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An uncertainty management perspective on long-run impacts of adversity: The influence of childhood socioeconomic status on risk, time, and social preferences

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ABSTRACT

While there has been a recent increase in focus on the role of early life socioeconomic status (SES) on preferences and decision-making, there is still debate surrounding the proper theoretical framework for understanding such effects. Some have argued that early life SES can fundamentally shift time preferences per se, such that those from low SES backgrounds favor current rewards over future rewards. Others have argued that, while early life SES has lasting effects on behavior, such effects are only observable in the presence of salient cues to mortality. Here, we propose an alternative framework that centers on environmental uncertainty. In this *uncertainty management* framework, early life deprivation promotes the development of strategies that minimize the downside costs of uncertainty across domains. We argue that this focus on managing uncertainty results in greater risk-aversion, present-orientation, and prosociality. Furthermore, these effects need not be dependent on salient cues to mortality. Across four large samples of participants (total N = 4714), we find that childhood deprivation uniquely predicts greater risk-aversion (both incentivized and hypothetical) and greater prosociality in economic games. Childhood deprivation also predicts greater present-orientation, but not above-and beyond current SES. We further find that mortality cues are not necessary to elicit these differences. Our results support an uncertainty management perspective on the effects of childhood SES on risk, time, and social preferences.

"Rich kids make a lot of bad choices.
They just don't come with the same sort of consequences."
Sean Reardon, Stanford University

1. Introduction

Converging lines of evidence have demonstrated the influence of early life socioeconomic status (SES) on decision-making and a variety of related psychological mechanisms and behaviors (Amir, Jordan, & Bribiescas, 2016; Griskevicius, Delton, Robertson, & Tybur, 2011; Griskevicius, Tybur, Delton, & Robertson, 2011; Hill, Prokosch, DelPriore, Griskevicius, & Kramer, 2016; Mittal, Griskevicius, Simpson, Sung, & Young, 2015). While multiple accounts have been proposed, no consensus exists regarding what broader theoretical framework explains the relationship between early socioeconomic status and decision-making, in particular how deprivation in early life may shape adult preferences.

One way to approach developing a broader theory is to consider whether these patterns constitute adaptive responses to local environments (Fawcett, McNamara, & Houston, 2012; Hintze, Olson, Adami, & Hertwig, 2015; Kaplan, 1996; Nettle & Bateson, 2015) and to examine which causal pathways may underlie variation in preferences and choice. In line with this perspective, one primary account drawing from life history theory — which we will refer to as the *delay discounting account* — suggests that early life adversity fundamentally shifts time preferences to optimize outcomes given the local environment. For instance, some scholars have argued that early deprivation causes more weight to be placed on present gains over future gains (Dunkel & Kruger, 2015; Frankenhuis, Panchanathan, & Nettle, 2016; Pepper & Nettle, 2017), thereby explaining the patterns of behaviors observed among those from deprived environments, such as higher incidence of

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smoking and obesity. This account suggest that when environmental harshness or unpredictability is high, such as in low-SES environments, the relatively limited control associated with lower SES curtails the extent to which people can expect to realize deferred rewards (Pepper & Nettle, 2017). That is, to the extent that people believe they occupy an environment with high extrinsic mortality risk, they may be more willing to engage in behaviors that have short-term benefits and long-term costs. If this belief is justified in that the likelihood of actualizing rewards in the future is small, this account argues that the present-orientation seen among low-SES individuals is a contextually appropriate response (Pepper & Nettle, 2017). Additionally, while proponents of this framework acknowledge the potential relationship between time and risk preferences (Pepper & Nettle, 2017), a prominent iteration of the *delay discounting* account does not make specific predictions about risk or social preferences.

A second influential account, also stemming from life history theory — which we will refer to as the *mortality cues* account — suggests that the effects of childhood socioeconomic status are only evoked in the presence of mortality cues (Griskevicius, Tybur, et al., 2011). This paradigm involves priming participants with cues that call attention to extrinsic mortality, after which participants raised with low SES are more likely to take risks and discount the future (Griskevicius, Tybur, et al., 2011), along with exhibiting a preference for more children sooner (Griskevicius, Delton, et al., 2011). The logic of this account borrows from life history theory, highlighting the role of extrinsic mortality in shaping behavior. The authors posit that mortality cues in the environment may push people toward pursuing a faster or slower life history strategy, but that an individual's childhood background will influence which strategy is pursued. That is, those from deprived backgrounds may be impelled to pursue faster life history strategies — preferring risk-taking and immediate payoffs — but only in the presence of salient mortality cues. Consequently, there may not be any observable differences in intertemporal or risky choice between those raised with low childhood SES and those raised with high childhood SES under normal conditions, but such differences will appear when participants are induced to feel that the world is unsafe.

Here, we offer a different, broader theoretical framework. We propose that the key link between childhood SES and behaviors in adulthood is an underlying *uncertainty management strategy* in which those who experience deprivation in early life tend to develop preferences aimed at minimizing the downside costs of uncertainty. In simpler words, the heuristic that emerges from this framework is: "avoid uncertainty if you can't afford the bad outcome." This account is consistent with the *relative state model* of risk-taking, which argues that selection has favored agents who calibrate risk-taking based on implicit computations of conditions and/or competitive (dis)advantages (Barclay, Mishra, & Sparks, 2018). Our framework extends this further, however, by arguing for a privileged role of the early environment in this calibration process. We argue that preferences aimed at managing uncertainties are especially informed by conditions early in life — in part because one's early life environment is often a good predictor of one's adult environment.[2] Successful strategies across domains of uncertainty may be internalized early in life and implemented through preferences which help guide efficient decision-making in adulthood. That is, what people may interpret as an affordable risk is in part determined by their early socioeconomic environment, as those raised in low SES households are much less protected against small unexpected bad outcomes (e.g. an unexpected car problem can mean not having food for every meal or missing a few days from work due to illness might mean having to ask friends to borrow money for bills), the consequences of which may substantively impact one's life. Therefore, managing these uncertainties may be a fundamentally different problem for those in environments of abundance as opposed to those in environments of scarcity (Amir & Jordan, 2017). Here, we define uncertainty in the broader, economic sense, as containing both ambiguous choice (or choice under *Knightian uncertainty* (Knight, 1921), where outcomes are known but probabilities are not) and risky choice (where both outcomes and probabilities are known). We also take care to distinguish between risk preferences in the colloquial sense of risk — as relating to risky behaviors, such as speeding or smoking — and risky choice from an economic perspective — as relating to choices with variable payoffs governed by known probabilities. Our account is only focused on the latter.

