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Short Communication

Sweet revenge: Diabetic symptoms predict less forgiveness

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ABSTRACT

Conflict pervades social life. To forgive others, people must control their vengeful impulses. The efficiency by which the body uses glucose, an indicator of self-control, might have direct implications for interpersonal forgiveness. In four studies ($N = 693$), we tested the hypothesis that a physiological marker of deficient glucose use (i.e., type 2 diabetic symptoms) relates to less forgiveness. Higher type 2 diabetic symptoms correlated negatively with a dispositional tendency to forgive others (Study 1) and correlated positively with unforgiving motivations toward hypothetical transgressors (Study 2) and actual transgressors (Study 3). Diabetic symptoms correlated negatively with cooperative behavior in the Prisoner's Dilemma Game (Study 4). These findings provide the first evidence that forgiveness depends on how efficiently the body uses glucose.

1. Introduction

> "The weak can never forgive. Forgiveness is the attribute of the strong."
>
> –Mahatma Gandhi

Conflict abounds in daily life. Fortunately, most conflicts do not escalate to violence. Forgiveness helps to make this possible (McCullough, 2008). To forgive, people must control the impulse to retaliate when they are wronged. Self-control, defined as the ability to inhibit unwanted impulses to remain in line with social standards for desirable behavior (Baumeister, 1998), represents a crucial factor in promoting forgiveness. For example, trait self-control is positively linked with inhibiting potentially destructive impulses in romantic relationships (Finkel & Campbell, 2001). Cognitive processes linked with self-control, specifically executive functioning, also promote forgiveness by decreasing ruminative thoughts about past offenses (Pronk, Karremans, Overbeek, Vermulst, & Wigboldus, 2010).

The current research seeks to extend this prior research by investigating how physiological self-control processes relate to forgiveness. One inner process that may have direct implications for interpersonal forgiveness is how efficiently the body uses glucose (also called blood sugar). Glucose is a chemical in the bloodstream made from nutritious intake, which provides energy for brain processes. All brain activities require at least some glucose, but tasks that require self-control require large quantities of glucose (Fairclough & Houston, 2004). Low glucose predicts low self-control (Gailliot, Baumeister, DeWall, Maner, et al., 2007) and aggression and violence (Bolton, 1976; DeWall, Deckman, Gailliot, & Bushman, submitted for publication), whereas providing people with a boost of glucose increases self-control and helpfulness (DeWall, Baumeister, Gailliot, & Maner, 2008; Wang & Dvorak, 2010). This article focuses on the flipside of aggression and violence, namely forgiveness.

The current research provides the first test of the hypothesis that a physiological marker of self-control, namely type 2 diabetes symptoms, predicts less forgiveness. Diabetes is a serious illness that afflicts more people today than ever before (Winer & Sowers, 2004). People with diabetes cannot use glucose efficiently because they have low levels of the hormone insulin that metabolizes glucose, or are insulin resistant. Risk for type 2 diabetes is associated with an increased genetic resistance to insulin, along with an increased sedentary lifestyle and high caloric diet (Winer & Sowers, 2004). As low blood glucose predicts low self-control (Gailliot et al., 2007) and type 2 diabetes symptoms relate to a lessened ability to efficiently process glucose, we expect that type 2 diabetic symptoms will be linked to lower levels of forgiveness.

We tested this hypothesis in four independent studies. In each study, participants first reported their levels of type 2 diabetic symptoms using a standardized measure. Next, they completed standardized measures of interpersonal forgiveness. Study 1 measured dispositional forgiveness. Study 2 measured forgiveness toward transgressors in hypothetical scenarios. Study 3 measured forgiveness motivations toward an actual transgressor. Study 4 measured cooperation in a Prisoner's Dilemma Game. Forgiveness is a complex, multifaceted construct. Indeed, forgiveness researchers

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are still developing an understanding of what exactly forgiveness is. By using a variety of forgiveness measures, we were able to reduce the probability that our results were due in part to any artifact of any particular measure.

