# Visual Rhetoric of Self-Optimization Systems

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## ABSTRACT

Based on digital technology, *self-optimization systems (S.O.S.)* collect and visualize user data in order to *change behavior* and *improve performance* in areas like fitness, diet, work efficiency, or communication behavior. We analyzed S.O.S. interfaces both from a *rhetorical* and a *semiotic* perspective. How do they motivate users to adjust their behavior, and how do they transform abstract data into plausible and credible *signs of the self*? Firstly, S.O.S are constructed upon at least four persuasive patterns: *Self-Monitoring*, *Social Comparison*, *Normative Influence*, and *Gamification*. These techniques have been developed to influence others — now we apply them as techniques of *self-persuasion* to convince ourselves. Secondly, S.O.S. are based on specific visual language. The interfaces and the data display use *high-tech metaphors* and visualization methods known from *economic data display*. In frequent use, users *internalize* seemingly causal correlations between their activity and corresponding visual feedback. Therefore, the visual signs are perceived as *indexical*. In the past measuring technology and data visualization was developed to control machinery and economic processes. Today we employ these techniques to regulate ourselves – as techniques of *self-optimization*. In so doing, control, efficiency, and permanent improvement are being applied to nearly all aspects of life.

## 1. INTRODUCTION

In recent years, a growing market has emerged for systems designed to help users change their behavior. Based on smartphone, sensor, and web technology, these applications collect and visualize user-data for the purpose of optimizing performance in areas like fitness, diet, or sleep habits. At first glance, it appears to be of some assistance in improving people's lives and reducing healthcare costs. However, upon closer examination the effects are revealed to be a matter of debate. Technology originally developed to control machinery is now being employed to control human performance and increase human efficiency.

In our research, we analyze persuasive patterns of these machine-moderated processes and the semantics of visual data display. In what way do users become convinced these systems actually evaluate their physical and mental performance? Just how is the appearance of objectivity and credibility generated? What kinds of motivational effects emerge between users, virtual trainers, and the user community? In chapter two, we give a brief introduction to Self-Optimization Systems (S.O.S.). Chapter three discusses the patterns of persuasion employed in these systems and how they influence people's behavior by rhetorical and psychological means. In chapter four we analyze the visual language of the S.O.S. user interfaces and how it contributes to the system's credibility. In chapter five we describe the underlying semiotic process that is responsible for the user's sense-making from abstract data. As a conclusion, chapter six discusses the resulting societal dilemmata: the promises and the risks of S.O.S. as they develop into a technologically driven social norm system.

## 2. SELF-OPTIMIZATION SYSTEMS

Self-Optimization Systems (S.O.S.) are systems that help users change their attitude and/or behavior. Tools and applications designed for this purpose achieved mainstream attention as a result of the activities of the Quantified Self Community (Wolf, Kelly 2007). The site *quantifiedself.com* lists about 500 artifacts, applications, and services for self-tracking. Most of them promise to let users achieve target behaviors that seem barely possible to achieve without technical assistance. This is done by collecting data and corresponding visual feedback. Target behavior, such as improved fitness, better diet, or sleep habits are popular, but there are literally hundreds of other tools and services embracing almost all aspects of human life (mood, social behavior, work efficiency, financial conduct — even sex). The promise is to improve oneself without complicated medical or therapeutic treatment. S.O.S. promise to provide self-knowledge through data, and gain insights into areas that usually are hardly recognizable in our daily routines, and that are inaccessible by our senses or cognition. The software renders visible the invisible, e.g. harmful habits, false self-estimation, suspicious patterns, and destructive dependencies. Most S.O.S. are directly built in to everyday devices, such as smartphones, shoes, bracelets, watches, and newly designed artifacts, all easily portable, up to 24 hours a day. Thus, they are designed to fit in daily routines. We describe the persuasive sense-making process of S.O.S. by analyzing their user interfaces from a semiotic perspective. Algorithmic procedures create real-time visualizations out of masses of raw data which provide easily readable feedback. The systems provide charts and graphs recognized from statistical research, economics and ranking lists recognized from sports or computer games that indicate performance levels and scores, and performance changes over time, and show comparisons with other people. Through the visual language used, they create the impression that the signs are directly (and thus authentically) connected to people's activities: as *body signs,* or *signs of the self.* We use "The Eatery"[1] as a prototypic case study for demonstration, as it combines all features addressed in our research.


