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Psychological Science 2013 24: 2550 originally published online 30 October 2013
DOI: 10.1177/0956797613495244

Research Report

Psychological Science
24(12) 2550–2556

DOI: 10.1177/0956797613495244
pss.sagepub.com

Hunger Games: Fluctuations in Blood Glucose Levels Influence Support for Social Welfare

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Abstract

Social-welfare policies are a modern instantiation of a phenomenon that has pervaded human evolutionary history: resource sharing. Ancestrally, food was a key shared resource in situations of temporary hunger. If evolved human psychology continues to shape how individuals think about current, evolutionarily novel conditions, this invites the prediction that attitudes regarding welfare politics are influenced by short-term fluctuations in hunger. Using blood glucose levels as a physiological indicator of hunger, we tested this prediction in a study in which participants were randomly assigned to conditions in which they consumed soft drinks containing either carbohydrates or an artificial sweetener. Analyses showed that participants with experimentally induced low blood glucose levels expressed stronger support for social welfare. Using an incentivized measure of actual sharing behavior (the dictator game), we further demonstrated that this increased support for social welfare does not translate into genuinely increased sharing motivations. Rather, we suggest that it is "cheap talk" aimed at increasing the sharing efforts of other individuals.

Keywords

evolutionary psychology, social cognition, hunger, political attitudes, social welfare, dictator game

Received 9/20/12; Revision accepted 5/24/13

Social-welfare institutions represent intricate systems for exchanging resources in modern society. At the same time, social welfare is a token of the more general phenomenon of resource sharing, which has pervaded human evolutionary history (Kaplan & Gurven, 2005). In particular, the sharing of food among nonkin most likely predates modern society by millions of years (Hublin, 2009; see also Stiner, Barkai, & Gopher, 2009) and is found throughout the anthropological record (e.g., Gurven, 2004; Sugiyama, 2004) as well as among nonhuman animals (Kavanagh, 1972). Thus, there is reason to expect humans to have evolved a sophisticated psychology of food sharing designed to regulate and incentivize sharing in situations of hunger. In the present study, we investigated whether mental programs that originally evolved to regulate food sharing shape how humans think about sharing in the form of modern social welfare.

Anthropological observations suggest that foraging human ancestors regularly experienced hunger. For example, anthropological studies of foraging societies have shown that hunters regularly return empty-handed, and success rates in the hunting of large game can be as low as 4% (Hawkes, O'Connell, & Blurton Jones, 1991; Kaplan, Hill, Lancaster, & Hurtado, 2000). Consequently, it is plausible that human psychology evolved through natural selection to respond adaptively to body-energy depletion with motivations and behaviors that would help individuals acquire resources by means other than foraging (Kurzban, 2010; Petersen, Aarøe, Jensen, & Curry, 2013; Wang & Dvorak, 2010).

Consistent with this view, results from previous studies have revealed profound psychological effects of hunger. Focusing on fluctuations in blood glucose as a marker of low body energy, researchers have documented that blood glucose levels elicit behavior related to heightened greed, such as decreased self-control and impulse

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inhibition, increased risk taking, and greater discounting of the future (e.g., Briers, Pandelaere, Dewitte, & Warlop, 2006; Gailliot & Baumeister, 2007; Gailliot et al., 2007; Hagger, Wood, Stiff, & Chatzisarantis, 2010; Muraven, Pogarsky, & Shmueli, 2006; Symmonds, Emmanuel, Drew, Batterham, & Dolan, 2010; Wang & Dvorak, 2010). Most researchers have interpreted such observations as evidence that the depletion of important metabolic resources constrains self-control (e.g., DeWall, Baumeister, Gailliot, & Maner, 2008; DeWall, Deckman, Gailliot, & Bushman, 2011; Gailliot & Baumeister, 2007). However, these findings are equally interpretable as the activation, in states of resource depletion, of adaptive strategies for aggressive resource acquisition involving directly seizing resources from other individuals and defending already held resources.

