests that not all experiences of scarcity are the same, and that scarcity does not inherently lead to increased impulsivity or general present-bias. These findings contribute to the ongoing debate regarding why scarcity influences intertemporal choice, help to explain why effects of scarcity may diverge or fail to replicate, and suggest that more attention should be devoted to nuances across experiences of scarcity.

Scarcity and Intertemporal Choice

Scarcity is a ubiquitous human experience (Daoud, 2010) and can influence people's psychological and physiological well-being (Mullainathan and Shafir, 2013). Scarcity is defined as a subjective sense of having more needs than resources (Mullainathan and Shafir, 2013, p. 86). As such, it can be experienced among those with lower and higher resource levels alike, so long as one's needs exceed their resources (e.g., Jachimowicz et al., 2017, Mani et al., 2013; Sharma and Alter, 2012; Tully, Hershfield, and Meyvis, 2015). Scarcity is not relegated to those who have the lowest absolute amount of resources, as resource levels alone are neither a necessary nor sufficient condition for scarcity; it is only when resource levels are compared to a need and determined to be insufficient that those resources are deemed scarce (Daoud, 2010). In line with this notion, over a quarter of American families making over \$100,000 report feeling that their finances are insufficient (Hamilton et al., 2019; Schor, 1998). Moreover, perceptions of scarcity are malleable. They can be induced experimentally by providing different levels of resources for the same underlying needs (e.g., providing different amounts of "shots" in a game; see Shah, Mullainathan, and Shafir, 2012), or by changing participants' perceptions about the adequacy of their resources for their needs (e.g., considering the demands on one's financial resources, see Jachimowicz et al., 2017, Mani et al., 2013; writing about why the amount of

one's remaining time is short or long, see Kurtz, 2008). In sum, scarcity is a relative concept; differences in perceptions of scarcity can arise naturally or be induced experimentally.

A large literature supports a relationship between scarcity and intertemporal choice. Intertemporal choices require individuals to indicate preferences or make tradeoffs between costs and benefits across time periods (e.g., Frederick, Loewenstein, and O'Donoghue, 2002). These choices are widespread and have important consequences for well-being. For example, people's decisions to spend, save, and borrow resources today influence their future well-being. Although intertemporal choices present themselves in various ways, empirical investigations into intertemporal choices commonly examine preferences between sooner outcomes and later outcomes such as choosing a lesser number of resources today versus a greater number of resources at a future date.

The dominant view in the literature is that resource scarcity causes people to make decisions that favor the present. Research has argued that "Scarcity, of any kind, will create a tendency to borrow, with insufficient attention to whether the benefits outweigh the costs" (Shah et al., 2012) and that "Scarcity causes myopic and impulsive behavior, prioritizing short-term gains over long-term gains" (Zhao and Tomm, 2018). A range of findings have been used as evidence to support such propositions. For example, research showing that households with lower incomes and food insecurity take on high-interest loans (e.g., Fitzpatrick and Coleman-Jensen, 2014; Melzer, 2011) has been used to support the proposition that scarcity leads to decisions that favor the present. Although households with lower income and food insecurity may differ from other households on many dimensions other than scarcity, more direct evidence for the relationship between scarcity and intertemporal choice is found in experimental research. For instance, Carvalho, Meier, and Wang (2016) found that participants made more present-

biased decisions when those decisions were made before (versus after) their payday. In research conducted by Shah, Mullainathan, and Shafir (2012), participants facing greater time scarcity to make guesses in a game of *Family Feud* were more likely to "borrow" time now at the expense of having a lesser amount of time in the future. In another context, Jachimowicz et al. (2017) found that participants who were induced to feel a sense of financial scarcity were more myopic on a temporal discounting task. In sum, a range of findings have contributed to the prevailing view that scarcity leads people to make choices that favor the present over the future.

In the current work, we question whether all scarcity is the same or whether, instead, responses to scarcity might depend on the demands on people's resources. To date, research has devoted little attention to systematically investigating differences across the needs for which resources are scarce. Most needs have a *time horizon*, a term we use to refer to the time period in which resources are necessary to meet needs without negative consequences. Consider contexts in which people may experience scarcity. People may experience scarcity if they have inadequate resources for a need that requires those resources immediately (e.g., paying a bill that is currently due, buying concert tickets that are about to sell out). However, people may also experience scarcity if they feel they have inadequate resources for a need that does not necessarily have a deadline (e.g., replacing a rundown car, taking a vacation), if they expect to deplete their resources before their resources are replenished (e.g., anticipating running out of money before next month's paycheck, expecting to run out of food or water before more is available), or if they feel their resources are inadequate for a need with a longer time horizon (e.g., a future wedding, future college tuition). While the first example refers to threatened needs with time horizons that are unequivocally short, the latter examples refer to threatened needs with a broader range of time horizons. In the current work, we investigate whether the time horizon of needs threatened

by scarcity impacts intertemporal choices under scarcity.

Despite the vast amount of research on scarcity and intertemporal choice, it is unclear whether and how scarcity affects intertemporal choice when threatened needs have longer time horizons. One reason for this lack of clarity is that the empirical evidence used to support a relationship between scarcity (or related constructs) and intertemporal choice has primarily examined situations in which insufficient resources threaten needs with a shorter time horizon, or where the time horizon of threatened needs is unclear (see **Appendix 1**). Thus, there is little empirical work to guide predictions about how people's intertemporal preferences are influenced when perceptions of scarcity threaten needs with longer time horizons. Beyond the lack of empirical studies, existing explanations for the effect of scarcity on intertemporal choice suggest competing predictions about how scarcity will impact intertemporal choices when scarcity threatens needs with longer time horizons.

Some existing research suggests that scarcity produces a general mindset — having inadequate resources for one's needs fundamentally changes how one thinks about and responds to situations. For instance, one explanation for myopic decisions is that scarcity is cognitively consuming, leading to greater attentional focus on the present or reduced abilities to consider future consequences (e.g., Mani et al., 2013; Mani et al., 2020; Zhao and Tomm, 2018). A second explanation is that lacking resources diminishes self-control, leading to more myopic and impulsive behavior (e.g., Bernheim et al., 2015; Kirk and Logue, 1997). A third explanation is that scarcity increases risk aversion (e.g., Gloede, Menkhoff, and Waibel, 2015; Gneezy, Imas, and Jaroszewicz, 2020), which might explain preferences for smaller, sooner outcomes to the extent that larger, later outcomes seem more uncertain. Indeed, greater trust and agency can increase risk tolerance and decrease preferences for smaller, sooner outcomes (e.g., Gneezy,

Imas, and Jaroszewicz, 2020; Jachimowicz et al., 2017). Yet another explanation is that scarcity creates a desire to acquire more of the scarce resource as quickly as possible (Cannon, Goldsmith, and Roux, 2019). To the extent that these mechanisms are activated by a general scarcity mindset, independently of the time horizon of needs threatened by scarcity, these theories largely suggest that scarcity will increase preferences for smaller, sooner outcomes over larger, later outcomes, even when scarcity primarily threatens needs that are not imminent.

While the abovementioned work on the scarcity mindset suggests that all scarcity results in a general mindset that uniformly increases attention to and preference for options in the here and now, work in the areas of resource conservation and opportunity cost consideration provides suggestive evidence that scarcity may not inherently prevent people from considering future consequences (e.g., Aisbett and Steinhauser, 2014; Spiller, 2011, Study 3; Tully, Hershfield, and Meyvis, 2015). If people can consider future consequences, at least in some situations of scarcity, then it is plausible that the time horizon of needs threatened by scarcity may moderate the relationship between scarcity and intertemporal choice. Indeed, an early economic theory argues that the effect of scarcity on intertemporal choice is partly a function of rational desires to meet one's needs (Fisher, 1930). According to this theory, intertemporal choices under scarcity reflect differences in the expected marginal utility of outcomes with respect to meeting people's threatened needs. As such, the marginal utility account suggests that individuals experiencing scarcity choose smaller, sooner outcomes because doing so allows them to best meet their consumption needs — with the implicit assumption that threatened needs have shorter time horizons and are thus better served by sooner outcomes. In the current work, we extend this line of reasoning to situations in which scarcity threatens needs across a broader time horizon. The marginal utility account would predict that scarcity threatening needs with longer time horizons

will result in a reduced likelihood of choosing smaller, sooner outcomes to the extent that waiting for larger, later outcomes improve the ability to address threatened needs with longer time horizons. Moreover, under some conditions, people experiencing scarcity that threatens needs with longer time horizons may be less likely to choose smaller, sooner options compared to people not experiencing scarcity. This may occur when larger, later options are perceived as providing greater marginal utility toward meeting threatened needs.

Given the competing explanations for the effect of scarcity on intertemporal choice, we investigate whether scarcity has similar or divergent effects on intertemporal choice when threatened needs have longer time horizons. The current work uses diverse samples including a data set of Americans surveyed by the Consumer Finance Institute (CFI) at the Federal Reserve Bank of Philadelphia, Facebook users, as well as online participants. Thus, our samples include participants with a broad range of demographic and economic backgrounds. We examine scarcity across multiple resource types (i.e., money, time, food supply) as well as a variety of needs threatened by scarce resources (e.g., ability to make ends meet, self-generated needs, wedding expenses). These examinations include both naturally occurring and experimentally induced perceptions of scarcity.

Study 1 uses a data set obtained from the Federal Reserve Bank of Philadelphia's CFI. Because this data set is proprietary, these data are not publicly available. All of the remaining studies are preregistered, and data, analysis code, and research materials are publicly available at Research Box and can be accessed at

<u>https://researchbox.org/543&PEER_REVIEW_passcode=XNGONZ</u>. For these studies, our sample size and data exclusions were determined before data collection, and we report all attrition, conditions, measures, and data exclusions. All randomizations used in studies were

determined by Qualtrics' randomization function. Data were analyzed using SPSS, version 28.

Study 1¹

CFI began conducting a national survey of consumers to investigate the financial health and stability of consumers during the global pandemic. This survey, called the *CFI COVID-19 Survey of Consumers*, ran in 10 waves in total. In Wave 10, the Consumer Finance Institute added a question measuring intertemporal preferences. Using this data set, we examine whether the time horizon of participants' needs moderates the impact of perceived financial scarcity on intertemporal choice.

Method

Participants. Data were obtained from CFI. The data set included responses from 3,605 U.S. participants. However, 2,354 participants answered the intertemporal choice question and were thus available for analysis (Median age range = 36-55 years old; 1,212 females, 1,137 males, 5 "other"; Median income range = \$55,000 to \$74,999). There were no data exclusions.

Procedure. CFI created and distributed an online survey to U.S. participants, asking a range of questions related to how COVID-19 was impacting their lives. Of relevance to the current research question, the survey included an intertemporal choice question and two measures related to the sufficiency of participants' money and the relative time horizon of needs threatened by insufficient financial resources.

¹ The survey data are derived from the Federal Reserve Bank of Philadelphia's *CFI COVID-19 Survey of Consumers*. The views expressed here are solely those of the author(s) and not necessarily those of the Federal Reserve Bank of Philadelphia or the Federal Reserve System.

The intertemporal choice question asked participants, "If you were offered an opportunity to postpone your [mortgage/rent] payments for the next three months but would have to increase your monthly payments going forward, how interested would you be? (1 = not at all interested, 7 = very interested). Whether the question pertained to mortgage or rent was personalized based on a previous question asking participants about their housing situation.

The survey included two questions that could plausibly assess scarcity and the time horizon of threatened needs. The survey asked participants, "How concerned are you about your ability to make ends meet over these time periods, on a scale of 1 (not at all concerned) to 5 (very concerned)?" Participants answered this question about the next 3 months, 6 months, 9 months, and 12 months. These four questions allowed us to examine whether participants were relatively more concerned about needs with a longer time horizon (over the next 6, 9, or 12 months) versus needs with a shorter time horizon (within the next 3 months). Specifically, we calculated the maximum concern participants had over making ends meet in future time periods (6 months, 9 months, and 12 months) and subtracted their concern over making ends meet in the next 3 months. As such, this variable ranged from -4 to 4, with higher numbers indicating longer time horizons. Following this question, the survey asked participants, "If you believe you will need to access additional resources, how soon do you believe that will be necessary?" (I already had to seek additional resources, 1–2 weeks, 2–4 weeks, 4–8 weeks, 2 or more months, or I don't anticipate needing to seek additional resources). Since the variation in time periods for this question were all less than the 3-month period used in the intertemporal choice question, none of the responses could be clearly identified as having a "longer" time period. Thus, we used this question to create a dummy-coded variable capturing perceptions of scarcity. We coded participants as experiencing scarcity if they indicated needing additional resources at any time

period (scarcity = 1; 57.9% of the sample), and as not experiencing scarcity if they indicated not needing additional resources (no scarcity = 0; 42.1% of the sample).

Results

We regressed participants' interest in postponing their housing payments (at a cost of increased future payments) on the binary measure of financial scarcity from the question about needing additional money, the time horizon of participants' needs, and their interaction. There was an effect of scarcity (B = 2.53, 95% CI [2.36, 2.70], SE = .09, t(2350) = 28.92, p < .001, $f^2 = .19$). There was no effect of time horizon, (B = 0.09, 95% CI [-.05, .24], SE = .07, t(2350) = 1.30, p = .193, $f^2 < .01$). However, there was a significant scarcity by time horizon interaction (B = -0.38, 95% CI [-.56, -.21], SE = .09, t(2350) = -4.31, p < .001, $f^2 = .01$, see **Figure 1**). Among participants with shorter time horizons, participants experiencing scarcity were more interested in postponing housing payments in the present with an increased cost in the future. However, this difference was attenuated among participants with longer time horizons.



Figure 1. Intertemporal Preferences by Scarcity and Time Horizon

In a series of robustness checks that use different operationalizations of scarcity and time horizon of needs (e.g., using means instead of maximums, using the four "concern about making ends meet" questions as measures of both scarcity and time horizon of needs) and that control for demographic characteristics and bill payment history, we find that this moderation does not depend on the model specification used (see Supplemental Materials).

Study 2

Study 2 was designed to examine whether the relationship between perceived financial scarcity and intertemporal choice depends on the time horizon of the unmet need(s) that people believe are threatened by scarcity. We hypothesized that when scarcity primarily threatens a need with a shorter time horizon, such that resources are needed before the timing of the later outcome, scarcity increases the likelihood of selecting sooner outcomes. However, we expected this effect to attenuate when scarcity threatens a need with a longer time horizon.