Why should people be concerned with managing uncertainty? In addition to arguments for state-dependence as an important factor in risky choice (Barclay et al., 2018; Mishra, 2014; Mishra, Barclay, & Sparks, 2017), there is good reason to believe natural selection favored heightened sensitivity to state and extrinsic uncertainty in humans, more broadly. Given that the emergence of our genus *Homo* — between 2 and 3 million years ago — played out against a backdrop of rapidly shifting environmental conditions (Potts, 2012), it's plausible that humans, in particular, have experienced strong selection for behavioral mechanisms that can effectively minimize the costs of uncertainty. Evolutionarily speaking, extrinsic uncertainty poses an important adaptive problem, such that in stochastic environments, increasing variance detrimentally affect the long-run average rate of increase in fitness. While the specifics of how variance affects fitness are dependent on many factors, such as the frequency and informativeness of cues (Fawcett & Frankenhuis, 2015), where in the life cycle it is experienced, and degree of environmental autocorrelation (Nettle, Frankenhuis, & Rickard, 2013), all things being equal: variance negatively affects fitness (Jones, 2005). Additionally, as uncertainty is a variance multiplier (Weitzman, 1998, 2009), making a decision that is poorly calibrated to the probabilities or magnitude of downside costs can be evolutionarily disastrous. This is further exacerbated when the decision-maker starts life in a compromised state (such as being born into a low-SES environment), as the margins are lower and costs more consequential. As it's rarely the case that choices are made based on explicit calculations of likely fitness outcomes, organisms must make decisions based on proxies to fitness (Mishra et al., 2017). In most Western societies, socioeconomic status is a good predictor of life outcomes, particularly those related to fitness such as all-cause and infant mortality (Lynch et al., 1994). Consequently, cues to socioeconomic status can serve as credible proxies to fitness.

In sum, our *uncertainty management* account suggests that early life deprivation leads to a set of preferences aimed at minimizing the downside costs of uncertainty across a variety of domains. And additionally, because preferences are tuned in early life and persist into adulthood, they ought to be generally present in decision-making and do not need to be elicited by mortality cues. We lay out the converging and diverging predictions of the *mortality cues* account, the *delay discounting* account, and our *uncertainty management* account as they pertain to risk, time, and social preferences below.

2. Competing theories and predictions

While there is some overlap between the *delay discounting* and *mortality cues* account, largely based on their grounding in life history theory, these frameworks do generate different predictions across domains. In the domain of risk preferences – that is, trade-offs between expected value and variance in outcomes (Mishra et al., 2017) – the *delay discounting* account does not make specific predictions (as it focuses on time preferences), while the *mortality cues* account argues that early life deprivation leads to risk-*seeking* behavior in the context of cues to mortality (Griskevicius, Tybur, et al., 2011), perhaps because a low-yield but safe decision results in a payoff that is less favored by an individual in an unsafe environment. Here, our *uncertainty management* view predicts the opposite: low childhood SES should lead to risk

[2] While this may not always hold true in the modern world, it was certainly a reasonable assumption throughout our evolutionary history.

aversion. When living in an environment marked by low access to resources and high uncertainty, avoiding losses is particularly important for welfare. As a result, taking sure gains when they are available should be preferred to gambles with probabilistic outcomes and higher expected value: if you can't afford the bad outcome, don't take the risk.[3] While our framework makes unique, specific claims about the role of *childhood* SES, it is in line with a number of findings from diverse populations demonstrating a link between low *adult* socioeconomic standing and risk aversion (Cancian, 1989; Donkers, Melenberg, & Van Soest, 2001; Haushofer & Fehr, 2014; Miyata, 2003; Wik, Aragie Kebede, Bergland, & Holden, 2004), along with findings implying that negative income shocks are also linked to risk aversion (Paravisini, Rappoport, & Ravina, 2015; Thaler & Johnson, 1990). We also want to be careful to distinguish here between the economic concept of risky choice— accepting an increase in outcome-variance in exchange for an increase in expected value — and the more general concept of risky behavior — activities associated with undesirable outcomes like substance abuse (Pepper & Nettle, 2017; Wärneryd, 1996). Our account deals with risk preferences as they pertain to risky choice (or choice under uncertainty), rather than risky behaviors. Its implications for risky behavior more generally are unclear, as such behaviors may be motivated by a range of factors other than one's preferences over uncertain outcomes.

In the domain of time preferences, the *mortality cues* account predicts present-orientation only in the context of salient cues of mortality, while the *delay discounting* account predicts that early deprivation leads *directly* to present orientation, and that this is the underlying mechanism explaining the variety of behavioral differences due to early SES. Our account predicts that early deprivation should lead to present orientation, insofar as present orientation reflects an aversion to uncertainty about the future. This is plausible, given that an unwillingness to delay rewards might reflect a range of uncertainties: uncertainty that the future reward will be obtained, that the individual will be there to obtain it, that the reward will retain the same value in the future, and so on (Amir & Jordan, 2017; Frederick, Loewenstein, & O'donoghue, 2002).

