Ideal living requires people to work together, cooperate, and help one another. Hence, prosocial behavior is a necessity in modern life. Culture functions largely in part by people helping one another. Helping others is not easy, however, and can often demand effort and energy. Ingrained tendencies and other factors might predispose people toward selfishness and failing to help others. Self-regulation (or self-control) is the capacity that allows for the resolution of conflict arising from competing thoughts and behaviors (e.g., by overriding one thought or behavior with another) and for the exertion of effort. Self-regulation thus allows for increased prosociality, to the extent that factors (e.g., selfishness) that decrease prosociality must be overridden.

Work on self-regulation has found that self-regulation is impaired after prior self-regulatory exertion (Muraven & Baumeister, 2000). This occurs because glucose – a primary energy for the brain – in the bloodstream is metabolized (used up) during self-regulation faster than it is replenished. The lowered glucose levels then undermine self-regulation. Work on helping behavior shows a similar pattern, consistent with the idea that helping requires self-regulation. After self-regulating, people are less helpful in various ways. Some work suggests that this effect involves changes in glucose levels. Ingesting glucose can prevent helping from decreasing after prior self-regulation.

Though empirical evidence indicates glucose as a determinant of helping behavior, energy – construed in ways less clearly related to biological, metabolic energy – might also influence helping. Specifically, factors that help increase or save metabolic energy might increase helping, including increased metabolic stores (especially in the brain), reductions in other metabolic demands (e.g., demands met by money and tools), healthy nutrition, increased externalization of metabolic demands (e.g., social support
aiding coping with stress), increased efficiency (e.g., observing efficient models), ideal air quality (e.g., carbon dioxide content), and a psychologically empowered self.

**Helping as Effortful and Energy-Demanding**

Several lines of thinking and evidence suggest that prosocial behavior is effortful. Helping others requires additional thought and action in which one would otherwise not engage and therefore requires additional effort. Evolutionary theory suggests that people are inherently selfish and think of others primarily after themselves or relatives (Dawkins, 1976). Helping others is an additional goal and therefore should require the effort of altering or relinquishing existing goals so as to help. For example, a student might have to stop studying to help someone fix a flat tire. People might strive to align their own personal goals with those of others and therefore must use some effort to align their own goals with those in need of help. People of course view the world from their perspective, and helping others can require taking others’ perspectives, which might be effortful. People do not live in a vacuum – they are already helping others and themselves. When talking about prosocial behavior, people therefore often mean helping additional others. Additional helping requires additional energy for exertion, and so helping is effortful.

**Self-Regulation – Effortful and Energy-Demanding**

Self-regulation allows people to achieve their goals, maintain good physical and mental health, and get along well with others (Shoda, Mischel, & Peake, 1990; Tangney, Baumeister, & Boone, 2004). Although having good self-control can be highly desirable, people do not possess an unlimited, undisruptable capacity for self-control. Instead, self-control is limited. Several experimental studies and other evidence demonstrate that exerting self-control impairs self-control later on (Baumeister, Heatherton & Tice, 1994; Baumeister, Vohs, & Tice, 2007). In the laboratory, participants complete two subsequent tasks. For the first task, participants either exert self-control (e.g., by controlling their attention, emotions, or thoughts, resisting sweet food, or consuming bad tasting
beverages) or do not exert self-control (e.g., solve math problems or watch a video). Afterwards, all participants perform a self-control task (e.g., effortful persistence on an impossible task). The typical finding is that participants who completed the initial self-control task perform worse on the second self-control task, relative to participants who completed the initial task that did not require self-control. This pattern has been found with many different self-control tasks. Completing any self-control task initially can impair performance on any other later on. Findings that have been found to fit this pattern thus far are shown in the table.

