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Anuj K. Shah et al.
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showed a similar pattern to H3 after the first GSC division (fig. S3).

The consistent asymmetric cell divisions of GSCs could be lost under certain conditions, such as ectopic activation of the key JAK-STAT signaling pathway in the niche (23–25). It has been shown that overexpression of the JAK-STAT ligand unpaired (OE-upd) induces overpopulation of GSCs (23, 24). Consistent with the loss of asymmetry in expanded GSCs, the asymmetric distribution pattern of the histone H3 was not observed in OE-upd testes 16 to 20 hours after heat shock (Fig. 4). These results demonstrate that the asymmetric histone distribution pattern is dependent on GSC asymmetric divisions. We propose a two-step process as our favored explanation (fig. S4A; an alternative explanation is discussed in fig. S4B): Old and newly synthesized histones are incorporated to different sister chromatids during S phase; then, during mitosis, the sister chromatid preloaded with old histones is preferentially segregated to GSC.

These data reveal that stem cells preserve preexisting histones through asymmetric cell divisions. The JAK-STAT signaling pathway required for the asymmetric GSC divisions contributes to the asymmetric histone distribution pattern. This work provides a critical first step toward identifying the detailed molecular mechanisms underlying old histone retention during GSC asymmetric division. These findings in the well-characterized GSC model system will facilitate understanding of how epigenetic information could be maintained by stem cells or reset in their sibling cells that undergo cellular differentiation.

References and Notes
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Supplementary Materials
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Materials and Methods
Figs. S1 to S4
Tables S1 to S4
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Some Consequences of Having Too Little
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Poor individuals often engage in behaviors, such as excessive borrowing, that reinforce the conditions of poverty. Some explanations for these behaviors focus on personality traits of the poor. Others emphasize environmental factors such as housing or financial access. We instead consider how certain behaviors stem simply from having less. We suggest that scarcity changes how people allocate attention: It leads them to engage more deeply in some problems while neglecting others. Across several experiments, we show that scarcity leads to attentional shifts that can help to explain behaviors such as overborrowing. We discuss how this mechanism might also explain other puzzles of poverty.

The poor often behave in ways that reinforce poverty. For instance, low-income individuals often play lotteries (12, 14), fail to enroll in assistance programs (3), save too little (4), and borrow too much (5). Currenly there are two ways to explain this behavior. The first focuses on the circumstances of poverty, such as

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manuscript deadline, we might fail to prepare next week’s lecture. Attentional neglect appears in many domains. Low-income homeowners often do not attend to regular home maintenance while they focus on more pressing expenses (18). Neglected, these small repairs become major projects. Similarly, in areas where water-borne illness is common, families might focus on pressing daily expenses while failing to procure periodic water treatments (19).

Attentional neglect can explain another particularly striking behavior: why low-income individuals take short-term, high-interest loans, with interest rates that can approach 800% (20–22). These loans make it easier to meet today’s needs, but the loans’ deferred costs make it difficult to meet future expenses. If scarcity creates a focus on pressing expenses today, then attention will go to a loan’s benefits but not its costs. This suggests a clear prediction: Scarcity, of any kind, will create a tendency to borrow, with insufficient attention to whether the benefits outweigh the costs.

Consistent with this prediction, the busy also borrow. Facing tight budgets (i.e., deadlines), they borrow time by taking extensions. Like the poor, the busy often take extensions because they focus on urgent tasks, but neglect important tasks that seem less pressing (23). We suggest that both forms of borrowing stem from how scarcity shifts attention.

We test this theory with the use of an approach that psychologists have employed to study other social problems, such as obedience to authority (24), helping behavior (25), and conformity (26). Simple experiments can distill a problem’s primary features in the lab, abstracting from the complexities of the world and highlighting how selected features guide behavior. Here, we distill scarcity and test its influence on how people borrow. Experiments 2 to 5 demonstrate how (and why) scarcity leads people to borrow. Experiments 1 and 2 show that scarcity creates increased focus. Experiments 2 to 5 demonstrate how scarcity leads people to borrow.

