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

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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 searches for ways to change attitudes and behaviors, it often neglects the science of self-control. We present the *Chocolate Machine*, an exploratory interactive product to train self-control strength based upon *Ego Depletion* theory. A field study showed the machine to increase perceived self-control over time, while providing a sustained positive experience. This makes the machine *transformational*, aiming at facilitating behaviors people find worthwhile, but hard to implement.

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

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H.5.m [Information Interfaces And Presentation]: Miscellaneous;

General Terms
Design, Experimentation, Human Factors

INTRODUCTION
Chocolate is far too delicious. Although we are all well aware of the fact that it should be consumed moderately, we – at least now and then – indulge ourselves in the vice. 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 a *Mars* bar and an apple (given a preference for the *Mars* bar), we must weigh our immediate desire against future costs. While in the long run, staying in shape is certainly preferable to a *Mars* bar, the choice is nevertheless a difficult one. From our vantage point (with the *Mars* bar in

full view), staying healthy is a vague and abstract remote future outcome, while the sweet fudge is concrete and now. At the heart of this problem is *temporal 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." Discounting describes people's tendency to devalue future outcomes due to their inherent uncertainty. The bird in the hand is certain; the birds in the bush can still fly away. Steep discounting surfaces as impulsivity and impatience. However, people can counteract impulsivity by exerting *self-control*, a highly adaptive cultural technique. Agriculture, for example, is impossible without the farmer's capability to reserve a part of the crop for future sowing – no matter how hungry he is.

Self-control lies at the heart of change. Even after having accepted all arguments in favor of a beneficial behavior, an individual still needs to implement this new behavior – each and every day. Successful persuasion thus turns into an individual self-control problem. Interestingly, while the field of Persuasive Technologies [1] explicitly searches for ways to change attitudes and behaviors, it often neglects the science of self-control (for an exception, see [3]). It rather focuses on monitoring devices and feedback, that is, arguments and information, than addressing change directly. In contrast, focusing on self-control implies focusing on the *transformation* of people 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), but to support people with realizing the goals, they find worthwhile, but hard to implement [2].

EGO DEPLETION AND THE CHOCOLATE MACHINE
The present paper explores the notion of transformational products aimed at increasing individual self-control through an exploratory object – the *Chocolate Machine* – based on *Ego Depletion* Theory (e.g., [6]). *Ego Depletion*, views self-control strength as analogous to a muscle. 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). It consists of a slender container filled with wrapped chocolate balls placed at a study desk. Every 40 to 60 minutes the machine releases a chocolate ball onto the desktop. The user can either eat the chocolate or put it back into the machine, which is registered by a counter. Repeatedly resisting the chocolate trains self-control strength, just like working out trains muscles.

THE COCOLATE MACHINE AT HOME

To explore individual responses to the *Chocolate Machine* and its potential impact on perceived self-control, we conducted a 14-day field study. Twenty-four individuals, predominantly students, participated (15 female; age: M=26, Min=22, Max=28). The study was introduced as self-control training. After a pre-study, participants were assigned to either a treatment or a control group. Both groups were matched according to the participants' preference for chocolate, general self-control capability (measured as a trait by the 13-item version of the *Self-Control-Scale*, [10] , Cronbach's α=.77), general motivation to change, a number of contextual aspects (e.g., participants own a desk), and demographics (age, sex).

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 self-control, however without actually depleting self-control strength [8].

Every second day (i.e., seven measurement points), participants got an online questionnaire to fill in (i.e., a logbook). We were interested in two aspects: participants' *perceived required self-control strength* (low, high; in short: *self-control*) and the *valence* (positive, negative) of their experience. *Self-control* was measured with three five-point Likert items (e.g., "The task required a lot of self-discipline" adapted from [8]) ranging from *fully disagree* (0) to *fully agree* (4). The items were averaged to derive a scale value (Cronbach's α: from .51 to .88 for the different measurement points) with high numbers indicating a high requirement of self-control. We expected more required self-control for the *Chocolate Machine* (compared to math exercises), which, however, decreases over time as a consequence of the training. *Valence* of experience was measured with two seven-points semantic differential items (*happy–unhappy*, *satisfied–unsatisfied*) ranging from -3 to 3. The items were averaged to derive a scale value (Cronbach's α: from .67 to .97 for the different measurement points) with positive numbers indicating a

positive and negative numbers a negative experience of the task (chocolate machine, math exercise). We expected a more positive experience of the *Chocolate Machine* (compared to math exercises), which is sustained over time.

After the 14 days, the first author visited each participant at home. The first author ran 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 to explore feelings, thoughts and actions related to using the *Chocolate Machine*.

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

In addition to the qualitative interview and the quantitative logbook data, we were interested in estimating potential generalization instilled by using the *Chocolate Machine*. *Ego Depletion* theory assumes that not only the specific self-control problem (here: resisting chocolate) but also self-control strength in general will benefit from the training. To study this, we measured participants' initial level of self-control strength (as a part of the pre-study) with a widely-used procedure (e.g., [7]): We first depleted participants' self-control strength (by an exhausting but monotonous task) and then asked them to work through and solve a list of eleven anagrams with a length of five to fifteen letters (e.g., GERTI > TIGER). 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 (as a part of closing interview) to register changes in self-control strength.

