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Psychology

Adding to our problems

Tom Meyvis & Heeyoung Yoon

A series of problem-solving experiments reveal that people are more likely to consider solutions that add features than solutions that remove them, even when removing features is more efficient. **See p.258**

Consider the Lego structure depicted in Figure 1, in which a figurine is placed under a roof supported by a single pillar at one corner. How would you change this structure so that you could put a masonry brick on top of it without crushing the figurine, bearing in mind that each block added costs 10 cents? If you are like most participants in a study reported on page 258 by Adams *et al.*[1], you would add pillars to better support the roof. But a simpler (and cheaper) solution would be to remove the existing pillar, and let the roof simply rest on the base. Across a series of similar experiments, the authors observe that people consistently consider changes that add components over those that subtract them – a tendency that has broad implications for everyday decision-making.

For example, Adams and colleagues analysed archival data and observed that, when an incoming university president requested suggestions for changes that would allow the university to better serve its students and community, only 11% of the responses involved removing an existing regulation, practice or programme. Similarly, when the authors asked study participants to make a 10 × 10 grid of green and white boxes symmetrical, participants often added green boxes to the emptier half of the grid rather than removing them from the fuller half, even when doing the latter would have been more efficient.

Adams *et al.* demonstrated that the reason their participants offered so few subtractive solutions is not because they didn't recognize the value of those solutions, but because they failed to consider them. Indeed, when instructions explicitly mentioned the possibility of subtractive solutions, or when participants had more opportunity to think or practise, the likelihood of offering subtractive solutions increased. It thus seems that people are prone to apply a 'what can we add here?' heuristic (a default strategy to simplify and speed up decision-making). This heuristic can be overcome by exerting extra cognitive effort to consider other, less-intuitive solutions.

Whereas the authors focused on participants' failure to even consider subtractive solutions, we propose that the bias towards additive solutions might be further compounded by the fact that subtractive solutions are also less likely to be appreciated. People might expect to receive less credit for subtractive solutions than for additive ones. A proposal to get rid of something might feel less creative than would coming up with something new to add, and it could also have negative social or political consequences – suggesting that an academic department be disbanded might not be appreciated by those who work in it, for instance. Moreover, people could assume that existing features are there for a reason, and so looking for additions would be more effective. Finally, sunk-cost bias (a tendency to continue an endeavour once an investment in money, effort or time has been made) and waste aversion could lead people to shy away from removing existing features[2], particularly if those features took effort to create in the first place.

These perceived disadvantages of subtractive solutions might encourage people to routinely seek out additive ones. This is consistent with Adams and colleagues' suggestion that frequent previous exposure to additive solutions has made them more cognitively accessible, and thus more likely to be considered. However, in addition, we posit that previous experience could lead people to assume that they are actually expected to add rather than subtract. As a result, the study's participants might be generalizing from past experiences and instinctively assume that they should

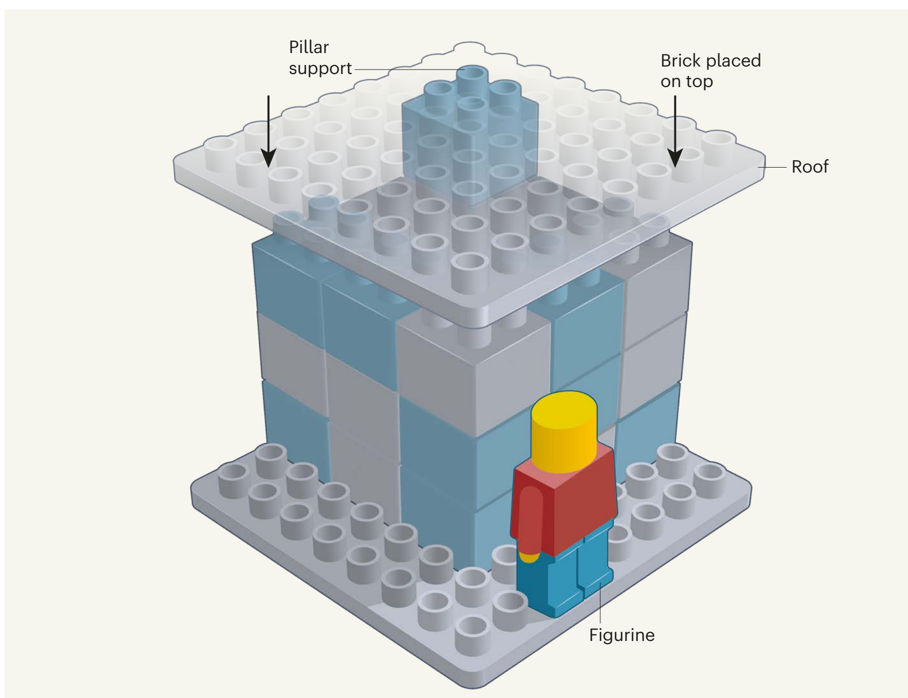

Figure 1 | Improving the stability of a Lego structure. In this structure, a roof is supported by a pillar at one corner of a building. When a brick is placed on top, the roof will collapse onto the figurine. Adams *et al.*[1] asked study participants to stabilize the structure so that it would support the brick above the figurine, and analysed the ways in which participants solved the problem. (Figure adapted from Extended Data Figure 2 of ref. 1.)

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add features, only revisiting this assumption after further reflection or explicit prompting. Similarly, members of a university community might implicitly assume that the incoming president wants them to formulate new initiatives, not criticize existing ones.