Table. *Tasks, domains, and self-controlled behaviors impaired by prior self-control and/or that impair subsequent self-control.*

<table>
<thead>
<tr>
<th>Task or Domain</th>
<th>Reference</th>
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<tbody>
<tr>
<td>Simulated automobile driving for 8 hours</td>
<td>Ryan &amp; Warner, 1936</td>
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<tr>
<td>Controlling visual or auditory attention</td>
<td>DeWall, Baumeister, Stillman, &amp; Gailliot, 2006; Gailliot &amp; Baumeister, 2006; Gailliot, Baumeister, et al., 2007; Gailliot, Schmeichel, &amp; Baumeister, 2006; Govorun &amp; Payne, 2006; see Hockey, 1983; Inzlicht, McKay, &amp; Aronson, 2006; Oaten &amp; Cheng, 2005; Richeson, Baird et al., 2003; Richeson &amp; Shelton, 2003; Richeson &amp; Trawalter, 2005; Rotton, Olszewski, Charleton, &amp; Soler, 1978; Schmeichel, Vohs, &amp; Baumeister, 2003; Sherrod &amp; Downs, 1974; Stucke &amp; Baumeister, 2006; Trawalter &amp; Richeson, 2006; Vohs, Baumeister, &amp; Ciarocco, 2005; Wallace &amp; Baumeister, 2002; Webb &amp; Sheeran, 2003</td>
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<tr>
<td>Cursing</td>
<td>see Hockey, 1983</td>
</tr>
<tr>
<td>Description</td>
<td>References</td>
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<td>---------------------------------------------------------------------------</td>
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<tr>
<td>Being exposed to uncontrollable noise</td>
<td>Glass &amp; Singer, 1972</td>
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<tr>
<td>Mental persistence (on math problems, word fragments)</td>
<td>Frankenhaeuser &amp; Lundberg, 1977; Gailliot, Baumeister, et al., 2007; Gailliot &amp; Baumeister, 2006; Vohs, Baumeister, &amp; Ciarocco, 2005</td>
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<tr>
<td>Physical persistence (breath holding, handgrip)</td>
<td>Ciarocco, Sommer, &amp; Baumeister, 2001; Finkel et al., 2006; Inzlicht, McKay, &amp; Aronson, 2006; Muraven, Baumeister, &amp; Tice, 1999; Muraven &amp; Slessareva, 2003; Muraven, Tice, &amp; Baumeister, 1998; Seeley &amp; Gardner, 2003; Vohs, Baumeister, &amp; Ciarocco, 2005</td>
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<tr>
<td>Persistence on impossible tasks (figure tracing, puzzles)</td>
<td>Baumeister, Bratslavsky, Muraven, &amp; Tice, 1998; Ciarocco, Sommer, &amp; Baumeister, 2001; Cohen &amp; Spacacan, 1978; Moller, Deci, &amp; Ryan, 2006; Muraven &amp; Slessareva, 2003; Muraven, Tice, &amp; Baumeister, 1998; Rotton, Olszewski, Charleton, &amp; Soler, 1978; Wallace &amp; Baumeister, 2002; Webb &amp; Sheeran, 2003; Vohs &amp; Schmeichel, 2003</td>
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<tr>
<td>Emotion regulation (suppressing or amplifying emotions, including sadness, happiness, disgust)</td>
<td>Baumeister, Bratslavsky, Muraven, &amp; Tice, 1998; Finkel &amp; Campbell, 2001; Shamosh &amp; Gray, 2006; Muraven &amp; Slessareva, 2003; Muraven, Tice, &amp; Baumeister, 1998; Vohs, Baumeister, &amp; Ciarocco, 2005; Schmeichel, Vohs, &amp; Baumeister, 2003; Gailliot, Schmeichel, &amp; Maner, 2006; Schmeichel, Demaree, Robinson, &amp; Pu, 2005</td>
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<tr>
<td>Motor control (staying still while watching)</td>
