Universidade Federal de Pernambuco
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JOSÉ LUCIANO DE MENDONÇA MELO

PERSUASIVE TECHNOLOGY

Recife
2016

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Final thesis submitted to the
Federal University of Pernambuco
- UFPE, as a partial requirement
for the degree of
Computer Engineer.

Supervisor: PhD. Alex Sandro Gomes

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Aprovado em: _____/ _____/_____.

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Recife
2016

This paper is dedicated to my mother.

Acknowledgements

I would like to express my gratitude to a few people whose help and companionship were fundamentals to the conclusion of this paper.

First, my supervisor Professor Alex Sandro Gomes, whose knowledge inspired and contributed enormously to my own development and served as a source for new discoveries. My sincere gratitude to my family, which have watched and tutored me for all those years, specially my mother who guided me with love and patience.

And at last, to all my university friends, which includes a few professors, that made all the difference when I most needed.

Resumo

Com o avanço dos sistemas computacionais, a virtualização das tarefas cresceu cada vez mais, adentrando a vida de seus usuários que se tornaram cada vez mais *digitalizados.* Estas tecnologias se aperfeiçoaram para não apenas entregar respostas, mas influenciar uma mudança de comportamento e hábitos. Tecnologias cujo objetivo é mudar ou influenciar comportamentos humanos sem o uso da força ou imposição são denominadas persuasivas. Na última década, três grandes frameworks foram elaborados independentemente para esclarecer os princípios e técnicas de tais sistemas. O intuito deste trabalho é, além de fazer uma extensiva análise de tais frameworks, estabelecer conexões entre eles, justificando-as com exemplos reais que já vêm sendo aplicados na computação. Além disto, este trabalho de graduação tem como objetivo ser uma referência em Tecnologia Persuasiva para a Universidade Federal de Pernambuco e outros centros cujo conhecimento na área ainda é incipiente. Para isso, foi-se realizado dois estudos de caso, ilustrando as técnicas e princípios da Tecnologia Persuasiva mencionados nos frameworks já disponíveis da literatura. Os resultados foram construídos capítulo a capítulo, a cada novo framework estudado, enquanto um mapa mental foi construído e conexões foram estabelecidas. Com os resultados, os casos de estudo conseguiram uma marca de mais de 50% no nível de persuasão proposto pelos frameworks. Finalmente, uma avaliação dos principais pontos faltantes nos estudos de caso foi realizada, e melhorias foram propostas como forma de os tornar mais persuasivo.

palavras-chave: tecnologia persuasiva, mudança de comportamentos, softwares de mudança comportamental

Abstract

With the advance of computing systems, the virtualisation of tasks had grown even more, making the life of people even more *digitalized.* Those technologies have become more precise not only to deliver results (outputs), but also to influence and change behaviours. Technologies the aims to change or influence behaviours without coercion are named to be persuasive. In the last decades, three big frameworks were independently elaborated to clarify the principles and techniques of such systems. The goal of this paper is, besides doing an extensive analysis of these frameworks, establishing connections between them, with basis on real examples that have been applied in computing. Besides that, this final thesis aims to be a reference in Persuasive Technology to the Federal University of Pernambuco and other academic centres whose knowledge in this field is still taking its first steps. To achieve those results, two case studies were done, illustrating the principles and techniques of Persuasive Technology that are already mentioned in the frameworks from the literature. The results were made chapter by chapter, as the frameworks were explained, and a mind-map was built to point out possible connections between features and concepts. With the proposed enhancements, the case studies could score more than 50% in the principles, as compared to lower results before the suggestions. Finally, an evaluation of the flaws and weak points from the case studies was done in order to come up with enhancements, helping them become even more persuasive.

key-words: persuasive technology, behaviour change, behaviour change related softwares

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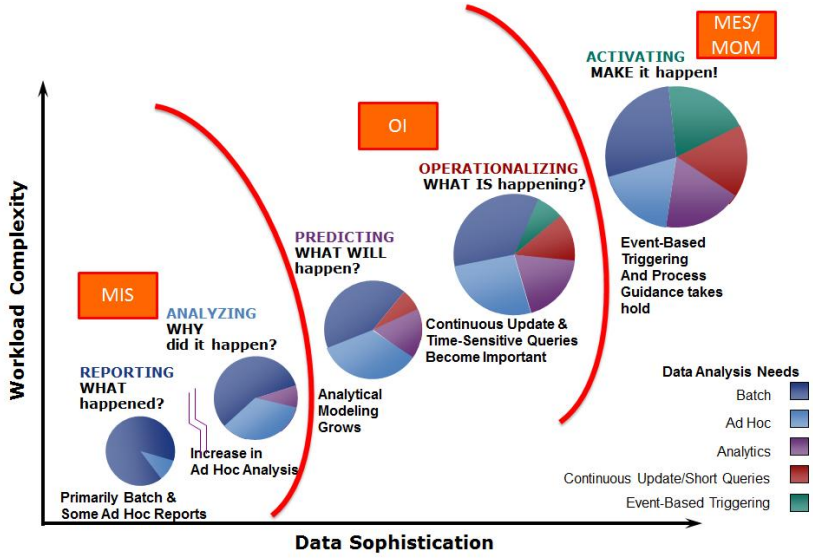
1 Introduction

When the first computers were brought to the commercial use, the companies were highly interested in the power of data processing. What before was made by human hands could now be done by machines. The core value was merely computational: the input was inserted and the output was collected. And humans could decide based on those answers[1].

Figure 1: The evolution of data sophistication



Source: GREEFF, Gerhard. **Demystifying real-time manufacturing data acquisition solutions**. LinkedIn. Disponível em: <https://www.linkedin.com/pulse/20140918054455-5235307-demystifying-real-time-manufacturing-data-acquisition-solutions>. Acesso em: 8 dez. 2016.

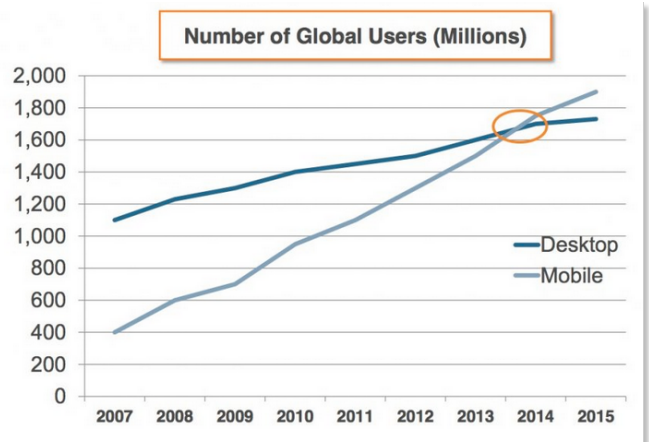
The second evolution of commercial computers[1] was done by the Operational Intelligence systems (OI), whose most relevante feature was the capability of predicting certain scenarios. The questions raised were “what’s happening?” and “what will happen?”, and that allowed the operators to know more about their companies and their future outcomes. The power of processing’s concerns changed into the power of prediction, but the core aspects of such systems relied still on data.

Once the third evolution took place, it used the system’s self-generated data as the resource to predict and make changes happen, automatically. It was the substitution of the human specialisation by the machine’s soundness. More and more artificially intelligent

machines were built in order to ease the burden of the human decision. This new era of computing rely on artificial expertise and exists to assist human thinking and provide better solutions in a daily basis.

The late 2000's and the beginning of the 2010's were important for the popularisation of personal devices and apps, when they became smaller and ubiquitous. In 2015, the world reached a breaking point when the number of smartphone users surpassed the number of desktop computers[2], representing a shift in the industry's focus and people's interests.

Figure 2: Number of smartphone users



Source: CHAFFEY, Dave. **Mobile marketing statistics 2016**. Mobile marketing analytics. Disponível em: <http://www.smartinsights.com/mobile-marketing/mobile-marketing-analytics/mobile-marketing-statistics/>. Acesso em: 8 dez. 2016.

As even more people continue to use smartphones to assist their tasks, new solutions are released everyday to help people achieve their goals, interact with their peers and have a greater experience in their daily life. In this scenario, the technology changes the behaviour of people towards an intended goal.