What are the implications of Adams and colleagues' findings? There are many real-world consequences of failing to consider that situations can often be improved by removing rather than adding. For instance, when people feel dissatisfied with the decor of their home, they might address the situation by going on a spending spree and acquiring more furniture — even if it would be equally effective to get rid of a cluttering coffee table. Such a tendency might be particularly pronounced for resource-deprived consumers, who tend to be particularly focused on acquiring material goods[3]. This not only harms those consumers' financial situations, but also increases the strain on our environment. On a grander scale, the favouring of additive solutions by individual decision-makers might contribute to problematic societal phenomena, such as the increasing expansion of formal organizations[4] and the near-universal, but environmentally unsustainable, quest for economic growth[5].

Adams and colleagues' work points to a way of avoiding these pitfalls in the future — policymakers and organizational leaders could explicitly solicit and value proposals that reduce rather than add. For instance, the university president could specify that recommendations to remove committees or policies are both expected and appreciated. In addition, both individuals and institutions could take self-control measures to guard against the default tendency to add. Consumers could minimize their storage space to restrain their purchases, and organizations could specify sunset clauses that trigger the automatic shutdown of initiatives that fail to meet specific goals.

Of note, it is unlikely that a bias towards addition will always apply. In some situations, it should arguably be easier to generate subtractive changes, because those do not require imagining something that isn't already there. Indeed, when people imagine how a situation could have turned out differently, they are more likely to do so by undoing an action they've taken rather than by adding an action they failed to take[6]. Going forwards, it would be worth exploring when our readiness to imagine removing events extends to imagining removing features, thereby helping us to solve problems through subtraction.

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1. Adams, G. S., Converse, B. A., Hales, A. H. & Klotz, L. E. *Nature* **592**, 258–261 (2021).
2. Arkes, H. R. & Blumer, C. *Organiz. Behav. Hum. Decision Processes* **35**, 124–140 (1985).
3. Tully, S. M., Hershfield, H. E. & Meyvis, T. *J. Consumer Res.* **42**, 59–75 (2015).
4. Meyer, J. W. & Bromley, P. *Sociol. Theory* **31**, 366–389 (2013).
5. Victor, P. *Nature* **468**, 370–371 (2010).
6. Byrne, R. M. J. & McEleney, A. *J. Exp. Psychol.* **26**, 1318–1331 (2000).

Quantum information

Quantum computer based on shuttling trapped ions

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A microchip-based quantum computer has been built incorporating an architecture in which calculations are carried out by shuttling atomic ions. The device exhibits excellent performance and potential for scaling up. **See p.209**

Quantum computing based on trapped atomic ions has already proved itself to be a leading hardware platform for quantum information processing. Indeed, trapped ions have been used to realize quantum gates — the basic building blocks of a quantum computer — that have the smallest quantum-computation errors of any hardware platform[1,2]. The approach also stands out because it could allow practical machines to be built that do not require cooling to ultra-low (millikelvin) temperatures. However, there have been few comprehensive demonstrations of quantum-computing architectures capable of being scaled up to thousands of quantum bits (qubits). On page 209, Pino *et al.*[3] report the construction and operation of a prototype microchip-based, trapped-ion quantum computer that incorporates a promising architecture based on ion shuttling.

The concept of quantum computing relies on the strange phenomena of quantum physics, the counter-intuitive predictions of which Albert Einstein referred to as spooky. Quantum computers promise to perform calculations in hours or even minutes that might take millions of years to run on the fastest conventional supercomputer. Full-scale quantum computers containing millions of qubits would have transformative uses in nearly every industry, from simulating chemical reactions and helping to develop pharmaceuticals to disruptive

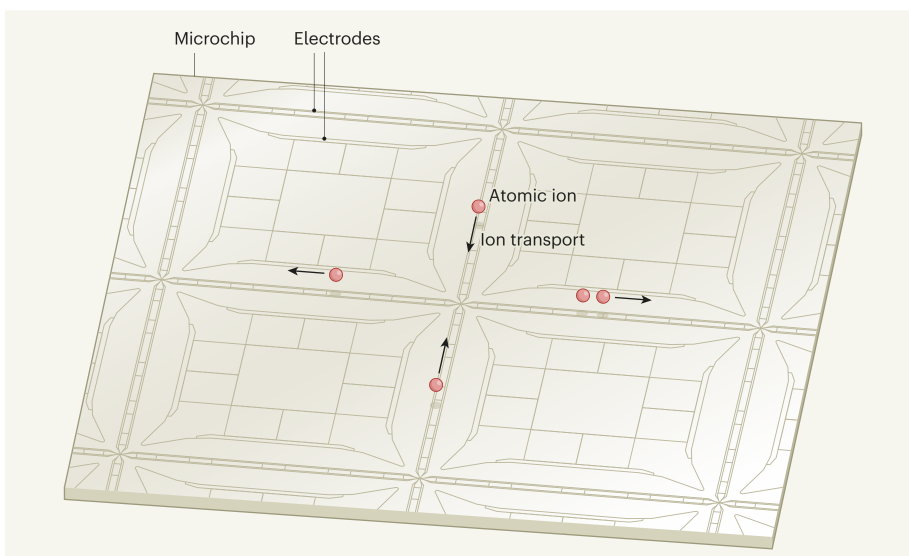

Figure 1 | Quantum-computing architecture based on ion shuttling. In a computing platform known as the quantum charge-coupled device (CCD) architecture, atomic ions hover above the surface of a microchip. These ions are transported along tracks by changing the voltages applied to electrodes (grey lines not in tracks) located on the chip's surface. Quantum computations consist of a sequence of such ion-transport operations interleaved with other operations called quantum gates (not shown). Pino *et al.*[3] built a quantum computer according to this quantum-CCD design.

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