In addition to risk and time preferences, our *uncertainty management* perspective also makes predictions about preferences in the social domain, as prosociality is often a form of uncertainty management. As outlined above, those living at the margins are more vulnerable to fluctuations in their environment. To defend against such shocks, they may benefit from risk-pooling through cooperation with social partners. This kind of risk-pooling has been described in foraging models, which have demonstrated that participating in reciprocity relationships is a risk-mitigating strategy in the face of uncertain returns (Winterhalder, 1986, 1990). Furthermore, there is typically uncertainty about whether any given interaction involves future consequences, such that one would be punished for defecting (Bear & Rand, 2016; Delton, Krasnow, Cosmides, & Tooby, 2011) – thus, individuals who are seeking to reduce uncertainty will be driven to cooperate, just in case. These successful strategies are then internalized, and spill over into one-shot interactions (Peysakhovich & Rand, 2015; Stagnaro, Arechar, & Rand, 2017). Taken together, this predicts that low childhood SES should lead to greater prosociality. While the *mortality cues* account does not make specific predictions about social preferences, the *delay discounting* account implies the opposite prediction from our account: theories of reciprocity stipulate that the possibility of future rewards and punishments can motivate cooperation, and thus that individuals who discount the future to a greater extent will be less inclined to cooperate (Maskin & Fudenberg, 1986; Rand & Nowak, 2013). Thus, if early life deprivation leads to present orientation, those who grew up with low SES ought to value payoffs from future interactions less and therefore be less prosociality.

A summary of the predictions from these accounts across domains can be found in Table 1.

3. Current study

Here, we investigate the role of childhood SES on risk, time, and social preferences to determine which framework best predicts behavior across these domains. Additionally, we investigate whether cues to mortality are necessary to elicit these differences. This investigation protocol and recruitment were approved by the Yale University Human Subjects Committee.

4. Study 0: induction pilot

4.1. Methods

To investigate whether mortality cues are necessary in evoking differences between those with high and low childhood SES, our main studies adapted a protocol from Griskevicius and colleagues (Griskevicius, Tybur, et al., 2011; Mittal & Griskevicius, 2014) in which participants either read a "Dangerous World" news story about a recent surge in violence or a control story. Since the majority of previous work on this topic was conducted in the laboratory rather than in online labor markets, we piloted the induction texts online to determine whether or not our texts had similar effects in the Amazon Mechanical Turk population as the original texts did among undergraduate populations. There are several benefits to using online labor markets (Horton, Rand, & Zeckhauser, 2011) which yield data of the same quality as in-lab studies (Buhrmester, Kwang, & Gosling, 2011). In the context of these studies, we were able to take advantage of a more diverse participant pool that is older, more likely to have their own income (which college students tend not to have), and more variable on the dimension of childhood SES. Based on previous inductions, we wrote a brief 200-word text called "Dangerous times ahead: life and death in the 21st century" which outlined a recent surge in violence and highlighted the unpredictability of this form of violence. The control induction was a brief 200-word text called "How to choose the perfect rain jacket" that outlined several criteria for selecting a quality rain jacket (see Supplement for the full text of both inductions). This story matched that of the Dangerous World story in its length. We should clarify here that these were not the same articles used in previous research (Griskevicius, Delton, et al., 2011; Griskevicius, Tybur, et al., 2011), and therefore this study, and those that follow, should be considered conceptual replications. Participants were randomly assigned to one of these conditions.

In previous work, participants were asked five questions to gauge the effect of the induction: (1) "To what extent did the story make you think the world will become a more dangerous place?", (2) "To what extent did the story make you think the world will become unsafe?", (3) "To what extent did the story make you think the world will become more unpredictable?", (4) "To what extent did the story make you think the world will become more uncertain?", and (5) "To what extent did the story make you feel emotionally aroused?"

In our pilot, half of participants answered these questions (specifically asking about how the story made them feel), while half of participants answered version of these questions asking about how they feel more generally (e.g., "To what extent do you think the world will become a more dangerous place?"). These items were rated on a 7-point scale anchored at "not at all" and "very much" and presented in random order.

[3] Of course, it is possible that individuals may find themselves in situations where the only way to avoid a catastrophic outcome is to take a risk. That is, when the sure outcome itself is catastrophic, taking the risk is the only sensible thing to do. We will assume here that individuals who grew up in the United States in the 20th century are very unlikely to be in these circumstances.

Table 1
A summary of predictions across the three competing theories.

Framework	Risk preferences	Time preferences	Social preferences
Uncertainty management	Risk averse	Present-oriented	More prosocial
Delay discounting	*No clear predictions*	Present-oriented	Less prosocial
Mortality cues	Risk-seeking in the presence of cues to mortality	Present-oriented in the presence of cues to mortality	*No clear predictions*

4.2. Study 0 results

All four sets of responses were highly reliable (all Cronbach's $\alpha > 0.86$), which allowed us to combine them into aggregate measures. We found a main effect of induction such that those in the Dangerous World condition gave higher ratings ($M = 4.69$, $SD = 1.53$) than those who read the Control story ($M = 2.73$, $SD = 1.58$), $F(1,160) = 81.51$, $p < .001$, and a main effect of question type such that those who were asked about more general feelings gave higher ratings ($M = 4.35$, $SD = 1.45$) than those who were asked about how the story made them feel ($M = 3.08$, $SD = 1.98$), $F(1,160) = 31.16$, $p < .001$. We also found a story by question type interaction such that the difference between ratings in the Dangerous World condition and the Control condition was greater when asked specifically about the story than when asked about more general feelings, $F(1, 160) = 18.74$, $p < .001$. That is, although the induction was effective no matter how we asked participants about how they felt, the change in feelings induced by the Dangerous World story may be smaller than previous research (which used manipulation check questions specifically about the story) has suggested.

5. General methods studies 1–4

5.1. Procedure

Across four studies, we recruited 4714 participants ($M_{age} = 35.11$, 2212 male) from Amazon's Mechanical Turk. A flowchart of the entire protocol can be found in Fig. 1.

In each study, participants were randomly assigned to either the Dangerous World condition or the Control condition and told that they were going to read a short piece of text for a memory test, and that the test would occur after their memory of the text had decayed for at least 2 min. To allow for memory decay in those few minutes, participants would participate in a short activity (such as an economic game). As outlined above, the Dangerous World condition described a rise in violence and highlighted the unpredictability of violent acts, while the text in the Control condition focused on how to effectively pick a rain jacket. In Study 1, the UG and DG were collected in separate batches and not randomly assigned, which we randomized in subsequent studies. Study 1 included 1489 participants. Study 2 included 916 participants. Study 3 included 1016 participants. And Study 4 included 1293 participants.