Fig. 1) "The Eatery" interface (from left): a) take a photo, b) rating input by users, c) rating result, d) day by day and social comparison, e) weekly average

## 3. PERSUASIVE PATTERNS

In this chapter, we figure out the four strongest persuasion principles in S.O.S.: *Self Monitoring*, *Social Comparison*, *Normative Influence* and *Gamification*. They are part of a large set of patterns used in Persuasive Technology, combining a psychological (Fogg 2003: 255-261), engineering (Oinas-Kukkonen, Harjumaa 2008) and design perspective (Lockton, Harrison, Stanton 2010).

[1] For further details about The Eatery, see http://eatery.massivehealth.com (accessed: 27 November 2012)

*Self-Monitoring*. Monitoring is a technique usually used in restrictive settings such as prisons to surveil people's behavior. Monitored people behaviorally adjust, driven by a surveillance-based power that rewards and punishes specific behavior. Quantified Self tools incorporate this technology of power into the user's self-recognition – they start to observe and control themselves. For example, "The Eatery" monitors the user's diet, based on other users' evaluations of photographed food. Users take pictures of every meal and rate other people's food on a scale from 0 (fat) to 100 (fit). Through this the user obtains feedback on personal eating habits, presented on a dashboard-style meter display (fig. 1e). Several other features are present such as a weekly report, performance increase/decrease over time, the worst/best food memory, detailed rating charts for each dish, and so on. They provide a dense *real-time profile* — a personal food diary based on social knowledge. These *data diaries* are structured like personal profiles on social media platforms such as Facebook or Google+. Particularly when tools combine diverse data from one person[2] — health and communication data, schedules, locations, and photographs — Self-Monitoring really begins to capture all aspects of people's lives. These profiles instantly report status and performance in real-time and motivate people to optimize their "digital self" by improving their real world behavior. As a result, users accept and even welcome this technology of power. Self-surveillance creates the notion of autonomic self-control.

*Social Comparison* is often directly built into the structure of Self-Monitoring features. "The Eatery" displays the user's performance in relation to an average-user performance in the weekly report (fig. 1d). Klout[3] uses *scores* for personalized social comparison: Scores of users are compared directly, creating a data-driven social hierarchy. Aside from statistics in mass media, S.O.S. allow people to compare themselves in real-time and in a specific community of interest. Similar forms of social ranking are traditionally used in sports, educations, and gaming. They are powerful persuasive mechanisms because they not only display one's own status (cf. Self-Monitoring) but also reveal how other people do, stimulating users to improve their performance. This creates *social peer pressure*: Peoples' decisions and choices depend on what the majority does — even if they do not share their opinion (Asch 1955). On social media sites, teenagers are placed under stress by popular posts of their friends (McAfee 2012). In his "Behavior Design Model", Fogg identified *Social Acceptance/Rejection* as one of the key motivational factors in behavior changing design (Fogg 2009). Hence, social comparison changes behavior by utilizing the need to be socially accepted. For this reason most S.O.S. systems integrate communities into their services. Due to this, social relationships are experienced in a competitive way.

*Normative Influence* is produced by the evaluation of data sets taken from numerous users. Standards obtained by statistic methods are fed into the feedback loop. From industrialization on statistical knowledge has been used to provide models of *normal* and *abnormal* behavior (Link 1998). People review their own behavior based on dominant statistical norms. S.O.S. do this in real-time and with data that usually is not accessible from institutional research agencies. For instance, in the "Massive Health Study" (Raskin, Kamal 2011) eating habits of social groups are evaluated and thus normative knowledge on healthy eating is produced ("Who eats what", "Eating habits are contagious"). This kind of knowledge can stigmatize people classifying their behavior as unhealthy.