That's where the concept of Persuasive Technology (PT) comes in handy. The study of this kind of technology clarifies the principles that influence people in different aspects of their lives[3]. Persuasive technology concerns the human behaviour and how it can be changed in non-coercive ways. The power of predicting is now substituted by the power of assisting and keeping the desired behaviour.

This paper will highlight the fundamentals of persuasive technology, in order to contrast and associate the concepts already known in the literature and provide a clear panorama of what this new field of study is. The methodology is detailed in the following section.

As a comparison and illustration tool, the Persuasive Technology and its principles are explained with the assistance of two existing applications (case studies). The reward program systems (such as flight miles and bonus cards) and smartphone application “Seven Minute Workout”, produced by the Wahoo Fitness L.L.C.

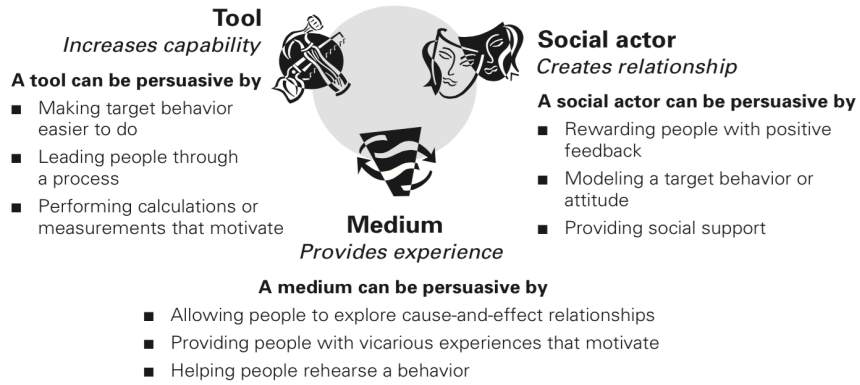
2 The functional triad

B.J Fogg defined Persuasive Technology as a computing system designed to change people's behaviours or attitudes[4]. A system can have a macro or a micro level of persuasion, where the first are the systems designed specifically with the intent to persuade and the latter are the systems with a *side-intent* to persuade.

Macro persuasive systems are, for example, applications designed to change some specific behaviour, such as the *7 minute work out app*, which is responsible to help people have a healthier life.
Micro persuasive systems are, for instance, e-mail delivery programs, whose intent is not to change any particular behaviour but in some part of its use, it alters how people perform their tasks (by having appointment notifications, or big interactive buttons, for example).[4]

B.J Fogg introduces a framework to help understanding how computers perform, from the user perspective. This framework relies on the *functional triad*, three roles that computers can play: tool, media and social actor.

Figure 3: The functional triad



source: FOGG, B J. Persuasive technology: Using computers to change what we think and do. Amsterdam: Morgan Kaufmann Publishers, 2014.

It's important to clarify that those three roles are not "inherently" persuasive. They can perform as such for their characteristics, which are explained in the next sections.

Computers' fundamental task is to provide more computacional power to its user. It'll read data and understand it in a way that humans could not do. And that's one of the roles it can perform as stated in the functional triad[4]: computer as a tool.

The computer as a tool is the system that helps people with their tasks, making it easier to achieve. Its concerns are about the capability and performance.

Once the computers help the users so much, from reading more data to predicting future scenarios, it's easy to notice that it can and has changed human behaviour. In the scenario where those systems are designed to change a particular attitude or behaviour by making the desired task (*outcome)* easier to achieve[4].

There are seven types of persuasive tools, listed by Fogg[4]. They are: Reduction, tunnelling, tailoring, suggestion, self-monitoring, surveillance and conditioning. Once the systems perform one of those functions in order to change a behaviour towards a desired goal, it's said to persuasive. It's worth noticing that a system usually performs more than one of those tools at the same time.

2.1.1 Tool: Reduction

This is a simple yet powerful persuasive tool. Reduction relies on cutting down the number of steps towards the user's goal and it's currently a common practice by the technology companies.

One clear example: a mother makes the lunch for their kids, going through the process of cooking, storing and arranging the packages by day so the children won't have to do all those steps in order to feed themselves. Desired goal: have the kids fed. Steps reduced: cooking, storing the ingredients and arranging the food by day. Actual task performed by the users: grab the package and eat.

The computers systems perform like the mother from the previous example. They do many previous tasks and require only the minimum amount of steps to be performed by the users. And then the desired behaviour is reached.

Principle of Reduction:
“Using computing technology to reduce complex behaviour to simple tasks increases the benefit/cost ratio of the behaviour and influences users to perform the behaviour.”, B.J Fogg.

2.1.2 Tool: Tunneling

Tunnelling is a common persuasive tool computer engineers have adopted along the past decades. It’s about leading the user throughout a path towards a determined goal, step by step while giving them feedback.

An easy yet powerful example of tunnelling are the software installation assistants. Once the user starts the process, they must only click “next” a few times, reducing their concerns and decisions. There are a few moments where you can decide things in the tunnel, but mostly they’re clear and linear decisions.

Principle of Tunnelling:
“Using computing technology to guide users through a process or experience provides opportunities to persuade along the way.”, B.J Fogg.

B.J. Fogg warns[4] about possible ethical problems with the tunnelling persuasion methods. Once the engineer establishes a path where the user can follow, this path must have a clear end goal and the user can quit without any backlash. Example given: instant messengers, such as Whatsapp, ask for permissions during the use of the app to access personal informations, and depending on how the solicitation is required, it could seem as if there’s no other option of using the app if the user wants to deny its request. It can lead to coercion[4].

2.1.3 Tool: Tailoring

Tailoring is about showing information that's relevant to the user. Once the amount of available data is enormous, people can get quite distracted and not motivated if they have to read or understand it all. Good tailoring systems show what's needed, in a language their target audience understands and copes with positive behaviour.

One good example of Tailoring are the relevance algorithms of search systems, such as Google, which filters the most useful pages for the users, based on their search history, location, age and other factors. The average user is more likely to click on the first links naturally. However, this can lead to unethical concerns, if the system provides misleading information in order to shape up the desired behaviour.

Principle of Tailoring:
"Information provided by computing technology will be more persuasive if it is tailored to the individual's needs, interests, personality, usage context, or other factors relevant to the individual.", B.J Fogg.

2.1.4 Tool: Suggestion

The suggestion persuasive tool concerns about giving feedbacks on the right time[6]. Marketing companies are very good at making people want their products and reaching to them at an opportune moment. E.g., once it's six o'clock, food delivery apps send the users a message to remind them it's dinner time (therefore *ask for the food time*).

The suggestions based on *context* have increased in the past decade, mostly due to the enhancements of the technology and market demands to know better about people's habits, but its complexity is still a concern.[5]

Principle of suggestion:
"A computing technology will have greater persuasive power if it offers suggestions at opportune moments.", B.J Fogg.

2.1.5 Tool: Self-Monitoring

A useful tool to persuade is to tell the users in real time their progress. And that's the essence of self-monitoring: to give the user the capabilities of seeing how he or she performs a specific task and how it impacts on the bigger goal (behaviour change). It avoids the tedious sensation when a repetitive task must be done.

For example, when a student is learning a language and receives straightaway a feedback on how their fluency level has improved by completing a task, the student can get more motivated and is less likely to think that the task has little or no impact on the progress as a whole.

Nowadays, health-related apps, such as RunKeeper, counts the steps a person takes per day in order to report how many calories they have burned and how it affects their general weight loss goals[5].

It's important to point out the importance of a clear path towards a desired goal so the persuasive systems in question can give proper feedback and measure the improvement of such habits. If the information is not accurate, the user might get lost or be mislead.

Principle of Self-Monitoring

"Applying computing technology to eliminate the tedium of tracking performance or status helps people to achieve predetermined goals or outcomes." B.J Fogg.

2.1.6 Tool: Surveillance

When user's behaviours are being watched through a computer system that's able to feedback and give incentives towards a desired goal, this computer system is called a surveillance persuasive tool.