2. Studies 1–3

2.1. Method

2.1.1. Participants

Participants were 511 volunteers (395 women; Study 1 $n = 158$; Study 2 $n = 127$; Study 3 $n = 226$). The average age was 27.95 years ($SD = 12.34$); 76% of participants were white.

2.1.2. Materials and procedure

Participants were recruited using online ads in different US cities. The ad provided participants with a link to the survey. After giving informed consent, participants completed a demographic questionnaire that measured their gender, age, and race. Next, they completed the revised Diabetic Symptoms Checklist (Grootenhuis, Snoek, Heine, & Bouter, 1994), which measures the number and severity of type 2 diabetes symptoms (e.g., "numbness or loss of sensation in the feet," "shortness of breath at night," "an overall sense of fatigue") experienced within the past month. This scale has been shown to be a valid and reliable measure of type 2 diabetes symptoms (Arbuckle et al., 2009). We created a diabetic symptom variable by averaging symptom number and severity (Cronbach α's were .85, .88, and .88 for Studies 1–3, respectively). The average number of diabetic symptoms were 9.11 ($SD = 6.08$), 9.12 ($SD = 6.57$), and 8.76 ($SD = 6.09$) for Studies 1–3, respectively.

Next, participants completed a forgiveness measure. To increase generalizability, different measures were used in different studies. In Study 1, participants completed the Trait Forgiveness Scale, which is a 10-item measure of dispositional forgiveness (e.g., "I can forgive a friend for almost anything"; Cronbach $\alpha = .85$; Berry, Worthington, O'Connor, Parrott, & Wade, 2005; $M = 3.35$, $SD = 0.85$). In Study 2, participants completed the Transgression Narrative Test of Forgiveness (Berry, Worthington, Parrott, O'Connor, & Wade, 2001), which measures forgiveness to 5 hypothetical scenarios. In one scenario, for example, a person reveals a secret to peers by gossiping. Participants imagined that they were the person who was harmed, and rated how much they should and would forgive the transgressor (e.g., "I would actually forgive"; Cronbach $\alpha = .85$) and what they would insist on doing before forgiving the transgressor (e.g., "getting revenge"; Cronbach $\alpha = .96$). The two responses were averaged after reverse scoring items about revenge (Cronbach $\alpha = .96$; $M = 2.92$, $SD = 0.67$). In Study 3, participants reported how much they had actually forgiven a recent transgressor. They completed the 18-item Transgression-Related Interpersonal Motivations inventory (e.g., "I wish that something bad would happen to him/her"; Cronbach $\alpha = .93$; $M = 2.77$, $SD = 0.81$; McCullough, Root, & Cohen, 2006).

2.2. Results

Our main prediction was that diabetic symptoms would relate to less forgiveness. The results from our first three studies consistently supported this hypothesis. Multiple regression analyses were computed to examine the relationship between number of diabetic symptoms and forgiveness, while statistically controlling for age, ethnicity, race, and gender. We controlled for these demographic factors because of their potential comorbidity with diabetic symptoms. As people grow older, for example, they are more prone to experience diabetic symptoms (e.g., Mezuk, Eaton, Albrecht, & Golden, 2008). By controlling for the variance that is due to demographic variables, we are better able to pinpoint specifically the relationship between diabetic symptoms and forgiveness.

In Study 1, diabetic symptoms correlated negatively with a dispositional tendency to forgive others, $\beta = -.18$, $t(152) = -2.16$, $p < .03$, $r = -.17$. In Study 2, diabetic symptoms correlated positively with unforgiving motivations toward hypothetical transgressors, $\beta = .19$, $t(121) = 2.15$, $p < .04$, $r = .19$. In Study 3, diabetic symptoms correlated positively with unforgiving motivations toward an actual recent transgressor, $\beta = .23$, $t(220) = 3.46$, $p = .001$, $r = .23$. The consistency of our results across these three different measures of forgiveness suggests a robust relationship between diabetic symptoms and interpersonal forgiveness. These results provide the first evidence that an individual difference variable related to lower physiological self-control relates to lower levels of forgiveness.

