

A transformational product to improve self-control strength: the *Chocolate Machine*

ABSTRACT

Lack of self-control is at the heart of many undesirable behaviors, such as overeating, overspending, and even overworking. While the field of persuasive technologies explicitly searches for ways to change attitudes and behaviors, it more or less neglects the science of self-control. We present the *Chocolate Machine*, an interactive device to train self-control strength based upon *Ego Depletion* theory. A longitudinal, control-group, field study showed the machine to increase self-control strength over time, while providing a sustained positive experience. This makes the machine a *Transformational Product*, aimed at facilitating the realization of behaviors, people find worthwhile, but hard to implement.

Author Keywords

Transformational Product, Persuasive Technology, Self-Control, Willpower, Experience Design

ACM Classification Keywords

H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

General Terms

Design, Experimentation, Human Factors

INTRODUCTION

Chocolate is far too delicious. Although we know that it should be consumed moderately, we tend to stuff ourselves with the vice – at least now and then. If chocolate is not what you prefer (we almost hear your smug denial), it will surely be cake, pretzels, crisps, steaks, French fries, Italian salami, beer, wine, soft drinks, or cigarettes. We too often indulge in too much of everything unhealthy.

When confronted with the choice between another *Mars* bar and an apple (given a preference for the *Mars* bar), we must weigh our immediate desire against future costs. Although staying in shape is certainly preferable to a *Mars* bar in the long run, the choice is nevertheless a difficult one. From our vantage point (with a clear view of the *Mars* bar),

staying healthy is a vague and abstract outcome, taking place in a remote future, while the sweet fudge is concrete and now. However, choosing an apple over a *Mars* bar is at least about balancing our present and future Selves. Saving energy or water, avoiding waste and pollution even requires us to select between an immediate pleasurable outcome and a presumable more desirable outcome, we may not live long enough to witness.

At the heart of all this is *discounting* (see [4] for an overview), a psychological principle, responsible for the existence of interest rates and the conviction that "a bird in the hand is worth two in the bush." Steep discounting (i.e., not considering the future much) equals impulsivity and impatience. However, people can counteract impulsivity by exerting *self-control*, a highly adaptive cultural technique. Agriculture, for example, is unthinkable without the farmer's capability to reserve a part of the crop for future sowing – no matter how hungry he is.

While self-control seems at the heart of persuasive technologies [1], it is not widely taken into account (for an exception, see [3]). This may also be a consequence of the many enthusiasts understanding persuasive technologies as serving their ends rather than the users' ends (see "gamification"). However, designing technologies, which lure people into buying, consuming, or simply doing things, they should better not buy, consume or do, is problematic for at least two reasons. First, it is simply unethical; second, it is already well understood – one can call it seduction (a more flirtatious term of this type of persuasion).

In contrast, our focus on persuasive technologies is on the *transformation* of its users according to their own aspirations. Zimmerman [11], for example, argued to *Design for the Self*, to strive for products "that help people move closer to their idealized sense of self" (p. 395). We call those products *transformational*. Their primary objective is not to maximize change *per se* (e.g., reducing energy consumption, buying more chocolate bars), that is to comply to external requirements, but to support people with realizing goals, they find worthwhile to pursue, but hard to implement [2]. The present paper explores the notion of a transformational product – the *Chocolate Machine* – based upon *Ego Depletion* Theory (e.g., [6]) and reports our experiences with the device in the field

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee.

CHI 2012, May 5-10, 2012, Austin, TX, USA.

Copyright 2012 ACM xxx-x-xxxx-xxxx-x/xx/xx...\$10.00.

EGO DEPLETION AND THE CHOCOLATE MACHINE

Numerous theories about self-control (or willpower) exist. Many assume two different systems, one impulsive, myopic, and "hot" the other considerate, farsighted, and "cool" (e.g., [5]). While the hot system is pressing to immediate pleasure, the cool system strives for control. Self-control strength is the capacity to exert this control.

One particular theory, *Ego Depletion*, views self-control strength as analogous to a muscle (e.g., [6]). The implications are twofold: First, like the muscle, self-control strength will fatigue the more it is used without time for regeneration. Second, self-control strength can be trained. The latter was the starting point for the *Chocolate Machine* (Figure 1).