In all experiments, participants were randomly assigned budgets; “poor” participants had smaller budgets than “rich” participants [see (27) for a full description]. These budgets were distributed in “paychecks” across multiple rounds of a game. Poor participants had proportionally smaller paychecks than rich participants. On each round, participants used the resources to earn rewards. If participants moved on from a round without exhausting their paycheck, unspent units were saved for future use. Participants were also assigned to different borrowing conditions. Some could not borrow—when a paycheck was exhausted, they moved to the next round. Other participants could borrow at a cost $R$: Borrowing an additional resource unit for the current round subtracted $R$ units from their overall budget.

In experiment 1, 60 participants played a version of Wheel of Fortune (WoF). Scarcity was manipulated by budgeting participants’ chances to guess letters in word puzzles. Poor participants had 84 total guesses (6 per round); rich participants had 280 guesses (20 per round). Previous work suggests that greater engagement in WoF will cause cognitive fatigue and worse performance on subsequent cognitive tasks (28). As a measure of cognitive fatigue, after WoF, participants completed a version of the Dots-Mixed task, which assesses executive functions such as attention and cognitive control (29). Participants responded to visual stimuli presented to the left or right of a fixation cross. On congruent trials, participants had to press a key on the same side as the stimulus; on incongruent trials, they had to press a key on the opposite side. Congruent and incongruent trials (40 each) were randomly presented. Although WoF included a scarcity manipulation, the Dots-Mixed task was identical for all participants.

A simple model of effort might suggest that the rich should be more fatigued because they spent more time and made more guesses playing WoF. In our model, however, the poor would engage more deeply and could be more fatigued despite spending less time.

We measured the total number of correct responses in the attention task. Four participants were removed from the analyses for having zero correct responses. Poor participants performed worse (mean ± SD, 45.12 ± 15.87) than did rich participants (62.93 ± 12.79) $[F(1, 54) = 4.16, P < 0.05]$, effect size $\eta^2 = 0.07$; see table S1 for performance based on trial type]. Scarcity seems to have created greater engagement. Even with less time played (and fewer guesses made), the poor were more depleted.

Experiment 2 offers a more precise look at how scarcity changes engagement. Sixty-eight participants played a video game similar to Angry Birds. They fired shots from a slingshot, earning points for clearing targets. The poor had budgets of 30 shots (3 per level); the rich had 150 shots (15 per level). Some participants could not borrow shots, whereas others could borrow with $R = 2$ (essentially, 100% interest). Participants played until exhausting their budget.

To analyze how scarcity affected focus, we measured how long participants spent aiming each shot (i.e., how careful they were with their resources). Poor participants spent more time aiming the first shot of each level (log-transformed milliseconds, 8.08 ± 0.42) than did rich participants (7.73 ± 0.39) $[F(1, 64) = 12.96, P < 0.001]$. These results held for subsequent shots as well. Because the rich could always earn more points (and each additional point increased the chances of winning a prize), they had an incentive to remain engaged and use their resources well. Yet they were less engaged than the poor. Still, one might argue that these differences are driven by rich participants losing interest later in the game. However, these differences emerged on the very first shot of the game (poor: 8.19 ± 0.52; rich: 7.86 ± 0.52) $[F(1, 64) = 6.58, P < 0.05]$. This engagement had some benefits for the poor. Among participants who could not borrow, the poor earned more points per shot (2.31 ± 0.60) than did the rich (1.67 ± 0.37) $[F(1, 31) = 11.92, P < 0.005]$. Rich participants had 5 times as many shots as the poor, but earned far fewer than 5 times as many points. If the rich had played as if they were poor, they would have performed better. It seems that to understand the psychology of scarcity, we must also appreciate the psychology of abundance. If scarcity can engage us too much, abundance might engage us too little.
These results illustrate scarcity’s focusing effect. Field data also show scarcity-induced fo-
cus. For instance, instead of offering bulk dis
counts, some retailers raise the per-unit cost of an
item as purchase quantity increases. Most people
overlook these occasional “quantity surcharges,”
but low-income consumers are more likely to
notice these surcharges (30). Low-income con-
sumers are also more sensitive to “hidden” taxes—
those not included in the posted price (31).

Our experiments also suggest that scarcity
leads people to neglect future rounds and bor-
row away from them. In experiment 2, each shot
used beyond a round’s paycheck counted as a
shot borrowed. Borrowed shots were summed
across a participant’s game. As a fraction of their
budget, poor participants borrowed more shots
(0.24 ± 0.15) than the rich (0.02 ± 0.05) [F(1, 33) =
27.53, P < 0.001].