RESULTS AND INTERPRETATION

The presentation of the results starts with the major insights revealed by the qualitative interviews, complemented with the quantitative data from the logbook and the more controlled self-control strength assessment.

Qualitative data

Nine (of 10) *Chocolate Machine* users expressed positive feelings towards the training and the machine. 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. 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. The math exercise generated neutral or even negative feelings (6 of 14), such as being irritated, finding it monotonous, or being indifferent.

The participants experienced the temptation represented by the *Chocolate Machine* as significant. Over time, seven (of 10) found it easier to resist. They reported the gradual acquisition of two different strategies to deal with the temptation: *reinterpretation* (e.g., thinking of the chocolate balls as wooden), 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]). *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. Participants in the control group found the math exercises neither a temptation nor especially hard to carry out. As expected, this task did not tap much into self-control strength.

Participants (8 of 10) were skeptical about potential generalizations from resisting a chocolate ball to other self-control problems. 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, the 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 and were more aware of their own behavior. Participants in the control group did not believe in generalization either (10 of 14). The math exercises were predominantly perceived as meaningless, some even started to question their relation to self-control.

Quantitative data

Figure 2 shows the mean *perceived required self-control* for the treatment and the control condition. As expected, the initial mean required self-control (Figure 2, day 2) was 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. Resisting chocolate was a much more potent self-control problem than solving math exercises. To estimate change over time, we correlated the self-regulation measure with time point (day) for each participant. This captured each participant's linear change over time. The mean correlation (using Fisher-Z-transformations) over time was a large and significant -.61 for the treatment group, df=8, p<.05, one-tailed, but only a small and insignificant -.22 for the control group, df=12, ns, one-tailed. All in all, while resisting the chocolate initially posed a stronger self-control problem, the required self-control did not stay on this level but constantly decreased (down to the level of the math exercises). Resisting the chocolate became easier each day. Combined with the interviews, this supports the notion of a training effect instilled by the machine.
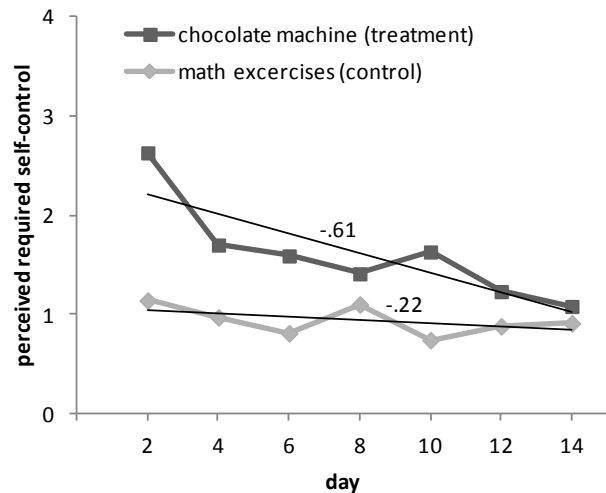

Figure 2: Perceived required self-control strength over time

From an experience point of view, 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. Linear change (estimated analogous to *self-control*) was only -.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.

We measured general self-control strength as minutes spent on a difficult anagram task (i.e., *persistence*) before and after the training to get an idea of the behavioral and generalizing effects of using the *Chocolate Machine*. We performed a 2x2 mixed analysis of variance with *time* (before vs. after the study) as within-subjects factor, *treatment* (chocolate machine, math exercise) as between-subjects factor and *persistence* as independent variable. To control confounding aspects, we included general motivation to change as a covariate, i.e., we partialled out the effect of general motivation. In addition, we controlled the effect of the *valence* of the experience on *persistence* after the study by a regression. By this, we focused on training effects *not* instilled by general motivation or the attitudinal effects resulting from a positive/negative subjective experience of either the math exercise or the *Chocolate Machine*. The analysis revealed a significant

Time x *Treatment* interaction only, F(1, 19)=4.94, p<.05, partial η^2=.21. While persistence was in general poorer after the study (a difference of -12.5 minutes on the absolute values) – an effect well-known from literature (e.g.,[7]) – the *reduction* of persistence in the *Chocolate Machine* group was only 8.5 minutes compared to 16 minutes in the math exercise group. To summarize, other than participants themselves suspected, there was a 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 product not so much targeted at a particular behavior (e.g., saving energy, stopping overeating), but at general self-control strength. Our study 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 resisting will get the harder the more consummatory, action-oriented (i.e., "hotter") the outcome representation is. "Cooling it down" through reinterpretation or tabooing is, thus, an effective strategy acquired by using the machine. The acquisition of useful strategies as well as the subjective feelings of being more self-reflective and self-aware may further be the basis for a potential generalization from resisting a chocolate ball to resisting other vices.

Many persuasive technologies rely on monitoring, feedback, and competition alone. 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 is 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.

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