5.2. Social preferences

Before moving on to the incentivized memory task, participants played either an Ultimatum Game (UG) or a Dictator Game (DG). Participants were randomly assigned to play either the UG or the DG (note that in Study 1, all participants in the UG condition were collected first, and then all subjects in the DG were collected, such that there was not true random assignment across games). All measures, manipulations, and exclusions are represented in the methods described and analyses presented. Analyses of relevant, but secondary measures, including comprehension checks, are presented in the supplement.

In the UG, one player—the proposer—is given a 100-point endowment and can divide the endowment however they like between themselves and the responder. Once the proposer has made their offer, the responder can either accept the offer, in which case the offer stands, or reject the offer, in which case both players get nothing. The goal, then, for a payoff-maximizing proposer who treats the UG as the one-shot interaction it is, is to offer the minimum amount that exceeds the responder's minimum acceptable offer. However, higher offers are both more likely to be accepted and more likely to be viewed as cooperative. Consequently, the UG tracks preferences in the face of uncertainty in a social context. Therefore, to the extent that low childhood SES favors risk pooling via cooperative acts, those with low childhood SES ought to offer more in the UG than those with high childhood SES.

In the DG, one player—the proposer—is given a 100-point endowment and makes a unilateral decision about how much of the endowment to keep and how much to send to the other player—the responder. Contrary to the UG, in which the responder can reject the proposer's offer, in the DG the responder is a passive recipient of the proposer's offer. The proposer keeps what they do not send, and the responder must accept what is sent to them. High offers in the DG can be interpreted as straightforward acts of prosociality. Previous work on social heuristics and cooperative spillovers suggests that strategies which are useful in daily life become automated as heuristics that help guide social decision making (Peysakhovich & Rand, 2015; Rand, 2016; Rand, Brescoll, Everett, Capraro, & Barcelo, 2016). Based on this logic, we argue that because those raised in low childhood SES were more likely to rely on reciprocal relationships to smooth the downside costs of uncertainty, low childhood SES should lead to greater habitual cooperation, and therefore more giving in purely prosocial contexts. Therefore, we expect higher offers among those with low childhood SES who have internalized cooperative strategies as a means of risk pooling.

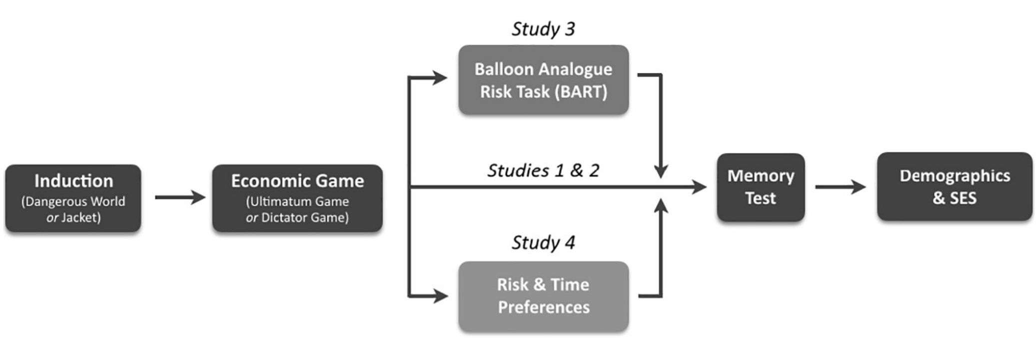

Fig. 1. An overview of the general procedure across four studies.

Thus, the UG & DG capture uncertainty management at two different levels, with UG behavior reflecting a response to local uncertainty within the game that can be overcome with higher offers, and DG behavior reflecting a response to more general environmental uncertainty that can be overcome through prosociality and reciprocity relationships.

After all decisions were collected, participants were matched with actual partners to determine their earnings. Earned points were converted to actual monetary payment at an exchange rate of 5 points = 1 cent at the end of the study.

5.3. Balloon analog risk task

In Study 3, participants completed the Balloon Analog Risk Task (BART) for real stakes after they completed the economic game. In the BART, participants receive money for inflating a (digital) balloon, but they only get to keep the money they earn by cashing out before the balloon pops. Here, for a total of 10 balloons, each pump earned the participant 2 points, and at the end of the study points were converted to cents at the same exchange rate as the points in the games. The task involves risky choice because the participant doesn't know how many pumps will pop the balloon: when the balloon pops is determined by the probability [1/(32 - # of pumps so far)], so with each pump, the likelihood of popping increases. Because participants did not have access to the popping algorithm, the BART represents a *Knightian* uncertainty task.

5.4. Risk and time preferences

In Study 4, participants completed hypothetical risk and time preference questions from Griskevicius, Tybur, et al. (2011) after completing the economic game. The risky choices were a series of questions of the form: "Do you want a 50% chance of getting $800 OR get $____ for sure?". The guaranteed value started at $100 and incremented by $100 until the guaranteed value was $700. The seven choices were aggregated into a risk index by summing the number of times each participant chose the risky option. The time preference measure followed the same pattern. Participants were asked: "Do you want to get $100 today OR $____ 90 days from now?". The larger, later value started at $110 and incremented by $10 until the larger, later value was $170. The seven choices were aggregated into a time index by summing the number of times each participant chose the larger, later option.

5.5. Demographics

In all studies, participants completed the incentivized memory test after the behavioral measures, and then moved on to a set of demographic questions about both their childhood and current SES. To assess the role of childhood SES, we drew from work highlighting the importance of the first seven or so years of life (Belsky, Steinberg, & Draper, 1991) by using the following two measures, both phrased in terms of family status between the ages of 5 and 10 years of age: 1) "Approximately how much money did your parents make per year when you were between 5 and 10 years old? Don't worry if you're not sure, just give us your best guess"; and 2) "When you were growing up, what was your assessment of your family's social and economic status?" Participants selected from a range of income brackets for question 1 and used a 7-point Likert scale to answer question 2, ranging from very low to very high social and economic status. These childhood SES and childhood income were highly reliable (α = 0.70), so we calculated a childhood SES score using our two items, which is our main SES variable. For additional analyses using previously used childhood SES measures, see the supplement.