Method

This survey was preregistered on AsPredicted (https://aspredicted.org/BZP_FXL).

Participants. Study 2 and Study 3 were conducted after Study 4 and Study 5. Because Study 4 and Study 5 revealed a small- to medium-interaction effect, in this study, we conducted a power calculation assuming a small difference in beta coefficients between the shorter- and longer-time horizon variables ($f^2 = .2$, $\alpha = .05$, *power* = 80%). The power analysis suggested a total of 395 participants. To exceed this, we aimed to recruit 1,000 U.S. participants through Cloud Research; 1,057 participants opened the survey. In total, 1,008 participants completed the entire study. For 18 participants, no dependent measure was available due to inconsistent switching points on the titration task. An additional 11 participants failed the instructional manipulation check (IMC) and were excluded from analysis. Thus, the final sample was 979 participants (Mean age = 40.81, SD = 13.40; 501 females, 466 males, 6 "other," 6 prefer not to answer; Median income = \$50K-\$60K).

Procedure. Participants indicated their intertemporal preferences by completing a series of 15 binary choices, choosing between a U.S. dollar amount today and a different U.S. dollar amount in three months. To assess whether the majority of participants were taking the task seriously, in three of the choice pairs, the later amount was less than or the same amount as the sooner amount (e.g., \$150 today and \$150 in three months; \$150 today and \$140 in three months). These three choice pairs were expected to be uniformly in favor of the sooner outcome and to not differ across conditions but were preregistered to be included in the measurement of intertemporal preferences. Participants were informed that a participant would be randomly

selected to receive one of their choices in the form of a bonus, and this bonus was provided upon completion of the survey. Thus, this survey was incentive compatible.

To measure perceptions of scarcity, participants were asked to think about their financial resources and indicate which of the following options best described their financial situation: (1) I feel I have enough money for the things I want or need in life ("no scarcity"); (2) I feel I do not have enough money, and the things I am most concerned about not being able to afford require money within the next three months ("scarcity – shorter time horizon"); (3) I feel I do not have enough money, and the things I am most concerned about not being able to afford require money in the future (3+ months from now) ("scarcity – longer time horizon"); (4) I feel I do not have enough money, and the things I am most concerned about not being able to afford don't require money at any specific time ("scarcity – no specific time horizon"). The order of the scarcity and intertemporal choice measure was counterbalanced, and the order did not impact any of the results.

Participants provided their age, gender, primary language, income, and level of education. Participants also indicated their bill payment history (see supplemental materials for scale). In addition, we included an exploratory measure of perceptions of slack change over time (e.g., Zauberman and Lynch, 2005) to explore its relationship with the time horizon of participants' needs (see supplemental materials for scale and results). Finally, participants completed an IMC (Oppenheimer, Meyvis, and Davidenko, 2009) asking participants to ignore the options provided and write the word "attention" in the space provided.

Results

Scarcity. Across the sample, 31.3% of participants indicated having no scarcity, 25.9% of

participants indicated having scarcity that threatens needs with a shorter time horizon, 26.0% of participants indicated having scarcity that threatens needs with a longer time horizon, and 16.8% of participants indicated having scarcity that threatens needs with no specific time horizon.

Intertemporal choice. We first examined whether participants were taking the titration task seriously by examining the three options in which the sooner option was equal to or greater than the later option. As expected, 98.6% of participants chose the sooner options across these three pairs, and their choice did not vary by their perceptions of scarcity, $X^2 = 2.37$, p = .499. Next, we calculated a "switching point" for each participant. The switching point was coded as the first choice pair at which participants switched from choosing the sooner option to the later option, ranging from 0 if they always chose the later option to 15 (always preferring the sooner option) if they never switched. Participants who switched between sooner options and later options multiple times were identified as not having a consistent switching point.

We then examined whether scarcity, collapsed across time horizon, predicted intertemporal choices (no scarcity = 0, any scarcity = 1). Replicating previous research, we found an overall effect of scarcity on intertemporal choice, where scarcity was associated with later switching points, B = 1.18, 95% CI (.61, 1.76), SE = 0.29, t(977) = 4.03, p < .001, $f^2 = .02$.

Next, we performed our main analysis examining whether the time horizon of needs threatened by scarcity moderates the relationship between scarcity and intertemporal choice using the following regression: preference for sooner outcomes = $b_0 + b_1$ (scarcity: shorter time horizon) + b_2 (scarcity: longer time horizon) + b_3 (scarcity: no specific time horizon). As shown in Model 1 of **Table 1**, participants with perceptions of scarcity threatening needs with a shorter time horizon had later switching points, indicating an increased preference for smaller, sooner outcomes compared with participants without any financial scarcity. In contrast, participants with perceptions of scarcity threatening needs with a longer time horizon did not have significantly different intertemporal preferences compared with participants without any financial scarcity. In line with our preregistration, to formally test for moderation, we examined whether b₁ was significantly greater than b₂ by calculating a Wald statistic (see Supplemental Materials for details). Indeed, as expected, this difference was significant, Wald $\chi^2 = 51.05$, p < .001, $f^2 = .05$. Moreover, all beta coefficients were found to significantly differ from one another. Scarcity most strongly predicted intertemporal preferences in favor of the present when needs had a shorter time horizon, less strongly predicted intertemporal preferences in favor of the present when there was no specific time horizon, and did not predict intertemporal preferences when threatened needs had a longer time horizon.

In addition to our main preregistered analysis, we examined how scarcity and need timing relate to demographics and objective financial factors (see Supplemental Materials for results). We found that scarcity, regardless of time horizon, was associated with lower incomes, less education, and having more overdue bills, relative to those not experiencing scarcity. However, some of these factors varied by time horizon among those facing scarcity. For example, although all participants experiencing scarcity had lower incomes, those experiencing scarcity for needs with shorter time horizons had lower incomes than those experiencing scarcity for needs with longer time horizons. This is consistent with the finding that those with lower incomes have more immediate needs (Jachimowicz et al., 2017). Thus, we examined whether and how the time horizon of needs threatened by scarcity impacts intertemporal preferences accounting for objective characteristics (i.e., age, gender, income, education level, primary language, bill payment history). Interestingly, accounting for objective characteristics, those who experienced scarcity for needs with a longer time horizon had significantly earlier switching points (an

increased preference for larger, later outcomes) compared with those who did not perceive their finances as scarce — a reversal of the established effect of scarcity on intertemporal choice (see Model 2 in Table 1).

Table 1. Intertemporal Choice as a Function of Scarcity

	(1)	(2)
Scarcity — shorter time horizon	2.57***	1.16**
	[1.88, 3.26]	[0.35, 1.98]
	(0.35)	(0.41)
Scarcity — longer time horizon	-0.06	-0.84*
	[-0.75, 0.63]	[-1.58, -0.11]
	(0.35)	(0.37)
Scarcity — no specific time horizon	0.97*	0.34
	[0.18, 1.75]	[-0.47, 1.16]
	(0.40)	(0.42)
Controlling for objective metrics	No	Yes
N	979	953
\mathbb{R}^2	.066	.112
p < .05, ** p < .01, ***p < 0.001		

Note: The dependent measure is the point at which participants switch from selecting the sooner option to the later option across the 15 choice pairs. Numbers in brackets refer to the 95% confidence intervals. Numbers in parentheses refer to the standard error. In Model 2, objective metrics include age, gender (female), income (bracket), education level, primary language (English), and bill payment history. Differences in the number of observations across (1) and (2) result from 26 observations for which bill payment history values were not interpretable for analysis (e.g., "Don't know/Refuse to answer").

Discussion

Study 2 replicates the results of Federal Reserve data, providing correlational evidence that the relationship between scarcity and intertemporal preferences is moderated by the time horizon of needs threatened by scarce resources. Differences in intertemporal preferences across need timing could not be explained by differences in objective metrics across participants. Instead, interestingly, accounting for differences in objective metrics, the effect of need timing became more exaggerated, and perceptions of scarcity that threatened needs with longer time horizons.

predicted significantly fewer choices of sooner options. This finding suggests that all else equal, subjective experiences of scarcity that threaten needs with longer time horizons may at times lead people to be more willing to wait for later outcomes. We build on this exploratory finding, a reversal of the effect found in previous research, in the remaining studies.

Study 3

In Study 3, we manipulate perceptions of scarcity using a manipulation that asked participants to indicate why they experience a sense of financial scarcity and how this impacts their lives, similar to prior manipulations that have asked participants to write about the demands on their financial resources (e.g., Jachimowicz et al., 2017, Study 3; Moeini-Jazani et al., 2019, Study 2). We examine whether responses to scarcity depend on the time horizon of the needs threatened by scarce resources. We expected scarcity to increase preferences for smaller, sooner options when the needs threatened by scarcity had a shorter time horizon (required resources before the timing of the larger, later payout). However, we expected scarcity to increase choices of larger, later options when the needs threatened by scarcity had a longer time horizon (required resources after the timing of the larger, later payout).

Method

This incentive-compatible study was preregistered on AsPredicted (https://aspredicted.org/R3M_KNN).

Participants. Using the same criteria for power as in Study 2 ($f^2 = .02$, $\alpha = .05$, *power* = 80%), a power analysis suggested a total of 395 participants. To provide additional power to detect a potential reversal when the time horizon was longer, we aimed to collect data from 1,300 U.S. participants; 1,448 participants opened the survey. In total, 1,302 participants on Cloud

Research completed the survey in exchange for monetary payment.² For 34 participants, there was no valid dependent measure due to inconsistent switching points on the titration task. Thus, the final sample was 1,268 participants (Mean age = 34.77, SD = 12.55; 608 females, 644 males, 16 "other"/"prefer not to answer"; Median income range = \$60K-\$69K).

Procedure. The experiment included two between-subjects conditions: scarcity versus control. In the scarcity condition, participants were told that we were interested in learning about the financial scarcity they experience in their life and to indicate why they feel a sense of scarcity and how it impacts their life (see supplemental materials for prompt wording).

Participants in the control condition went immediately to the intertemporal choice task. In the intertemporal choice task, participants completed a titration task that was similar to that used in Study 2 but with different U.S. dollar amounts and a different time period. Specifically, participants chose between getting \$30 today or a different amount in 45 days. Similar to Study 2, we also included a choice pair in which the later amount was less than the sooner amount (i.e., \$30 today versus \$25 in 45 days) and a choice pair in which the later amount was the same as the sooner amount (i.e., \$30 today versus \$30 in 45 days). In this study, we preregistered that we would exclude these two measures in the calculation of the dependent measure and focus only on intertemporal choices that reflect decisions between smaller, sooner and larger, later options.

Participants then completed a financial scarcity manipulation check measure using a seven-point scale: "As you completed this study, to what extent did you feel that your finances were scarce, limited, or inadequate?" (1 = Not at all, 7 = Very much).

² Of those who did not complete the study, 14 were assigned to the control condition and 132 participants were assigned to the scarcity condition. Thus, attrition in this study unexpectedly varied by condition, Wald $\chi 2 = 107.16$, p < .001. Importantly, the final sample did not significantly differ by condition on any measured demographic characteristics (e.g., gender, income, bill payment history). Thus, the differential attrition was more likely a function of disinterest in completing a writing task versus no task than of differences in financial situations. However, a conceptual replication without differential attrition is also available in the supplemental materials (see Supplemental Study 1), and this is not an issue in any other study in this manuscript.

Next, participants in the scarcity condition were reminded of the earlier task in which they considered why they experience financial scarcity and to indicate whether they were primarily thinking about things they want or need to spend on in the next month and a half that they did not have enough money for ("Yes, I was primarily thinking about things that I want or need to spend on within the next month and a half that I don't have enough money for" = shorter time horizon; "No, I was primarily thinking about things that have a longer time horizon and could be met with additional money gained in a month and a half from now" = longer time horizon). Responses to this question served as our time horizon measure among those in the scarcity condition.

All participants then provided demographic information, including age, sex, household income, education, and their primary language, in addition to their bill payment history (see Study 1). In addition, they answered a few exploratory measures assessing other subjective assessments of one's finances. Specifically, we measured participants' SES using the MacArthur scale of Subjective Social Status (e.g., Adler and Stewart, 2007), as well as the extent to which participants were focused on their perceptions of slack change over time (e.g., Zauberman and Lynch, 2005) by asking participants to indicate the extent to which their decision about receiving money today or in future was driven by their beliefs about when they will have more spare money using a seven-point scale (1 = Not at all, 7 = Very much). Analyses of these variables are available in the Supplemental Materials. At the end of the survey, one participant was selected to receive one of their choices to the intertemporal titration task in the form of a bonus.

Results

Manipulation check. Regressing the manipulation check on condition (0 = control, 1 = scarcity)condition) revealed that participants in the scarcity condition (M = 4.33, 95% CI [4.18, 4.47], SD = 1.74) reported their finances as being more inadequate, scarce, or limited for their needs compared with participants in the control condition (M = 3.41, 95% CI [3.27, 3.55], SD = 1.92; B = .91, 95% CI (.71, 1.12), SE = .10, t(1266) = 8.83, p < .001, $f^2 = .05$). Next, we examined whether those in the scarcity condition felt greater scarcity than those in the control condition, both when the time horizon of needs was shorter and when it was longer. To do this, we created two dummy-coded variables. One dummy variable identified participants who indicated experiencing scarcity for needs with a shorter time horizon, and the other identified participants who indicated experiencing scarcity for needs with a longer time horizon: (1) "scarcity: shorter time horizon" = 1, "control" = 0, "scarcity: longer time horizon" = 0 and (2) "scarcity: longer time horizon" = 1, "control" = 0, "scarcity: shorter time horizon" = 0. We regressed the manipulation check on these two dummy variables. As such, the control condition served as the reference group. Participants in the financial scarcity condition indicated feeling greater financial scarcity than did those in the control condition, regardless of whether they indicated that their needs had a shorter time horizon (M = 4.96, 95% CI [4.76, 5.17], SD = 1.51; B = 1.55, 95% CI (1.27, 1.83), SE = .14, t(1265) = 10.86, p < .001, $f^2 = .08$) or a longer time horizon (M = 3.96, 95% CI [3.78, 4.14], SD = 1.75; B = .55, 95% CI (.32, .78), SE = .12, $t(1265) = 4.69, p < .001, f^2$ = .02).

