

# A SCREENPLAY APPROACH TO SIMULATE SOCIAL IMPACTS OF TECHNOLOGY IN HEALTH CARE PRACTICES

JANTINE BOUMA  
HANZE UNIVERSITY OF APPLIED SCIENCE  
J.T.HANZE@PL.HANZE.NL

## ABSTRACT

Designers have grown increasingly interested in social consequences of new technologies. As social impacts become increasingly important it might be fruitful to understand how social impacts develop and how a designer can anticipate these consequences. In health care practices, for instance, it is important to control unintended social impacts at forehand. Social impact is an outcome of the mediating effect of a technology with its social environment. Human behaviour in a social environment can be analysed from the perspective of a social ecological system. To anticipate social impacts simulations of social practices are needed. To simulate practices the persona approach has been adapted to a screenplay approach in which the elements of a social ecology are used to gain a rich description of a social environment. This has been applied for a 'Heart Managers' case. It was concluded that the screenplay approach can be used for a systematic simulation of future social impacts.

## INTRODUCTION

During recent years, designers have grown increasingly interested in social consequences of new technologies. Modern information technology, in particular, creates extensive possibilities to influence social behaviour. The responsibility of a designer changes in the case of social innovation. In such cases social outcomes are connected to the intentions of designers and therefore become a responsibility. As social innovations become increasingly important it might be fruitful to understand how social impacts of products develop and how a designer can anticipate these consequences.

Social impacts of new technologies have been the subject of several studies. One example is a study performed at the Rathenau Institute in the Netherlands (Schuurman et al., 2007). They analysed the consequences of Aarts & Marzano's concept of ambient technologies (2003). In the study, the Rathenau institute examined current and future scenarios for different types of future technologies to ensure a discussion about ethical consequences of ambient technologies. From this study the question was raised that although the Rathenau institute acquired important information about social impacts, it was by no means certain that all reasonably predictable results were found (Bouma, 2013). For a designer such an approach might not be sufficient.

When a designer sets out to develop a new product, he may find he needs specific information about the possible social impacts that will allow him to make choices about the product that is to be developed. In health care practices, for instance, it is important to control unintended social impacts at forehand in order to prevent harmful situations for vulnerable patients. I will explain this with an example from the study at the Rathenau institute. The scenario discussed here is an example of context-aware technology that is still limited

in intelligence and describes a man with heart problems who wants to go on a holiday with his wife.

...His cardiologist doesn't want to let him go, unless he is willing to use a 'Heart Manager'. The Heart Manager consists of sensors on his body that continually register his heart rhythm and brain activity (via ECG and electroencephalography) and a gps tracker. The sensors were provided by his insurance company. Were any problems with his heart to develop, ambulances or doctors would be directly alerted.

While on his holiday, he also went mountaineering, during which activity the sensor registered declining cardiac function. After the holiday, he was confronted with this information by his medical coach during a regular check-up. The coach indicated that his insurance might not insure future trips that included hiking in mountains.

For the Rathenau institute (Schuurman, et al., 2007), it is evident that such consequences have ethical implications. Ambient intelligence creates the possibility of adapting to highly personalized needs of patients, such as, in the above example, the support during mountaineering. However, it also creates new possibilities for other parties, in this case, an insurance company, who might ask its policyholders to demonstrate healthier (risk avoiding) behaviour.

The scenario describes one situation in one specific context. Other consequences can be imagined as well: a heart manager used by a user with different characteristics in a different setting. If the purpose of research is to have a thorough understanding of possible social impacts, it might be better to have a systematic way of finding consequences.

In previous research a theoretical framework has been developed and validated that describes the elements that are concerned with the formation of social impact (Bouma, 2013). The validation of this model has been based on cases in which social impact already existed and needed to be identified. For the identification a social ecological model has been used to describe reality in a holistic way. In the case of anticipations of social impacts it is needed to simulate future social practices. Probably the social ecological approach can be used to simulate future practices as well.

The purpose of this paper will therefore be to discuss whether social impacts of technologies can be simulated in health care practices.

#### LITERATURE AND THEORY

Social impact is an outcome of the mediating effects of a technology with its social environment. To identify social impacts it is therefore necessary to describe the process of social mediation on a social level: we need to expand from the traditional use context -which is common for user centred research- to a social context. This has led to the following starting points which are visualized in figure 1:

- Human behavior in a social setting can be analyzed from the perspective of a social ecological system. Ecological systems theory treats individuals as active agents who constantly shape, and are shaped by, their environments (Lounsbury and Mitchell, 2009). A social ecological approach therefore enables us to determine the factors of influence within a social environment (Stokols, 1996). Every change in a context leads to intended and unintended changes due to other factors that can be related to social (formal and informal), individual and physical factors (Clitheroe et al., 1998)[1].
- Contextual characteristics of products interact with the social environment. A product cannot be differentiated between contextual characteristic and use characteristics; they are inseparable (Brown and Duguid, 1994). The only way to identify these characteristics is in the context of use<sup>1</sup> [2].
- The introduction of a new technology leads to a interdependent relation with a social environment (Akrich, 1992; Latour, 1992; Law, 1992), called mediation between an user and a technology in a certain context (Verbeek, 2005). Mediation comes about in a complex interplay between technologies and their users. A new technology will be translated into a form that is more appropriate for potential adopters, by choosing some elements of the technology and leaving out others (Tatnall, 2010). So, it is not sure what kind of mediations will take place. Mediations in a social environment lead to the involvement of additional actors and therefore they are called social mediations [3].

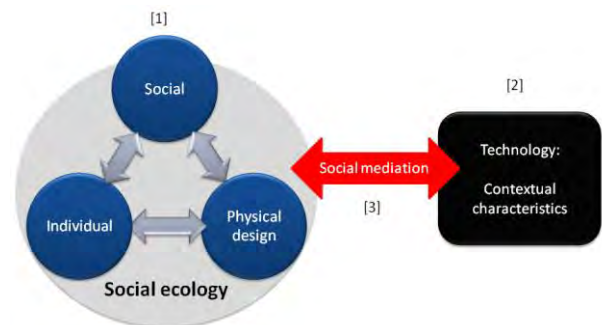


Figure 1: visual representations of the elements that are concerned with the formation of social impact

<sup>1</sup> When they ran up against the problem of the inseparability of products and their contexts Brown and Duguid found it helpful to think in terms of a relation between centre and periphery. Some actions of a product are related to the centre and some to the periphery. Typing on a typewriter, for instance, can be regarded as an action within the centre of a product; the fact that typing on the typewriter makes noise and therefore communicates the fact that someone is at work to co-workers in an office can be regarded an interaction within the periphery. However, when the noisy typewriter starts to make strange noises as an indication that a malfunction has occurred, this sound can be interpreted as a centre relation. Depending on the user, centre-periphery relations can differ.

## A WORKING MODEL FOR IDENTIFICATION

Derived from earlier research it was found that for the *identification* of social impact the social ecological approach helps in determining important factors of influence, which gives an holistic view on a social environment. However, mediation is difficult to predict and will always be combined with an observation in reality. The process leading to the identification of social impact can be summarized in the following research steps:

- *Construction of a social ecology.* Determination of important influential factors on the social environment related to social goals of a specific social network. For a holistic view of a social network, a description of a social ecology should contain at least four factors of influence (e.g. individual, social, technical and physical factors). The social goals are related to the health and sustainability of the social ecology; the number and diversity of interactions. It has been found that it is important to determine specific factors of influence for any specific social network. A social ecology is a framework of theories rather than one specific way of thinking and therefore includes different insight from social sciences.
- *Observation of new practices.* This is an attempt to describe changed practices in a social network resulting from the intervention of a specific technology. Practices that directly or indirectly have been influenced through an intervention need to be observed and are derived from the influences determined from a social ecology.
- *Construction and interpretation of social mediation patterns.* Based on step 1 and 2, mediation processes can be constructed which will generate information about the way mediations have developed. The confrontation between insights from the social ecology and actual practices leads to a construction of social mediations. This step is taken in order to understand which functionalities of a particular product are responsible for which kind of social impacts. The impact is related to changes in the number and diversity of interactions.
- *Identification of relevant contextual characteristics.* Based on this step, a designer can gain insight into the characteristics of a product leading to undesired social impacts and the contextual characteristics that lead to desired social impacts.

In the case of *anticipating* the social impact of a product like a Heart Monitor it is difficult to describe the social environment in which the social impact will take place (because the product can be used in different social environments) and it is not possible to observe social practices. The working model therefore has to be adapted. In the next section I will discuss the possibilities of an adapted form of the persona approach to be used for this purpose.

## FROM PERSONA TO SCREENPLAY

In user-centred design approaches, it is common for product designers to anticipate future user behaviour. One well-known method involves the use of persona: abstract representations of users with which the designer engages in order to understand the end users of his product (Courage and Baxter, 2004; Pruitt and Adlin, 2006; Valkenburg et al., 2008). One of the benefits of personas according to Courage and Baxter (2004) is that they can be used as a discussion tool in cognitive walkthroughs, storyboarding, construction of realistic scenario's and other usability activities.

Personas can be used to understand a person in his or her context and to anticipate current and future behaviours with the use of scenarios. In research on social impact it has been concluded that the focus of attention needs to shift from the use level towards the social level (Tromp et al., 2011). For the anticipation of social impact we therefore need to employ this approach on a social level. The description of a persona must be supplemented by a description of physical, technical and social factors; in other words, a social ecological description must be provided.