In Self-monitoring tools, the user has the chance to monitor their own behaviour, while in Surveillance tools, the user is being watched and becomes more likely to change their attitudes when informed about their own behaviours and compare them to their peers'.

There are two types of monitoring the behaviour with computer systems: overt and covert[4]. The first relies on letting the user know that they're being watched, and it gives positive incentives towards a better attitude. The latter is internal and mostly isn't visible to the user (it's hidden), in a way that the wrong or negative attitudes are punished. This covert systems are not persuasive, they are punishing systems and are less likely to change a behaviour permanently.

Principle of Surveillance

"Applying computing technology to observe others' behavior increases the likelihood of achieving a desired outcome." B.J Fogg.

2.1.7 Tool: Conditioning

Operant conditioning (also called "behaviourism") is a tool that uses positive reinforcements to increase the instances of a behaviour or to shape complex behaviours[7].

This technique is well known when one's training their pets, such as a dog or cat, and a reward is given every time a desired task is done (e.g seating, rolling, playing dead). The essence of giving positive incentives is to enhance the experience and to stimulate the attitude's repetition, making it into a habit.

In the last few years, *gamefication*[8] became popular in rewarding systems, because it introduced the idea of giving digital rewards in order to simulate the physical rewards such as coins, points or advantages.

Principle of Conditioning

“Computing technology can use positive reinforcement to shape complex behaviour or transform existing behaviours into habits.” B.J Fogg.

2.2 Computer as Media

With the advent of virtual reality, engineers could see the power simulations have upon the users. For example, a teenager can have nauseas while experiencing a roller-coaster simulator, and a kid can get scared when watching a horror movie. Those experiences have become part of de digital users’ lives and they’re everywhere.

When a person watches a video about animal slaughter, they are more likely to have a pro-vegetarianism point of view when asked afterwards about the subject. It’s due to the experience he or she just underwent via a video, a principle that is called *empathy*[9]. And similar experiences can be compared, as the aforementioned roller-coaster simulation.

B.J. Fogg states in his article that if the simulated experience is compelling, computers can shape attitudes and behaviours[4]. The power of simulation by computers have a strong impact on how the users learn, react and change behaviours.

It’s proposed three main categories for underlining the simulations that are relevant to persuasive technologies. They are: simulated cause and effect scenarios, simulated environments and simulated objects. They are explained in the following sections.

2.2.1 Media: Cause-Effect Scenarios

When users can see a broad panorama of the current scenario, simulate possible attitudes and see their outcomes, they are more likely to perform a desired task with compliance. The simulation of cause and effect empowers the users with a general perspective of future events, in relation to a desired goal.

The concept of persuasion through cause-effect scenarios relies on shortening the distance between input and output by showing the link between them in a clearer way. The

key feature is *time-forwarding* (being able to show the future by simulating it), without the impacts of the real world consequences.

E.g when a person wants to lose weight, if they eat junky food they won't see the immediate effects (impacts) on their general goal. But a computer system can emulate this *future* for them, showing how his or her body will be if the behaviours won't change. The person is thus more likely to opt in for a better attitude.

Principle of Cause and Effect

"Simulations can persuade people to change their attitudes or behaviors by enabling them to observe immediately the link between cause and effect." B.J Fogg.

It's worth pointing out the connection between the experience persuasion system (cause and effect scenarios) with the self-monitoring tool mentioned above in the previous section. Both of them are concerned about giving the user a clear perspective of their future and their progress. The difference is that the self-monitoring tool relies on the information, while the cause-effect scenario relies on the impact of an experience (the observation of a possible *future*).

2.2.2 Media: Simulated Environments

With the same intent as cause-effect scenarios, the simulated environments are concerned about bringing a safe and controlled simulation where the user can test their attitudes and see their consequences. It can be done through virtual rehearsal (repetition) or virtual rewards.

Once the user can repeat and train their attitudes, they are more likely to stick to the desired behaviour. For example: if a person is taking driving lessons, it can be smart to train the skills in a controlled environment, so they can see their flaws and correct them.

A simulation[10] was made to train inhabitants of a dutch village to respond correctly to climate change, due to their conditions of living under sea-level. Those experiments were also useful in case of floods, a common phenomenon in the region. The participants could

see their villages in a three-dimensional game, and had to decide what were de best alternatives to complete the game (in real life, stay alive).

Principle of Virtual Rehearsal

“Providing a motivating simulated environment in which to rehearse a behaviour can enable people to change their attitudes or behaviour in the real world.”, B.J Fogg.

The simulation can also reward virtually the users for their positive behaviours. And this virtual rewards help building a better behaviour in the real world. If one pays attention carefully to the concept of virtual rewards, it may come to mind the relation with the persuasive tool of Conditioning, where positive behaviours were pushed forward by the presence of positive rewards.

While the Conditioning tool concerns about giving a positive rewards to improve attitude, the rewarding system in simulated environments is concerned about the experience and how those rewards can be done virtually, mocking real life.

Principle of Virtual Rewards

“Computer simulations that reward target behaviors in a virtual world, such as giving virtual rewards for exercising, can influence people to perform the target behavior more frequently and effectively in the real world.” B.J. Fogg.

Two connections were made and the mind-map had been expanded into more definitions. It looks now like this:

2.2.3 Media: Object Simulations

The most powerful of the technological persuasive methods concerning the experience of the user: the simulation of the virtual in real-life objects or situations. It’s just the opposite of the simulated environments: while the first aims bringing the virtualisation of real-life, showing possible consequences in the digital world, the object simulation is more concerned of bringing to a real life object situations that can make the user reflect about their behaviour, train it and change it.

A very classical example is the training for becoming an astronaut. It's hard to predict someone's behaviour when facing unknown conditions[11], since such conditions are not present on earth. But engineers could make a prototype version of their vehicles and beyond-earth environments and with such, they can reach good results in shaping behaviour and inducing a successful mission when it really happens.

The power of this method relies on the little dependence on beliefs or imagination. The user doesn't need to imagine the outcomes, it can interact directly with a simulation of the object.

Principle of Simulations in Real-World Contexts
"Portable simulation technologies designed for use during everyday routines can highlight the impact of certain behaviors and motivate behavior or attitude change." B.J Fogg

2.3 Computer as Social

Once computers interact with people, it can trigger social reactions and emotions: from anger and frustration to love and satisfaction. The power of social clues rely in the human being's own existence: we are interactive creatures made to respond to the environment. And not surprisingly, the technology plays social roles that can influence people's behaviours and attitudes.

Researchers have found that robots with social expressions and personality are more likely to be accepted and appreciated by human beings, since they can relate more closely to the technology[12].

B.J. Fogg introduces therefore a third role in its functional *persuasive* triad: the social role. When computers can mimic social clues, it can persuade, influence and motivate people. There are five kinds of social clues computers can do: physical, psychological, language, social dynamics and social roles. And they're explained as follows.

2.3.1 Social: Physical Cues

Having physical characteristics embodied in a digital or physical way is already enough to say a computer performs a social role. Wether a robot with an eye or a mouth[11] that can mimic expressions or a software with a digital pet that motivates people through their tasks, those social cues do act as persuasive factors.

As for the humans, attractiveness plays a big role in influencing people when it comes to technology as well. And the more beautiful a social technology actor is, the more capable is it to influence their users[13][14].

A good example of a social persuasive computer with physical clues are the english learning app Duolingo[15], which uses an human-like owl to motivate its users in doing more tasks and progress.

Principle of Attractiveness

“A computing technology that is visually attractive to target users is likely to be more persuasive as well.” B.J. Fogg.

2.3.2 Social: Psychological Cues

When a computer behaves in a more human way, such as with icons (emoji’s) that express emotions or texts that provide empathy, it’s playing a psychological social role and it can be persuasive. Psychological cues can be simple, such as affection-based texts, or more complex, such as a bugged system that irritates the users (making the emotion come up).

The afore mentioned cat-like robot, iCat[12], from Phillips, plays with the expressions and it is used in order to help diabetic people adopt better habits and stick to the new behaviour while interacting with it. The psychological cues are everywhere, since empathy and personality are some of the traits the robot can perform and mimic from humans. The research with diabetic people[12] has helped the scientists identify a guideline to make it more persuasive based on psychological persuasive cues.