Intertemporal choice. Most participants (98.3%) selected the smaller, sooner options on the two intertemporal choice questions designed to examine whether participants were completing the titration task seriously. Additionally, as expected, binary logistic regressions

demonstrated that these responses did not vary by assigned condition or by scarcity with the inclusion of time horizon (control, scarcity: shorter time horizon, scarcity: longer time horizon), all Wald $\chi^2 < 1$.

We calculated a switching point as in Study 2 and regressed this switching point on condition (0 = control, 1 = scarcity). Overall, there was no effect of scarcity condition on intertemporal choice (1 = smaller, sooner outcome, 0 = larger, later outcome), B = -.12, 95% CI (-0.42, 0.18), SE = .15, |t| < 1, p = .419, $f^2 < .01$. We next examined the effect of financial scarcity on intertemporal choice based on the time horizon of participants' needs. To do so, we regressed intertemporal choice on the two dummy-coded variables identifying time horizon. As predicted, participants in the "scarcity: shorter time horizon" condition had a later switching point (increased preference for sooner options) compared with those in the "control" condition, B = .79, 95% CI (.37, .1.20), SE = .21, t(1265) = 3.73, p < .001, $f^2 = .01$, while participants in the "scarcity: longer time horizon" condition had an earlier switching point (increased preference for later options) compared with those in the "control" condition, B = -.65, 95% CI (-.99, -.31), SE = $.17, t(1265) = -3.74, p < .001, f^2 = .01$, see Figure 2. Similar to Study 2, we also calculated a Wald statistic to examine the difference between the two coefficients to test for moderation. As expected, this difference was significant, Wald $\gamma 2 = 38.24$, p < .001, $f^2 = .03$. All results remain significant in models including the measured objective metrics and other subjective assessments of one's finances (see Supplemental Materials).



Figure 2. Intertemporal Choice in Study 3

Note: Participants' switching point on the titration task. Error bars represent 95% confidence intervals. The upper panel indicates the switching point as a function of scarcity condition. The lower panel indicates the switching point as a function of both scarcity condition and time horizon. Higher responses indicate increased preference for sooner options.

Discussion

In Study 3, we manipulated perceptions of scarcity and did not find an overall effect of scarcity on intertemporal choice. At first glance, this result appears to show that the scarcity manipulation did not impact intertemporal preferences. However, by incorporating the time horizon of needs threatened by scarcity, we both replicate and reverse the effect found in existing research on scarcity and intertemporal choice. In particular, scarcity significantly increased preferences for smaller, sooner outcomes when it threatened needs with shorter time horizons and significantly decreased preferences for smaller, sooner outcomes when it threatened needs with longer time horizons. We replicate this polarizing effect of scarcity in a supplementary study that employs a similarly demanding and negatively valanced writing task in the control condition (see Supplemental Study 1 in the Supplemental Materials).

Study 4

The polarizing effect of scarcity on intertemporal choice based on the time horizon of threatened needs is consistent with the marginal utility account, whereby scarcity increases participants' interest in outcomes that can best address their threatened needs. However, another possibility is that experiencing scarcity attunes people to the time horizon of their threatened needs, resulting in generalized changes in time preferences. If so, experiencing scarcity that threatens a need with a longer (shorter) time horizon could enhance the value of any option that occurs later (sooner). Relatedly, it is possible that scarcity exaggerates individual differences in time preference or time orientation. That is, if someone is typically a planner, scarcity may attune people to needs with longer time horizons, strengthening natural tendencies to care about the future. In contrast, if someone is typically short sighted, scarcity may attune them to needs with shorter time horizons, strengthening natural tendencies to care about the present. To examine these alternative possibilities, we induced scarcity among all participants and varied whether participants experienced scarcity of time or money. The generalized time preference account and the individual difference account would suggest that the time horizon of individuals' needs will predict their intertemporal choices, irrespective of the type of resource scarcity (time or money). In contrast, the marginal utility account would suggest an interaction between scarcity (time versus money) and the time horizon of the needs threatened by scarcity.

Method

This incentive compatible experiment was preregistered on AsPredicted.org (<u>https://aspredicted.org/blind.php?x=FPX_YED</u>).

Participants. Aiming to recruit 500 U.S. participants on Cloud Research, 529 people opened the survey and 504 participants completed the experiment in exchange for monetary payment. Attrition did not vary by condition, Wald $\chi 2 < 1$. We could not calculate a valid dependent measure for 69 participants due to inconsistent switching points. An additional 19 participants failed the IMC, which did not vary by condition, and were thus excluded. Two additional participants were identified as providing nonsensical responses when asked to write about a need (e.g., "6") and were thus excluded. This exclusion did not vary by condition. All exclusions were preregistered. The final sample was 415 participants (Mean age = 39.58, SD = 13.00; 271 females, 144 males; Median income range = \$50K-\$60K). This sample allowed us to detect a significant result for a small effect ($f^2 = .02$) with an alpha of .05 and power of .80.

Procedure. Participants were asked to list one important need that they felt they did not have enough money (monetary scarcity condition) or time (time scarcity condition) for and to describe why this need was important to them. Then, participants completed an incentive-compatible titration task, making 15 choices between getting \$30 now and a larger amount (\$X) 45 days later, where \$X ranged from \$30 to \$60. None of the later options were less than the \$30 now, and all decisions were included in the analysis. Participants were informed that at least one person would be chosen to receive one of their choices in the form of a bonus payment at the end of the experiment.

Next, we reminded participants of the important need they wrote about and asked them to indicate the extent to which they needed additional money (monetary scarcity condition) or time (time scarcity condition) within the next 45 days to meet that need on a seven-point scale (1 = Definitely needs to be before 45 days, 7 = Definitely can be after 45 days). We also measured how much money/time was required for the need. Participants then completed two manipulation checks, indicating the extent to which they thought about their money as being insufficient, inadequate, or scarce, as well as the extent to which they thought about their time as being insufficient, inadequate, or scarce (both seven-point scales; 1 = not at all, 7 = very much). Finally, they completed an IMC (Oppenheimer et al., 2009) and demographic information including age, gender, and household income. At the experiment's end, one participant was selected and received one of their selected choices from the titration task as a bonus.

Results

Manipulation checks. Regressing each of the manipulation checks on scarcity type (time = -1, money = 1) revealed that both the time and money scarcity manipulations were successful. Participants in the monetary scarcity condition (M = 5.73, 95% CI [5.54, 5.92], SD = 1.35) rated their money as more scarce than did those in the time scarcity condition (M = 3.93, 95% CI [3.64, 4.22], SD = 2.13, B = .90, 95% CI (.73, 1.07), SE = .09, t(413) = 10.19, p < .001, $f^2 = .25$. Participants in the time scarcity condition (M = 5.65, 95% CI [5.42, 5.88], SD = 1.47) rated their time as more scarce than did those in the monetary scarcity condition (M = 3.74, 95% CI [3.50, 3.98], SD = 1.96), B = -.96, 95% CI (-1.12, -.79), SE = .08, t(413) = -11.28, p < .001, $f^2 = .31$. Moreover, to assess whether participants in both scarcity conditions were experiencing similar levels of scarcity, we calculated the maximum scarcity score across either resource. Participants in the monetary scarcity (M = 5.88, 95% CI [5.71, 6.05], SD = 1.25) condition experienced similar levels of scarcity as did participants in the time scarcity condition (M = 5.99, 95% CI [5.83, 6.15], SD = 1.19), B = -.06, 95% CI (-.17, .06), SE = .06, $|t| < 1, p = .355, f^2 < .01$.

Intertemporal choice. We calculated a switching point as in Studies 2 and 3. Regressing this switching point on scarcity type was not significant, B = .09, 95% CI (-.35, .52), SE = .22, |t| $< 1, p = .697, f^2 < .01$, suggesting that experiencing monetary scarcity did not increase preference for smaller, sooner options. We then incorporated the time horizon of participants' needs by regressing intertemporal choice on scarcity type, the extent to which participants stated needing additional resources within 45 days (mean-centered), and their interaction. The analysis revealed a significant effect of time horizon (B = -.34, 95% CI [-.54, -.15], SE = .10, t(411) = -3.46, p < -.15.001, $f^2 = .03$), and a nonsignificant effect of scarcity type (B = .36, 95% CI (-.09, .80), SE = .23, $t(411) = 1.59, p = .113, f^2 < .01$). Importantly, as predicted, there was a significant scarcity type by time horizon interaction (B = -.37, 95% CI (-.57, -.18), SE = .10, t(411) = -3.77, p < .001, $f^2 =$.03), depicted in Figure 4. Specifically, in the monetary scarcity condition, the shorter time horizon was associated with later switching points (increased preferences for smaller, sooner outcomes, B = -.72, 95% CI (-0.99, -0.44), SE = .14, t(411) = -5.15, p < .001, $f^2 = .06$), but in the time scarcity condition, time horizon was unrelated to intertemporal choice (B = .03, 95% CI (-.25, .31), SE = .14, $t(411) < 1, f^2 < .01$).

Next, we used Hayes' Process macro in SPSS (Hayes, 2013, template 1) to identify the Johnson-Neyman regions of significance for the effect of resource type across different levels of need timing (Spiller et al., 2013). As shown in **Figure 3**, when need timing was more imminent (less than 3.81, representing 40.5% of participants), monetary scarcity was associated with later switching points (increased preferences for smaller, sooner outcomes). However, when need timing was not imminent (greater than 6.93, representing 25.3% of participants), the pattern reversed, and monetary scarcity led to earlier switching points (increased preferences for larger,

later outcomes). Results are robust to the use of the discount rate and are also largely unchanged when controlling for demographic information.



Figure 3: Intertemporal Choice in Study 4

Note: Participants' switching point on the titration task, as a function of time horizon across the time scarcity and monetary scarcity conditions. Higher responses indicate increased preference for sooner options. Vertical dotted lines refer to the Johnson-Neyman points.

Discussion

In Study 4, scarcity type interacted with the time horizon of threatened needs to influence intertemporal choices. Specifically, the time horizon of needs threatened by scarcity only influenced intertemporal choices in the monetary scarcity condition, where the intertemporal choice provided the type of resource that could help participants meet their threatened needs. These results are consistent with some recent research suggesting that scarcity does not necessarily impact intertemporal choices across domains (Carvalho, Meier, and Wang, 2016) and provides further evidence that the reversal of intertemporal choices when need timing is longer is consistent with a marginal utility explanation (vs. individual differences or changes in general time preference).

Study 5

Study 5 was designed to further mitigate the possibility that the observed interactions between resource scarcity and the time horizon of threatened needs is a function of participants' self-reported time horizons merely reflecting individual differences in present-bias for that resource. As such, we designed Study 5 to introduce exogenous variation in the time when resources were required to meet threatened needs.

Existing research has shown that considering major financial expenditures induces a sense of financial scarcity. Thus, in Study 5, we selected a major financial expenditure for which individuals commonly experience financial resource scarcity: paying for a wedding. Indeed, one survey found that 74% of couples plan to take on debt to cover their wedding expenses, and that couples commonly delay their wedding date due to financial concerns (Kirkham, 2018). In this context, the time horizon of participants' needs is a function of their wedding date and thus unrelated to their time preference for money. Verifying this assumption, a separate study among online participants who had been married found no relationship between the date of the person's wedding and their intertemporal preferences for money, self-reported patience, or demographic characteristics (see supplemental materials). Therefore, if scarcity perceptions that threaten people's ability to pay for their wedding expenses result in polarized intertemporal preferences based on their wedding date, it would provide further evidence that the results cannot be explained by individual differences in time preference, patience for money, or demographics. In addition, holding constant the need for which resources are scarce (one's wedding) mitigates the

possibility that differences in responses to scarcity based on time horizon result from systematic differences in the types of needs threatened by scarcity (e.g., needs with shorter time horizons being more important, on average, than needs with longer time horizons).

Method

This incentive compatible study was preregistered on Aspredicted.org

(https://aspredicted.org/LEO_ZXH). The study followed a 2 (scarcity: control versus higher) by 2 (wedding timing: before or after larger, later payout) between-subjects design, with wedding timing based on participants' self-reported wedding date.

Participants. We aimed to recruit U.S. participants who were getting married over the summer of 2019 and who were financially responsible for the majority of their wedding. To do so, we posted advertisements through Facebook's "Ads Manager" in April 2019. We selected an audience of people who matched the following criteria: 18-40 years old, location = "United States," relationship status = "engaged." We used Facebook's automatic advertisement placement function, which maximizes click throughs across all of their available placements according to where they are likely to perform best. The advertisement was an image of a bride's and groom's body that read, "Getting married this summer? Answer 5 quick questions for a chance to win!" (see Supplemental Materials). The words above this image read "SUMMER 2019 WEDDING? Take a short survey for FREE expert planning tips and a chance to win \$200!" No demographic information was collected in this study.

Whether participants' wedding dates were scheduled before or after the date of the later payout determined participants' time horizon assignment. Since this measure was collected at the end of the survey and because we did not know, a priori, the proportion of participants whose wedding dates would fall before or after the date of the later payout, we preregistered that we would recruit participants until we reached at least 100 participants in each of the four conditions, excluding participants who did not find the survey organically or who indicated that they were not financially responsible for their wedding. However, because a greater proportion of participants had weddings after (versus before) the date of the larger, later payout, our stopping rule (at least 100 participants per condition) was met at 1,033 responses, at which point the Facebook ads were deactivated and the data were downloaded for analysis. Of these participants, two participants were excluded because they did not provide the year of their wedding (i.e., "05/30," "June"), and it was unclear whether the month of their wedding would occur before or after the date of the larger, later payout. Thus, these two participants could not be assigned to a wedding timing condition. Seven participants were excluded for finding the survey through friends or family, and an additional 272 participants were excluded for indicating that they were not financially responsible for the majority of their wedding. The final sample included 100 participants in the "scarcity / before" condition, 105 participants in the "control / before" condition, 296 participants in the "scarcity / after" condition, and 251 participants in the "control / after" condition" for a total of 752 participants.³ Note that for this study, an a priori power analysis was not conducted, as it was our first experiment testing an interaction using a binary dependent measure. A post-hoc sensitivity analysis using Demidenko's (2007) sample size calculator, with *power* = 80% and α = .05, revealed that a sample size of N = 752 was sensitive enough to detect a small-to-moderate effect size (odds ratio = 2.64; inverted odds ratio =.38).

³ To be compliant with the preregistered stopping rule, the data were periodically downloaded to determine the number of participants in each condition (coding time horizon based on wedding dates). Although data were downloaded for this purpose, data analysis on the dependent variable was not performed until data collection was complete.