*Gamification* builds on people's existing motivation to win in competitive scenarios. One feels more motivated when competing with a rival (which also can be a friend) than acting as a single player. The pattern benefits from users' gaming experiences such as role playing, attaining levels, time or resource restrictions, scores, and ranking, etc. Thus, Gamification can be used in behavior change design. It transforms unpleasant tasks into joyful experiences by reformulating goals ("be the runner of the day" instead

[2] For instance Tictrac, see http://www.tictrac.com (accessed: 27 November 2012)

[3] For further details about Klout, see http://klout.com (accessed: 27 November 2012)

of “go jogging”) and provides some kind of additional benefit. Apps like “Goalympia”[4] permit users to create their own competitions for whatever task they wish. In so doing, human activities can be transformed into self-optimization challenges moderated by technical artifacts.

To conclude this chapter, it is observed that in S.O.S., users commit themselves to mechanisms of (self-)surveillance, public ranking, norm conformity and competitive systems. S.O.S. are, in that sense, technologies of power that serve to control and regulate oneself.

## 4. VISUAL LANGUAGE

The persuasive power of the systems is — among others — based on its direct visual feedback. The user interfaces and the data visualization displays make use of visual high tech metaphors and visualization methods familiar from economic data display.

In S.O.S. user performance is often displayed in a *measuring instrument* style (fig. 1e). The source domains of these dial gauge metaphors are engineering, motorsports, industrial production, natural science, and precision measurement. For instance, visual attributes of car dashboard instruments are used to display user data; as is the case with the health index of recent eating behavior. Design patterns from precision measuring instruments such as analog pressure gauges, are used to display workout or running performances. The appearance of precision measurement gear is connoted with scientific objectivity. Car dashboard instruments like tachometers are connoted with performance, power and modernity. Both connotative associations are transferred from the metaphors’ source domain to self-optimization applications. The user perceives the self-optimization app as being objective and scientific — a performant high-tech artifact. In this respect, the persuasive aspect of these apps is rooted in an iconic sign process; high tech appeal and »scientific« persuasiveness are based on a *similarity* to familiar high-tech artifacts and measuring gear.

The first data charts were curve diagrams and bar charts displaying time on the x-axis and money on the y-axis (Tufte 2001: 32–34). Even today this type of graph is used most frequently. This display method is not only suited to show monetary data, but can, of course, be used to compare all kind of time-based data (Zelazny 1972: 4). Increase, decrease, trends, and peaks of numeric data can be easily read out when the numeric data is rendered in such a diagram — whether it be performance in sports, sleep duration or calorie consumption (fig. 1d). In recent centuries, reading and interpreting stock exchange charts was a specialists’ task assigned to stock brokers and economic analysts. Today, stock index performance charts are revealed to the general public in almost every news show on television and radio. The public may have deep, troubling doubts about the financial system and criticize its mechanics and the reasoning behind stock broking, but the display methods themselves are not a subject of vehement or critical scrutiny. It may well be questionable that stock broking creates realistic prices (whatever they may be) but, the correctness of the related charts is never doubted. Prices may be based on subjective judgments whereas the related data display is based on seemingly objective visualization algorithms. Thus the implementation of economic data visualization methods in self optimization system apps transfers this notion of objectivity and “calculatedness” to the app's context. The app profits from this image of objectivity. It seems safe to assume that most users are not able to differentiate between the objectivity of the display method and the validity of the displayed data. When data that has been produced with questionable methods is displayed in a correct visualization, the risk is great that users will simply accept the displayed data as valid.

[4] For further details about Goalympia, see http://goalympia.com (accessed: 27 November 2012)

## 5. SEMIOTIC PROCESS

In this chapter we set out to analyze the process of data collection and visualization in the "The Eatery" application from a semiotic perspective. Both processes, data generation (input) and data visualization (output) are characterized by multiple semiotic transformations.