3. Study 4

To provide additional evidence regarding the link between type 2 diabetic symptoms and forgiveness, we conducted a study to test whether diabetic symptoms relate to real-time, forgiving behavior. To measure forgiveness, we used the Prisoner's Dilemma Game, a task used to understand how people deal with interpersonal conflict (Axelrod, 1980). On each trial, participants can choose whether to cooperate with their partner. We were especially interested in how participants responded when their partner behaved in an uncooperative, antagonizing manner. Would they forgive their partner, or would they also refuse to cooperate? Prior research has shown that people who play with a partner who begins the game by choosing not to cooperate, compared to people who play with a partner who begins the game by choosing to cooperate, tend to behave less cooperatively throughout the remainder of the game (Axelrod, 1984). Other work has shown that situational factors linked to vengeance behavior and poor self-control, such as social rejection, also decrease cooperative responses on the Prisoner's Dilemma Game (Twenge, Baumeister, DeWall, Ciarocco, & Bartels, 2007). Thus, we predicted that type 2 diabetic symptoms would relate to less cooperative behavior on the game.

3.1. Method

3.1.1. Participants

Participants were 182 volunteers (142 women). The average age was 24.11 years ($SD = 12.00$); 76% were white.

3.1.2. Materials and procedure

Like Studies 1–3, Study 4 was conducted on the Internet. After giving informed consent, participants reported their gender, age, and race (used as covariates, as in Studies 1–3). They also completed the revised Diabetic Symptoms Checklist (Cronbach $\alpha = .86$). Similar to Studies 1–3, the average number of diabetic symptoms was 9.27 ($SD = 5.97$).

Next, participants played a 10-trial Prisoner's Dilemma Game against another person (actually the computer). Points for each trial were awarded as follows: 4 points each when both players cooperated; −2 points each when both players refused to cooperate; and 8 points to the antagonizer and −5 points to the cooperator when only one player cooperated. Participants were told to earn as many points as possible. Their "partner" refused to cooperate on the 1st, 5th, and 9th trials. On the other trials, the computer mimicked the real player's response on the preceding trial (i.e., tit-for-tat responding). The measure of forgiveness was how many times participants chose to cooperate with their "partner" ($M = 5.40$, $SD = 2.69$). A debriefing followed.

3.2. Results and discussion

Our main prediction was that diabetic symptoms would predict how cooperatively participants behaved toward a partner who began their interaction by antagonizing them. As expected, diabetic symptoms correlated negatively with cooperative behavior, $\beta = -.16$, $t(176) = -2.17$, $p = .03$, $r = -0.16$. These findings replicate and extend the results of the previous studies by showing that type 2 diabetic symptoms related to less actual forgiving behavior.

4. General discussion

Amidst the potential for daily conflict, most people go through their days without lashing out at others. When a vengeful impulse has been stimulated through transgression, self-control is needed to override that impulse in order to remain in line with standards that encourage forgiveness and discourage aggressive retaliation (DeWall, Baumeister, Stillman, & Gailliot, 2007; Finkel & Campbell, 2001; Pronk et al., 2010). Hence, self-control processes facilitate forgiveness.

Whereas prior work has linked psychological self-control processes to forgiveness, the current work is the first to link a physiological marker of poor self-control (i.e., glucose tolerance) to forgiveness. Glucose is fuel for the brain and acts of self-control deplete glucose levels, leading to poorer subsequent self-control (Gailliot et al., 2007). How efficiently the body breaks down sugar into energy, better known as glucose tolerance, also relates to self-control. People who have symptoms associated with poor glucose tolerance, such as diabetes, show an assortment of self-control impairments (see Gailliot and Baumeister (2007), for a review).