Although these exclusions were pre-registered and determined when we stopped collecting data, we unexpectedly observed differential exclusions by condition upon data analysis. More participants in the financial scarcity condition indicated being financially responsible for the majority of their wedding compared to those in the control condition, p = .001. In addition, although the Facebook ads were deactivated when our stopping rule was triggered, and the data set was immediately downloaded, a recent download of the data from Qualtrics revealed that 50 additional responses were recorded after our stopping rule was met. To be consistent with our preregistration, the analyses provided in the main paper use the data based on our preregistered stopping rule. However, for robustness, we provide analyses using the recently downloaded dataset, without any exclusions, in the Supplementary Materials (note all of the results remain significant).

Procedure. People who clicked on the Facebook advertisement were randomly assigned to either the scarcity or control condition. Participants in the scarcity condition were asked whether planning their wedding ever made them feel as though they don't have enough money and what they plan to have or wish to have at their wedding that they feel they do not have enough money for (open-ended). They then saw a list of potential wedding costs (e.g., venue, food and drinks, rehearsal) and indicated which factor was the primary source of their financial concerns. Participants in the control condition also reflected on their upcoming wedding but were instead asked what they were most excited about doing at their wedding (open ended). They saw a similar list of wedding aspects (e.g., venue, food and drinks, rehearsal) and indicated which of the aspects they were most excited about.

As wedding season typically begins in May and lasts through October, we selected July 1st as the date of the larger, later payout to provide adequate variation in whether participants' weddings would occur before or after the payout date. The dependent measure read, "When you submit your answers, you will be entered into a lottery to win \$200. We're interested in whether you would prefer to get \$200 to spend now or get \$300 on July 1st." Participants chose whether they preferred getting the advertised lottery amount now or the larger amount in three months (binary choice).

Next, to assess the time horizon of the need (i.e., wedding), we asked participants to specify the expected date of their wedding (month and year). Participants then completed a scarcity manipulation check by indicating the extent to which they felt their finances were scarce, limited, or inadequate (1 = not at all, 7 = very much). They next indicated whether they and their fiancé were personally responsible for paying for the majority of their wedding (yes or no). In addition, to ensure responses would not be impacted by participants talking to one another about the survey, participants were asked how they found the survey (through Facebook ads or sponsored posts versus through friends and family). Finally, participants had the option of providing their email address to receive their money in case they won the lottery. All participants received expert planning tips based on behavioral research insights, and one participant was selected to win the lottery.

Results

Time horizon was determined by coding participants' wedding dates based on whether their wedding date was scheduled before or after the larger, later payout. In total, there were 205 weddings before July 1 (shorter time horizon) and 547 weddings after July 1 (longer time horizon).

Manipulation check. There were 25 missing values on the manipulation check measure.

Participants in the scarcity condition rated their finances as more scarce (M = 5.19, 95% CI [5.00, 5.39], SD = 1.51) than did participants in the control condition (M = 4.82, 95% CI [4.63, 5.01], SD = 1.79, F(1, 723) = 7.36, p = .007, $\eta_p^2 = .010$). There was neither an effect of time horizon nor an interaction on this measure, both F < 1, $\eta_p^2 \le .001$. These results suggest that the scarcity writing task successfully manipulated scarcity.

Intertemporal choice. We first examined whether there was an effect of scarcity on intertemporal choice. A binary logistic regression testing only the effect of scarcity (control = 0, scarcity = 1) on intertemporal choice (smaller, sooner outcome = 1, larger, later outcome = 0) did not reveal a significant effect (B = -.21, 95% CI (-0.54, 0.11), SE = .17, Wald $\chi^2(1, N = 752) = 1.65, p = .199$, odds ratio = 0.81; see Figure 4).

Next, we incorporated the time horizon of the need. A binary logistic regression including scarcity (control = 0, scarcity = 1), time horizon (shorter time horizon = 0, longer time horizon = 1), and their interaction as independent variables revealed a marginally significant effect of scarcity condition (B = .55, 95% CI [-0.01, 1.11], SE = .28, Wald $\chi^2(1, N = 752) = 3.75$, p = .053, odds ratio = 1.73), a significant effect of time horizon, (B = -1.40, 95% CI [-1.89, -0.90], SE = .25, Wald $\chi^2(1, N = 752) = 30.77$, p < .001, odds ratio = 0.25), and a significant scarcity by time horizon interaction (B = -1.21, 95% CI [-1.95, -0.48], SE = .37, Wald $\chi^2(1, N =$ 752) = 10.43, p = .001, odds ratio = 0.30). Follow-up contrasts showed that when participants' wedding dates were before the payout of the larger, later outcome, scarcity increased choice of the smaller, sooner option (Mean difference = .13, 95% CI (.00, .27), Wald $\chi^2(1, N = 752) =$ 3.85, p = .050, odds ratio = 1.73). However, we found a reversal when participants' weddings were after the payout of the larger, later option. Under these circumstances, scarcity decreased choice of the smaller, sooner option (Mean difference = -.08, 95% CI (-.14, -.02), Wald $\chi^2(1, N =$
752) = 7.30, p = .007, odds ratio = .52). Results are shown in Figure 4.



Figure 4. Intertemporal Choice in Study 5

Note: Top panel: the effect of scarcity on intertemporal choice. Bottom panel: The effect of scarcity on intertemporal choice as a function of time horizon.

Discussion

The results of Study 5 once again revealed a polarizing effect of scarcity on intertemporal choice based on the time horizon of participants' threatened needs. Among participants whose weddings had shorter time horizons (were scheduled to occur before the larger, later payout), scarcity increased choice of the smaller, sooner option. However, among participants whose weddings had longer time horizons (were scheduled to occur after the larger, later payout), scarcity increased choice of the larger, later option. Since one's wedding date is not related to individual differences in time preferences for money, patience, or demographics, these results cast doubt on individual differences as an alternative explanation.

This study also examined differences across needs as an alternative explanation. In this study, we held the overarching need constant by asking all participants to think about their weddings. Moreover, to examine the specific needs people were focused on, we had a separate sample of online participants rate the specific aspects of the wedding that were provided to participants in the main study on the extent to which each aspect is necessary for a wedding. While participants in the scarcity condition were more focused on necessities for a wedding, these ratings did not differ across time horizon, nor was there an interaction of scarcity and need timing (see supplemental materials for details). Thus, this study suggests that the polarizing effect of scarcity by time horizon of needs is unlikely to be explained by systematic differences in the types of needs threatened by scarcity.

Study 6

Studies 1–5 demonstrate that the effect of scarcity on intertemporal choice is moderated by the time horizon of needs threatened by scarcity. An important question that remains is when a

longer time horizon of threatened needs leads to attenuation as in Study 1 and when it leads to a reversal of intertemporal preferences as in later studies. We suspect that such differences may be explained by the relative marginal utility of intertemporal choice options in addressing needs threatened by scarce resources. In this way, whether responses to scarcity threatening a need with a longer time horizon lead to increasing, decreasing, or unchanged preferences for sooner outcomes should depend on the relative marginal utility provided by the sooner and later options. In line with this reasoning, a post-test examining the relative marginal utility of options in Study 1 found that the sooner option (deferring housing payments for 3 months) was still perceived as providing more marginal utility to people experiencing scarcity for needs with longer time horizons compared to those not experiencing scarcity (see Study 1 Post Test in the Supplemental Materials). Study 6 was designed to formally test the impact of the relative marginal utility of intertemporal choice options in explaining why and how the time horizon of threatened needs moderates the relationship between scarcity and intertemporal choice.

Study 6 manipulated scarcity, where some participants expected to deplete their resources before their resources could be replenished, whereas others had sufficient resources. We then varied the intertemporal choice participants received. In one condition, participants had to make an intertemporal choice where selecting the sooner option provided greater marginal utility toward addressing scarcity. In another condition, participants had to make an intertemporal choice where selecting the later option provided greater marginal utility toward addressing scarcity. Finally, in a third condition, participants had to make an intertemporal choice where the intertemporal choice options were unrelated to addressing scarcity. Importantly, across all intertemporal choices, participants could receive the benefits of the later option before the threatened need would lead to negative consequences (i.e., threatened needs had a longer time

horizon). When selecting the later option provided greater marginal utility toward addressing threatened needs, we expected to replicate the reversal found in the previous studies where those in the scarcity (vs. control) condition would be more likely to choose the later option. However, we predicted that when selecting the sooner option provided greater marginal utility toward addressing threatened needs, those in the scarcity (vs. control) condition would be more likely to choose the sooner option despite the longer time horizon of their needs. Finally, we predicted that scarcity would have no impact on intertemporal choice when the choice was unrelated to addressing scarcity.

Method

This study followed a 2 (scarcity: scarcity vs. no scarcity) x 3 (marginal utility: more now versus more later versus unrelated) between-subjects design and was preregistered on AsPredicted (<u>https://aspredicted.org/ZBW_NF4</u>).

Participants. Because this study used a different paradigm and design than earlier studies, we conducted our power analysis based on the smallest effect size of interest. Specifically, in Study 6, we predicted a nonsignificant effect when intertemporal choice is unrelated to marginal utility. As such, we calculated the sample size required to detect a small effect in the "unrelated marginal utility" conditions with 90% power (odds ratio = 1.68, α = .05, *power* = 90%). This analysis suggested a sample size of 643 participants. Since there were three marginal utility conditions, we calculated a total required sample size of 1,929. To exceed this, we aimed to recruit 2,000 U.S. individuals on Cloud Research in exchange for monetary payment; 2,023 participants opened the survey and 2,001 participants completed the survey. Of the 22 people who did not complete the study, 6 did not complete enough of the study to get

assigned to a condition. The remaining 16 participants did not vary by condition, all $p \ge .236$. There were 42 people who failed the IMC and were excluded from analysis, leaving a final sample of 1,959 participants (Mean age = 40.70, SD = 12.78; 1019 females, 940 males). This exclusion did not vary by condition, all $p \ge .349$.

Procedure. Participants engaged in a simulation of a five-day backpacking trip with friends. Using a series of photographs and text, participants were guided through this experience. On the second evening of their backpacking trip, all participants had an encounter with a bear. In the scarcity condition, this encounter left participants with half the amount of food they had brought, which would be inadequate to last the entire trip (the next three days).⁴ In the control condition, the encounter did not affect their food supply, and thus they had adequate food for the entire trip (see supplemental materials for details).

The morning following the bear encounter, participants filled up their water bottles and began hiking. All participants then made an intertemporal choice, with the relative utility of each option varying across conditions. In one condition, participants had to make an intertemporal choice where selecting the later option provided greater marginal utility toward alleviating the concern over not having enough food by the end of the trip (marginal utility: more later). This question required participants to decide whether to eat a protein bar that they have or save it for later (Eat the protein bar = 1, Save it for later = 0). In another condition, participants had to make an intertemporal choice where selecting the sooner option provided greater marginal utility toward alleviating the toward alleviating the concern over not having enough food by the end of the trip (marginal utility toward alleviating the concern over not having enough food by the sooner option provided greater marginal utility toward alleviating the concern over not having enough food by the end of the trip (marginal utility toward alleviating the concern over not having enough food by the end of the trip (marginal utility toward alleviating the concern over not having enough food by the end of the trip (marginal utility: more now). Specifically, participants were told that they found berries that are safe to eat but often cause mild headaches a few hours after eating them, and they had to decide whether to

⁴ This scarcity manipulation is based on a real-life encounter that was experienced by one of the authors in Yosemite National Park in 1999.

eat the berries (Eat the berries and deal with the potential mild headache later = 1, Don't eat the berries and avoid the potential mild headache later = 0). Finally, in the last condition, participants had to make an intertemporal choice where the options were unrelated to alleviating the concern over running out of food by the end of the trip (marginal utility: unrelated). Participants in this condition were told that they realize they have to poop and must decide whether to go now in the woods or wait till they reach a restroom at their campsite (1 = Go now in the woods, 0 = Wait and go in a bathroom when you get to the campsite). The relative marginal utility of the options in each choice pair were validated in a separate study (see Supplemental Materials). Of note, across all choice pairs, the timing of the later outcome occurred (or could occur) prior to the end of the backpacking trip; thus, scarcity threatened needs across a longer time horizon across all choice pairs. Whether participants selected the sooner or later option served as our dependent measure.

After completing the simulation, participants completed a manipulation check: "In the scenario you read, to what extent was the food you had remaining for the rest of your trip scarce or inadequate after your bear encounter?" (7-point scale: 1 = Not at all scarce/inadequate, 7 = Very scarce/inadequate). Last, they completed an IMC, demographic information including age and gender, and had the opportunity to provide any thoughts they had about the study.

Results

Manipulation check. There was one missing response on this measure, leaving 1,957 participants with completed manipulation check responses. The manipulation check was submitted to an analysis of variance (ANOVA) with scarcity condition and marginal utility condition entered as factors. As intended, there was a significant effect of resource scarcity.

Participants in the resource scarcity (M = 5.17, 95% CI [5.09, 5.24], SD = 1.15) condition reported their food resources as being more scarce than did participants in the control (M = 1.74, 95% CI [1.67, 1.82], SD = 1.29) condition, F(1, 1951) = 3897.80, p < .001, $\eta_p^2 = .666$. There was also an unexpected effect of marginal utility condition, F(1, 1951) = 15.49, p < .001, $\eta_p^2 = .016$, where those in the more marginal utility later condition (M = 3.78, 95% CI [3.62, 3.94], SD = 2.08) perceived greater scarcity than those in the more marginal utility now condition (M = 3.21, 95% CI [3.05, 3.38], SD = 2.10) and the unrelated condition (M = 3.38, 95% CI [3.22, 3.55], SD = 2.10). However, importantly, there was no interaction between scarcity and marginal utility on perceptions of scarcity (F(2, 1951) = 1.68, p = .187, $\eta_p^2 = .002$).

