CORRESPONDENCE:

Intrinsic motivation and pro-environmental behaviour

To the Editor — The term 'warm glow' was first introduced by economist James Andreoni in an attempt to explain why people sometimes act altruistically (for example, donate to charity)[1]. The theory suggests that people often act pro-socially because it is rewarding; we derive a positive emotional experience from the act of helping others (that is, a warm glow). In a recent Letter, Taufik, Bolderdijk and Steg[2] show that acting green elicits a literal warm glow: people's psychological state directly influences their thermal state. In the experiment, participants who acted in an environmentally friendly way perceived significantly higher temperatures than those who did not. Importantly, the effect on perceived temperature was mediated by a positive self-signal.

What Taufik and colleagues describe in their study is closely related to a psychological concept known as the 'helper's high'[3]: when doing good actually makes people feel good. Although Taufik *et al.* did not find any systematic effects on changes in skin temperature, there is a substantial body of research suggesting that when people do good this often results in many observable physiological and psychological benefits[4]. In fact, the brain's response to increasing body heat (warm glow) is the release of 'feel-good' neurotransmitters such as oxytocin[5]. By doing good or the 'right' thing, I do not refer to opaque cultural conceptualizations of good and evil, but rather to morality as an evolved capacity. Moral emotions such as empathy and the ability to be compassionate are evolutionarily adaptive traits[6]. It is therefore not entirely surprising that doing the right thing sends a positive self-signal: the act of helping actually makes people feel good, both physically as well as psychologically.

Yet, while the study by Taufik *et al.* clearly adds to a growing body of research highlighting that people are motivated by more than just monetary and extrinsic incentives[7,8,9], I argue that the authors are in fact too modest in stressing the importance of understanding the intrinsic motivational basis of pro-environmental behaviour. One major challenge in behavioural science and psychological research more generally is the (in)ability to sustain (experimental) treatment effects over time[10,11]. In the face of many urgent global challenges, whether social (for example, inequality), public health (disease), economic (poverty) or environmental (climate change), understanding how to make positive behaviour change stick is one of the most pressing policy-relevant (but under-researched) questions in social science today. I argue that the answer to this question lies in recognizing both the fundamental limitations of extrinsically-oriented incentives as well as the severely under-leveraged potential of intrinsically motivated behaviour.

To illustrate this principle, I analyse (Fig. 1) the behavioural impact of a campus-wide energy conservation campaign that was recently administered at Princeton University. The 2014 'Do-It-in-the-Dark' campaign (www.wattvision.com/competition/princeton/home) is a perfect example of a popular nationwide energy competition initiative where students across universities (more than 100 took part) are encouraged to reduce their residential energy consumption over the course of a month (the competition period). The so-called campus conservation nationals (CCN; www.competetoreduce.org) is the largest competition of its kind. Usually, several prizes are handed out to the winners of the competition. Using interrupted (change-point) time-series analysis, I assess the (slope-) changes in the energy-usage trend shortly before (pre), during, and after (post) the competition was launched. It is clear from Fig. 1 that the competition noticeably reduced aggregate residential energy consumption across