<td>Finkel et al., 2006; Stucke &amp; Baumeister, 2006; Rotton, Olszewski, Charleton, &amp; Soler, 1978; Wallace &amp; Baumeister, 2002; Webb &amp; Sheeran, 2003; Vohs &amp; Schmeichel, 2003</td>
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<tr>
<td>Behavior</td>
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<tr>
<td>Thought suppression (of thoughts of white</td>
<td>Gailliot &amp; Baumeister, 2007; Gailliot,</td>
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<td>bears, death, or sex)</td>
<td>Baumeister, et al., 2007; Gailliot,</td>
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<td>Schmeichel, &amp; Baumeister, 2006; Gailliot,</td>
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<td>Schmeichel, &amp; Maner, 2006; Muraven,</td>
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<td>Baumeister, &amp; Tice, 1999; Muraven,</td>
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<td></td>
<td>Collins, &amp; Nienhaus, 2002; Muraven &amp; Slessareva, 2003; Muraven, Tice, &amp;</td>
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<td></td>
<td>Baumeister, 1998; Oaten &amp; Cheng, 2005; Seeley &amp; Gardner, 2003; Vohs,</td>
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<td></td>
<td>Baumeister, &amp; Ciarocco, 2005; Vohs &amp; Schmeichel, 2003</td>
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<tr>
<td>Dietary restraint and healthy eating</td>
<td>Baumeister, Bratslavsky, Muraven, &amp; Tice, 1998; DeWall, Baumeister,</td>
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<td></td>
<td>Stillman, &amp; Gailliot, 2006; Kahan, Polivy, &amp; Herman, 2003; Muraven &amp;</td>
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<td>Slessareva, 2003; Stirling &amp; Yeomans, 2003; Stucke &amp; Baumeister, 2006;</td>
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<td></td>
<td>Vohs &amp; Heatherton, 2000</td>
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<tr>
<td>Drinking (alcohol) restraint</td>
<td>Muraven, Collins, &amp; Nienhaus, 2002; Muraven, Collins, Shiffman, &amp; Paty,</td>
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<td></td>
<td>2005</td>
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<tr>
<td>Sexual restraint (sexual infidelity)</td>
<td>Gailliot &amp; Baumeister, 2006</td>
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<tr>
<td>Aggressive restraint</td>
<td>DeWall, Baumeister, Stillman, &amp; Gailliot, 2006; Stucke &amp; Baumeister,</td>
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<tr>
<td></td>
<td>2006</td>
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<tr>
<td>Monetary restraint (shopping, buying lottery</td>
<td>Bruyneel, Dewitte, Franses, &amp; Dekimpe, 2005; Vohs &amp; Faber, 2004</td>
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<tr>
<td>tickets)</td>
<td></td>
</tr>
<tr>
<td>Overriding habits (of crossing out letters</td>
<td>Baumeister, Bratslavsky, Muraven, &amp; Tice, 1998; DeWall, Baumeister,</td>
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<tr>
<td>for a laboratory task)</td>
<td>Stillman, &amp; Gailliot, 2006; Gailliot &amp; Baumeister, 2006</td>
</tr>
<tr>
<td>Suppressing stereotypes and related</td>
<td>Gailliot, Plant, Butz, &amp; Baumeister, 2006;</td>
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</table>
Glucose and Self-Regulation