The data generation process is a process of *abstraction*. It transforms indexical signs to iconic signs, and iconic signs to symbols. The user begins the sign transformation by taking a photograph of their food. Through this, indexical signs (physical, mostly visual information about the meal) are transferred to an iconic depiction (a photograph of the meal). The photograph then gets rated by other users of "The Eatery", thus transforming the iconic visual information into a single number — a symbolic sign. In a subsequent step an average of all ratings is calculated. This process is obviously highly subjective and prone to errors. There is still no general agreement in science about what exactly is healthy. Rating food health is therefore based mainly on widespread stereotypes. It is also save to assume that the rating is dependent on the photographic quality and the verbal description accompanying it. Calculating a simple average is also problematic since 0 and 100 will result in the same average as will two times 50.

In contrast to the abstraction process that produced a single symbolic number, the subsequent process of visualization is again a process of *concretion*. The symbolic numbers are transferred into visual data charts and diagrams. Following Peirce, diagrams are icons (Peirce 1956) — even if the similarity with the sign's object is only structural. Morris would classify it as an icon with low iconicity (Morris 1971). An even higher level of iconicity is reached when visual metaphors like measuring instruments are employed in the app interface. These visualization techniques have a persuasive power, as described in chapter four. However, the semiotic transformation by the application is not decisive in the process of persuasion. The strongest persuasive effect is based on a sign semiosis (Keller 1998) that eventuates in the user's perception by frequent use of the system. Even if the visualization algorithms are symbolic and therefore cryptic and non-transparent to the user, there is still a visible correlation between the user's input and the visual feedback. Through frequent use, the users internalize the correlations between their activity and the corresponding visual feedback. They perceive a *causal* relation between his or her behavior and the visualized data. This causal inference is typical for *indexical* signs. The conception of indexicality induces credibility, even if it is not based on the laws of physics, but on human-made rules, coded into symbolic algorithms. The visualization becomes an *index* for the healthiness of a diet. The system is perceived as objective and correct, in spite of the flawed processes upon which it is based.

## 6. CONCLUSION: THE DILEMMATA

On the one hand, it seems obvious that S.O.S can be assist in improving people's well-being. They can provide knowledge of the self and, in the long term have the effect of cutting healthcare costs and reducing the need for medical and therapeutic treatment, on the other hand, the assumption that we need to enhance our senses and cognition by self-tracking technology can be quite fallacious.

Technology can assist and support people in learning preferable behavior, but in our research we discovered that current S.O.S. seem to provoke behavior-, but poor attitude change. The language of the systems remains abstract — it does not provide any information on the methods of measurement and interpretation. They do not deal with the reasons behind one's behavior and the dependencies of choice in complex social systems, thus, each human is treated the same. A causal identification process between sustainable behavior and the technological manipulation of graphs seems to be established as mono-directional feedback system, and people may well become addicted to its strong indexicality.

Measuring technology and data visualization was originally developed to control machinery and economic processes. Persuasive techniques have been used to influence others for millennia. We now employ both to control and influence our individual selves. Thus, S.O.S. apply norm-oriented self-control, efficiency, and permanent improvement to nearly all aspects of human life. The normative influence of the data they produce leads to a complete economization of life.

It remains unclear whether these systems sustainably change people's attitudes and/or routines and as a result their long-term behavior, or just provoke system-conform reactions limited to the period of use only. One could argue that both our intuition and a vital civilizing process based on self-experience and intimate social interaction could become obsolete (cf. Tetrad of media effects, McLuhan 1988). Being brought up in a society that delegates the responsibility to decide on good/bad behavior to machinery feedback, it could become extremely difficult to form critical self-reflection, social responsibility, and decision-making authority. A critical discourse on this trend appears to be as urgently needed as is a more transdisciplinary approach to S.O.S. design.

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