Intertemporal choice. A binary logistic regression on intertemporal choice entering only scarcity condition (control = 0, scarcity = 1) found a significant effect of scarcity condition (B = -.334, 95% CI = [-.52, -.14], SE = .10, Wald $\chi^2(1) = 11.83$, p < .001, odds ratio = 0.72), such that scarcity decreased participants' likelihood of selecting the sooner option. We then conducted a binary logistic regression on participants' selection of the sooner option as a function of scarcity condition, marginal utility condition, and the interaction of scarcity and marginal utility conditions, with both scarcity and marginal utility being entered as fixed factors.⁵ The model fit tests revealed no effect of scarcity condition (Wald $\chi^2(1) = 137.24$, p < .001). Importantly, we found the

⁵ This analysis was conducted using Generalized Linear Models (GLM) in SPSS. Importantly, the GLM procedure using fixed factors (i.e., conditions entered as categorical rather than linear variables) provides likelihood-ratio statistics for the model fit omnibus test. For categorical variables with 3 or more levels, this test indicates whether all of the dummy indicators for that factor are jointly significant, allowing us to examine whether there is an overall effect of marginal utility as well as an overall interaction of scarcity and marginal utility. This analysis procedure creates dummy variables for each fixed factor (scarcity: control = 0, scarcity = 1; marginal utility (more later): marginal utility unrelated = 0, more marginal utility now = 0, more marginal utility later = 1; marginal utility (unrelated): marginal utility unrelated = 1, more marginal utility now = 0, more marginal utility later = 0). As such, the control condition within the scarcity manipulation and the more marginal utility now condition within the marginal utility manipulation served as the reference groups in this analysis.

expected scarcity by marginal utility interaction (Wald $\chi^2(1) = 128.98$, p < .001).

We then used planned contrasts to examine the effect of scarcity within each of the marginal utility conditions. As predicted, resource scarcity increased the likelihood of selecting the sooner option in the more marginal utility now condition (Mean difference = .17, 95% CI [.12, .22], Wald $\chi^2(1) = 37.83$, p < .001, odds ratio = 4.52), decreased the likelihood of selecting the sooner option in the more marginal utility later condition (Mean difference = -.43, 95% CI [-.50, -.36], Wald $\chi^2(1) = 148.19$, p < .001, odds ratio = .16), and did not significantly affect intertemporal choices in the marginal utility unrelated condition, mean difference = .00, CI [-.08, .07], Wald $\chi^2(1) < 1$, p = .910, odds ratio = .98 (see Figure 5).





Note: Percentages are estimated marginal means. Error bars indicate 95% confidence intervals.

Discussion

Study 6 extends our findings beyond financial scarcity by examining scarcity of another resource type: food supply. Beyond replicating the finding that scarcity that threatens needs with a longer time horizon can result in a decreased propensity to select sooner options, this study demonstrates that the effect of scarcity on intertemporal choice is moderated by the relative marginal utility of intertemporal choice options.

General Discussion

Scarcity is a subjective perception arising from a perceived insufficiency of resources for one's needs. The current work finds that scarcity does not uniformly impact people's preferences. In particular, we show that the time horizon of needs threatened by scarce resources is an important determinant of scarcity's effects. We replicate existing findings showing that scarcity increases choices of smaller, sooner outcomes when those outcomes help address needs with shorter time horizons. Importantly, however, this pattern attenuates and in some cases reverses when threatened needs have longer time horizons. Thus, we show that scarcity can have polarizing effects on intertemporal choice depending on the time horizon of threatened needs.

Across our experiments, individuals facing scarcity made intertemporal choices that were consistent with the marginal utility account. That is, when faced with scarcity, people made choices that they believed would better alleviate the needs threatened by scarcity. While these results are inconsistent with the idea that scarcity of any kind inherently makes people more likely to borrow, they are consistent with the idea that scarcity attunes people to their pressing needs (Shah, Mullainathan, and Shafir, 2012). We reconcile this apparent discrepancy by recognizing the time horizon of needs threatened by scarcity and noting that needs do not have to be immediate to be pressing. When scarcity threatened needs with shorter time horizons,

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participants preferred smaller, sooner outcomes; when scarcity threatened needs with longer time horizons, participants did not prefer smaller, sooner outcomes and sometimes preferred larger, later outcomes. When intertemporal choices were unrelated to participants' ability to meet their threatened needs, there was no relationship between scarcity and intertemporal choice. In addition, when we constructed the intertemporal choice such that the smaller, sooner outcome was better able to address participants' threatened needs, scarcity increased preferences for the smaller sooner, even when the threatened needs had a longer time horizon. Finally, in an additional study described in the supplemental materials, participants experiencing scarcity reported being more focused on meeting their threatened needs, both when threatened needs had a shorter and a longer time horizon. Taken together, these results suggest that responses to scarcity can reflect a desire to meet threatened needs and challenge the idea that scarcity inherently impedes cognitive functioning and causes individuals to focus on the present at the expense of the future.

The existing economic literature conceptualizes scarcity as the perceived inadequacy of resources for needs and desires (e.g., Raiklin and Uyar, 1996). Inherent to this conceptualization is the notion that scarcity is not purely a function of resource levels, but rather a combination of resource levels and the demands on those resources. Considering the vast array of demands on people's financial resources, it is perhaps not surprising that existing research shows a weak relationship between income levels and perceptions of financial scarcity (e.g., Gasiorowska, 2014). In fact, in the data from the Consumer Finance Institute, income was more strongly correlated with demographic variables such as being older (age; r = .16), female (gender; r = .33), and more educated (education; r = .53) than with scarcity perceptions. The relationship between income and scarcity perceptions was weak, both when scarcity was operationalized as

needing additional financial resources (r = -.10) and when operationalized as the average (r = -.07) or maximum (r = -.08) level of people's concerns about making ends meet (for a greater explication of why objective financial measures often differ from subjective assessments, see Tully and Sharma, 2022). Thus, research on the effects of scarcity that use objective indicators such as income should be interpreted with caution, as they may also reflect effects stemming from demographic and societal differences. We encourage future research to use measures that incorporate the perceived inadequacy of people's resources for their needs to better isolate the effects of scarcity on decision-making.

Our results may shed light on potential failures to replicate effects of scarcity (e.g., Camerer et al. 2018; O'Donnell et al., 2021). For instance, prior research on scarcity and intertemporal choice primarily shows that scarcity increases preferences for smaller, sooner outcomes. Yet, in many of our studies, we failed to find an overall effect of scarcity on intertemporal choice. Importantly, we reconcile this discrepancy by demonstrating the moderating role of the time horizon of threatened needs. Our work suggests that failures to replicate — whether they be null effects or effects in the opposite direction — may be the result of differences across scarcity (e.g., differences in underlying needs threatened by scarce resources) or differences in the relationship between the choice paradigm and the threatened needs (e.g., the relative utility of the intertemporal choice options). Moreover, omitting the time horizon of threatened needs may result in an underestimation of scarcity's effects on intertemporal choice when needs have shorter time horizons. Indeed, in Study 2, although we found an overall effect of scarcity on intertemporal choice (B = 1.18), this effect was much stronger among participants experiencing scarcity that threatened needs with shorter time horizons (B = 2.57). Thus, our work builds on recent claims about the need to carefully consider measures and manipulations of scarcity when attempting to replicate or extend existing work on scarcity (e.g., O'Donnell et al., 2021; Tully and Sharma, 2022).

Deeper understanding of the concept of scarcity may be increasingly important as society evolves and people have more exposure to and a desire for a wider variety of needs and wants. Indeed, scarcity is believed to increase rather than decrease as society grows and evolves (Raiklin and Uyar, 1996, p. 54). This is not simply because of greater population size or usage of resources, but also because of the growing list of needs and wants that humans seek as they learn about what others have and what is available. As the needs threatened by scarcity become more varied, responses to scarcity may become less predictable. Thus, more research is needed to understand which aspects of scarcity are universal and which may change as a function of the specific resources or needs threatened.

In the current work, we focused on examining the time horizon of important needs threatened by scarcity. However, future research could examine other systematic differences across needs. Additionally, given that scarcity may influence a number of needs at any given time and that scarcity can encourage people to prioritize their needs (e.g., Fernbach, Kan, and Lynch 2014), future research ought to consider how such prioritization is done. All else equal, imminence is likely to influence prioritization—for instance, eating today is likely more important than eating tomorrow. However, other potential factors may include the severity of consequences to oneself or loved ones, the reversibility of consequences, or the extent to which threatened needs relate to one's self-concept. Future research should investigate individual and situational factors that impact the prioritization of needs.

While our results suggest that the effects of scarcity on intertemporal choice depend on the timing of the need threatened by scarcity, it is possible that moderating factors cause scarcity to result in more generalized impatience in some contexts. For example, research has shown that childhood socioeconomic status can impact how people respond to scarcity cues in their environment (Mittal and Griskevicius, 2014; Griskevicius et al., 2013), increasing impulsivity and risk taking due to differences in stress or perceived control. In addition, research has shown that visceral states (e.g., extreme hunger, thirst, or drug withdrawal) lead to more short-sighted decisions (e.g., Loewenstein, 1996). Integrating these findings with those presented in the current research suggests the need to develop a taxonomy of scarcity that includes various dimensions on which scarcity may differ and, in turn, lead to different outcomes. The current work offers an initial step toward this goal.

In sum, the current work provides a nuanced perspective on the relationship between scarcity and intertemporal choice, showing that the effect of scarcity on intertemporal choice is moderated by the time horizon of threatened needs. The current work highlights the importance of incorporating the underlying needs threatened by scarcity into investigations of scarcity, contributes to the ongoing debate regarding when and why scarcity affects intertemporal choice, and suggests that experiences of scarcity may not be as homogeneous as previously believed.

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Appendix 1

Research That Has Been Used to Support a Relationship Between Scarcity and Intertemporal Choice

Authors (Year)	Study	Independent variable	Manipulated/ measured	Time horizon of needs (short/ long/unclear)	Dependent variable	Impact on intertemporal choice (favor short-term/long- term outcomes)	Subject Population
Carvalho (2010)	Section 5	Poor households in rural Mexico vs. U.S households	Measured	Short	Estimated discount factor	Favor short-term outcomes	24,000 households in rural Mexico
Carvalho, Meier, & Wang (2016)	Study 1 - 2	Before vs. after payday	Manipulated	Short	Present bias in intertemporal choices	Favor short-term outcomes	Low-to-moderate income members of two Internet panels (Study 1: N = 1191 Study 2: N = 3110) 1013 households in Bamako, Mali
Dean & Sautmann (2014)		 Exogenous income shocks during the present week Exogenous preference shocks during the present week Level of savings during the present weak 	Measured	Short	Marginal rate of intertemporal substitution (MRS)	Favor short-term outcomes. The effect was attenuated when credit constraints were high.	
Fitzpatrick & Coleman-Jensen (2014)		Food inadequacy and marginal food security	Measured	Short	Use of payday loans in the past 12 months	Favor short-term outcomes	Dec 2008 and Jan 2009 Current Population Survey (20 518 households)
Gneezy, Imas, & Jaroszewicz (2020)	Study 1	Time to complete a cognitive task	Manipulated	Short	Time preferences	Favor short-term outcomes	Mturk ($N = 217$)
Jachimowicz et al. (2017)	Study 1	Household income	Measured	Short	Discount factor using Dynamic Experiments for Estimating Preferences (DEEP)	Favor short-term outcomes. The effect was attenuated when community trust was high.	Mturk (N = 647)
Jachimowicz et al. (2017) Lawrance (1991)	Study 3	Participants imagined 4 scenarios with relatively minor vs. severe financial implications	Manipulated	Short	Discount factor using Dynamic Experiments for Estimating Preferences (DEEP)	Favor short-term outcomes. The effect was attenuated when community trust was high.	Mturk (N = 120)

		Household income	Measured	Short	Time preference rates identified from estimation of consumption Euler equations	Favor short-term outcomes	Panel Study of Income Dynamics (PSID) (1513 households)
Moeini-Jazani, Albalooshi, & Seljeseth (2019)	Study 1	Income	Measured	Short	Participants indicated the amount of money they would require in 3, 9, and 18 months in the future, to make them indifferent to receiving \$65 now	Favor short-term outcomes. Self- affirmation reduces delay discounting of the financially deprived.	Mturk (N = 546)
Moeini-Jazani, Albalooshi, & Seljeseth (2019) Ong, Theseira, & Ng (2019) Orhun & Palazzolo (2019)	Study 2	Feelings of financial deprivation: participants were told they [lacked/had adequate] financial resources relative to others and wrote about how it felt to live a financially [constrained/adequate] life	Manipulated	Short	Participants indicated the amount of money they would require in 3, 9, and 18 months in the future, to make them indifferent to receiving \$65 now	Favor short-term outcomes. Self- affirmation reduces delay discounting of the financially deprived.	Mturk (N = 432)
	The field study	Debt relief (before vs. 3 months after receiving debt relief)	Measured	Unclear	Present bias in intertemporal choices	Favor short-term outcomes	196 applicants to the debt-relief program in Singapore
Ong, Theseira, & Ng (2019) Orhun & Palazzolo (2019)		Household income	Measured	Short	Bulk buying; Purchase acceleration to take advantage of a temporary deal	Favor short-term outcomes (i.e., not spending)	Nielson consumer panel data (2006- 2014) (N = 3.2 million purchases)
Shah, Mullainathan, & Shafir (2012)	Study 2	Number of shots in a game	Manipulated	Short	The fraction of budget (shots) borrowed across the game	Favor short-term outcomes	Mturk (N = 68)
Orhun & Palazzolo (2019)	Study 4	Time to play a game	Manipulated	Short	The fraction of budget (time) borrowed across the game	Favor short-term outcomes	Mturk (N = 118)
Shah, Mullainathan, & Shafir (2012) Tanaka, Camerer & Nguyen (2010) Zauberman and Lynch (2005)	Study 5	Time to play a game	Manipulated	Short	The overall points earned in the game	Favor short-term outcomes	Mturk (N = 137)

Shah, Mullainathan, & Shafir (2012) Tanaka,	The time discounting experiment	Household income	Measured	Short	Time discounting rate	Favor short-term outcomes	181 subjects in 9 villages in Vietnam
Camerer & Nguyen (2010) Zauberman and Lynch (2005)	Study 7	Resource slack (tomorrow and in two weeks)	Measured	Unclear	Preference to delay helping (i.e., devote resource to local charities)	Slack gain: favor short-term outcomes; Slack loss: favor long-term outcomes	130 undergraduate students

Note: This table includes papers that directly examine scarcity as well as papers that use objective financial indicators and have been used to support a relationship between scarcity and intertemporal choice. Based on research showing that lower-income individuals have more temporally proximal needs for money (Jachimowicz et al., 2017), the time horizon of needs is coded as short for research examining the effects of lower-household income or poverty.

