and thereby pass on your genes. However, from such straightforward beginnings, the game of maximising long-term genetic representation is altered in humans – extensively, profoundly, and multidimensionally. The combination of advanced cognitive skills, a high degree of sociality, and cumulative culture means that the way that humans relate to their physical environments and to each other is unique. The resulting possibility of accumulation of different forms of "capital" creates new channels through which individuals can differ in their fitness prospects from one another. Schema for conceptualising these diverse capital forms are too numerous to discuss at length here (e.g., Bourdieu 1986; Kaplan et al. 2003). They may include physical possessions, land entitlement, technical skills, cognitive capacity, emotional resilience, social esteem, social contacts, and financial resources. Some of these forms of capital do exist in tangible physical form, but others are more abstract and are not subject to the same constraining laws of trade-offs and depreciation as somatic capital.

Inheritance of capital in these forms down the generations will have been central to human fitness dynamics, a matter that P&N touch upon in their mentions of educational investment. Those who are able to use their own capital to increase the capital held by their descendants will cause them to thrive, buffer them against environmental adversity, and ultimately enable them to multiply. In fact, selection for staying alive beyond the fifth decade (an ancestral feature of humans) can only have been entirely driven by intergenerational capital transfers from females, and this is probably mostly true for males also (Vinicius et al. 2014). Therefore, adaptive responses to adversity will be to a significant extent driven by the fact that the threat of reduced healthy years left to live not only decreases reproductive opportunities (Fig. 1, pathway i) but also decreases the opportunities to transmit capital down the generations to existing descendants (Fig. 1, pathway ii).

Explicit acknowledgment of the separation of these pathways is pregnant with implication. A bigger question rears its head: Just how large a role does the reduced opportunity for intergenerational resource transfer play in shaping adaptive responses to adversity? (Fig. 1, **pathway iii**). P&N do allude to the role that social and financial capital limitation may play, but they do not consider the likely importance of such pathways relative to those that limit healthy life spans. In short, apparent evidence for adaptation to **pathway i** may also be evidence for adaptation to **pathway iii** as well as **pathway ii**.

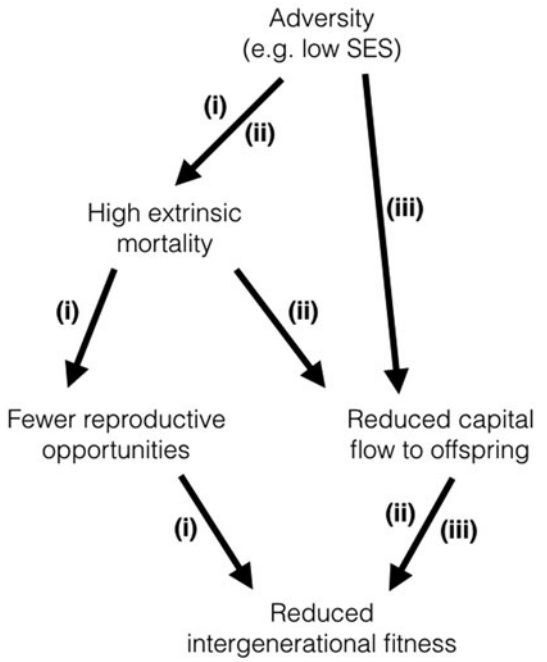

Figure 1 (Rickard). Schematic showing three pathways through which adversity, such as low socioeconomic status, may reduce evolutionary fitness and to which behavioural adaptation may evolve.

A high degree of complexity in human fitness dynamics is engendered by the diverse forms of capital involved in these additional pathways and the various ways in which they can interact with one another. There are numerous opportunities for synergies and positive feedback processes operating within and between generations. Skills may be used to advance social positions. Possessions may be traded for favours. Parents may purchase education for their children. This complexity is likely to have been reflected in human adaptive evolution, specifically in cognitive processes that enable humans to adapt to the opportunities and constraints concomitant with possessing high or low levels of capital in the various currencies. Low SES individuals may lack capital in forms that high SES individuals take for granted (e.g., Mani et al. 2013) and behave in ways that are, once all is said and done, tractable and perhaps rational. This is likely a rich area for future research.

Caution must be applied when applying an adaptive framework to understanding the behavioural response to deprivation. For most of our evolutionary history, constraints on capital accumulation limited the extent to which individuals and lineages could deviate from one another in terms of status. The complexity of socially structured societies that have arisen since the dawn of agriculture has multiplied further still the ways by which individuals with means can advantage their descendants, leading to a dramatic increase in inequality (Borgerhoff Mulder et al. 2009). Adaptive evolution is unlikely to have had a chance to catch up with this specific development. Therefore, we must be alive to the prospect that individuals sometimes respond to inequality maladaptively or that adaptations may be achieved through general, rather than specific, cognitive processes.

Why does this matter? There are real implications of taking a broader approach to understanding human fitness dynamics that take the capacity for intergenerational resource transfer, in addition to intrinsic somatic health, to be central to adaptive behavioural processes. It is clear that many aspects of an individual's intrinsic capacity for healthy life are determined by early life processes beyond his or her control. Indeed, the capacity of policy makers to make a difference in the face of such tangible inequality, embodied as well as embedded, may be limited. What we might well call their capacity for "well-being," on the other hand, is influenced by myriad different factors rooted in the social world and as a result may offer clues for routes of constructive intervention, with consequences for subsequent generations.

Stuff goes wrong, so act now

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Abstract: Pepper & Nettle make an ambitious and compelling attempt to isolate a common cause of what they call the behavioral constellation of deprivation. We agree with the authors that limited control can indeed help explain part of the difference in observed present-oriented behavior between the poor and the rich. However, we suggest that mortality risk is not the primary mechanism leading to this apparent impatience.