Principle of Similarity

“People are more readily persuaded by computing technology products that are similar to themselves in some way.” B.J Fogg.

2.3.3 Social: Language Cues

One of the most powerful interaction methods of the human being, the language is important not only to communicate but also to persuade. Most of the computer systems use language to interact with the user, at least at some moment of the process.

It’s important to point out that when it comes to language interactions, human beings are more open to persuasion if the language in use is positive and offers incentives and praises. As stated in B.J. Foggs Praise Principle, as follows:

Principle of Praise
“By offering praise, via words, images, symbols, or sounds, computing technology can lead users to be more open to persuasion.”

2.3.4 Social: Social Dynamics

The human interactions are made of non written rules. Just like with protocols in software engineering systems, such as the Handshake Protocol[16], normal interactions also have their custom. When the computer uses of such social conventions, such as asking for permission to perform a task, the user can relate more to what’s being done and offered.

Almost every system that interacts with human beings follow some protocols, which are already common to us. E.g, one has certainly already seen the message “would you like to report this error?” when their browser or application crashes, because the engineers know that people’s privacy should be preserved.

It happens that when a computer makes a *favour* to a user, he or she will feel the need to respond in a positive way.

Principle of Reciprocity
“People will feel the need to reciprocate when computing technology has done a favour for them.” B.J. Fogg.

A good example of this method being used as an advantage to persuade users is the *rating systems* of online app stores. When a person is using an app that was download for free, they may get a message “You seem to like our app! Would you mind spending a bit of your time to rate it?”.

2.3.5 Social: Roles of Authority

When a computer adopts the role of authority (expert), the users will automatically associate it with trust and expertise. That's what happens when a "professional" version of a program is available, or when a health-related app has "Doctor" in its name.

Th website "Specialist in Websites", http://specialistinwebsites.nl, uses this notion of authority to show confidence and trust to its clients.

Figure 4: Role of authority on Specialist in Websites

Source: Specialist in Websites, https://specialistinwebsites.nl (2016)

3 The Systematic Framework of Oinas-Kukonnen and Harjumaa

Just like B.J. Fogg introduced his own functional triad as a framework to establish the principles of Persuasive Technology (PT), Oinas-Kukonnen and Harjumaa also did a similar task. Independently, they reported on their article “A Systematic Framework for Designing and Evaluating Persuasive Systems”, a framework with four big schemes for PT: PT as primary task support, PT as a dialogue support and PT as a system credibility support and PT as a social support.

The topics that each scheme represents may have a direct connection with B.J. Fogg’s principles for persuasive technology, sometimes they have even the same name.

3.1 Primary Task Support

This scheme of the framework relies on the same principles of the “Tool” branch in Fogg’s functional triad. The computer helps the user achieve their main goal (primary task) and therefore can be persuasive towards a desired behaviour.

In this primary task branch, there are seven characteristics, in which most of them are directly connected to Fogg’s principles. They are:

Reduction
Just like as in the functional triad’s reduction principle, computers can reduce the effort of the user towards a task, helping them achieve a target behaviour.

Tunneling
The system should guide users towards the goal. And there’s a direct connection with the functional triad’s tunnelling principle.

Tailoring

There’s a direct connection with the functional triad’s tailoring principle, where the information that’s showed is exactly what the user needs, reducing the amount of useless information being displayed.

Self-monitoring

There’s a direct connection with the functional triad’s self-monitoring principle, where the user can track their own performance in order to see their status and give themselves a feedback.

Rehearsal

There’s a direct connection with the functional triad’s simulated environments, where the user can try a digital version or a prototype of their target behaviour's environment in order to train their attitudes.

3.1.1 Primary Task Support: Personalisation

When a person goes to a nutritionist to mount a weekly plan for eating healthier, the Doctor must prescribe some requirements to make the goals, such as losing weight, achievable. And people can feel frightened by the rules and conditions that may arise from such commitment.

A technique to help people follow the instructions is to give them the capability of personalising the plan. If the patient feels he or she is in control of the options, and makes the plan the closest to their own tastes, they’re more likely to cope up with it.

Principle of Personalisation

“A system that offers personalised content or services has a greater capability for persuasion.” Oinas-Kukonnen and Harjumaa.

3.2 Dialogue Support

This scheme of the framework relies on the idea of pushing the user towards their desired behaviours, keep them moving. The computer uses communication tools to interact with the user in a positive and motivating way.

In this dialogue support branch, there are more seven characteristics, in which most of them are directly connected to Fogg's principles. They are:

Praise

There's a direct connection with the functional triad's *language cues* principle, where the software uses of affectionate and positive language to help users progress with their behaviour change.

Rewards

There's a direct connection with the functional triad's *virtual rewards* principle, where the system can provide virtual rewards to the user in order to give them credit for their good behaviours or attitudes.

Suggestion

There's a direct connection with the functional triad's suggestion principle, where the system givers clues and hints at opportune moments in order to keep the user doing their activities and performing their tasks.

Similarity

There's a direct connection with the functional triad's psychological cues, where it's stated that people are more readily persuaded by computing technology products that are similar to themselves.

Liking

There's a direct connection with the functional triad's physical cues, where it's stated that computing technology that is visually attractive to target users is likely to be more persuasive as well.

Social Role

There's a direct connection with the functional triad's authority role principle, where it's stated that when a computer adopts the role of authority (expert), the users will automatically associate it with trust and expertise.

3.2.1 Dialogue Support: Reminders

People in urban centres carry a smartphone with them, making them be connected with a virtual world most of the time. One of the smartphones', personal digital agendas' and similar products' features is the capability of reminding their owners of tasks or appointments they have. The feature of reminding people what they should do is a strong persuasive characteristic and it is each time more evident in apps and websites.

The Brazilian credit card *Nubank*[18] warns their clients that the payment date is approaching and after that, fees will be charged. This simple feature prevents people of making bigger debits than they were first willing to make.

3.3 System Credibility Support

This branch of the framework relies on the idea that credible systems can be more persuasive. It differs in many ways from Fogg's functional triad, since there's only a few characteristics that deal with trust in that framework. Nevertheless, there are a few common points. They are:

Expertise and Authority

Just like the Authority Role in Fogg's triad, Oinas-Kukonnen and Harjumaa refer to the core characteristics of displaying a sense of expertise, and how it impacts on the user's sense of trust. The expertise is usually combined with a role of Authority, when the software identifies itself as an specialist.

Surface Credibility

This characteristic related to Fogg's attractiveness principle, where it's stated that more appealing visuals will be more persuasive.

The other factors in the System Credibility Support branch differ in essence from Fogg's principles. They are as follows:

3.3.1 System Credibility Support: Trustworthiness

A system that is trusted by the users is more credible and therefore more persuasive. And techniques towards this goal rely on showing the user useful and unbiased information.

A good example to show how trustworthiness works through displaying useful information are the newspapers: they report not only the news, but also who wrote it and the sources of their work and those simple patterns guarantee the users will trust it more[19].

3.3.2 System Credibility Support: Real-World Feel

When one's enter in an institutional website nowadays, a very common section is the "About Us". This section displays the people behind the company, their purpose and possibly a way to contact them.

This idea of connecting the real-world aspects of the company to their digital services make users have more trust towards the company itself and therefore more likely to be persuaded.

3.3.3 System Credibility Support: Third-Party Endorsements

Not only displaying the company's people behind the services is important. Once there's information about other companies, services and people that already use or endorse the system, people are more likely to trust it and be persuaded. Systems should provide statements from other respected sources in order to be more persuasive.

The current e-commerces available online display security certificates in order to gain trust. While NGO's display pictures of the institutions they help so people will know how and where their donation is going.

3.3.4 System Credibility Support: Verifiability

It's important that once sources and third-party partners are present on the system, the users can verify easily if the information is accurate directly via outside sources.

It's a simple task, but most of the websites don't do it fearing they'll lose their audience. But they pay the price of mistrust instead. Providing links to the source or other websites will make the system/website more persuasive.