Supplemental Materials

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Study 2 Additional Study Details

Additional Procedure Details

This is a study about financial decision making. You will make a few choices and answer some questions. It is important that you READ THE INSTRUCTIONS VERY CAREFULLY as you will be asked questions about them.

page break

[The order of the scarcity and dependent measures was randomized]

Scarcity

In this part of the study, we are interested in how you feel about your finances. Take a moment and think about your financial resources. Some people feel that they do not have enough money for the things they want or need in life whereas others feel that they have a sufficient amount of money. Even those that feel they don't have enough money can differ in what they feel their financial resources are insufficient for. Which of the following best describes your financial situation?

 \bigcirc I feel I have enough money for the things I want or need in life (1)

 \bigcirc I feel I do not have enough money, and the things I am most concerned about not being able to afford **require money within the next three months.** (2)

 \bigcirc I feel I do not have enough money, and the things I am most concerned about not being able to afford require money in the future (3+ months from now) (3)

I feel I do not have enough money, and the things I am most concerned about not being able to afford **don't require money at any specific time** (4)

page break

Dependent Measures

For each row below, please indicate which of the two options you prefer (get \$150 today or the specified amount in 3 months). At the end of the study, one participant will be randomly selected to receive one of their choices in the form of a bonus.

	(1)	(2)	
Get \$150 today	0	\bigcirc	Get \$140 in 3 months
Get \$150 today	0	\bigcirc	Get \$145 in 3 months
Get \$150 today	0	\bigcirc	Get \$150 in 3 months
Get \$150 today	0	\bigcirc	Get \$155 in 3 months
Get \$150 today	0	\bigcirc	Get \$160 in 3 months
Get \$150 today	0	\bigcirc	Get \$165 in 3 months
Get \$150 today	0	\bigcirc	Get \$170 in 3 months
Get \$150 today	0	\bigcirc	Get \$175 in 3 months
Get \$150 today	0	\bigcirc	Get \$180 in 3 months
Get \$150 today	0	\bigcirc	Get \$185 in 3 months
Get \$150 today	0	\bigcirc	Get \$190 in 3 months
Get \$150 today	0	\bigcirc	Get \$195 in 3 months
Get \$150 today	0	\bigcirc	Get \$200 in 3 months
Get \$150 today	0	\bigcirc	Get \$205 in 3 months
Get \$150 today	0	\bigcirc	Get \$210 in 3 months

page break

Age

What is your current age?

Gender

What is your gender?

 \bigcirc Male (1)

O Female (2)

Other (3)

 \bigcirc Prefer not to answer (4)

Primary Language

Is English your primary language?

O Yes (1)

O No (2)

Household Income

What is your estimated combined annual household income (in your home currency)?

- O under \$20,000
- \$20,000-\$29,999
- \$30,000-\$39,999
- \$40,000-\$49,999
- \$50,000-\$59,999
- \$60,000-\$69,999
- \$70,000-\$79,999
- \$80,000-\$89,999
- \$90,000-\$99,999
- \$100,000-\$109,999
- \$110,000-\$119,999
- \$120,000-\$129,999
- \$130,000-\$139,999
- \$140,000-\$149,999
- \$150,000+

Education

What is your highest level of education?

- \bigcirc Less than high school (1)
- \bigcirc High school graduate (2)
- \bigcirc Some college (3)
- \bigcirc Bachelor's degree (4)
- \bigcirc Professional degree (5)
- \bigcirc Master's degree (6)
- O Doctorate (7)

Slack

Think about your likely expenses and your available spare money **today**. Now consider your likely expenses and available spare money **3 months from now**. Which day do you expect to have more money available?

- \bigcirc Much more money available today. 1 (1)
- O 2 (2)
- O 3 (3)
- 0 4 (4)
- 0 5 (5)

 \bigcirc I expect the amount of spare money I have to be similar today and 3 months from now. 6 (6)

- 07(7)
- 0 8 (8)
- 0 9 (9)
- 0 10 (10)

 \bigcirc Much more money available 3 months from now. 11 (11)

page break

Bill Pay History

Which of the following best describes your financial situation?

 \bigcirc I pay all of my bills on time and have no debts in collection. (1)

 \bigcirc I sometimes miss a payment but have no debts in collection. (2)

 \bigcirc I struggle to pay my bills every month but have no debts in collection. (3)

 \bigcirc I am getting calls from collectors and struggle to pay my bills every month. (4)

 \bigcirc I am seriously considering filing for bankruptcy or have filed for bankruptcy in the past three years. (5)

 \bigcirc I am not involved at all in any financial decisions including how money is spent in our household. (6)

 \bigcirc Don't know/Refuse to answer (7)

Instructional Manipulation Check

People's needs can often be grouped into broad categories. Below are some categories that can be used to group needs. However, we are not interested in how your needs related to these categories. These categories are simply here to make sure you are taking the time to read our

instructions carefully. Please demonstrate that you took the time to read these instructions by selecting "other" and writing attention in the space provided below.

Family (0)
Exercise (0)
Sleep (0)
Errands (0)
Paperwork (0)
Housing (0)
Food and Water (0)
Friendships (0)
Other (1)

Study 3 Additional Study Details

Additional Procedure Details

[Scarcity Condition]

Most people experience some form of financial scarcity in their lives. That is, it often feels as though our money is inadequate or insufficient for all of our spending needs and desires. For instance, people can feel their income is not enough for their expenses, that they cannot afford things that they want, or they don't have enough money to feel financially secure. Although most people experience some form of financial scarcity, the factors that contribute to feelings of scarcity vary from person to person.

We are interested in understanding more about the financial scarcity you experience in your own life. Please describe **why** you may feel a sense of financial scarcity and how this scarcity impacts your life.

[Control Condition]

Please proceed to the next part of the study.

page break

[All participants]

The next part of this study is about financial decision making. You will make a few choices and answer some questions. It is important that you READ THE INSTRUCTIONS VERY CAREFULLY as you will be asked questions about them.

page break

In the next part of the study, you will be asked to make trade-offs between receiving an amount of money today or a different amount 33 days from now.

Click Next to start.

page break

Dependent Measures

	(1)	(2)	
Get \$30 to spend now	\bigcirc	\bigcirc	Get \$25 in 45 days
Get \$30 to spend now	\bigcirc	0	Get \$30 in 45 days
Get \$30 to spend now	\bigcirc	0	Get \$35 in 45 days
Get \$30 to spend now	\bigcirc	0	Get \$40 in 45 days
Get \$30 to spend now	\bigcirc	0	Get \$45 in 45 days
Get \$30 to spend now	\bigcirc	\bigcirc	Get \$50 in 45 days
Get \$30 to spend now	\bigcirc	0	Get \$55 in 45 days
Get \$30 to spend now	\bigcirc	0	Get \$60 in 45 days
Get \$30 to spend now	\bigcirc	\bigcirc	Get \$65 in 45 days
Get \$30 to spend now	\bigcirc	\bigcirc	Get \$70 in 45 days
Get \$30 to spend now	\bigcirc	\bigcirc	Get \$75 in 45 days
Get \$30 to spend now	\bigcirc	0	Get \$80 in 45 days
Get \$30 to spend now	\bigcirc	\bigcirc	Get \$85 in 45 days
Get \$30 to spend now	\bigcirc	\bigcirc	Get \$90 in 45 days
Get \$30 to spend now	\bigcirc	\bigcirc	Get \$95 in 45 days

For each row below, please indicate which of the two options you will choose (get \$30 to spend now or get a larger amount in 45 days).

page break

Scarcity Manipulation Check

As you completed this study, to what extent did you feel that your finances were scarce, limited, or inadequate?

Not at all 1 (1)
2 (2)
3 (3)
4 (4)
5 (5)
6 (6)
Very much so 7 (7)

page break

[Scarcity Condition]

Time Frame

Earlier in the study, you were asked to consider why you may feel your money is insufficient for your needs or desires. As you completed this study, were you primarily thinking about things you want or need to spend on **in the next month and a half** that you don't have enough money for?

 \bigcirc Yes, I was primarily thinking about things that I want or need to spend on within the next month and a half that I don't have enough money for. (0)

 \bigcirc No, I was primarily thinking about things that have a longer time horizon and could be met with additional money gained in a month and a half from now (or after). (1)

page break

[All participants]

Age

What is your current age?

Household Income

What is your estimated combined annual household income (in your home currency)?

- O under \$20,000
- \$20,000-\$29,999
- \$30,000-\$39,999
- \$40,000-\$49,999
- 50,000-\$59,999
- \$60,000-\$69,999
- \$70,000-\$79,999
- \$80,000-\$89,999
- \$90,000-\$99,999
- \$100,000-\$109,999
- \$110,000-\$119,999
- \$120,000-\$129,999
- \$130,000-\$139,999
- \$140,000-\$149,999
- \$150,000+

Education

What is your highest level of education?

 \bigcirc Less than high school (1)

 \bigcirc High school graduate (2)

 \bigcirc Some college (3)

 \bigcirc Bachelor's degree (4)

 \bigcirc Professional degree (5)

 \bigcirc Master's degree (6)

 \bigcirc Doctorate (7)

Bill Pay History

Which of the following best describes your financial situation?

 \bigcirc I pay all of my bills on time and have no debts in collection. (1)

 \bigcirc I sometimes miss a payment but have no debts in collection. (2)

 \bigcirc I struggle to pay my bills every month but have no debts in collection. (3)

 \bigcirc I am getting calls from collectors and struggle to pay my bills every month. (4)

 \bigcirc I am seriously considering filing for bankruptcy or have filed for bankruptcy in the past three years. (5)

 \bigcirc I am not involved at all in any financial decisions including how money is spent in our household. (6)

O Don't know/Refuse to answer (7)

Sex

What is your gender?

O Male (1)

O Female (2)

 \bigcirc Prefer not to answer (3)

Primary Language

Is English your primary language?

 \bigcirc Yes (1)

O No (2)

page break

Socioeconomic Status

Below you will see a ladder with 10 rungs. The ladder represents where people stand in society.


At the top of the ladder are the people who are the best off, those who have the most money, most education, and best jobs. At the bottom are the people who are the worst off, those who have the least money, least education, worst jobs, or no job.

Where do you think you stand on the ladder?

0	10 (10)
0	9 (9)
0	8 (8)
0	7 (7)
0	6 (6)
0	5 (5)
0	4 (4)
0	3 (3)
0	2 (2)
0	1 (1)

Spare Money

Earlier in the study, you were asked to make decisions about getting an amount of money today or a different amount later in time. To what extent was your decision about receiving money today or in 45 days driven by your beliefs about when you will have more spare money (now or in 45 days)?

- \bigcirc Not at all 1 (1)
- O 2 (2)
- \bigcirc 3 (3)
- 0 4 (4)
- 0 5 (5)
- 0 6 (6)
- \bigcirc Very much so 7 (7)

Study 4: Additional Study Details

Additional Procedure Details

[Money condition]

We use money to satisfy our needs (e.g., groceries, bills, vacation, buying a home, retirement). However, we often perceive our money as scarce, limited, or inadequate. In the text box below, please list <u>one important need</u> that you feel you <u>do not have enough money</u> for.

Please describe why this need is important to you in the text box below. **Please be as detailed as possible.**

[Time condition]

We spend time on various things (e.g., getting groceries, doing paperwork, going on vacation, doing housework, working). However, we often perceive our time as scarce, limited, or inadequate. In the text box below, please list <u>one important need</u> that you feel you <u>do not have enough time</u> for.

Please describe why this need is important to you in the text box below. **Please be as detailed as possible.**

page break

In the next part of the study, you will be asked to make trade-offs between getting \$30 to spend now or getting a larger amount 45 days later. One participant will be selected to receive one of their choices in the form of a bonus payment.

page break

Dependent Measure

For each row below, please indicate which of the two options you will choose (get \$30 to spend now or get a larger amount in 45 days).

0	0	Get \$30 in 45 days
0	0	Get \$32 in 45 days
0	0	Get \$34 in 45 days
0	0	Get \$36 in 45 days
0	0	Get \$38 in 45 days
0	0	Get \$40 in 45 days
0	0	Get \$44 in 45 days
0	0	Get \$46 in 45 days
0	0	Get \$48 in 45 days
0	0	Get \$50 in 45 days
0	0	Get \$52 in 45 days
0	0	Get \$54 in 45 days
0	0	Get \$56 in 45 days
0	0	Get \$58 in 45 days
0	0	Get \$60 in 45 days

page break

Need Timing

Earlier in the survey, you wrote about an important need that you felt you do not have enough [time/money] to fulfill: [The need they wrote earlier]

To what extent do you need additional [time/money] within the next 45 days to meet this need?

Definitely						
needs to be						Definitely
before 45						can be after
days						45 days
1	2	3	4	5	6	7

page break

[Money condition]

How much money do you need to spend on it? Please write down a number (in dollars).

[Time condition]

How much time do you need to spend on it? Please specify the time period (e.g., hours, days, months).

page break

Scarcity Manipulation Check

As you comple	ted the surve	ey, to what exte	ent did you thi	ink about you	r money as b	eing
insufficient, ina	idequate, or	scarce?				
Not at all						Very much
1	2	3	4	5	6	7

As you completed the survey, to what extent did you think about your **time** as being insufficient, inadequate, or scarce?

Not at all						Very much
1	2	3	4	5	6	7

page break

Instructional Manipulation Check

People's needs can often be grouped into broad categories. Below are some categories that can be used to group needs. However, we are not interested in how your needs related to these categories. These categories are simply here to make sure you are taking the time to read our instructions carefully. Please demonstrate that you took the time to read these instructions by selecting "other" and writing attention in the space provided below.

- o Family
- o Exercise
- o Sleep
- o Errands
- o Paperwork
- o Housing
- o Food and Water
- o Friendships
- o Other

page break

Demographic Information

What is your age?

Which gender do you identify with?

- o Male
- o Female

What is your combined annual household income?

- o under \$20,000
- o \$20,000-\$29,999
- o \$30,000-\$39,999
- o \$40,000-\$49,999
- o \$50,000-\$59,999
- o \$60,000-\$69,999
- o \$70,000-\$79,999
- o \$80,000-\$89,999
- o \$90,000-\$99,999
- o \$100,000-\$109,999
- o \$110,000-\$119,999
- o \$120,000-\$129,999
- o \$130,000-\$139,999
- o \$140,000-\$149,999
- o \$150,000+

Do you have any additional comments about this survey? Feel free to include them here.

Study 5: Additional Study Details

Instructions

Answer 5 quick questions about your wedding, & we'll give you FREE expert planning tips & a chance to win \$200!

[Scarcity condition]

Does planning for your wedding ever make you feel you don't have enough money? What would you like to have for your wedding that you currently cannot afford?