Why are people worse at self-control after they have exerted self-control? One reason is that exerting self-control can metabolize glucose from the bloodstream faster than it is replenished. This is supported by work in which blood-glucose levels decrease as participants exert self-control (e.g., perform the Stroop task, engage in effortful conversations, try to look away from stimuli), but not when participants do not exert self-control (e.g., sit and watch a video, engage in less effortful conversations) (Fairclough & Houston, 2004; Gailliot et al., 2007). Self-control requires more glucose than processes that overlap less with self-control (Gailliot & Baumeister, 2007). The decrease in glucose levels in the bloodstream thus undermines self-control – there simply is too low a level of glucose, which leads to suboptimal self-control. Likewise, after having exerted self-
control, ingesting a drink containing glucose improves self-control and eliminates the
typical impairments found after exerting self-control (Gailliot et al., 2007).

*Prosocial Behavior, Self-Regulation, and Glucose*

Evidence suggests that people are less helpful after they have exerted self-control. For instance, participants who exerted self-control (e.g., by changing an habitual routine, effortfully looking away from stimuli) were less helpful afterwards, compared to participants who had not exerted self-control but instead completed a different task that did not require self-control. They indicated on questionnaire measures that they would be less likely to donate food or money to people in need, and they volunteered for fewer hours to help stuff envelopes and complete other office tasks to help in one situation (Gailliot, Baumeister, Maner, & DeWall, 2006; see also Gailliot et al., 2007). When participants had consumed a glucose drink, before or after the initial self-control task, exerting self-control on the initial task did not reduce helping (Gailliot et al., 2006; see also Gailliot et al., 2007). This pattern of findings suggests that helping behavior is reduced when glucose levels are low and that increasing glucose levels can increase helping behavior.

Other evidence is consistent with the idea that initial mental efforts, at least akin to self-control, reduce helping behavior later on. Participants who completed a difficult listening task, relative to participants who completed an easy listening task, were less helpful with another experiment (Sherrod & Downs, 1974). Being in a larger crowd of people (which can be more stressful and hence mentally demanding), relative to being in a smaller crowd of people, reduced helping a person find a contact lens (Cohen & Spacacan, 1978). It is possible that other factors, aside from self-control (e.g., difficult
tasks, crowding, stress), that influence glucose levels also influence prosocial behavior. Factors associated with suboptimally low glucose levels will be associated with reduced helping, whereas factors associated with optimal glucose levels will be associated with increased helping.

Helping others requires additional thought and action in which one would otherwise not engage in the absence of the helping situation and therefore requires additional effort. Thought and behavior require metabolism, and thus helping takes additional metabolism. The capacity for work is directly related to the amount of available energy needed to perform that work, and prosocial behavior is no exception to this law of physics. Glucose is one energy need for the psychological work of thought and behavior underlying prosocial behavior. When this energy is low, helping is less likely. Low glucose means less helping.

**Glycogen and Prosocial Behavior – Increasing Prosocial Behavior**

It is plausible that helping behavior is decreased when glycogen – glucose stored in the brain – is low. Glycogen use is similar to glucose use in that exerting self-control might decrease brain glycogen and be suboptimal when glycogen levels are low (Gailliot, in press). Glycogen stores increase to higher levels after being depleted chronically. This might help explain work suggesting that repeatedly using self-control causes self-control to be less easily fatigued (Baumeister, Gailliot, DeWall, & Oaten, 2006; Gailliot, Plant, Butz, & Baumeister, 2007; Oaten & Cheng, 2005; 2006a; 2006b). Exerting self-control repeatedly might deplete brain glycogen, thereby causing brain glycogen to increase to larger amounts later on. This process might be one means by which prosocial behavior increases. Exerting self-control or perhaps even helping others might decrease glycogen,
causing glycogen to increase with time, thereby increasing helping behavior when glycogen stores otherwise would have been low.

The idea that repeated glycogen depletion can increase helping behavior parallels the idea that helping requires people to learn how to help with repeated exposures to opportunities to help. A person might not help the first time he or she sees a person in need of help, but will be more likely to help upon repeated exposures to similar helping situations. Upon subsequent exposures, the person develops a schema or learns how to help and respond, so he or she is more likely to respond by helping. Decreases in glucose and perhaps glycogen might follow initial helping situations, as the person learns how to help in that situation. The amount of metabolites used up during the learning process might be related to the amount of metabolites needed to form the new neuronal connections formed during the learning process as the person learns to help. This idea fits with data indicating that decreases in glucose, or ego-depletion (Baumeister, Bratslavsky, Muraven, & Tice, 1998; Muraven, Tice, & Baumeister, 1998), is associated with greater learning. Specifically, among participants performing the Stroop task, larger decreases in glucose were associated with larger increases in improvement, assessed when participants completed the Stroop task 2 weeks later (Gailliot, 2007). The depletion of glucose might occur at least partly because people learn as they exert self-control. Learning self-control might be one process that requires a relatively large amount of metabolites (e.g., glucose, glycogen), perhaps because the normal brain activity would require normal amounts of metabolites but additional metabolites would be required for the growth underlying the learning of self-control.