Pepper & Nettle (P&N) make an ambitious and compelling attempt to isolate a common cause of a large set of related behaviors that seem to differ across rungs on the socioeconomic ladder. The focus of this paper is a set of behaviors that are related through their temporal aspect of "front-loading" consumption and gratification to the present despite potential negative consequences in the future. The common cause is hypothesized to be limited control associated with lower socioeconomic status (SES). We agree with the authors' view that limited control, as well as the *perception* of limited control, can indeed help explain part of the difference in observed present-oriented behavior between the poor and the rich. However, we disagree with the use of mortality risk as the primary illustrative example of a mechanism leading to this apparent impatience: In our view, several other mechanisms are more plausible.

Intrinsic mortality appears like a reasonable mechanism behind present-oriented behavior observed in low-SES individuals: If mortality risk makes the future uncertain, it makes sense to consume now. When we combine data on temporal discounting from 53 different countries recently reported by Wang et al. (2016) with country-specific mortality rates from the World Health Organization (WHO), we do indeed find a negative correlation between mortality and discount factors ($r = -0.36$, $p = 0.0096$), with lower discount factors being associated with more discounting (see also Heimer et al. 2017 for further evidence). However, observed rates of temporal discounting are much too high to be accounted for by mortality risk, even when we generously ascribe *all* mortality risk to extrinsic causes. Specifically, people discount 46% over one year in Wang et al. (2016) – that is, they are indifferent between receiving a payment of $\$x$ one year from today and $\$x * 0.46$ today, which translates into a required interest rate of more than 116%. However, average mortality risk over one year in the countries in this dataset is only 0.148%;[1] thus, if the risk of dying before a future payment were realized were the only factor influencing discounting, people would be indifferent between receiving $\$x$ in one year and $\$x * 1/(1 + 0.00148) = \$x * 0.999$ today. Mortality risk can therefore only account for 0.13% of the observed discounting. To produce discounting on the order of magnitude observed in the data, people would have to mis-estimate the prevailing mortality risk by a factor of 769. This mismatch would be even more egregious if we restricted the mortality risk to extrinsic (i.e., uncontrollable) causes, as argued by P&N, and would remain significant even when using the lower discount rates typically estimated with the convex time budget method (Andreoni & Sprenger 2012). Thus, even if mortality rates partially explain the behavioral constellation of deprivation, it seems unlikely that it is the most important explanatory factor.

However, in our view, the authors' main hypothesis is correct; in the following, we illustrate three examples for the kind of uncertainty that could produce differences in observed discount rates at different rungs of the SES ladder.

First, poor individuals often face unpredictable income streams and liquidity constraints. The magnitude of these fluctuations can be substantial, and they mechanically create a preference for immediate payments over delayed payments. An example comes from Carvalho et al. (2016), who study time preferences of poor individuals before and after payday, finding that these people are more present-biased before payday for monetary but not effort outcomes. These findings suggest that liquidity constraints and income uncertainty in resource-poor contexts can lead to a focus on the present.

A completely different illustration of the environmental risks faced by individuals in low-income contexts comes from attrition rates in household surveys, such as those often undertaken by economists in developing countries. In our own work in Kenya, we typically expect 10% to 15% of attrition between survey rounds one year apart; i.e., we cannot find the same respondent one year later, even though the survey usually provides incentives on the order of half a daily wage. Now, imagine relying on others as business partners to deliver on promises in this context, relying on return visits from a health professional, or relying on public service delivery from government officials: It is likely that even higher rates of "attrition" are found in such situations, creating strong incentives to realize transactions now rather than later.

Finally, although the above risks are external, in our view there is a significant "internal" risk that creates incentives to act now in poor contexts: forgetting. In our own work, we have found that when individuals in Kenya have the opportunity to earn half a day's wage by simply sending a text message on a specified future date, they forget to perform this simple action at high rates, reaching about 50% for delays of a month (Haushofer 2015). When this risk is combined with the inferior availability of automatic transactions or reminder technology in resource-poor contexts, it creates strong incentives to want to act today. In line with this argument, our respondents in Kenya actually prefer to send the text message sooner rather than later, because they are aware of their own likelihood of forgetting.

In sum, P&N have outlined a provocative and compelling hypothesis for the prevalence of short-sighted behaviors in resource-poor contexts. Their hypothesis makes several testable predictions. Most importantly, it predicts that individuals in resource-poor contexts should want to act now for gains and losses: They should not only wish to consume immediately but also wish to incur costs that lead to larger benefits immediately rather than later. Our text-message study is one such example; one might imagine similar studies that use health behaviors, such as vaccination, as outcome variables. Future work of this kind promises to provide important insights into the mechanisms that drive behavior at the low end of the income distribution and point to interventions that could improve health and other outcomes in these populations.

NOTE

1. We use WHO data for mortality between ages 15 and 50 at age 15, assuming constant probability of death across this period for simplicity.

Deprived, but not depraved: Prosocial behavior is an adaptive response to lower socioeconomic status

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Abstract: Individuals of lower socioeconomic status (SES) display increased attentiveness to others and greater prosocial behavior compared to individuals of higher SES. We situate these effects within Pepper & Nettle's contextually appropriate response framework of SES. We argue that increased prosocial behavior is a contextually adaptive response for lower-SES individuals that serves to increase control over their more threatening social environments.

Individuals with lower socioeconomic status (SES) tend to be more empathetic, attentive to others, and prosocial than those with higher SES (Kraus et al. 2012; Piff & Moskowitz 2017; Piff et al. 2016). The prosocial tendencies of lower-SES individuals, who have fewer resources and reduced rank relative to upper-SES individuals, may seem irrational. We propose, however, that lower-SES individuals' other-regarding tendencies reflect adaptive responses to low personal control and greater vulnerability