[Control condition]

What are you most excited about doing at your wedding (e.g., vows, seeing friends, dancing)?

[Scarcity condition]

Although many factors may contribute to feeling your money is inadequate for your wedding needs and wants, which of the following factors is the **primary source of your financial concerns**?

- o Venue cost
- o Food/drink costs
- o Travel costs
- o Wedding dress costs
- o Suit/tuxedo costs
- o Flowers/decoration costs
- o Music, games, entertainment
- o Photographer costs
- o Honeymoon costs
- o Other_____

[Control condition]

Although many details may make a wedding feel special, which of the following are you **most** excited about?

- o Enjoying the venue
- o Having food/drinks
- o Traveling
- o Wearing the wedding dress
- o Wearing the suit/tuxedo
- o Seeing flowers/decorations
- o Music, games, entertainment
- o Photographs
- o Honeymoon
- o Other ____

[All participants]

Dependent Measure

When you submit your answers, you will be entered into a lottery to win \$200. We're interested in whether you would prefer to get \$200 to spend now or get \$350 in 3 months.

- o Get \$200 to spend now
- o Get \$350 in 3 months

Wedding Timing

What is the expected date of your wedding? *Please specify month and year (XX/XXXX)*. *If no date has been selected, please estimate the date to the best of your ability.*

page break

You are almost done!

Just answer a couple more questions to be entered into the \$200 lottery and receive your free expert wedding planning tips.

Scarcity Manipulation Check

As you completed our questions, to what extent did you feel your finances were scarce, limited, or inadequate?

Not at all						Very much
1	2	3	4	5	6	7

Are you and your fiancé personally responsible for paying for the majority of your wedding expenses?

- o Yes we are paying for most of it.
- o No we are not paying for most of it.

How did you find out about this survey?

- o A facebook ad or sponsored post
- o Friend, family member, or other

Please enter the email address you would like us to send you the \$200 gift card, if you are selected as the winner of the lottery.

This is completely optional. This information is only for the purposes of the lottery, will not be given to any advertisers or third parties, and will be deleted after a winner is chosen. Expert tips will be provided on the next page either way.

Study 6: Additional Study Details

On the next few pages, you will read about a backpacking trip where you go camping with friends. Try to imagine yourself in the situation as best as possible. Think about what you would

do in this situation.

Please read carefully as you will be asked questions about the situation at the end.

page break

You and your friends decide to go on a 5 day backpacking trip. You are excited to be getting away from everything. The first day you hike in a few miles. On day two, you hike a bit further and find a really awesome spot to relax.



page break

You and your friends decide to set up camp for the night. While you are setting up, your friend mentions that the area you are in is known as "bear country" and suggests that you hang your food in the tree so that it doesn't get eaten by bears.



page break



While you are hanging out by the campfire, a bear comes and climbs the tree to eat your food.

page break

Your friend hears the rustling and goes to see what is going on. They bang some pots and pans together to make loud noises that scare away the bear.



page break

[Control Condition]

Your friend had tied the bag very well and the bear was unable to get into your food before it was scared away. This means you still have plenty of food for the remaining 3 days of your trip.

[Scarcity Condition]

Your friend had tied the bag very well, but the bear ate half of the food before it was scared away. Since you are already 2 days into the trip, there is no store nearby to restock. This means that you have only half the amount of food you need for the remaining 3 days of your trip.

page break

The next day, you fill up your water bottle at the nearby stream and start hiking again.

page break

Dependent Measure

[Marginal Utility: More Later]

You start to get hungry. You think about one of the protein bars left in your bag and need to decide whether to eat it now or save it for later. What do you do?



- Eat the protein bar now
- Save the protein bar for later

[Marginal Utility: More Now]

You find some berries. Your friend recognizes them as manzanita berries immediately. They are perfectly safe to eat, but often cause mild headaches a couple of hours after eating them due to their high tannin levels. Do you eat the berries?



- \circ Eat the berries and deal with the potential mild headache later
- \circ $\,$ Don't eat the berries and avoid the potential mild headache later

[Marginal Utility: Unrelated]

On the trail, you realize you need to poop. You brought a trowel (shovel) and toilet paper with you, but you were told there is a bathroom at tonight's campsite. Do you go in the woods or wait until you get to the campsite?



- Go now in the woods
- Wait and go in a bathroom when you get to the campsite

page break

You spend the next few days enjoying the outdoors, but tell yourself that the next time you go backpacking you will bring a bearproof food container!

page break

Manipulation Check

In the scenario you read, to what extent was the food you had remaining for the rest of your trip scarce or inadequate after your bear encounter?

Not at all						Very
scarce /						scarce /
inadequate						inadequate
1	2	3	4	5	6	7

page break

Instructional Manipulation Check

Responses to this survey may depend on whether you've ever gone backpacking. However, more important than whether you've been backpacking is whether you take the time to read the scenario in full.

Please indicate that you were taking the time to read the scenario by ignoring the options below, selecting "other" and writing the word backpack in the box provided below.

- I've been backpacking before.
- I've never been backpacking before but want to go.
- I've never been backpacking before and am not interested in going.
- Other _____

page break

Demographic Information

What is your age?

Which gender do you identify with?

- o Male
- o Female

Study 1: Supplemental Analyses

The following are a series of robustness checks using different operationalizations of scarcity and time horizon.

	(1)	(2)	(3)	(4)
Scarcity	2.53***	2.38***	0.86***	0.91***
	(0.09)	(0.08)	(0.03)	(0.41)
Time Horizon	0.09	0.03	-0.09	0.30
	(0.07)	(0.09)	(0.22)	(0.37)
Scarcity x Time Horizon	-0.38***	-0.39***	-0.08	-0.25***
	(0.09)	(0.11)	(0.05)	(0.05)
N	2354	2354	2354	2354

†p < .10, *p < .05, **p < .01, ***p < 0.001

(1) Scarcity = Binary measure of needing additional resources, Need Timing = Maximum concern over making ends meet in the next 6, 9, or 12 months, less their concern over making ends meet in 3 months

(2) Scarcity = Binary measure of needing additional resources, Need Timing = Mean concern over making ends meet in the next 6, 9, or 12 months, less their concern over making ends meet in 3 months

(3) Scarcity = Maximum concern over making ends meet across all time periods, Need Timing = Maximum concern over making ends meet in the next 6, 9, or 12 months, less their concern over making ends meet in 3 months
(4) Scarcity = Mean concern over making ends meet across all time periods, Need Timing = Mean concern over making ends meet in the next 6, 9, or 12 months, less their concern over making ends meet in 3 months

As seen in the table, three of these four models found significant interactions. However, we note that the mean concern over making ends meet across all time periods and the maximum concern over making ends meet across all time periods were not normally distributed:



Since the mean across all time periods was skewed, we also examined a model with a log transformation of this variable. The interaction in this model was significant (p < .001). Since the maximum across all time periods was bimodal, we also examined a model recoding this variable as a binary measure (low maximum concern vs. high maximum concern) using a median split. The interaction in this model was significant (p < .001).

We also ran these models accounting for the following objective characteristics: age, gender, income, education level, and a binary measure of whether they ever had overdue bills during the crisis. The significance of the interaction does not change with the inclusion of these factors in any of the models.

Additionally, we coded the question asking participants whether they needed additional resources into 3 groups as follows: "No scarcity" = "I don't anticipate needing to seek additional resources"; "Scarcity – shorter time horizon" = "I have already had to seek additional resources," "1-2 weeks," "2-4 weeks," and "4-8 weeks"; "Scarcity – longer time horizon" = "2 or more months." Each of the groups was coded as a dummy variable and submitted to a regression with "No scarcity" as the reference group. Though both beta coefficients of scarcity predicted an increased interest in deferring housing payments, we used the same method of statistical comparison of the beta coefficients as described in Study 1 of the main paper to test for moderation. The beta coefficient for the longer time horizon was significantly smaller than the beta coefficient for the shorter time horizon (p < .001), providing evidence for moderation.

In sum, the robustness checks provide evidence that the moderation by the time horizon of threatened needs in the main manuscript is not a function of decisions about how to operationalize scarcity or time horizon.

Study 2: Supplemental Analyses

We use the following equation to calculate a Wald statistic to test for the equality of two coefficients from the same regression:

Wald
$$\chi^2 = \left(\frac{b_1 - b_2}{SE(b_1 - b_2)}\right)^2$$

Note that this statistic is statistically identical to the F-statistic calculated using the following SPSS syntax:

GLM DV_SwitchingPoint WITH ScarcityDummy_ShorterTime ScarcityDummy_LongerTime ScarcityDummy_NoSpecificTime

Differences across objective characteristics (age, gender, income, education, overdue bills) by the time horizon of needs threatened by scarcity relative to the control:

Age: Participants experiencing scarcity were younger on average.

	В	SE	Wald Chi-Square	Sig.
Scarcity — Shorter time horizon	-5.46	1.12	23.77	<.001
Scarcity — Longer time horizon	-4.84	1.11	18.71	<.001
Scarcity — No specific time horizon	-3.00	1.28	5.52	.019

Gender (Female): Participants experiencing scarcity-threatening needs with shorter time horizons were less likely to be female compared to those not experiencing scarcity. Note that this analysis uses binary logistic regression.

	В	SE	Wald Chi-Square	Sig.
Scarcity — Shorter time horizon	358	.17	4.40	.036
Scarcity — Longer time horizon	050	.17	.086	.769
Scarcity — No specific time horizon	276	.19	2.02	.155

Income (Bracket): Participants experiencing scarcity had a lower income than those not experiencing scarcity across all three groups of scarcity.

	В	SE	Wald Chi-Square	Sig.
(Intercept)	8.249	.21	1515.596	.000
Scarcity — Shorter time horizon	-3.840	.31	149.206	.000

Scarcity — Longer time horizon	-3.014	.31	92.123	.000
Scarcity — No specific time horizon	-2.798	.36	60.970	.000

Education Level: Participants experiencing scarcity had less education than those not experiencing scarcity across all three groups of scarcity.

	В	SE	Wald Chi-Square	Sig.
Scarcity — Shorter time horizon	568	.10	32.181	.000
Scarcity — Longer time horizon	292	.10	8.500	.004
Scarcity — No specific time horizon	483	.11	17.919	.000

Bill Payment History: Participants experiencing scarcity indicated being more behind in paying their bills than those not experiencing scarcity across all three groups of scarcity.

	В	SE	Wald Chi-Square	Sig.
Scarcity — Shorter time horizon	1.431	.08	295.216	.000
Scarcity — Longer time horizon	.656	.08	61.849	.000
Scarcity — No specific time horizon	.517	.10	29.301	.000

We also explored whether the time horizon of threatened needs acts as a proxy for slack change perceptions (e.g., Zauberman and Lynch, 2005). Participants experiencing scarcity believed they would have less slack in the future than they currently have compared with those not experiencing scarcity across all three groups of scarcity.

	В	SE	Wald Chi-Square	Sig.
(Intercept)	6.958	.1210	3306.478	.000
Scarcity — Shorter time horizon	387	.1797	4.632	.031
Scarcity — Longer time horizon	785	.1795	19.131	.000
Scarcity — No specific time horizon	415	.2048	4.102	.043

Moreover, we do not find that scarcity (as a binary measure collapsed across time horizon) interacts with slack change perceptions to predict intertemporal choice, Wald $X^2 < 1$, NS. Thus, the time horizon of needs threatened by scarcity is conceptually distinct from slack change over time.

Study 3: Supplemental Analyses

	(1)	(2)	(3)
Scarcity — Shorter time horizon	0.59** (0.22)	0.59** (0.21)	0.44* (0.22)
Scarcity — Longer time horizon	-0.62*** (0.18)	-0.62*** (0.17)	-0.64*** (0.18)
Objective Metrics Included	Yes	No	Yes
Subjective Metrics Included	No	Yes	Yes
N	1145	1268	1145

*p < .05, ** p < .01, ***p < 0.001

Note: Models test the contrast of each group to those in the control condition. Objective metrics include age, gender (female), income, primary language (English), education, and bill payment history. Subjective metrics include subjective socioeconomic status and the extent to which they considered differences in spare money across time periods.

Study 5: Supplemental Analyses

As mentioned in the main manuscript, we unexpectedly found that our manipulation impacted participants' likelihood of indicating that they were not financially responsible for their wedding. Moreover, a later download of the data set revealed an additional 50 responses recorded in Qualtrics after the ad was deactivated on Facebook. Although these exclusions were preregistered and determined when we stopped collecting data, we also provide the analysis of the full data set. There were a total of 1,083 observations. Four participants' time horizon could not be coded due to ambiguous or missing wedding dates (e.g., "June"), leaving a final sample of 1,079 participants (no exclusions).

We first examined whether there was an overall effect of scarcity on intertemporal choice. A binary logistic regression testing only the effect of scarcity on intertemporal choice

(smaller, sooner outcome = 1, larger, later outcome = 0) did not reveal a significant effect, B = -.15, 95% CI (-.44, .13), SE = .15, Wald $\chi^2(1, N = 1,079) = 1.13$, p = .289, odds ratio = 0.86.

Next, we incorporated the time horizon of the need. A binary logistic regression including scarcity, time horizon, and their interaction as independent variables revealed an effect of scarcity condition, B = .60, 95% CI (0.17, 1.03), SE = .22, Wald $\chi^2(1, N = 1,079) = 7.32, p = .007$, odds ratio = 1.82, an effect of time horizon, B = -1.15, 95% CI (-1.55, -0.76), SE = .20, Wald $\chi^2(1, N = 1,079) = 32.05, p < .001$, odds ratio = 0.32, and a significant scarcity by time horizon interaction, B = -1.25, 95% CI (-1.87, -0.63), SE = .32, Wald $\chi^2(1, N = 1,079) = 15.68, p < .001$, odds ratio = 0.29. Follow-up contrasts showed that when participants' wedding dates were before the payout of the larger, later outcome, scarcity increased choice of the smaller, sooner option, M difference = 0.15, 95% CI (.04, .25), p < .001. However, we found a reversal when participants' weddings were after the payout of the larger later option. Under these circumstances, scarcity decreased choice of the smaller, sooner option, M difference = -0.07, 95% CI (-.12, -.02), p = .003.