To assess current SES, we computed a composite using four questions (#2–4 were borrowed from Griskevicius, Delton, et al., 2011): 1) "Please choose the category that describes the total amount of income you earned this past year. Consider all forms of income, including salaries, tips, interest and dividend payments, scholarship support, student loans, parental support, social security, alimony, and child support, and others"; 2) "I have enough money to buy things I want"; 3) "I don't worry too much about paying my bills"; and 4) "I don't think I'll have to worry about money too much in the future". The first of those was answered using income bins, while the other three were answered using a 7-point Likert scale anchored at "Strongly disagree" and "Strongly agree". These items were highly reliable (α = 0.82).

6. Results

6.1. Risk preferences

In accordance with our *uncertainty management* perspective, we find a main effect of childhood SES such that those who grew up with high SES were more risk seeking, β = 0.072, CI: [0.046, 0.098], $p < .001$, with no effects of the method used to elicit risk, β = −0.027, CI: [−0.109, 0.055], p = .519; that is, there were no significant difference in risk seeking between the BART task and the hypothetical risky choices. Furthermore, when we included both childhood SES, β = 0.070, CI: [0.043, 0.097], $p < .001$, and current SES, β = 0.007, CI: [−0.014, 0.018], p = .489, in the same regression, higher childhood SES remained a robust predictor of greater risk seeking across both tasks. We also analyzed the relationship between current SES and the two risk measures. Regression revealed no significant main effect of current SES, β = 0.019, CI: [−0.002, 0.039], p = .073, induction condition, β = −0.001, CI: [−0.083, 0.081], p = .980, or risk measure, β = −0.024, CI: [−0.106, 0.058], p = .570.

When considering the role of mortality cues in these processes, we standardized the BART and hypothetical risky choice responses for the 2309 participants (M_{age} = 36.56, 933 male) across the two studies (the results are equivalent when analyzing the two risk measures separately). We find no main effect of induction, β = −0.001, CI: [−0.082, 0.080], p = .980. Critically, we also find no evidence of the childhood SES by induction condition interaction reported by Griskevicius and colleagues, β = −0.013, CI: [−0.065, 0.039], p = .623. That is, in both the Control condition (β = 0.079) and the Dangerous World condition (β = 0.065) childhood SES was positively associated with preferring more risk (Fig. 2A), which is the same pattern as was found among participants who read the Control induction in prior work (Griskevicius, Tybur, et al., 2011). This pattern emerged for both incentivized risky behavior and hypothetical risky choice used in prior research. We also found no evidence of a current SES by induction condition interaction, β = −0.007, CI: [−0.049, 0.034], p = .727.

Because the risk preference measure we used in Study 4 was identical to the risk preference measure used by Griskevicius and colleagues (Griskevicius, Tybur, et al., 2011) — and we failed to find the relevant childhood SES by induction interaction (Fig. 2A) — we conducted a power analysis. Griskevicius and colleagues report an η^2 of 0.17 for the interaction between childhood SES and induction condition. With their sample of 71 participants, they had 96% power to detect this interaction. We collected risk preference data from 1293 participants, which gave us 100% power[4] to detect the childhood SES by induction condition interaction. Further, given our sample size, we have 95% power to detect an η^2 as small as 0.01 (and 90% power to detect an η^2 as small as 0.0081). We should note that our design differed from prior work in three ways. First, participants were drawn from MTurk, rather than from a university study pool. Second, participants completed either the UG or the DG before completing the risk measure. Finally, we wrote our own inductions because the exact text from prior studies was not

[4] Although it is impossible to have exactly 100% power, the software we used to conduct our power analyses only calculates seven significant digits, meaning we had at least 99.9999995% power.

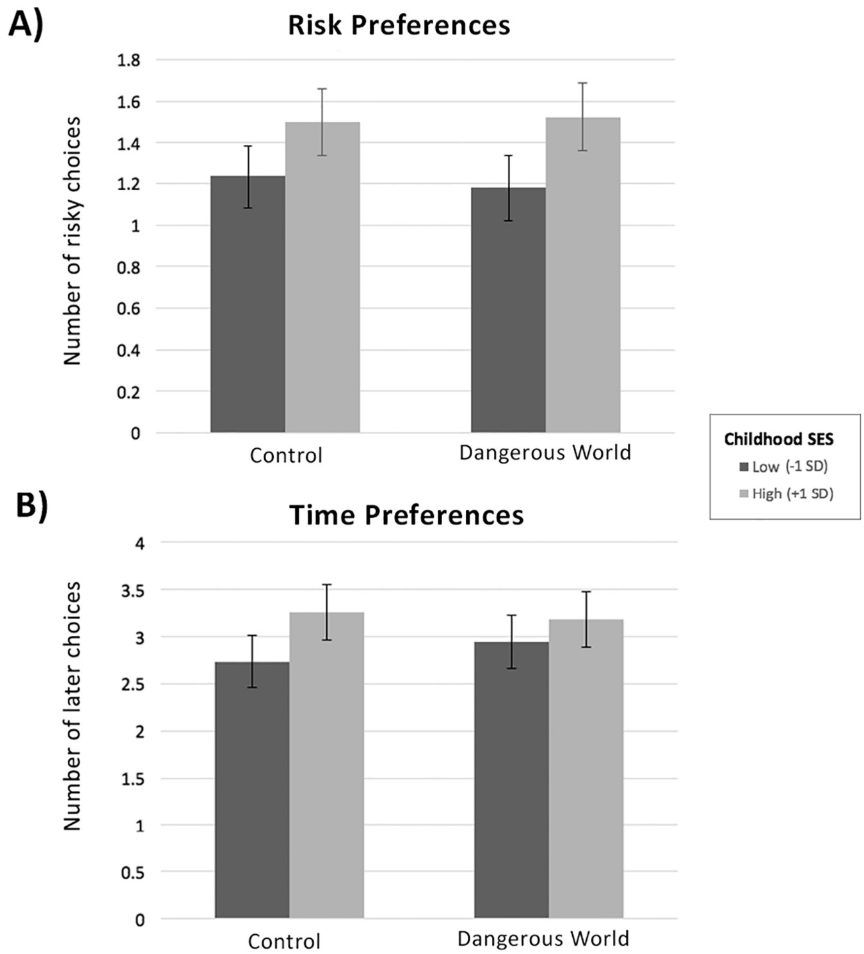

Fig. 2. (A) A comparison of low childhood SES participants (1 SD below the mean) to high childhood SES participants (1 SD above the mean) in risk preferences. Those with low childhood SES make fewer risky choices than those with high childhood SES. There is no effect of induction (Dangerous World or Control). (B) A comparison of low childhood SES participants (1 SD below the mean) to high childhood SES participants (1 SD above the mean) in time preferences. Those with low childhood SES make fewer later choices than those with high childhood SES. There is no effect of induction.

available – however, the manipulation check indicates that our inductions (like in the prior studies) were effective in manipulating the theorized dimension.