Across four studies, symptoms of type 2 diabetes related to lower levels of forgiveness. Higher type 2 diabetic symptoms related to a lower dispositional tendency to forgive others (Study 1), more unforgiving motivations toward hypothetical transgressors (Study 2) and actual transgressors (Study 3), and less cooperation toward an antagonizing stranger in the Prisoner's Dilemma Game (Study 4). Thus, symptoms indicative of poor glucose tolerance reliably predicted lower levels of forgiveness and cooperation.

5. Limitations and future research

The current work had several limitations, which may inform future research. First, our results were entirely correlational, which precludes our ability to make causal inferences regarding the relationship between diabetic symptoms and forgiveness. Although it is not possible to experimentally manipulate diabetic symptoms, future work may use a longitudinal design to explore the directionality of the relationship between diabetic symptoms and forgiveness. Second, our results do not provide an explanation regarding possible mediators of the diabetic symptoms and forgiveness relationship. There is abundant evidence that poor glucose tolerance is associated with a variety of health problems, including irritability, depression, and lack of restorative sleep (Mezuk et al., 2008; Tasali, Leproult, Ehrmann, & Van Cauter, 2008). Moreover, some forgiveness research has shown that negative emotions can help explain why people are less forgiving (McCullough, Bono, & Root, 2007). Therefore, it is possible that these health problems may mediate the relationship between diabetic symptoms and lower forgiveness. A third limitation is that participants in the current studies provided only self-report of their diabetic symptoms and the severity of those symptoms. To determine whether our findings have implications for people who live with diabetes, future research should include procedures to establish a formal diagnosis of diabetes.

6. Conclusions

Type 2 diabetes is on the rise worldwide, and especially in the United States (Winer & Sowers, 2004). Unfortunately, type 2 diabetes can engage a self-fuelling feedback loop that allows it to spiral out of control. It takes willpower to adhere to a healthy diet and exercising regularly, willpower that diabetics are more likely to lack due to the way they process glucose. Indeed, a large body of work has shown that people who have poor glucose tolerance exhibit poor self-control (Gailliot and Baumeister (2007), for a review). In addition, research has shown that self-control operates like a muscle (Gailliot et al., 2007). When people exercise self-control in one area (e.g., diet, exercise), they become tired and less able to exercise self-control in other areas (e.g., controlling aggressive impulses, forgiving others). To make matters worse, people with elevated type 2 diabetes symptoms have difficulty metabolizing glucose, the brain fuel needed to exercise self-control. Our research shows that type 2 diabetes symptoms are not only harmful to the individual, but they might also be harmful to society because these symptoms relate to lower levels of forgiveness and cooperation.

References

Arbuckle, R. A., Humphrey, L., Vardeva, K., Arondekar, B., Danten-Viala, M., Scott, J. A., et al. (2009). Psychometric evaluation of the Diabetes Symptom Checklist-Revised (DSC-R): A measure of symptom distress. *Value Health, 12*, 1168–1175.

Axelrod, R. (1980). More effective choice in the prisoner's dilemma. *Journal of Conflict Resolution, 24*, 3–25.

Axelrod, R. (1984). *The evolution of cooperation*. New York: Basic Books.

Baumeister, R. F. (1998). The self. In D. T. Gilbert, S. T. Fiske, & G. Lindzey (Eds.), *Handbook of social psychology* (4th ed., pp. 680–740). New York: McGraw-Hill.

Berry, J. W., Worthington, E. L., O'Connor, L. E., Parrott, L., III, & Wade, N. G. (2005). Forgivingness, vengeful rumination, and affective traits. *Journal of Personality, 73*, 183–225.

Berry, J. W., Worthington, E. L., Jr., Parrott, L., III, O'Connor, L. E., & Wade, N. G. (2001). Dispositional forgivingness: Development and construct validity of the Transgression Narrative Test of Forgivingness (TNTF). *Personality and Social Psychology Bulletin, 27*, 1277–1290.