Figure 1: The *Chocolate Machine* (see <http://youtu.be/pr-gtnMcFnE?hd=1> for a video figure)

It consists of a slender container filled with wrapped chocolate balls. Every 40 to 60 minutes the machine releases a chocolate ball onto the desktop. The user can now either eat the chocolate or put it back into the machine through an opening on top. This is registered by a counter. Putting back the chocolate is a small act of self-control, which supposedly trains self-control strain, like working out trains our muscles.

FIELD STUDY

Twenty-four individuals, predominantly students, participated in the study (15 female; Age: $M=26$, $Min=22$, $Max=28$). It was introduced as self-control training. After a pre-interview participants were assigned to either a treatment or a control group. Both groups were matched according to their preference for chocolate, general self-control capability (measured as a trait by the 13-item version of the *Self-Control-Scale*, [10], Cronbach's $\alpha=.77$), a number of contextual aspects (e.g., participants own a desk), and demographics (age, sex).

To measure initial level of self-control strength, we first used a modified d2-Test to deplete participants' self-control strength and then asked them to work through and solve a list of eleven anagrams with a length between five to fifteen

letters. All but two anagrams were solvable. The measure for self-control strength was the minutes spent on the anagrams (i.e., persistence). The task was announced as an intelligence test and people were told that only the number of solved anagrams was important, not the time spent on task. The same procedure was repeated at the end of the study to register changes in self-control strength.

Participants in the treatment group ($N=10$) got a *Chocolate Machine* installed at their desk at home for 14 days. It initially contained 25 chocolate balls of different flavors selected by the participants according to their personal preference. We told people that they were free to eat the chocolate balls when dispensed by the machine. However, to practice self-control, it would be good to resist temptation and to put the ball back into the machine.

Participants in the control group ($N=14$) got 14 daily sets of easy math exercises and the instruction to work through them day by day to practice self-control. Those exercises are perfect control tasks, because they *appear* to the participants as requiring to self-control, however without actually depleting self-control strength [8].

Every second day, participants got an online questionnaire to fill in (i.e., seven measurement points). It consisted of two seven-point items concerning the *experience of the self control task* (resisting chocolate balls, solving math exercises) ranging from *unhappy* with the task (-3) to *happy* with the task (3), $\alpha: .67$ to $.97$. Three five-point items measured *perceived required self-control strength* (e.g., "The task required a lot of self-discipline" adapted from [8]) ranging from *fully disagree* (0) to *fully agree* (4), $\alpha: .51$ to $.88$. Finally, participants had to fill in the counter reading from the machine or the number of solved math exercises.

After the 14 days, the first author visited each participant at home. Participants were again confronted with an anagram task to measure self-control strength. Finally, the first author carried out episodic interviews focusing on participants' experiences, self-observed changes in behavior, improvement suggestions and ideas. We obtained 434 statements, which were further grouped and categorized.

RESULTS AND INTERPRETATION

Qualitative data

Nine (of 10) *Chocolate Machine* users expressed positive feelings towards the training and the machine. The machine itself was found extraordinary. Two participants mentioned the attention needed: "You need to take care, like with a Tamagotchi". Another three anthropomorphized – they wanted to make a good impression or do the machine a favor. The counter (as a representative of successful self-control) was a particular source of pleasure and pride. Eight (of 10) shared their results with family and friends. Negative feelings resulted from technical problems, the noise the machine made and the occasional search for chocolate balls strewn on the floor. This was apparent only

at the beginning of the training phase. The math exercise generated neutral or even negative feelings (6 of 14), such as being irritated, finding it monotonous, or being indifferent.

Six (of 10) *Chocolate Machine* users incorporated the machine into daily habits and routines. For example, five (of 10) participants told us that upon returning home, they immediately checked the status of the machine and dealt with the chocolate balls dispensed while being away. When at home, nine (of 10) dealt with a ball, the moment it was dispensed. The participants experienced the temptation represented by the *Chocolate Machine* as significant. Over time, seven (of 10) found it easier to resist the longer they used the machine. They reported the gradual acquisition of two different strategies to deal with the temptation: *reinterpretation* (e.g., thinking of the chocolate balls as wooden ball), and *tabooing* (e.g., thinking of the chocolate balls as belonging to somebody else). Such strategies lie at the heart of self-control (e.g., [5]). Participants in the control group found the math exercises neither a temptation nor especially hard to carry out. As expected, this task does not tap much into self-control strength.