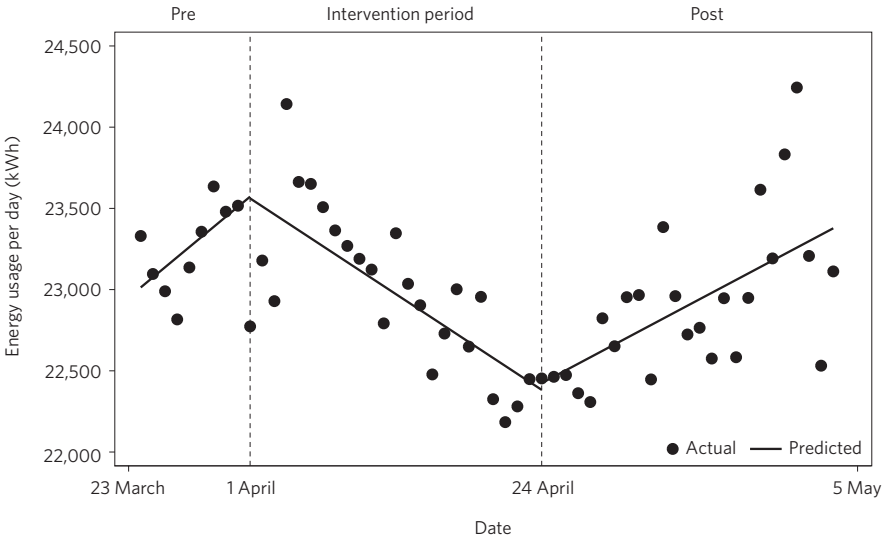

Figure 1 | Daily energy consumption before, during, and after the Do-It-in-the-Dark energy conservation competition in 2014. Estimates are obtained from an interrupted time series regression model (see Supplementary Information for full model specification). Aggregate energy usage represents the sum of de-trended daily energy consumption from all six residential colleges at Princeton University. The model controls for variation in local temperature trends over the period.

campus. Moving from the baseline (pre) to the competition period, the direction of the trend changes significantly, visibly shifting downward (β change = –111.21, t = –3.88, P < 0.01, 95% CI:–168.69, –53.74). What is particularly interesting, however, is that there is another significant trend change: as soon as the competition ends the positive effect of the intervention is reversed and energy usage bounces right back to the baseline consumption level before the competition was launched (β change = 88.81, t = –5.01, P < 0.01, 95% CI: 53.25, 124.38).

While competitions of this kind are usually well-intended (for example, they may help raise awareness), a competition by its very nature is an extrinsically motivated incentive that leverages people's intention to act in their self-interest (winning, in this case). Yet, what Fig. 1 illustrates is a fundamental characteristic of nearly all extrinsically sourced incentives; once they disappear, so does the positive impact on behaviour. There is a pervasive tendency in both public policy-making and social science to conceptualize our thinking and experiments around short-term motivators of behaviour change. Unfortunately, plenty of behavioural research has shown that extrinsic incentives often crowd out (that is, undermine) intrinsic motivation[12,13]. For example, emphasizing the monetary benefits of an energy-savings programme can actually decrease environmental concern and reduce overall willingness to participate[9].

Back to warm glow. When people decide to act pro-environmentally because they believe it is the right thing to do, because they are intrinsically motivated (and physically and psychologically rewarded for doing so) — change is much more likely to be sustained over time. The value of this line of research is not to simply demonstrate that people light up when they are doing something good. The real message lies in the fact that long-term environmental problems call for long-term motivators of pro-environmental behaviour.

While my evaluation of the energy conservation intervention does not directly speak to how behaviour change may be sustained, it does clearly highlight the inherent limitations of extrinsic incentives and serves as an example to encourage a shift in current thinking about how to most effectively promote durable behaviour change. I argue that harnessing people's hard-wired biological capacity to care about others and the environment is likely to far outlive the utility of trying to sway the public with short-sighted incentives. There is good evidence that people are intrinsically motivated to forge a more conserving and sustainable society[7–9,11]. Future research may be well advised to explore this promising line of inquiry. ❐

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Additional information

Supplementary information is available in the online version of the paper.

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CORRESPONDENCE:

Response of chinook salmon to climate change

To the Editor — Muñoz *et al.*[1] present some interesting and valuable experimental data about the physiological responses of chinook salmon (*Oncorhynchus tshawytscha*) to changes in developmental temperature. Especially notable is the way they develop quantitative genetic data to evaluate the adaptive potential of cardiac performance to different temperature regimes. Pacific salmon clearly have the ability to develop population-specific adaptations in cardiac performance over evolutionary time scales[2], but they found relatively little capacity for adaptive genetic or plastic responses in one key performance measure, the arrhythmic temperature, in the population they studied. However, we raise concerns about their extrapolation from a small study to broad conclusions about vulnerability of the entire species to climate change. They claim that "rising temperatures now threaten the persistence of [salmon]"[1]. While it is true that many individual salmon populations and some regional population groups are at risk, threats to persistence are multifaceted and population-specific[3]. Moreover, the premise that persistence of the genus, or any one of the *Oncorhynchus* species, is now threatened by rising temperature is not supported by other empirical evidence. We are also concerned that this study ignored the documented capability of salmonids to respond to environmental change with plastic and evolutionary changes in behaviour, such as upstream (adult) and downstream (juvenile) migration timing[4]. Changes in phenology, rather than physiological tolerances, provide greater capacity for resilience to climate change in salmonids[5] and other taxa more generally[6], although the two clearly interact and the relative importance of