6.2. Time preferences

In the domain of time preferences, regression revealed a main effect of childhood SES (β = 0.123, CI: [0.030, 0.215], p = .009) such that those who grew up with high SES were more likely to choose delayed options (i.e. they were more patient). When we examined the association between current SES and time preferences, we found a main effect of current SES (β = 0.196, CI: [0.124, 0.267], p < .001) such that those with higher SES preferred delayed rewards. In a model including both childhood SES (β = 0.069, CI: [−0.025, 0.163], p = .151) and current SES (β = 0.183, CI: [0.109, 0.257], p < .001), only current SES remained a significant predictor.

We also examined the role of the Dangerous World induction in determining time preferences. As in the case of risk preferences, we found no main effect of induction condition on choices (β = 0.072, CI: [−0.215, 0.359], p = .622). We also found no evidence of a childhood SES by induction condition interaction (β = −0.093, CI: [−0.277, 0.092], p = .325). As above, we found that in both the Control condition (β = 0.169) and the Dangerous World condition (β = 0.076) childhood SES was positively associated with delaying gratification (Fig. 2B). There was also no current SES by induction condition interaction (β = 0.089, CI: [−0.054, 0.233], p = .222).

6.3. Social preferences

Because we collected the same game play measures and used the same Dangerous World and Control inductions across all four studies, here we present meta-analytic results of regressions predicting offers using childhood SES, induction condition, game played, and the interactions between those variables.

Analyses revealed a strong evidence of main effect of childhood SES on offers (β = −0.950, CI: [−1.365, −0.534], p < .001) (Fig. 3), such that those who grew up with low SES offered more than those who grew up with high SES. This is in line with the *uncertainty management* view in which cooperation is a way to protect against the downsides of uncertainty through risk-pooling. We also found a main effect of game played on offers (β = 14.253, CI: [13.020, 15.487], p < .001) such that those who played the UG offered more (M = 47.209, SD = 17.208) than those who played the DG (M = 32.358, SD = 24.950).

In regards to mortality cues, we did not find that offers in the Dangerous World induction (M = 39.467, SD = 23.357) were significantly different from offers in the Control (M = 38.369, SD = 22.674), β = 1.129, CI: [−0.140, 2.398], p = .081.

Though the *mortality cues* account does not make specific predictions about social preferences, we wanted to examine whether mortality cues affected cooperation. We tested for any interaction effects between childhood SES, game, and induction condition on offers, none of which were statistically significant: childhood SES by induction condition interaction (β = 0.556, CI: [−0.275, 1.388], p = .190); childhood SES by

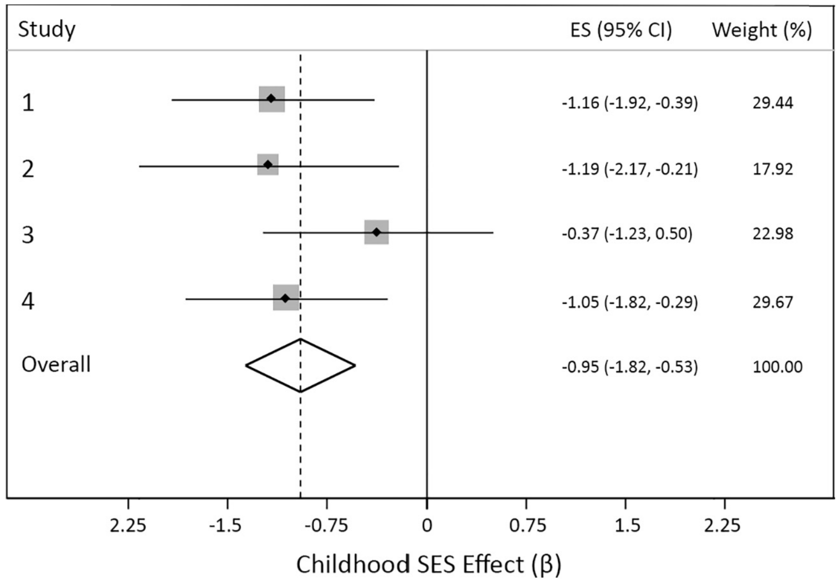

Fig. 3. A forest plot of the main effect of childhood SES on offers across four studies. In all but one study, we observed a significant main effect and the overall effect of childhood SES on offers is strong and negative. The black lines extending from the grey boxes signify 95% CIs around the study-level effect size estimate.

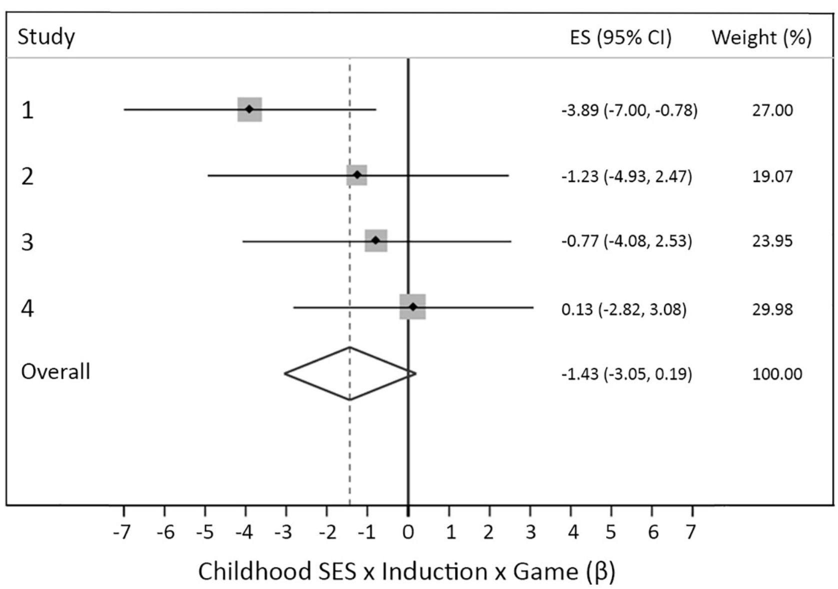

Fig. 4. A forest plot of the childhood SES by induction by game interaction on offers across four studies. We observed a significant three-way interaction in Study 1, but no others. The overall interaction was not significant. The black lines extending from the grey boxes signify 95% CIs around the study-level effect size estimate.