There is reason to believe that such strategies coexist with alternative strategies aimed at acquiring resources through the willful sharing of other individuals. Research in anthropology has shown that most occurrences of temporary hunger in small-scale societies are alleviated not through aggression but through peaceful sharing (Gurven, 2004), that acquiring food through aggressive means is punished (Erdal & Whiten, 1996), and that the importance of nonaggressive begging is zoologically widespread (e.g., McGrew & Feistner, 1992; Raabe, 2003). Given that sharing systems have been a major source of food in dire times throughout human evolutionary history, an ecologically rational strategy for hungry individuals would be to signal the kind of cues that would activate such systems and induce other individuals to transfer resources willfully (Petersen et al., 2013). Proximally, this would be felt as an increase in (a) the value placed on sharing and (b) the motivation to express support for sharing in the hungry individual. Ultimately, verbal expressions of support for sharing could serve to remind potential food donors about norms of communal sharing and reciprocal obligations. Hence, in any complex social context, an array of norms exists that can be appealed to (DeScioli & Kurzban, 2013). By making sharing norms salient for potential food donors, individuals can increase the likelihood of resource transfers (see, e.g., Bicchieri & Chavez, 2010; Brañas-Garza, 2007). This is especially the case when the potential donors are satiated because satiation reduces the marginal costs of transferring food (Blurton Jones, 1984).

Whereas food-transfer systems existed as informal small-scale exchange networks throughout most of human evolutionary history (Kaplan & Gurven, 2005; Kelly, 1995), the sharing of resources in the large-scale setting of mass politics—economic redistribution—is managed by an evolutionarily novel and highly complex system: the modern welfare state (Esping-Andersen, 1990). Previous research has suggested that individuals' representations of many culturally modern phenomena are shaped by mental programs that evolved to process evolutionarily recurrent equivalents (Hagen & Hammerstein, 2006; Petersen, 2012). We therefore expect that the mental programs that evolved to regulate behavior in situations of hunger shape attitudes on the mass political issue of social welfare (see also Petersen et al., 2013).

This invites the prediction that fluctuations in blood glucose levels as a physiological marker of hunger affect attitudes and behavior in the domain of social welfare (see Blood Glucose Levels in the Supplementary Methods section of the Supplemental Material available online). We expect that to make sharing norms salient, individuals with lower blood glucose levels will express greater attitudinal support for sharing in the modern form of social welfare (Prediction 1). At a theoretical level, we suggest that this attitudinal support is a signal aimed at increasing the sharing of others rather than a reflection of elevated behavioral sharing dispositions in the self—giving up actual resources is costly for hungry individuals (Blurton Jones, 1984). If correct, this leads to a second prediction: When given actual incentivized opportunities to redistribute resources, the hungry self's expression of support for sharing will be countervailed by motivations to keep resources and will not necessarily translate into increased sharing at the behavioral level (Prediction 2).

Method

Participants and procedure

To test the predictions, we recruited 104 university students aged 19 to 47 (M = 23.5, SD = 3.7) to participate in an experiment. Fifty-two participants were assigned to the treatment condition (25 females, 27 males), and 52 participants were assigned to the control condition (25 females, 27 males).

Participants were instructed not to eat or drink anything for 4 hr prior to the experiment (for further details about procedures, see Supplementary Information on Procedures in the Supplementary Methods section of the Supplemental Material). On arrival (Time 1, or T_1), participants were randomly assigned to conditions, and their initial level of blood glucose was measured. Following Wang and Dvorak's (2010) procedure, we had participants consume a caffeine-free soft drink containing either carbohydrates (Sprite, treatment condition) or an artificial sweetener (Sprite Zero, control condition). Participants then rated the pleasantness of the drink. The participants had their blood glucose levels measured a second time approximately 10 min after they had consumed the soft drink. After this second blood glucose measurement, our dependent variables—support for social welfare and redistributive behavior—were measured. Finally, blood glucose levels were measured a third time immediately prior to participants' leaving the lab (M = 16.6 min after

the second measurement). To increase reliability, we used the maximum observed value from the last two measurements as our Time 2 (T_2) measure of blood glucose level (see Blood Glucose Levels in the Supplementary Methods section of the Supplemental Material).

All empirical tests were conducted using structural equation modeling. Standardized coefficients with robust standard errors (where applicable) are reported. For all directional predictions, we report p values based on directed tests (cf. Rice & Gaines, 1994). For further details, see Stata and Structural Equation Modeling in the Supplementary Methods section of the Supplemental Material.

Measures

To measure support for social welfare, we asked participants to indicate how much they agreed with six statements about social welfare. Scores were summed to a satisfactorily reliable scale ($\alpha = .82$), with higher values indicating stronger support for social welfare (for more details and the full list of items, see Support for Social Welfare in the Supplementary Methods section of the Supplemental Material).