Bolton, R. (1976). Hostility in fantasy: A further test of the hypoglycemia-aggression hypothesis. *Aggressive Behavior, 2*, 257–274.

DeWall, C. N., Baumeister, R. F., Gailliot, M. T., & Maner, J. K. (2008). Depletion makes the heart grow less helpful: Helping as a function of self-regulatory energy and genetic relatedness. *Personality and Social Psychology Bulletin, 34*, 1663–1676.

DeWall, C. N., Baumeister, R. F., Stillman, T. F., & Gailliot, M. T. (2007). Violence restrained: Effects of self-regulatory capacity and its depletion on aggressive behavior. *Journal of Experimental Social Psychology, 43*, 62–76.

DeWall, C. N., Deckman, T., Gailliot, M. T., & Bushman, B. J. (submitted for publication). Sweetened blood cools hot tempers: Physiological self-control and aggression.

Fairclough, S. H., & Houston, K. (2004). A metabolic measure of mental effort. *Biological Psychology, 66*, 177–190.

Finkel, E. J., & Campbell, W. K. (2001). Self-control and accommodation in close relationships: An interdependence analysis. *Journal of Personality and Social Psychology, 81*, 263–277.

Gailliot, M. T., & Baumeister, R. F. (2007). The physiology of willpower: Linking blood glucose to self-control. *Personality and Social Psychology Review, 11*, 303–327.

Gailliot, M. T., Baumeister, R. F., DeWall, C. N., Maner, J. K., et al. (2007). Self-control relies on glucose as a limited energy source: Willpower is more than a metaphor. *Journal of Personality and Social Psychology, 92*, 325–336.

Grootenhuis, P. A., Snoek, F. J., Heine, R. J., & Bouter, L. M. (1994). Development of a type 2 diabetes symptom checklist: A measure of symptom severity. *Diabetic Medicine, 11*, 253–261.

McCullough, M. E. (2008). *Beyond revenge: The evolution of the forgiveness instinct*. San Francisco, CA: Jossey-Bass.

McCullough, M. E., Bono, G., & Root, L. M. (2007). Rumination, emotion, and forgiveness: Three longitudinal studies. *Journal of Personality and Social Psychology, 92*, 490–505.

McCullough, M. E., Root, L. M., & Cohen, A. D. (2006). Writing about the benefits of an interpersonal transgression facilitates forgiveness. *Journal of Consulting and Clinical Psychology, 74*, 887–897.

Mezuk, B., Eaton, W. W., Albrecht, S., & Golden, S. H. (2008). Depression and type 2 diabetes over the lifespan: A meta-analysis. *Diabetes Care, 31*, 2383–2390.

Pronk, T. M., Karremans, J. C., Overbeek, G., Vermulst, A. A., & Wigboldus, D. H. J. (2010). What it takes to forgive: When and why executive functioning facilitates forgiveness. *Journal of Personality and Social Psychology, 98*, 119–131.

Tasali, E., Leproult, R., Ehrmann, D. A., & Van Cauter, E. (2008). Slow-wave sleep and the risk of type 2 diabetes in humans. *Proceedings of the National Academy of Sciences in the United States of America, 105*, 1044–1049.

Twenge, J. M., Baumeister, R. F., DeWall, C. N., Ciarocco, N. J., & Bartels, J. M. (2007). Social exclusion decreases prosocial behavior. *Journal of Personality and Social Psychology, 92*, 56–66.

Wang, X. T., & Dvorak, R. D. (2010). Sweet future: Fluctuating blood glucose levels affect future discounting. *Psychological Science, 21*, 183–188.

Winer, N., & Sowers, J. (2004). Epidemiology of diabetes. *Journal of Clinical Pharmacology, 44*, 397–405.