3.4 Social Support

This branch of the framework differs in some aspects to Fogg's social role in the functional triad. While the triad relies on sociological aspects (such as humanlike interactions), Oinas-Kukonnen and Harjumaa focus more on the interaction between human beings in order to guarantee motivation and make the users more likely to be persuaded.

Social Learning and Social Comparison

Both factors complete each other and rely on the idea that other people's progress make a certain influence in oneself's progress. Once the user can see the progress of their peers and the outcomes of those behaviours, they can motivate themselves towards a positive attitude. And that's exactly the Surveillance tool of B.J Fogg's triad.

3.4.1 Social Support: Normative Influence

The normative influence is concerned about bringing together people with the same goals, so they can interact and motivate each other. Games are good at keeping people motivated, because it creates a sense of positive competition among the users.

Once a use interact with other human beings that have the same struggles or desires as him or her, they create a sense of belonging and they tend to keep up with the good behaviours.

3.4.2 Social Support: Social Facilitation

If users realise other people are doing the same tasks as them, they will feel less lonely and they will feel that the work might result in good outcomes. Even if they are not together, the users are still more likely to be persuaded if they work in a group environment or at least have the feeling that others are performing similar tasks along the way.

The company Apple is good at marketing with the idea that other (happy, successful) people are also using their products. The users can create a sense of connection to the company's products because they see people that already use them as a role model.

3.4.3 Social Support: Cooperation

Human assistance can be more intimate and trigger engagement, and co-operation can lead to more positive attitudes towards a behaviour change. People feel compelled to cope up when they are being watched or guided by other human beings.

Giving the possibility for humans to naturally collaborate towards a desired goal can lead to more successful approaches of changing behaviour. Oinas-Kukonnen and Harjumaa state[17] therefore that computer systems should provide those means *of cooperating* so the humans can interact with each other.

3.4.4 Social Support: Competition

The human being's natural survival instinct is triggered by competition and this leads to a more motivated (and energetically engaged) users. This is seen in the Olympic Games, a

tradition that already exists for centuries, and pushes people to even more challenging marks.

This is also reflected with computing interactions: when the users are performing any kind of competitive tasks, they feel more persuades to complete the tasks (and put more effort in it) simply by the urge of being better than others.

Principle of Competitiveness:

"A system can motivate users to adopt a target attitude or behaviour by leveraging human beings' natural drive to compete." Oinas-Kukonnen and Harjumaa.

3.4.5 Social Support: Recognition

It's a characteristic similar to "Praise", stated in the aforementioned sections, but Recognition relies on the idea of complimenting people that perform a good behaviour and also showing it to others.

It's more like a podium in Formula 1, when the winners get to step up and receive medals for their good job. Or when a employee is rewarded with the "member of the month" pin. It makes people more motivated to achieve better results, making them more likely to be persuaded to cope up with the proposed tasks.

Principle of Recognition:

"By offering public recognition (for an individual or a group), a system can increase the likelihood that a person or group will adopt a target attitude or behaviour." Oinas-Kukonnen and Harjumaa.

4 Weapons of Influence

In the book “Influence: the psychology of persuasion”[20], Cialdini explains six persuasive factors that go beyond computing systems, that he calls weapons of influence. Those factors are purely human-related and are extensively detailed in the book.

It’s possible to make a direct connection between Cialdini’s weapons of influence and Fogg’s and Oinas-Kukonnen and Harjumaa’s frameworks, and most of them were already explained in the previous sections.

The following weapons are already mentioned before: **Reciprocation** is related to Fogg’s Social Dynamics, **Social Proof** is related to the Social Support of Oinas-Kukonnen and Harjumaa, **Liking** is related to Fogg’s and Oinas-Kukonnen and Harjumaa’s Attractiveness and Liking characteristics and **Authority** is directly linked to Fogg’s Social Actors.

However, there are two entirely new persuasive *weapons* stated by Cialdini in his book, they are Commitment and Consistency and Scarcity.

4.1 Commitment and Consistency

Once a person is committed to follow a path, it’s more likely that he or she will be more motivated and certain about the positive outcomes they can *possibly* have. This commitment is related to the fact that users should choose a side and be consistent about it. If many options are all the time available, they will be more likely to doubt their own path and the feeling of belonging will be damaged.

4.2 Scarcity

People find the idea of exclusiveness as appealing as any other advantages or values a product or software may have. It’s a source of status and that motivates. But not only exclusive, the softwares and systems can transmit the idea of scarcity, meaning they are supposed to be few.

Once the user focuses on the urgency of a behaviour, a reward or a resource they can get from the app, they are more motivated to work for it. It's called the *potential loss* by Cialdini. It's a weapon the salesmen use all the time, *"only a few pieces left!"*, making people buy more and more.

5 Methodology

The three frameworks listed on sections 2, 3 and 4 assembles a series of principles and characteristics that are fundamental to check wether a system is persuasive or not. In the literature review, the connections between them were made and a final list of the principles can be listed as follows:

Table 1: Principles of Persuasive Technology

Tool	1	Reduction
	2	Tunneling
	3	Tailoring
	4	Suggestion
	5	Self-monitoring
	6	Surveillance
	7	Conditioning
Media	8	Cause-effect scenarios
	9	Simulated environments
	10	Object simulations
Social	11	Physical cues
	12	Psychological cues
	13	Language cues
	14	Social Dynamics
	15	Roles of authority
Primary task support	16	Personalisation
Dialogue support	17	Reminders
System credibility support	18	Turstworthiness
	19	Real-world feel
	20	Third-party endorsements
	21	Verifiability
Social support	22	Normative Influence
	23	Social facilitation
	24	Cooperation
	25	Competition
	26	Recognition
Weapons of Influence	28	Commitment and consistency
	28	Scarcity

Source: the author

It’s aimed to make an analysis of two case studies, **Lifesum**, a health-related mobile app, and **Dotz.com**, a reward system, based on the 28 principles presented on Table 1, and once the conformity with the principles are checked, propose improvements on the categories they are not conformed.

The condition of conformity is a clear presence of a feature available to the final user, demonstrated by the means of a figure on this paper and the judgement is upon the author’s responsibility. A more impartial heuristics shall be made for future works. In total, the 28 principles are tested and if not present, suggestions will be offered as part of the results and discussion. If a majority of the 28 principles are present in each case study, the correspondent case study is said to be persuasive.

6 Results

In this section, the conformity to the frameworks are analysed, principle by principle, for the two case studies. Following it, one can find a table with the results of conformity and non-conformity.

6.1 Results by principle

Here, one can find the detailed explanations of conformity for each principle of the frameworks presented in Table 1.

6.1.1 Tool: Reduction

Analysing the app Dotz.com, the digital reward system, one can study how he increases the power of the user by reducing some steps.

The first step is to store and provide the bonus collected from multiple stores or services. The user doesn't need to go from place to place to collect their bonus. It's all simplified to one platform.

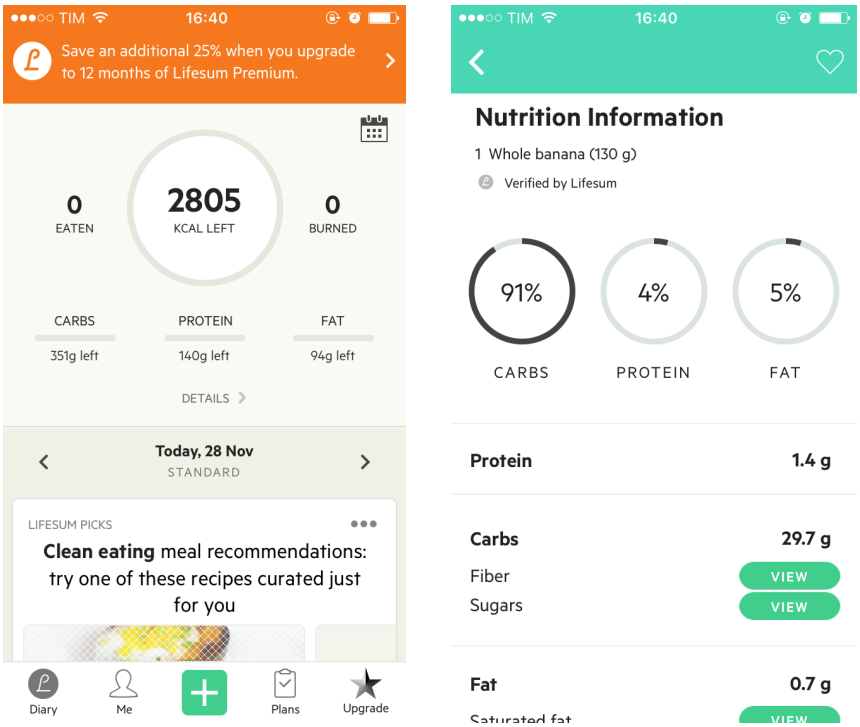
Figure 5: Dotz.com partners centered in one platform

Source: https://www.dotz.com.br/Parceiros.aspx (2016)

The health-related app LifeSum, which we are also analysing, has also reduction strategies. Once it provides a detailed and automatised count of how many calories a person has ingested during the day, it avoids the manual calculations, nutrition tables and so on.