Performance data suggest that this borrowing
was counterproductive. We measured perfor-
ance in z-scores, standardizing points earned
separately for the poor and the rich (Fig. 1;
see table S2 for unstandardized data). Rich par-
ticipants performed similarly whether they could
not borrow (−0.12 ± 0.77) or could (0.10 ± 1.18),
whereas poor participants fared better when
they could not borrow (0.55 ± 0.65) than when
they could (−0.55 ± 1.00) [scarcity × borrowing
interaction, F(1, 64) = 8.47, P < 0.005, n_p² =
0.12]. This suggests that the poor overborrowed.

The amount of borrowing by the poor was
significantly correlated with measures of engage-
ment. On rounds where poor participants bor-
rowed, the average amount of time spent aiming
each shot in their paycheck correlated positively
with how many shots they subsequently bor-
rowed [r(38) = 0.34, P < 0.05]. The more fo-
cused the poor were on the current round, the
more they neglected (and borrowed away from)
future rounds.

To ensure that this was not an artifact of a
particular context, we considered a different form
of scarcity: having too little time. In experiment
3, 143 participants were given budgets of time
with which to play Family Feud, a trivia game
where each question allows multiple answers.
Each round consisted of a new question and
round). Participants played until exhausting their
budget. There were three borrowing conditions:
no borrowing, borrowing with R = 1 (i.e., “with-
out interest”), and borrowing with R = 2 (“with
interest”).

Regardless of interest rate, poor participants
borrowed a greater proportion of their budget
(0.22 ± 0.15) than did rich participants (0.08 ±
0.15) [F(1, 102) = 22.39, P < 0.001]. Once again,
the poor overborrowed [interaction F(1, 137) =
6.54, P = 0.002, n_p² = 0.09; see table S3 for un-
standardized data]. Rich participants performed
similarly whether they had no option to borrow
(0.06 ± 1.10), borrowed without interest (−0.31 ±
0.88), or borrowed with interest (0.25 ± 0.98)
[F(1, 137) = 2.14, P = 0.15]. The poor performed
best when they could not borrow (0.60 ± 1.14),
less well when they borrowed without interest
(0.08 ± 0.67), and worst when they borrowed
with interest (−0.48 ± 0.94) [F(1, 137) = 7.49,
P < 0.001].

The effects of scarcity appear to be quite gen-
eral. But one concern with these studies might
be that the consequences of borrowing, which
were not felt until the end, were not sufficiently
salient. In experiment 4, we therefore modified the
game so that borrowing would create “debt” in
subsequent rounds. That is, the size of each pay-
check varied depending on how people borrowed
or saved. Initial paychecks were the same as in
experiment 3, but on subsequent rounds, pay-
checks equaled the total time remaining divided
by the number of remaining rounds. Participants
played until they exhausted their budget or com-
pleted 20 rounds, whichever came first. Exces-
sive borrowing on one round would therefore
lead to a smaller paycheck on the next round.
Some participants could not borrow, whereas
others could borrow with R = 2.

Poor participants borrowed a greater pro-
portion of their budget (0.27 ± 0.14) than did
rich participants (0.03 ± 0.04) [F(1, 56) =
70.50, P < 0.001] and consequently saw their
paychecks shrink during the game (Fig. 2).
For this analysis, each round’s paycheck was
converted to a proportion of the default pay-
check (i.e., dividing by 15 for the poor and by
50 for the rich). We regressed these propor-
tions on the round numbers and analyzed the
slopes for each participant. The poor accumu-
lated debt at a higher rate (mean of slope ± SD,
−0.13 ± 0.18) than did the rich (−0.01 ± 0.01)
[Mann-Whitney test, z = 5.46, P < 0.001]. Fur-
thermore, the poor did not adjust their borrow-
ing as they accumulated debt. Instead, as their
budgets shrunk, they gradually increased their
borrowing relative to their remaining budget (27).
As a result, rich participants performed similarly
when they could not borrow (−0.09 ± 0.81) and
when they could (0.11 ± 1.20). The poor per-
formed better when they could not borrow (0.54 ±
0.77) than when they could (−0.49 ± 0.94) [in-
teraction F(1, 114) = 12.81, P < 0.001, n_p² =
0.10; see table S4 for unstandardized data].