game interaction ($\beta = 0.708$, CI: [−0.098, 1.514], $p = .085$); game by induction condition interaction ($\beta = 2.086$, CI: [−0.381, 4.553], $p = .098$); three-way childhood SES by game by induction condition interaction ($\beta = -1.432$, CI: [−3.049, 0.186], $p = .083$) (Fig. 4).

In addition to analyzing childhood SES, we examined the role of current SES in predicting offers. Similar to childhood SES, we found a negative effect of current SES on offers ($\beta = -0.642$, CI: [−0.972, −0.312], $p < .001$) and no significant interactions between current SES and game ($\beta = 0.338$, CI: [−0.303, 0.979], $p = .30$), current SES and induction condition ($\beta = -0.354$, CI: [−1.014, 0.307], $p = .294$), or current SES, game, and induction condition ($\beta = 0.336$, CI: [−0.948, 1.620], $p = .608$).

When predicting offers using both childhood SES ($\beta = -0.862$, CI: [−1.285, −0.439], $p < .001$) and current SES ($\beta = -0.509$, CI: [−0.846, −0.173], $p = .003$), in the same regression, we found that both SES measures remained negatively predictive of offers. This finding suggests that the two measures are capturing independent variance in prosociality.

Thus, across four studies we found compelling evidence that childhood SES is a robust and independent predictor of prosociality across altruistic (DG) and strategic (UG) contexts (Fig. 5). We did not, however, find support for the necessity of mortality clues, as implied by the null effects of the Dangerous World induction, nor did we find support for the *delay discounting* account, as we found that low childhood SES results in *more* cooperation, not less.

7. Discussion

We set out to test the unique predictions of our *uncertainty management* account regarding the long-lasting effects of childhood SES on risk, time, and social preferences. For risk preferences, in accordance with our model, we found that low childhood SES is linked to greater risk aversion. Using two different risk measures—the BART task and a hypothetical risky choice task—we demonstrated a robust relationship

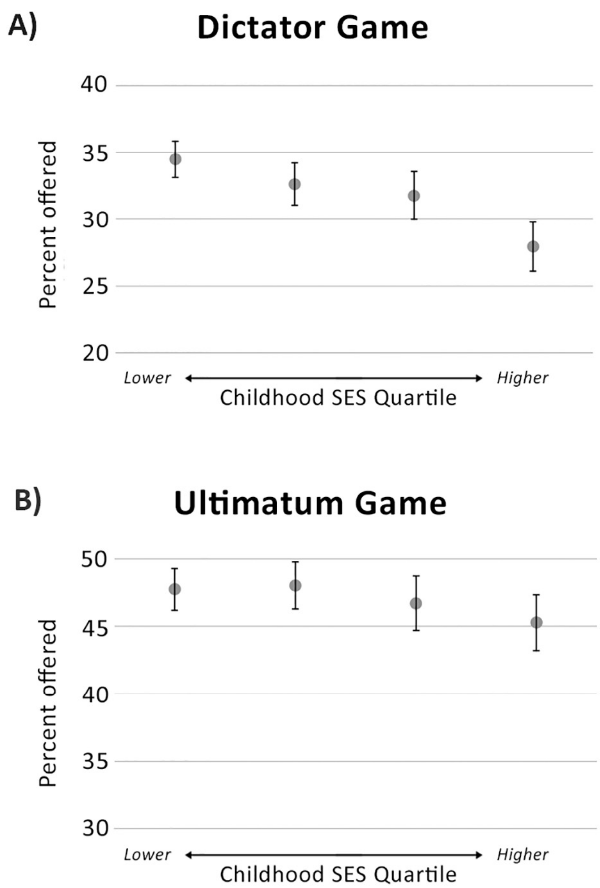

Fig. 5. (A) Percent offered in the Dictator Game broken down by childhood SES quartile. (B) Percent offered in the Ultimatum Game broken down by childhood SES quartile.

between childhood SES and risk preferences such that those who grew up with low childhood SES were more risk averse (even when controlling for current SES). Although these results can't speak to the validity of the *delay discounting* account, they do call into question the *mortality cues* account of risk preferences, which predicts risk-*seeking* behavior among low childhood SES participants in the context of salient cues to mortality.

Overall, we fail to find that mortality cues make much difference. In examining both risk and time preferences — domains which prior research has suggested are susceptible to manipulation by a mortality induction — we do not find a significant effect. Participants in both induction conditions in our studies showed the same pattern of risk and time preferences as those in the control condition in past studies: those who grew up with high SES preferred more risk. We also do not find any evidence of interaction effects between childhood SES and induction condition. Our null results are bolstered by a recent failure to replicate a similar induction in a British cohort (Pepper et al., 2017), which uncovered the same patterns we find in risk preferences: those with low childhood SES were less willing to take risks. The fact that we observe robust correlations between childhood SES and risk without contextual cues is problematic for the *mortality cues* account, but is precisely what our *uncertainty management* theory predicts. That being said, we should make clear here that our studies represent a *conceptual* replication of those conducted by proponents of the *mortality cues* account (Griskevicius, Delton, et al., 2011; Griskevicius, Tybur, et al., 2011), as our data was collected with participants who were (on average) older, completing the study online rather than in person, and reading slightly different stimuli.