Another reduction strategy is when LifeSum integrates all the food information already in its database, so the user won't need to update themselves how many calories, proteins, fat and carbohydrates there are in each food they ingest. A timesaver.

Figure 6: Reduction strategies of Lifesum



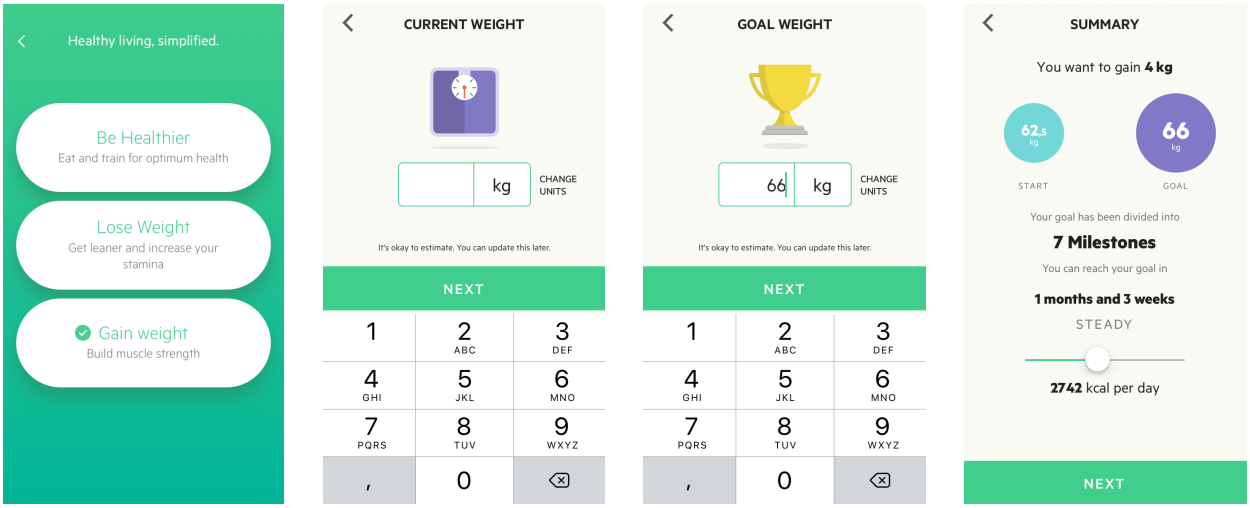
Source: application LifeSum available in November, 2016.

6.1.2 Tool: Tunneling

Dotz.com has not scored at the tunnelling persuasive characteristic, since it lacks of clear paths towards the end goal, where the user is left to decide whether they want to collect their bonus. Certainly there are some defined pathways, such as the configuration schemes, but it's nothing specific from this application.

In the other hand, LifeSum leads the user towards its setup process in a very clear path, where the user can go through without questioning which are the next steps. Once the user opens the app for the first time, he or she must decide the kind of diet they want to start, and a series of clear requisitions appear, one by one, and in the end the system has itself configured and operating.

Figure 7: Tunneling throughout LifeSum - Setting a new diet



Source: application LifeSum available in November, 2016.

6.1.3 Tool: Tailoring

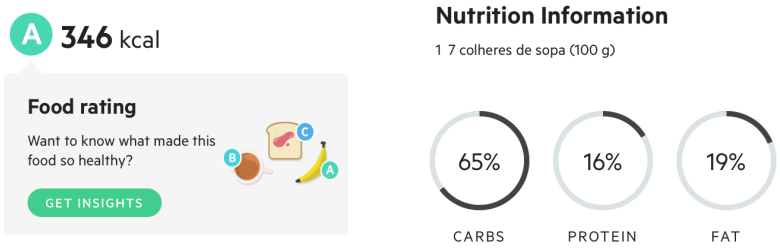
The reward system analysed here, Dotz.com, performs its tailoring when it summarises the points and user's shopping history in a very concise and clear panel as showed in the Figure 9. The information that's relevant for the user are only how many points he or she owns and how they can change it for their desired bonus.

Figure 8: Tailoring tool in Dotz.com: a panel that shows the points and their expiration date

Source: Source: https://www.dotz.com.br (2016)

When it comes to knowing how much of one's personal calorie intake must be ingested, the user may struggle with how healthy or how heavy that kind of food is. LifeSum performs its tailoring when it reduces all the specific (medical) information about the nutrients and show a very simple scale instead. All the food is ranked in a American school grade system, from A to E so the user knows the percentage of proteins, carbohydrates and fat that there is in each portion, as showed in the images below.

Figure 9: Tailoring tool in LifeSum simplifies complex info about food and nutrients



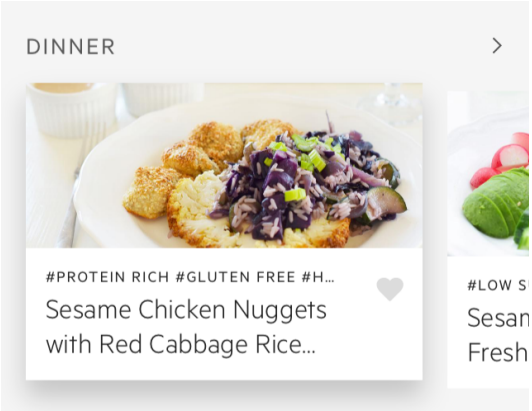
Source: application LifeSum available in November, 2016.

6.1.4 Tool: Suggestion

As to Dotz.com, the system can remind the users it's time to use their bonus again, but it's based on a marketing timing and not really on user's needs or similar. Little is done to understand how the customers react to different kinds of nudges and give feedbacks about their behaviours.

LifeSum has a different approach. At different moments of the day, the app suggests the meal the customers must eat so they can reach the right amount of calories and maintain a healthy life based on experts' opinions. A few other suggestions are made through pop-up messages during the day, such as reminds of water consumption and other health-related hints.

Figure 10: Suggestion tool in LifeSum provides info at the right time about meals and calories



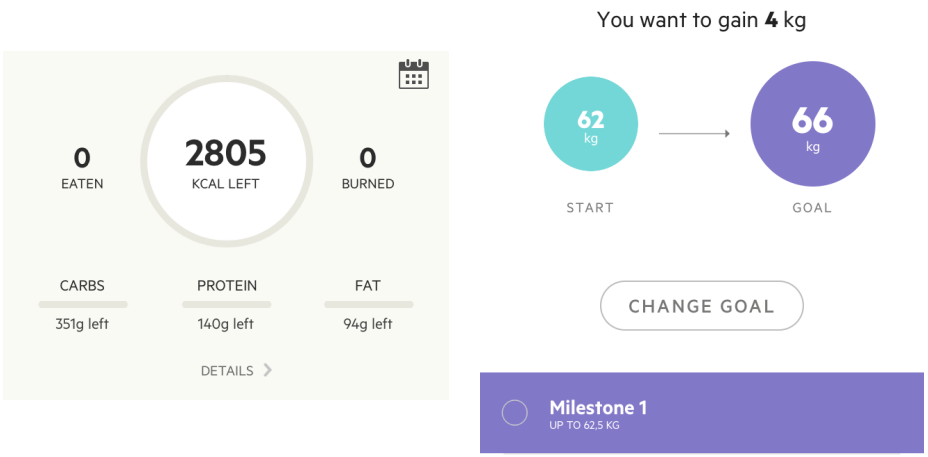
Source: application LifeSum available in November, 2016.