As in these experiments, neglect also creates
many forms of borrowing (beyond conven-
tional loans) among the poor in the world.
For example, the poor often focus on certain
expenses while neglecting utility payments, there-
by incurring reconnection fees that are like in-
terest payments—“borrowing” by paying the
bill late (32).

Experiment 5 offers more direct support for
the notion that scarcity creates attentional neglect.
One hundred thirty-seven participants played
Family Feud. Some participants could see pre-
views of the subsequent round’s question at the
bottom of the screen; others could not. We ex-
pected that poor participants would be too fo-
cused on the demands of the current round to
consider what comes next, whereas rich partic-
ipants would be able to consider future rounds
and whether moving on was beneficial. All par-
ticipants could borrow with R = 3. As predicted,
poor participants performed similarly with pre-
views (−0.02 ± 0.87) and without (0.02 ± 1.11),
while rich participants performed better with pre-
views (0.32 ± 0.98) than without (−0.35 ± 0.92)
[scarcity × borrowing interaction, F(1, 133) =
4.29, P < 0.05, n_p² = 0.03; for unstandardized
scores, see table S5]. One concern might be that
the poor did not have enough time to consider
the previews. But the experiments above found
that the poor were using too much; they were
overborrowing. Their performance in the no-
preview condition left substantial room for im-
provement. Even if poor participants had used
some of the borrowed time to consider the pre-
views and move on sooner, they could have
improved. That is, the previews benefited the rich
by helping them save more; they could have ben-
efited the poor by helping them borrow less. But
it appears they were too focused on the current
round to benefit.

Taken together, these studies provide com-
pelling support for the notion that scarcity elicits
greater engagement and that a focus on some
problems leads to neglect of others (manifesting
in behaviors such as overborrowing). An alter-
native account might be that the poor and rich
approached these tasks with the same mindset—
playing each round until they were satisfied with
their progress before moving on. By this account,
the poor borrowed only because they were facing
more severe constraints. But evidence from ex-
periments 1 and 2 suggests that the poor and rich
did not approach the tasks in the same way. The
poor were more engaged.

Another explanation might be that scarcity
creates cognitive load, thereby diminishing per-
formance. Cognitive load might prevent people
from figuring out the optimal borrowing rates,
or it might lead people to use their resources less
efficiently or make riskier financial decisions.
Although we agree that scarcity creates load, our
theory is more specific about the origins of that
load and its effects. We suggest that cognitive
load arises because people are more engaged with
problems where scarcity is salient. This con-
sumes attentional resources and leaves less for
elsewhere.

Once we appreciate where attention is drawn
under scarcity, we see how this mechanism can
explain behaviors other than overborrowing.
Scarcity-induced focus is not myopia, nor does
it necessarily imply steeper discount rates. The
poor often save for the future. However, their sav-
ings are not set aside in a generic account, but
rather are geared toward specific expenses. That
is, the poor often save for the same reason they
borrow. This has clear policy implications. Inte-
ventions that draw people’s attention to specif-
ic future needs should be particularly effective
at increasing savings (33). This mechanism also
Explain why the poor in many countries have a patchwork of financial instruments, with high turnover across accounts. A scarcity mindset leads people to choose the most locally convenient response to pressing demands, leading to constant financial juggling (34).

Questions surrounding poverty are large. Poverty has long occupied philosophers, social scientists, and policy-makers. No experiment can fully explain how poverty, and scarcity more generally, guides behavior. But the hypotheses, methods, and results above offer an approach to unpacking this problem. This paradigm can shed light on the cognitive consequences of poverty. Future research might also suggest ways to alleviate the taxing cognitive consequences of having too little. Finally, this approach can help us to understand circumstances even broader than poverty, because scarcity underlies problems as dire as hunger and as mundane as busyness. These problems have traditionally been studied as dire as hunger and as mundane as busyness. Poverty has long occupied philosophers, social scientists, and policy-makers. No experiment can fully explain how poverty, and scarcity more generally, guides behavior. But the hypotheses, methods, and results above offer an approach to unpacking this problem. This paradigm can shed light on the cognitive consequences of poverty. Future research might also suggest ways to alleviate the taxing cognitive consequences of having too little. Finally, this approach can help us to understand circumstances even broader than poverty, because scarcity underlies problems as dire as hunger and as mundane as busyness. These problems have traditionally been studied as dire as hunger and as mundane as busyness.

References and Notes
27. See supplementary materials on Science Online.

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