For time preferences, we found that those who grew up with low childhood SES preferred immediate rewards, which are more certain, to delayed rewards. However, this effect was not robust to controlling for current SES, suggesting that there is not actually a lasting, unique impact of childhood SES on time preferences above and beyond current SES. The original work examining this measure of time preferences did not control for current SES (Griskevicius, Delton, et al., 2011; Griskevicius, Tybur, et al., 2011), but a replication of this work found a similar pattern: when both adult SES and childhood SES were included in a model, only adult SES was predictive (Pepper et al., 2017). This lack of unique childhood SES effect on intertemporal choice is problematic for the *delay discounting* framework, which is built specifically around time preferences, per se. Our framework, conversely, is focused on managing uncertainty, and can accommodate this lack of relationship by concluding that intertemporal choice is not actually driven by uncertainty concerns (and thus is not a direct output of uncertainty management strategies internalized during childhood). In support of this lack of association between risk and time preferences, we note that among the participants in our data who gave responses to both risk and time preference questions ($N = 1293$) there was very little association between the two measures ($r = 0.07$). That is, our framework predicts present-orientation among those raised in deprivation only to the extent that a measure of time preferences is capturing *uncertainty* about the future. Evidently that was not the case with our measure, but it is possible that other measures have that feature, and we would predict that such measures would show lasting effects of early life deprivation.

This result raises a question about the *delay discounting* account more generally. If it is the case that changes in present-orientation do not fully account for the constellation of behaviors seen among those raised with low childhood SES, then what underlying psychology accounts for differences in behavior? It is possible that some aspects of this constellation, like obesity, are mechanical results of poverty; for example, resource-poor individuals in the developed world can often only afford less nutritious and high calorie density foods (like fast foods). But, other facets of the constellation of behaviors, such as smoking and drug use, cannot be explained by way of this mechanism. It is unclear from our data what explains these behaviors, but an investigation into the role of uncertainty management, and how people make inferences about the status of those who show the behavioral constellation of deprivation in low SES communities may help to explain the underlying mechanisms influencing risky behaviors.

In regards to social preferences, our results demonstrate a straightforward and robust correlational relationship between childhood SES and prosociality, in line with our theoretical predictions: those who grew up with lower childhood SES were more generous. This effect persisted even when we controlled for the effect of current SES, which has been the focus of most prior work on SES and prosociality (Kraus & Callaghan, 2016; Kraus, Piff, Mendoza-Denton, Rheinschmidt, & Keltner, 2012; Piff, Kraus, Côté, Cheng, & Keltner, 2010), indicating that childhood SES has unique predictive power. Furthermore, this predictive power was true for both the DG and the UG, despite the fact that offers in the UG reflect a kind of strategic fairness, as "fair" offers in the UG are driven mostly (or perhaps entirely) by the self-interested desire to avoid rejection, rather than by prosociality (Wells & Rand, 2013). In particular, as uncertainty about the responder's minimum acceptable offer goes up, it becomes increasingly rational to make fair offers (Rand, Tarnita, Ohtsuki, & Nowak, 2013). The additional strategic element that differentiates the UG from the DG explicitly in their instructions was the basis of our initial hypothesis that cues to uncertainty should induce different offers among those who are sensitive to such cues. Perhaps, though, the mind treats unilateral giving situations as having a strategic element of their own—despite the explicit instructions—because they create an opportunity for reciprocity and risk pooling (Trivers, 1971). In fact, recent work has shown that when future payoffs are uncertain, humans engage in "social foraging" for individuals who signal that they value the welfare of others, which in turn makes generosity a payoff-maximizing strategy (Delton & Robertson, 2012). Others have also tied risk preferences directly to cooperation, and have shown that in environments that are friendly to cooperation, those who are risk averse are more likely to cooperate (Glöckner & Hilbig, 2012). Thus, our data suggest that growing up with low childhood SES creates a general and stable tendency to play strategies that are optimized for repeated settings (even when one is in a one-shot setting), and that managing uncertainty can lead directly to cooperation.

There are a number of limitations to this work. The first is that when assessing preferences, social preferences were always asked before risk and time preferences. It is possible that participants' behavior in the Dictator Game or Ultimatum Game shaped their preferences for time and risk, and further work is necessary to explore this relationship.[5] Another limitation of this work is that the time and risk preference questions dealt with hypothetical outcomes, as opposed to real outcomes. However, we find no difference in behavior between the hypothetical risk task and the incentivized risk task (BART), suggesting that the hypothetical questions are effectively capturing preferences. A third limitation of this work is that it relies on retrospective self-reporting to synthesize a picture of childhood socioeconomic status. It is possible that these reports may be sensitive to memory biases. As such, further work is necessary to explore the development of these preferences in conjunction with more objective measures of childhood SES.

8. Conclusion

Our data are consistent with an *uncertainty management* account for the long-run impact of deprivation on preferences by demonstrating that childhood SES has lasting effects on risk and social preferences, and is related to, but not uniquely predictive of, time preferences. These domains share a common feature: in each, uncertainty is a key determinant of the optimal decision. Whether the uncertainty is about the fairness others demand or the outcome of a gamble, those who felt the uncertainty of growing up with low SES are more prosocial and risk averse as adults – regardless of their current SES. Thus, there is clearly an important role of life experience in optimizing decision processes. Thinking about the influence of early life environments on preferences as the result of experience may help to guide new research questions that could shed light on nature of the processes that give rise to such differences later in life—e.g., which cues in the environment are relevant and necessary, whether there is a critical period for exposure to such cues, and how those cues are processed and integrated.

Competing interests

We have no competing interests.

Authors' contributions

MRJ and DA designed the studies. MRJ and DGR carried out the data analysis. DA, MRJ, and DGR drafted the manuscript. All authors gave final approval for publication.

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[5] However, there is some reason to think playing economic games first did not influence preferences. In a similar dataset from our research team (Arechar, Kraft-Todd, & Rand, 2017), participants (N = 1527) played a variable number of economic games, ranging from 0 to 6, prior to the intertemporal choice questions. We do not observe a dose-dependent effect of game on discount rates (all βs > 0.09, all ps > 0.16), nor do we observe a difference between participants who didn't play any economic games versus those who played at least one ($\beta = -0.005$, SE = 0.049, p = .923).

Open practices

The data and analysis script to replicate our key results can be found here: https://osf.io/esw34/.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jesp.2018.07.014.

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