Participants were skeptical about potential generalizations from resisting a chocolate ball to other situations, which call for self-control (8 of 10). However, some participants (3 of 10) coupled the machine with daily tasks, which afford self-control. Through this, one participant reported about increased work performance with the machine at his desk, others tidied up more often or decreased smoking. Five (of 10) participant found themselves to be more self-reflective because of the machine. They thought more about themselves and their motives as well as were more aware of their own behavior. This is an important step towards better self-control. Participants in the control group even less believed in generalization (10 of 14). The math exercises were predominantly perceived as meaningless, some even started to question a relation to self-control. Only three (of 14) reported a somewhat increased self-reflection.

Quantitative data

Participants in the treatment group had on average resisted 271 times (SD=85). They ate nine chocolate balls (SD=9, Min=0, Max=30). Participants in the control group solved 235 (SD=38) math exercises.

On average, participants experienced the *Chocolate Machine* as more positive (M=1.60, SD=0.63) compared to the math exercises (M=0.63, SD=1.21), $t(22)=2.31$, $p<.05$. This did not change much over time. We computed the correlation of the experience measure with time point of measurement for each participant. This correlation captures the linear change over time. The mean (using Fisher-Z-transformations) correlation was $-.10$ for the treatment group and $-.03$ for the control group, both $p>.05$. As already apparent in the interviews, the *Chocolate Machine* was more fun, and this did not change over the course of the 14 days.

Figure 2 shows the mean *perceived required self-control strength* for the treatment and the control condition.

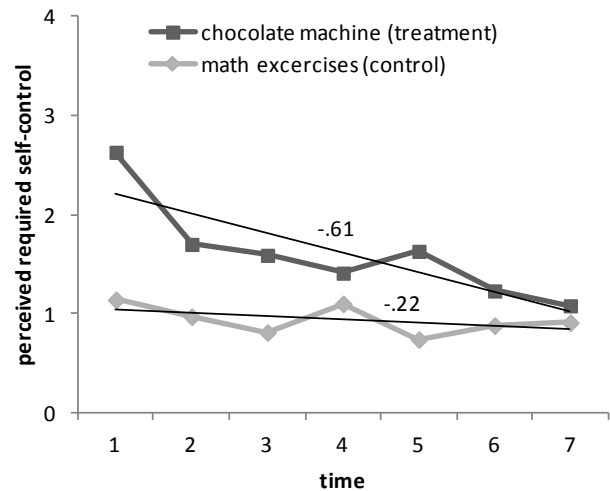


Figure 2: Perceived required self-control strength over time for the *Chocolate Machine* and math exercises

The initial mean *required self-control strength* (Figure 2, time 1) was one and a half-times higher for the treatment (M=2.63, SD=.78) compared to the control group (M=1.14, SD=.96), $t(22)=4.05$, $p<.01$. The linear change over time was $-.61$ for the treatment group, $df=8$, $p<.05$, one-tailed, but only $-.22$ for the control group, $df=12$, ns, one-tailed. All in all, resisting the chocolate balls initially posed a stronger self-control problem than solving math exercises. However, the required self-control did not stay on the initial level for the *Chocolate Machine* user, but constantly dropped. This is a first indicator for a training of self-control. It corresponds with the interviews.

We measured general self-control strength as minutes spent on a difficult anagram task (i.e., persistence) before and after the training. In general, self control strength was poorer after the training, $diff=-12.5$ minutes, $t(21)=4.99$, $p<.001$. This was observed in other studies before (e.g., [7]). The actual reasons for this are unclear. However, the *reduction* of self-control strength in the treatment group was only 8.5 minutes compared to 16 minutes in the control group. Due to the small sample size, this difference is not significant, $t(20)=-1.496$, $p>.05$. However, when using positive experience and general motivation to change as further control variables, the difference between treatment and control becomes significant, $F(1,19)=4.943$, $p<.05$. This highlights the importance of a general positive attitude towards change. To summarize, other than participants themselves suspected, there was a small generalization effect of the *Chocolate Machine*, in the sense that persistence of participants in the treatment group decreased less than persistence of participants in the control group.