6.1.5 Tool: Self-Monitoring

Dotz.com provides in real time the amount of points a customer has, as showed in Figure 8, and therefore the user can see how much is left to exchange the points into their bonus. Certainly these features could be smarter, where the user could possibly see the percentage of points he's got in order to change for a specific product that he or she previously would have informed the system.

LifeSum shows both the daily progress of calorie intake and the progress of the customer's weight loss or gain and how that impacts on their bigger goal. Its strategy relies on breaking the bigger goal into smaller parts, so the user will have a faster (and more relevant) view of their daily tasks' impacts

Figure 11: Self-monitoring tool in LifeSum provides feedback on each calorie that's consumed



Source: application LifeSum available in November, 2016.

6.1.6 Tool: Surveillance

Both apps, Dotz.com and LifeSum, present no evidences of Surveillance System.

6.1.7 Tool: Conditioning

Both apps analysed here, Dotz.com and LifeSum, lack of Conditioning tools. The motivation for using such apps is enhanced by the visualisation of the progress towards the desired goal.

6.1.8 Media: Cause and Effect Scenarios

None of the apps analysed in this paper offers a sensorial experience for their customers, and therefore lack of case-effect scenario persuasive media characteristics.

6.1.9 Media: Simulated environments

The systems analysed in this paper lack of any simulated experience for virtual rewarding and therefore must be improved in the following results section.

6.1.10 Media: Object Simulations

None of the analysed apps have this kind of experience since they offer no objective version in real life of their desired goals or outcomes.

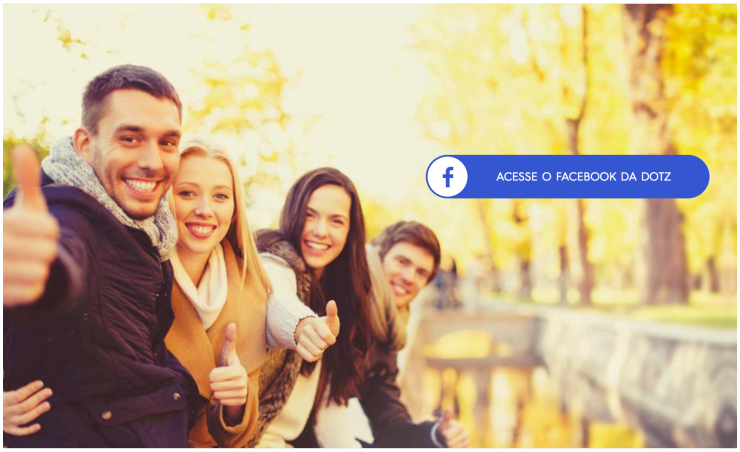
6.1.11 Social: Physical Cues

None of the apps analysed in this Paper, Dotz.com and Lifesum, has any physical social characteristics.

6.1.12 Social: Psychological Cues

Dotz.com relies its psychological cues on marketing advertisements, when it mimics human emotions to motivate people use the system or uses icons to illustrate affection. The positive environment is promoted by pictures of happy people.

Figure 12: Psychological cues in Dotz.com: heart icons to express love and happy people to convey empathy



♥ Lista de desejos

Source: Source: https://www.dotz.com.br (2016)

In the same sense, Lifesum also has some psychological characteristics such as the icons that express affection and a more positive perspective towards the informations provided.

6.1.13 Social: Language Cues

None of the apps analysed in this Paper, Dotz.com and Lifesum, has any characteristics of language cues.

6.1.14 Social: Social Dynamics

None of the apps analysed in this Paper, Dotz.com and Lifesum, has any social dynamics characteristics.

6.1.15 Social: Roles of Authority

None of the apps analysed in this Paper, Dotz.com and Lifesum, play roles of authority.

6.1.16 Primary Task Support: Personalisation

Although Dotz.com offers no options of personalising the app into a more intimate interface to the user, Lifesum has strong personalisation features, such as telling the amount of calories and nutrients they want to take, setting up the range of the goals and the time the desired goal must be achieved as showed in Figure 11.

6.1.17 Dialogue Support: Reminders

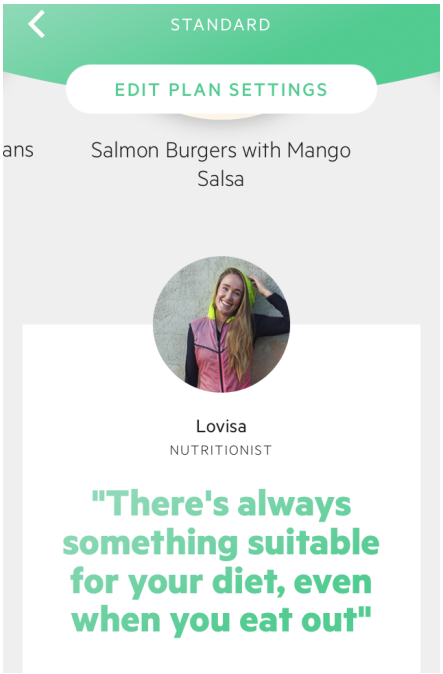
The analysed reward system Dotz.com sends daily e-mails to remind their clients to spend their points in bonus they can collect and this guarantees that people will come back eventually and continue using the system.

Lifesum has a constant notification set up for the users to remind them to drink water, in order to staying healthy. The app asks in the beginning of the installation if it can send the users alerts, otherwise the reminds would become annoying.

6.1.18 System Credibility Support: Trustworthiness

While Dotz.com doesn't show any characteristics of trustworthiness, Lifesum shows reviews and statements of nutritionists and other specialists then it offers and suggests their users a range of healthy habits.

Figure 13: Trustworthiness: Lifesum provides information from specialists



Source: application LifeSum available in November, 2016.

6.1.19 System Credibility Support: Real-World Feel

While Lifesum doesn't have any useful information about the real-life company displayed on the app, Dotz.com offers a small section to contact the responsible team, however the people behind it are not known or at least they are not visible anywhere.

6.1.20 System Credibility Support: Third-Party Endorsements

As showed in Figure 5, Dotz.com shows on its website the many companies they have in their portfolio, as a way to guarantee it's a credible system.

6.1.21 System Credibility Support: Verifiability

None of the apps analysed in this Paper, Dotz.com and Lifesum, have direct means of verifying the veracity of informations.

6.1.22 Social Support: Normative Influence

None of the two analysed apps have the Normative Influence characteristics in their systems, lacking of group interactions.

6.1.23 Social Support: Social Facilitation

Unfortunately neither Dotz.com nor Lifesum has those features since they don't connect any other people's progress to the user's.

6.1.24 Social Support: Cooperation

None of the apps analysed in this Paper, Dotz.com and Lifesum, shows any sign of cooperation methods among their users.

6.1.25 Social Support: Competition

None of the apps analysed in this Paper, Dotz.com and Lifesum, shows any sign of competition methods among their users.

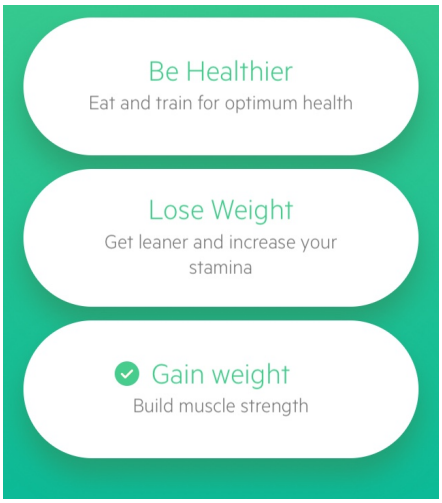
6.1.26 Social Support: Recognition

None of the apps analysed in this Paper, Dotz.com and Lifesum, shows any sign of recognition methods among their users.

6.1.27 Weapons of Influence: Commitment and Consistency

In Lifesum, the first thing the app asks to the user is what goal they want to pursue, and from that point, it will offer milestones to achieve that purpose. It guarantees that the user will stick to the desired behaviour, following a clear and constant path.