Energy and Prosocial Behavior
Other and perhaps more loose conceptualizations of energy might also help explain prosocial behavior. People are biological organisms and life is sustained though the acquisition and use of metabolic energy. Much of the human psyche might therefore be related to metabolism. For instance, helping behavior is effortful and more metabolically demanding, and therefore might be reduced when metabolic stores throughout the brain and body are low or less easily distributable (e.g., when liver glycogen stores are adequate but ineffectively distributed to processes enabling self-control). Eating healthily, for example, might increase helping because it improves metabolism (e.g., vitamins and minerals help catalyze metabolic processes, thereby allowing for the extraction of additional metabolic energy from a given amount).

Metabolic demands other than those that allow for helping behavior could plausibly divert metabolism from processes enabling helping behavior to other processes, such as reproductive processes (e.g., the production of reproductive hormones) or processes resisting physical illness (e.g., fighting pathogens, growth of cancer cells). This idea is supported by literature suggesting that metabolic needs of one biological process can be met by decreases in metabolic needs of other processes (Gailliot, 2008). For instance, evidence suggests that increases in brain size and metabolism were met by decreases in the size and metabolism of the gut, muscles, and/or other tissues.

Air is important to metabolism (e.g., the brain uses oxygen as a primary energy), and therefore air content might influence prosocial behavior. Levels of oxygen, carbon dioxide, and pollutants, for example, might influence helping behavior by influencing metabolism. Higher levels of carbon dioxide might undermine metabolic processes, given
that carbon dioxide is a waste product of brain activity, and thereby decrease helping behavior.

Helping behavior might be increased when biologically, internal metabolic processes are displaced from the individual into the external environment. For instance, friends help a person to cope with stress (e.g., by providing solutions to problems), and this can be viewed as reducing the metabolic demand the individual would experience to cope without social support (e.g., having to think about the problem at greater length). Increased social support might therefore increase helping behavior. Tools and perhaps culture more broadly might also increase helping by displacing metabolic demands. Metabolic demands of thermoregulation (i.e., keeping the body at a constant temperature) and transportation (e.g., walking) are met by tools such as air conditioners, heaters, bicycles, and automobiles. These might increase helping by freeing up metabolic resources for processes underlying prosocial behavior.

Improved metabolic efficiency might also increase helping behavior. For instance, as people learn and develop skills (e.g., playing Tetris), the amount of metabolic energy required to enact those skills decreases (Haier, Siegel, Tang, Abel, & Buchsbaum, 1992). Such improved efficiency might free up metabolism for processes that would increase prosocial behavior. Other factors that increase efficiency (e.g., observing efficient, rather than less efficient, models so as to behave later in more efficient ways) might also increase helping.

Other ideas are more speculative, yet might prove useful. One is that the self can be viewed as an entity possessing a strength that is relative to the non-self (the world, external factors). When the self is weakened (e.g., due to stress or illness), the non-self
has a stronger influence. For example, weakening the self by wearing a heavy, versus a
light, backpack makes distances seem farther to transverse (Proffitt, Stefanucci, Banton,
& Epstein, 2003). Strengthening the self physically, by taking medications that reduce
physical pain, have been found to reduce the impact of negative social events (DeWall et
al., 2007), as if the self becomes stronger and the external environment has a weaker
influence.

Last, an energy perspective on money might be informative to prosocial behavior.
Money can be viewed as a symbolic representation of prior energy expended (e.g., pay
for work) and future energy acquisition (e.g., the potential to acquire food, the potential
to save energy by taking a taxi rather than walking). In this sense, money is intrinsically
intertwined with metabolism. Money represents factors that will cause one to acquire,
save, and use different amounts of metabolites. The muscles will use fewer metabolites
while taking a taxi than walking, and the additional monetary cost of taking a taxi thus
intertwines with metabolism.

Conclusion and Summary

To summarize, prosocial behavior can be effortful and might be decreased by low
levels of metabolic energy (glucose). When glucose levels are above suboptimal, helping
should increase. Metabolism and energy more broadly might be important constructs in
the study of prosocial behavior. Factors that influence helping behavior might include
levels of stored metabolites, the displacement or relinquishment of internal metabolic
demands, air content, and efficiency of other metabolic processes.

References