SUMMARY AND CONCLUSION

The *Chocolate Machine* is a transformational device not so much targeted at a particular behavior (e.g., saving energy,

stopping overeating), but at general self-control strength. Our studies showed that people get better in resisting over time, presumably because they acquire strategies to deal with the temptation, such as reinterpretation. Metcalfe and Mischel [5] argued that representations of outcomes can differ in their "hotness". A "hot" representation emphasizes consummatory, action-oriented aspects (e.g., the crunchiness of a cookie), whereas the "cool" representation emphasizes abstract and informational aspects (e.g., eating too many cookies is not healthy). Resisting will get the harder the "hotter" the outcome representation is. "Cooling it down" through reinterpretation or tabooing is, thus, an effective strategy acquired by using the machine. While *Ego Depletion* predicts generalization, our results imply a rather small effect. However, participants acquire useful strategies as well as report on being more self-reflective and self-aware. This is at least a basis for potential generalization from resisting a chocolate ball to resisting other vices.

Many researchers in the field of persuasive technologies rely on monitoring, feedback, and competition. They hope to get people to do things by simple recording and rewarding, without voicing much of a position themselves. In contrast, we assume that people can readily see what is potentially good for them (after a little eye-opener, maybe), but have problems with accepting and implementing change. We all know that fast food is bad – and a stroke the worst – but it simply tastes so good. People may pretend not to know, or even deliberately abstain from related information, but they are not stupid. To approach these problems as deficits of information and monitoring seems at best naïve (at worst it is patronizing). What is needed beyond information is an alternative position to rub against or to align with. *Transformational products* deliberately take a position. They are "materialized arguments" (see [9]) provided by us, the designers. Transparency and humor seems crucial to this. A *Chocolate Machine* user was always fully aware of what we intended. Nothing was concealed. Admittedly, the machine slightly mocks people, it is a troublemaker, but it does so in a light way. By that, it draws its users into a playful "dialog loop" about their current Self and potential alternative Selves. And people seem to happily submit to it, as reflected by the positive feelings towards the device. To us, this playful, positive confrontation with own attitudes and behavior seems crucial to a persuasive technology. To create this, requires a new approach to the design of according interactive products – away from an aesthetic of convenience to one of playful positive friction.

REFERENCES

1. Fogg, B.J. *Persuasive Technology: Using Computers to Change What We Think and Do (Interactive Technologies)*. Morgan Kaufmann, 2003.
2. Laschke, M., Hassenzahl, M., and Diefenbach, S. Things with attitude: Transformational Products. *Create11 Conference*, (2011).
3. Lee, M.K., Kiesler, S., and Forlizzi, J. Mining behavioral economics to design persuasive technology for healthy choices. *Proceedings of the 2011 annual conference on Human factors in computing systems - CHI '11*, ACM Press (2011), 325-334.
4. Loewenstein, G. The Fall and Rise of Psychological Explanations in the Economics of Intertemporal Choice. In G.F. Loewenstein and J. Elster, eds., *Choice over time*. Russell Sage Foundation, 1992, 3-34.
5. Metcalfe, J. and Mischel, W. A hot/cool-system analysis of delay of gratification: dynamics of willpower. *Psychological Review* 106, 1 (1999), 3-19.
6. Muraven, M. and Baumeister, R.F. Self-regulation and depletion of limited resources: does self-control resemble a muscle? *Psychological Bulletin* 126, 2 (2000), 247-259.
7. Muraven, M., Baumeister, R.F., and Tice, D.M. Longitudinal improvement of self-regulation through practice: building self-control strength through repeated exercise. *The Journal of Social Psychology* 139, 4 (1999), 446-457.
8. Muraven, M. Building Self-Control Strength: Practicing Self-Control Leads to Improved Self-Control Performance. *Journal of Experimental Social Psychology* 46, 2 (2010), 465-468.
9. Redström, J. Persuasive design: Fringes and foundations. *Persuasive Technology*, (2006), 112-122.
10. Tangney, J.P., Baumeister, R.F., and Boone, A.L. High self-control predicts good adjustment, less pathology, better grades, and interpersonal success. *Journal of Personality* 72, 2 (2004), 271-324.
11. Zimmerman, J. Designing for the self. *Proceedings of the 27th international conference on Human factors in computing systems - CHI '09*, ACM Press (2009), 395-404.