Figure 14: Commitment and Consistency in Lifesum



Source: application LifeSum available in November, 2016.

6.1.28 Weapons of Influence: Scarcity

Dotz.com comprehends this concept when it has set an “expiration date” to the points and bonus they have, as showed in Figure 12. Every single point got as an award will expire in a period of time, and this urgency makes people spend or stick to the behaviour of getting always more points because they don’t accumulate enough.

6.2 Compilation of the results

Below, one can see a table that summarises the results mentioned in the section 6.1. If the principle is present for the case study, a “x” is marked on the correspondent line. If it’s not present, a “-“ was written.

Table 2: Results of the case studies in a nutshell

	Principle	Dotz.com	Lifesum
1	Reduction	x	x
2	Tunneling	-	x
3	Tailoring	x	x
4	Suggestion	-	x
5	Self-monitoring	x	x
6	Surveillance	-	-
7	Conditioning	-	-
8	Cause-effect scenarios	-	-
9	Simulated environments	-	-
10	Object simulations	-	-
11	Physical cues	-	-
12	Psychological cues	x	x
13	Language cues	-	-
14	Roles of authority	-	-
15	Personalisation	-	-
16	Reminders	-	x
17	Turstworthiness	x	x
18	Real-world feel	-	x
19	Third-party endorsements	x	-
20	Verifiability	x	-
21	Normative Influence	-	-
22	Social Dynamics	-	-
23	Social facilitation	-	-
24	Cooperation	-	-
25	Competition	-	-
26	Recognition	-	-
27	Commitment and consistency	-	-
28	Scarcity	-	x

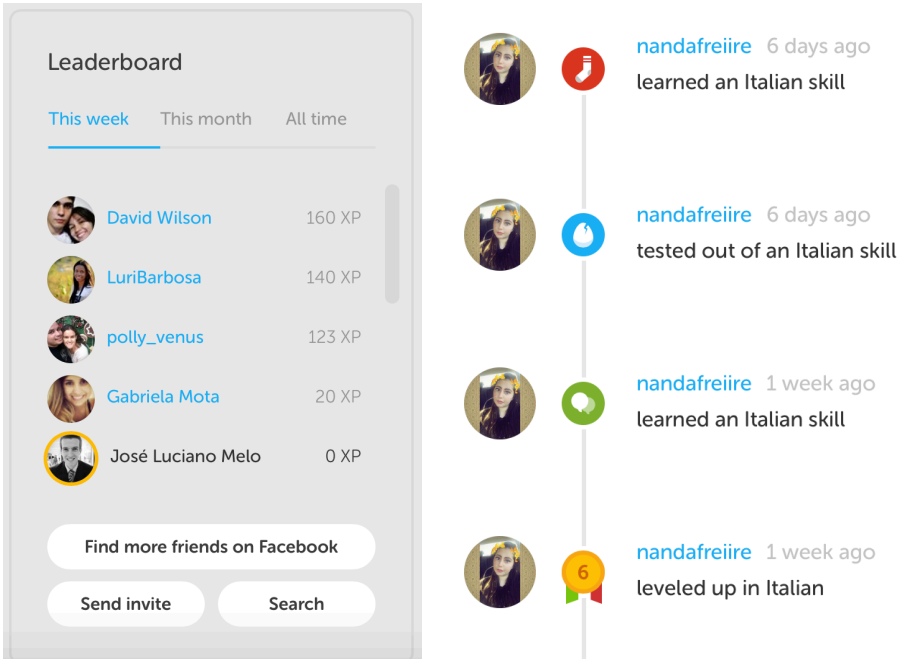
Source: the author

7 Discussions

As one can see in Table 2, both case studies scored low on the framework's principles presence marks. Dotz.com scored 7 principles out of 28 (25%) and Lifesum got a better result with 10 out of 28 (35,7%), and that must be due to the essence of the apps: the first is intended to keep people motivated in using the system, while the second is concerned about changing a behaviour and habits and making people stick to their new attitudes.

Since both apps present no evidences of Social Support, proposed by Oinas-Kukkonen and Harjumaa, it's certainly a topic to present as a suggestion. Other web apps already score high in this section, such as Duolingo[15], the language learning app that allows people keep track of their own progress, but also their peers' progress and with a rewarding system, it makes a competition among the user's friendship network, as showed below.

Figure 15: Duolingo performs high in Social Support characteristics



Source: Duolingo[15]

If a similar system can be put in both Dotz.com and Lifesum systems, they will score in the following categories: normative influence, social facilitation, competition and recognition. The guidelines for Dotz.com is that it can show the user's how many points they peers

have and therefore in what position they are. The same is valid to Lifesum with the calories and weight loss or weight gain, making people more motivated to keep up with the healthy habits.

Another category that got low scores was the Medium's functional triad. Both systems scored zero in this category, lacking of any persuasive experiences mentioned in the framework. Since bringing simulated objects to the context of reward systems or weight loss may be difficult, a suggestion of experiences in Cause-Effect environments can be proposed.

Dotz.com can implement a system where people can adjust how much they want spend in a month, and then Dotz.com can suggest where they can spend so they will the biggest amount of points. Altogether, they can give a suggestion whenever a user is near a shop Dotz.com has partnership with. Therefore, it'll score both in Suggestion category and Cause-Effect environments.
Lifesum can show a picture of the person in a near future whenever they add their calorie intake. If the food is healthy, the user will see a better looking version of his or her body. If the food is unhealthy, they'll see themselves fatter or sadder. The app will gain points in Cause-Effect experience.

Both apps can play the roles of authority. Dotz can adopt the role as the Finances Specialist, where it'll help people save money by using the points of the system. And Lifesum can play the Doctor role, giving specialised tips and suggestions in a more scientific way. Because of that, both apps will be more persuasive, following the Roles of Authority proposed in the three frameworks.

Other enhancements can be made in order to make the case studies more persuasive. Following the guidelines presented in tables 1 and 2, one can have a clear notion of what's lacking in such computing systems in terms of persuasion characteristics.

The conformity and non-conformity criteria of this paper were based on an extensive analysis of the framework principles, using the literature as source and support. For future works, new methods of analysis must be done to prove a characteristic is present under diverse points of view.

There’s a correlation between design guidelines and persuasion, as showed in Looije, Rosemarijn et al, 2006[12]. And therefore, designing more powerful systems means making those same systems more persuasive. It’s expected that with the implementation of the suggestions presented on this discussion, the two case studies can become assertive, more precise, in reaching their goal of changing people’s attitudes.

With the implementation of the suggestions, both apps have scored more points in the established criteria. Dotz’ grades has grown from 25% to 50%, reaching a total of 14 points. While Lifesum has grown from 35,7% to 57,1%, getting 16 points. The suggestions were enough to make them score more than 50% in the persuasion level presented in the frameworks.

8 Conclusion

People have used computer systems to help them achieve complex tasks. The popularisation of smartphones and other small computing devices has made technology present in everyday lives of most of the urban citizens, and therefore shaped their habits. Attempting to change people's behaviours without the need of coercion, persuasive technology (PT) has evolved into more complex and robust systems and it has changed how we see and use computers.

The three frameworks presented in this paper identify, collect and propose principles for building systems that are *persuasive*. And although they are idealised by different researchers, they have common characteristics, becoming an interconnected guideline for PT. In total, it's been found twenty-eight characteristics that are independent from each other across the three schemes, and they have served as heuristics for analysing the case studies for this research.

It's possible to tell by the results, that different systems have different persuasion levels, not only because they score different points in the conformity check, but also because they intrinsically have different purposes and ways of influencing people. While the first case study was concerned about selling more, shaping people's habits towards consumption, the second case study had a goal to change people's food habits into a more healthier perspective. And that's also accountable for how many points they scored in the final results.

The suggestions were based on a simple analysis of other existing persuasive applications, and with a few proposed guidelines, one could see that the case studies could increase their points in the general persuasive level. One case study doubled its score. However, a more in-dept research must be done, in order to identify more carefully the conformity of such characteristics and proposals, and that's due to the next steps of future works.

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