To measure actual incentivized sharing behavior, we relied on behavior in a dictator game (cf. Camerer, 2003). Participants were asked to divide 2,000 Danish kroner (approximately $350) between themselves and another anonymous participant in the study. They were instructed to divide the sum as they saw fit and were told that 2 participants chosen at random would actually receive the money (for more details, see Actual Sharing Behavior in the Supplementary Methods section of the Supplemental Material).

Results

Do individuals who consume soft drinks without carbohydrates express greater support for social welfare?

To test Prediction 1, we analyzed the effect of the glucose treatment on support for social welfare. Following Wang and Dvorak (2010), we estimated this effect by controlling for gender, the perceived pleasantness of the drink, blood glucose levels at T_1, and length of fasting to rule out possible effects due to gender differences in metabolism, initial differences in body energy, and mood-dependent preferences. The model showed a significant effect of the treatment on support for social welfare, such that participants who consumed the carbohydrate soft drink were less supportive of social welfare than were participants who consumed the soft drink without carbohydrates ($\beta = -0.16$, $p = .05$). This difference corresponds to an almost 10% decrease in social-welfare support (control group: $\hat{y} = .58$; glucose-treatment group: $\hat{y} = .53$; control variables kept at their mean and mode).

Consistent with Prediction 1, results showed that individuals with low body energy expressed stronger attitudinal support for social welfare (for results from ordinary-least-squares regression analyses, see Supplementary Analyses Using OLS Regression in the Supplementary Results section of the Supplemental Material).

In the Supplemental Material, we report results from additional analyses demonstrating that individuals with low blood glucose also expressed stronger motivation to disseminate information that was likely to increase the welfare support of other individuals. This finding provides more direct evidence that a component of the hunger effect is to remind other individuals of sharing norms. (In the Supplemental Material, see Motivation to Disseminate Information That Is Likely to Increase the Welfare Support of Others, in the Supplementary Methods section, and Effects of the Glucose Treatment on the Motivation to Disseminate Welfare-Relevant Information, Correlations Between Change in Blood Glucose Levels and Measures Related to Social Welfare, and Supplementary Analyses Using OLS Regression, in the Supplementary Results section, for full details.)

Is the effect of the glucose treatment on support for social welfare mediated by blood glucose levels?

To test Prediction 1 further, we investigated whether the effect of the glucose treatment on social-welfare support was mediated by differences in blood glucose levels. To this end, we conducted an observed-variable path analysis (see Fig. 1). Following Wang and Dvorak (2010), we specified support for social welfare as the dependent variable, the T_2 blood glucose level as the mediator variable, and the soft-drink condition, body mass index of the participant, and T_1 blood glucose as the exogenous variables. The experimental condition with consumption of Sprite was coded as 1, and the condition with consumption of Sprite Zero was coded as 0. The T_2 blood glucose level was specified as the full mediator of the experimental condition, and all other possible recursive paths were included in the model.

This mediational model had an excellent fit—goodness of fit: $\chi^2(1, N = 104) = 0.57$; $p = .45$; root-mean-square error of approximation $\approx .00$; comparative fit index ≈ 1.00. As expected, results showed that consumption of the carbohydrate soft drink was positively associated with T_2 blood glucose ($\beta = 0.69$, $p < .001$). We also observed that T_2 blood glucose was negatively associated with support for social welfare ($\beta = -0.23$, $p = .02$), which implies, as predicted, that individuals with low blood

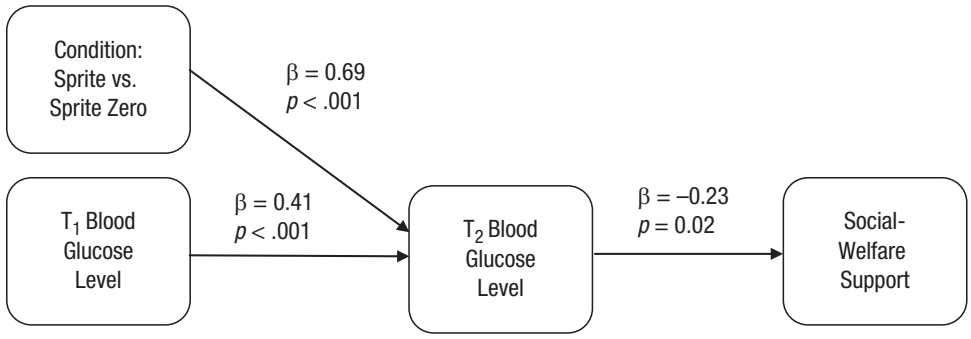

Fig. 1. The effect of the experimental manipulation of blood glucose levels (condition) and blood glucose level at Time 1 (T_1) on social-welfare support, as mediated by blood glucose level at Time 2 (T_2). Only significant paths ($p < .05$) are displayed.

glucose levels express stronger attitudinal support for social welfare. This effect establishes a significant indirect path from soft-drink condition to support for welfare ($\beta = -0.16$, $p = .02$), which suggests that the effect of the soft drink on welfare support was driven by physiological reactions to the glucose content. We also observed an indirect effect of T_1 blood glucose level on support for social welfare ($\beta = -0.10$, $p = .02$).