Study 1 Post-Test: Relative Marginal Utility of Deferring Housing Payments

Three hundred online participants completed this study on Cloud Research in exchange for monetary compensation. This was a 3-condition study. Depending on the condition, participants were asked to consider a person who was either (1) concerned about making ends meet over the next 3 months, (2) concerned about making ends meet over the next 12 months, or (3) had plenty of money. Participants were asked to imagine that this person was given the opportunity to defer housing payments for the next 3 months at the cost of increased future housing costs. Participants were then asked to indicate, regardless of what they believed the person should do, the extent to which this housing deferral option would help the person (1) make ends meet over the next 3 months, (2) make ends meet over the next 12 months, or (3) improve their finances (wording varying by condition).

Participants believed that delaying housing payments would be most helpful to those concerned about making ends meet over the next 3 months (M = 4.99, SD = 1.88), somewhat helpful to those concerned about making ends meet over the next 12 months (M = 3.53, SD = 2.11), and least helpful to those not facing scarcity (M = 2.43, SD = 1.72), all p < .001. As such, this study suggests that the sooner option in the intertemporal choice in the Fed survey was still perceived as providing more marginal utility to people experiencing scarcity for needs with longer time horizons (vs. those not experiencing scarcity).

Study 5 Post-Test: Relationship Between Wedding Dates and Intertemporal Preferences

In this post-test, we examined whether the month people choose to get married is related to their patience or general intertemporal preferences. Two hundred and two people completed the study in exchange for monetary compensation. Four participants indicated never having been married, 1 participant did not provide the month of the wedding, and one additional participant had inconsistent responses to the titration task for a final sample of 197 participants (62.2% female, 37.2% male, .5% nonbinary; median income = \$60K-\$70K, M age = 44.14 SD = 12.05). Participants completed a titration task that used the same monetary tradeoffs as the titration task in Study 2, but with a 2-month time frame to match the time frame used intertemporal choice of the wedding study in the main manuscript (Study 5), and it was incentive compatible. They also answered 11 questions assessing their general levels of patience taken from the Schnitker patience scale (Schnitker, 2012). In addition to these measures, participants indicated the month

they married, how long ago they were married (less than 1 year ago, 1–5 years ago, 5–10 years ago, more than 10 years ago), as well as demographics (age, gender, and income).

Responses to the titration study were coded to reflect the number of smaller, sooner options selected, and the patience scale questions were coded such that higher numbers reflect more patience. Interestingly, there was no relationship between responses to the titration task and self-reported patience (r = -.001, p = .992). More important, there was no relationship between the month that participants were married and their intertemporal choices (r = -.109, p = .128) or their self-reported patience (r = -.031, p = .665). We also coded wedding months to correspond to months of the year before the larger, later payout of the study in the main paper (January through June = 0, July through December = 1). Using this measure of wedding timing, we again find no significant relationship between wedding timing and intertemporal choices (r = -.084, p = .242) or self-reported patience (r = -.006, p = .933). All results remain insignificant adjusting for how long ago the participant was married and their demographics. As an additional check, we examined correlations within each of the time frames indicating how long-ago participants were married. None of the correlations were significant.

These results suggest that the month in which people get married is unrelated to their general patience or intertemporal preferences.

Reference

Sarah A. Schnitker. (2012). "An Examination of Patience and Well-Being." *The Journal of Positive Psychology* 7:4, 263–280, DOI: 10.1080/17439760.2012.697185.

Study 5 Post-Test: Relationship Between Time Horizon of Threatened Needs and the Necessity of Needs

We considered the possibility that needs with longer time horizons are less necessary (more

discretionary) than needs with shorter time horizons. A separate online sample of 31 participants rated the list of wedding aspects used in the main study (e.g., venue, food and drinks, honeymoon) to the extent to which each was necessary for a wedding (1 = not at all necessary, 7 = very necessary). Each participant in the main study was then assigned a necessity rating for the aspect of the wedding they were most excited/concerned about using the mean rating from this post-test. Note that because Other was not possible to rate, participants who selected Other were excluded from this analysis. We regressed these necessity ratings on scarcity condition, time horizon, and their interaction. There was a main effect of scarcity, such that those in the scarcity condition were thinking about aspects of a wedding that are more necessary, B = 0.37, SE = 0.13, t(698) = 2.89, p = .004. However, there was no effect of time horizon nor an interaction, both |t| < 1, *NS*.

Study 6: Validation of Marginal Utility Differences

A separate study was conducted to validate differences in marginal utility for the option pairs used in Study 6. Fifty participants completed this within-subject design study on Cloud Research in exchange for monetary compensation. All participants read, "If a person was on a multi-day backpacking trip and did not have enough food to last for the entire 3 days remaining of their trip, which of the following options would best **help them avoid being hungry at the end of their trip**?" They then indicated which option they believed would best help a person avoid being hungry at the end of their trip across the three different choice pairs used in Study 6 on 7-point scales (-3 = definitely [Option 1], 0 = It doesn't matter, 3 = Definitely [Option 2]). The order of the three choice pairs were randomized. Relative utility was examined by conducting a t-test against the midpoint of the scale. As expected, between eating a protein bar from their pack now and saving the protein bar for later, participants believed that saving the protein bar for later provided greater marginal utility, M = 1.38, SD = 1.65, t(49) = 5.91, p < .001. Between eating manzanita berries available on the trail that are perfectly safe to eat but can cause headaches a few hours after eating them and not eating the manzanita berries, participants believed that eating the manzanita berries that could cause a headache later provided greater marginal utility, M = -1.14, SD =1.89, t(49) = -4.25, p < .001. Finally, between pooping on the trail when the person feels they need to go and waiting to poop until the person gets to a campsite with a bathroom, participants did not believe either option provided greater marginal utility, M = 0.16, SD = 1.46, t(49) = 0.77, p = .443.

Supplemental Study 1: Resource Scarcity vs. Social Disruption

Supplemental Study 1 was designed to replicate the polarizing effect of scarcity and the time horizon of threatened needs found in Experiment 2. In doing so, we also sought to (1) address a potential alternative account for the reversal of preferences when scarcity threatens a need with a longer time horizon in Study 2 and (2) examine the extent to which people were thinking about meeting their threatened needs when making intertemporal choices.

With respect to the alternative account, we considered the possibility that the reversal we observed in Study 2 occurred because individuals who face negative circumstances (e.g., they cannot afford something) simply desire positive outcomes in the time period in which they expect to face those negative circumstances. To disentangle the effect of scarcity for a need with a longer time horizon from a mood story or a simple matching of negative circumstances with positive outcomes, in this study, all participants wrote about a negative circumstance in their life that resulted from COVID-19, but some considered their financial scarcity while others considered unfavorable disruptions of social activities. In addition, we measured the extent to which participants were considered meeting their needs threatened by COVID-19 while making intertemporal preferences.

Method

Participants were 800 individuals (M_{age} = 36.94, SD = 11.54; 58.4% male; Median income = \$50K-\$60K) on Cloud Research who were asked to complete a survey about COVID-19 at the end of March 2020 in exchange for nominal payment and a chance to win \$50 (for pre-registration. This study was preregistered on AsPredicted

(https://aspredicted.org/blind.php?x=px8fw4). The experiment followed a two condition between-subjects design. In both conditions, participants considered how COVID-19 was impacting their life. However, we varied whether this pertained to the financial scarcity that they were facing or social activities in which they could no longer participate. Specifically, participants were told the following (changes between conditions bolded for emphasis): "COVID-19 is having and is expected to have a large [financial / social] impact on people across the world. Think about all the ways that you may be affected [financially / socially] by COVID-19 right now or in the future." In addition, those in the financial scarcity condition received the additional paragraph:

"We know people worry about a range of things they will not have enough money for (e.g., rent, groceries, savings, buying a home, having children, retirement). In the space below, please describe the most important need that you're concerned about not having enough money for."

Those in the social (control) condition received the following paragraph:

"We know that people worry about a range of social engagements that they will not be able to participate in (e.g., family gatherings, birthdays, weddings). In the space below, please describe the most important social gathering that you're concerned about not being able to attend."

After completing this writing task, participants made a financial intertemporal choice, which served as our dependent measure. Specifically, they were told they will be entered into a lottery to win \$50 and that we were interested in whether they would prefer to get \$50 on that day or get \$100 at the beginning of June (approximately two months later).

Participants then completed a financial scarcity manipulation check measure using a 7point scale: "While completing this study, to what extent did you think about your finances as being inadequate, scarce, or limited for your short term or long term needs?" (1 = Not at all, 7 =Very much).

To measure marginal utility, we assessed whether their intertemporal decision was driven by an attempt to address threatened needs by asking participants to indicate the extent to which their decision about receiving \$50 now or \$100 in June was driven by their focus on addressing the concerns they wrote about earlier (7-point scale: 1 = Not at all, 7 = Very much). To measure slack change perceptions, we adapted a measure from Zauberman and Lynch (2005) and asked participants to complete the following measure using an 11-point scale: "Think about your expenses today and your available spare money. Now consider your likely expenses and available spare money for the same day of the week in June. On which day do you expect to have more financial reserves?" (1 = Much more money available today, 6 = I expect the amount of spare money I have to be similar today and in June, 11 = Much more money available in June). To measure the time horizon, participants in the financial scarcity condition recalled the important need that they were concerned about not having enough money for and indicated by when they needed money to fulfill that need. Participants in the social disruption condition recalled the social gathering they were concerned about not attending and indicated when the social engagement would take place. Participants in both conditions responded to their respective question using a binary measure (0 = Before June, 1 = During or after June).

We also assessed whether participants were financially affected by COVID-19 (1 = yes, 0 no) and socially affected by COVID-19 (1 = yes, 0 = no).¹ Finally, participants completed demographic information including their age, gender, and income. At the survey's end, participants were informed they would receive \$50 in the form of a bonus payment if they were selected for the lottery. One participant was selected randomly for this payment when data collection completed.

Results

Following our preregistration plan, 33 participants were removed from analysis for providing nonsensical responses to the writing task, leaving a final sample of 767 participants (M age = 37.11, SD = 11.57; M_{income} = 50-60K, 56.8% male). Exclusions did not vary by condition.

Manipulation checks. As expected, participants in the financial scarcity (M = 5.44, SD = 1.51) condition thought about their finances as being more inadequate, scarce, or limited for their needs compared to participants in the control (M = 4.41, SD = 1.92) condition, F(1, 765) = 67.85, p < .001. There was also an unexpected financial scarcity by time horizon interaction on this measure, F(1, 763) = 8.57, p = .004, whereby the effect was weaker in the longer-term need conditions. However, those in the financial scarcity condition indicated feeling greater financial

¹ Results are unchanged when we examine only participants who indicated being both financially and socially affected by COVID-19.

scarcity than did those in the social disruption condition, regardless of whether their need was shorter term (F(1, 763) = 72.20, p < .001) or longer term (F(1, 763) = 6.07, p = .014).

Intertemporal choice. Overall, there was an effect of scarcity on intertemporal choice (1 = smaller, sooner outcome, 0 = larger, later outcome) whereby those in the scarcity condition preferred smaller, sooner outcomes more so than did those in the social disruption condition, B = .36, SE = .15, Wald $\chi^2(1, N = 767) = 6.03$, p = .014, 95% CI [.07, .65]. Then we incorporated the time horizon of participants' needs by regressing intertemporal choice on scarcity, time horizon, and their interaction. There was an effect of scarcity, B = .72, SE = .30, Wald $\chi^2(1, N = 767) = 5.90$, p = .015, 95% CI [.14, 1.31] and an effect of time horizon, B = 2.04, SE = .25, Wald $\chi^2(1, N = 767) = 5.90$, p = .015, 95% CI [.14, 1.31] and an effect of time horizon, B = 2.04, SE = .25, Wald $\chi^2(1, N = 767) = 64.44$, p < .001, 95% CI [1.54, 2.54]. Importantly, however, we found the expected scarcity by time horizon interaction, B = -1.69, SE = .35, Wald $\chi^2(1, N = 767) = 23.35$, p < .001, 95% CI [-2.38, -1.00]. Follow-up contrasts showed that when the need had a shorter time horizon (i.e., before June), scarcity increased choice of the smaller, sooner option, Wald $\chi^2(1, N = 767) = 30.03$, p < .001, 95% CI [.15, .32]. When the need had a longer time horizon (i.e., during or after June), scarcity increased choice of the larger, later option, Wald $\chi^2(1, N = 767) = 5.84$, p = .016, 95% CI [.02, .23]. Results are shown in Supplemental Figure 1.

Supplemental Figure 1

Intertemporal Choice in Supplemental Study 1





Note: The top panel shows the effect of scarcity on intertemporal choice. The bottom panel shows the effect of scarcity on intertemporal choice as a function of need timing in Supplemental Study 1.

Addressing threatened needs. There were three missing values for participants on this measure. There was a main effect of scarcity on need focus, F(1, 760) = 74.90, p < .001, and no effect of need timing on need focus, F < 1. However, the main effect of scarcity was qualified by a significant interaction, F(1, 760) = 8.20, p = .004. Although the simple effect of scarcity was greater in the shorter term condition than in the longer term condition, scarcity increased focus on meeting needs in both conditions (shorter term condition: F(1, 760) = 98.50, p < .001; longer term condition: F(1, 760) = 12.64, p < .001).

Perceptions of slack change. There was no effect of scarcity, time horizon, or their interaction on perceived slack change, all F < 1. In addition, participants in each condition reported average scores that were significantly greater than the scale's midpoint (all $p \le .012$), indicating that participants expected to have greater slack in the future than they had currently — even those who indicated having threatened needs with a longer time horizon. These results suggest that the effect of scarcity and need timing on intertemporal choice is better explained by

increased focus on addressing threatened needs rather than which time period one expects to have more or less spare money.

Discussion

In Supplemental Study 1, participants elaborated on how COVID-19 negatively affected their lives, because of either financial scarcity or social disruption. We measured their preferences for a smaller, sooner or larger, later monetary outcome as well as the period in which they were most concerned about their financial or social situation negatively affecting them. In line with the results found in Experiment 2, participants in the financial scarcity (vs. social disruption) condition demonstrated a greater preference for the smaller, sooner monetary amount when they expected to have insufficient resources for a threatened need occurring before the payout of the larger, later outcome. However, this result reversed when they expected to have insufficient resources for a threatened need occurring after the payout of the larger, later outcome.

The observed interaction casts doubt on the possibility that the polarization of preferences under scarcity is a function of participants' desire to pair negative circumstances in their lives with positive outcomes, since participants in both conditions considered negative circumstances in their lives. The results also provide evidence that the polarization of preferences results from an increased desire to address needs threatened by scarce resources.