Do the prosocial effects of low blood glucose generalize to actual redistributive behavior?

According to Prediction 2, a potential resource-acquisition strategy in situations of hunger is to remind others of the importance of sharing to increase their contributions while simultaneously keeping resources available for oneself. In other words, the heightened prosociality associated with support for social welfare in situations of low body energy might not generalize to behavior.

To test Prediction 2, we performed another observed-variable path analysis. Extending the model shown in Figure 1, we added behavior in the dictator game as an endogenous variable and specified additional paths (see Fig. 2). First, we specified an indirect path from T_2 blood glucose level to sharing behavior through social-welfare support. Second, we specified an unmediated path from T_2 blood glucose level directly to sharing behavior to estimate any countervailing effects at the behavioral level. In addition, paths from the two control variables, body mass index and T_1 blood glucose, to sharing behavior were added to the model. Besides these extensions, the model was equivalent to the model depicted in Figure 1. This extended model also showed an excellent fit with the data—$\chi^2(2, N = 104) = 2.85$; $p = .24$; root-mean-square error of approximation = .06; comparative fit index = .99.

We found that social-welfare support was positively associated with sharing behavior in the dictator game ($\beta = 0.40$, $p < .001$). Because blood glucose level is negatively associated with social-welfare support (cf. our

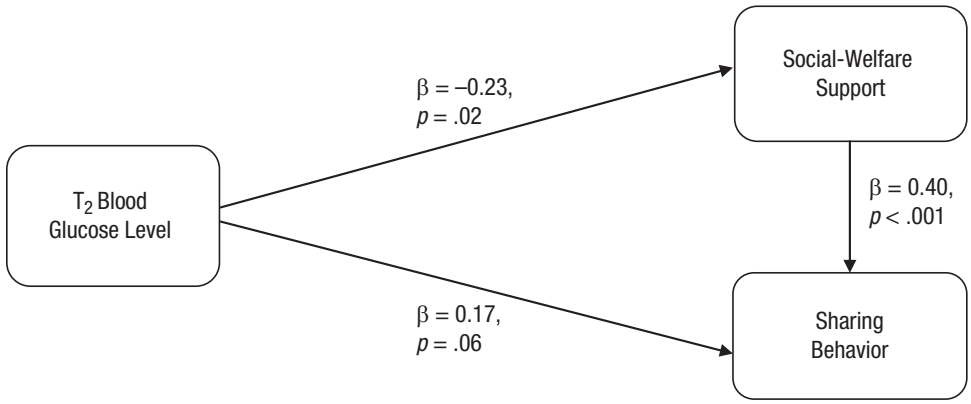

Fig. 2. The effects of blood glucose level at Time 2 (T_2) on social-welfare support and sharing behavior in the dictator game. Only variables with direct and significant or marginally significant ($p \leq .06$) effects on social-welfare support or sharing behavior are displayed.

earlier analysis), social-welfare support establishes a significant indirect path from blood glucose level to sharing behavior in the dictator game (β = –0.09, p = .02). Thus, as shown in Figure 3, there was a negative indirect correlation between blood glucose and the amount shared in the dictator game: Lower blood glucose levels increased support for social welfare, which in turn was associated with increased donations to other individuals. It is important to note, however, that consistent with Prediction 2, results showed that T_2 blood glucose had a direct countervailing positive association with donations in the dictator game (β = 0.17, p = .06; see Figs. 2 and 3). When people are given actual incentivized opportunities to distribute resources, the apparent prosocial effects of low blood glucose levels are offset by a countervailing motivation for keeping resources.

Thus, as shown in Figure 3, the total net effect of T_2 blood glucose levels on actual redistributive behavior was null: Individuals with low levels of blood glucose did not share more resources (β = 0.08, p = .29), although they moralized that people ought to. Consistent with this finding, results of an analysis of the overall effect of the experimental glucose treatment, rather than of T_2 blood glucose, on sharing behavior also showed an insignificant effect (β = –0.04, p = .45; this analysis used the statistical setup used in the initial test of Prediction 1). The expressed prosociality in conditions of hunger is, in other words, "cheap talk." This is consistent with the theoretical notion that the effects of hunger on social-welfare support do not reflect genuine increased prosociality but, rather, constitute a strategy designed to induce other individuals to transfer resources.

Conclusion

This study is the first to test the effects of blood glucose fluctuations on political attitudes. We showed that individuals with low body-energy levels (a) express greater support for social welfare but (b) do not share more resources with other individuals when given actual, incentivized possibilities. Low blood glucose as a physiological indicator of hunger seems to proximally increase the value put on resource transfers and, as revealed by additional analyses (detailed in Effects of the Glucose Treatment on the Motivation to Disseminate Welfare-Relevant Information in the Supplementary Results section of the Supplemental Material), the motivation to disseminate expressions of support for such transfers. In terms of ultimate functions, we argue that these proximate effects indicate that hunger activates clusters of strategies working together to alleviate hunger through resource acquisition by means other than foraging: Strategies for keeping and defending resources are joined by attempts to increase the willful sharing of other individuals by reminding them of sharing norms. In this perspective, the increased prosociality is a strategic social signal to other individuals.

The ultimate functions of the "cheap" prosocial effects of hunger, however, must be verified further in future

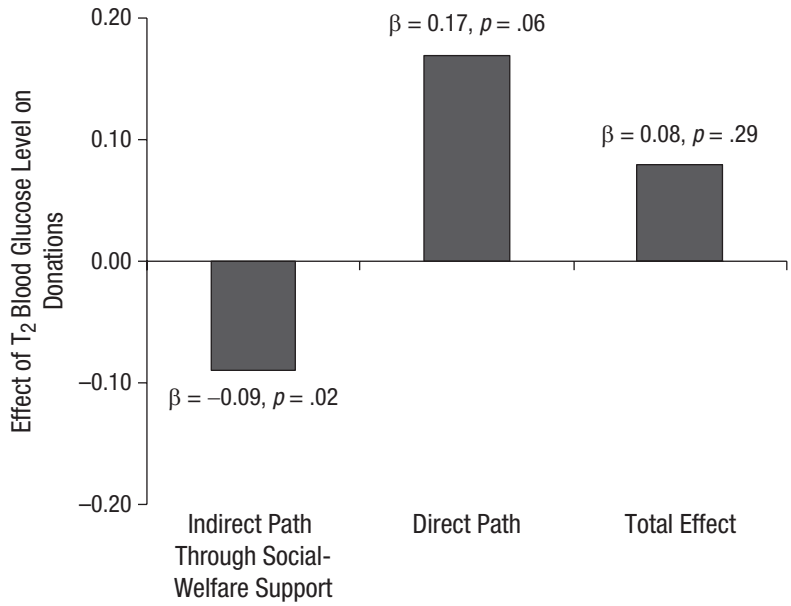

Fig. 3. Effects of Time 2 (T_2) blood glucose levels on sharing behavior in the dictator game: coefficients for the indirect path through social-welfare support, the direct path, and the total effect.

research. First, because all dependent measures were obtained through pen-and-pencil questionnaires—and, hence, were private—we are in no position to provide direct evidence of social signaling per se. Second, the results of the present study cannot directly verify that signals about sharing norms do indeed serve the presumed function and, hence, increase resource transfers in other individuals (although some previous evidence exists, e.g., Bicchieri & Chavez, 2010; Brañas-Garza, 2007). Finally, although we observed that countervailing motivations for keeping resources rendered motivations to support sharing "cheap," the net effect of these opposing motivations could differ from situation to situation depending on their relative intensity.

In line with recent research, our findings vindicate Aristotle's notion of humans as political animals (Hatemi & McDermott, 2011). The human mind is equipped with mental programs designed by natural selection to adaptively navigate the social problems of the small-scale hunter-gatherer society. These programs continue to shape how people think about equivalent political problems in the modern world.

Author Contributions

The authors contributed equally to all aspects of the research and to the composition of the manuscript.

Declaration of Conflicting Interests

The authors declared that they had no conflicts of interest with respect to their authorship or the publication of this article.

Supplemental Material

Additional supporting information may be found at http://pss.sagepub.com/content/by/supplemental-data

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