This could be considered a screenplay, which is defined as 'the words that are written for a film / movie (= the script), together with instructions for how it is to be acted and filmed' (Hornby and others, 2010), i.e., an extended version of a script. The screenplay approach may be regarded as an extension of the persona approach, enhanced with a description of social structures, technical and physical design characteristics. The screenplay is a description of the social influence in which social impact can develop and will be (like a persona) a start for the formation of scenario's. These scenarios have a different starting point, unlike the traditional use of scenarios. Normally scenarios on a use level are the concrete narratives that describe the hypothetical use of a product being designed (Anggreeni, 2010). Scenarios on a social level however describe hypothetical social consequences. From these scenario's anticipated social mediations can be constructed. As has been mentioned earlier, contextual characteristics of products can only be identified in the contexts of use. Therefore a hypothetical social mediation process will reveal which characteristics of a product might lead to which social impacts.

Whether the screenplay approach is an interesting way of simulating social ecologies and practices needs to be further analyzed. In the next section, the consequences for the working model are discussed.

## A WORKING MODEL FOR A SCREENPLAY APPROACH

The insights that have been derived about social mediations indicate that a chain of interactions merges into changed practices (Bouma, 2013). In order to anticipate the impact of a product on a general social environment, a way must be found to form possible chains of interactions in a systematic manner.

This leads to the following steps:

- *Construction of different screenplays.* In the first phase, the social ecological characteristics of possible future users of a product must be established. What kind of influencing factors are relevant in this specific case? Also, possible functionalities of the future technology need to be defined. All possible attributes will be gathered.
- *Simulation of new practices with scenarios.* The attributes from the social ecologies will be combined in a number of variations and translated into hypothetical future scenarios. Social impact scenarios need to be made for a variety of social ecologies.
- *Construction and interpretation of social mediation patterns.* In this phase, possible social mediations need to be identified. These are derived from the scenarios in step two. The confrontation between insights from the social ecology and simulated practices leads to a construction of social mediations. This step is taken in order to understand which possible functionality leads to which kind of social impact. For a correct interpretation of social impact, two questions need to be asked: Is the social impact likely to happen? Is the social impact wanted or unwanted, in the light of the general social goals of the specific environment?
- *Identification of relevant contextual characteristics.* Based on this step, a designer is enabled to recognize which characteristics of a product lead to unwanted social impacts and which contextual characteristics yield the desired social impacts.

In the next section, I will apply the insights from the working model in the screenplay approach.

#### RESULTS FOR THE HEART MANAGER CASE

In the introduction I have discussed the case of the Heart Manager. This case will be used to see whether the screenplay approach has potential for simulating social practices.

The steps of the working model will be used to describe the results.

##### *Step 1: Construction of different screenplays.*

The first step consists of constructing the social ecologies for possible future users. What screenplays can be determined that are relevant for this case?

Several factors of influence were described (see table 1). For the individual factors various users who might receive a heart manager are identified. These were:

- an adventurous man (not afraid of a little risk) called John.

- a concerned man (who has never changed his job and is likely to go on holiday in the Netherlands every year) called Patrick.

For the social factors, a social setting was added to each of these individual users. A different perspective was chosen for each individual. This is also the case for the physical design context. For the future concept of the Heart Manager, different physical characteristics were identified.

In the next table an overview of characteristics are shown:

INFLUENCES	DETERMINATION <sup>2</sup>	ATTRIBUTES
INDIVIDUAL	identity, status, goals, skills, tasks, requirements, expectations	John: adventurous, education: university, middle class, sportsman, besides heart problems in good shape  Patrick: conservative, low income, passive lifestyle, job as a factory worker
SOCIAL	(relationships)  Formal; job, voluntary jobs, doctors, insurance company  Informal; friends, family, neighbours, passive, active interactions	John: married, independent, no children, spends a lot of time with his friend.  Patrick: his daughter and son are his most important contacts. They visit him every weekend. He is also a volunteer at the local football club
PHYSICAL	Housing characteristics  Living environments  Recreational environments	John: bought his house in. It is a characteristic, detached house. Holidays in Spain and Austria.  Patrick: has a rental home in the northern part of the country (Meppel) in a row house. He spends his holidays in his own caravan at a campsite in Diever

<sup>2</sup> These factors have been deduced from an analysis in chapter 5 (Bouma, 2013)

TECHNICAL CHARAC-TERISTICS	Functionalities of technologies  Contextual characteristics	The information provided by the heart manager can be handled in various ways  Who and when do people have access to the data/information?  What is the design of the heart manager?  (e.g. visibility)
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Table 1: Summarized overview of possibilities for different screenplays

*Step 2: simulation of new practices with scenarios.*

In this step various screenplays were constructed. The attributes in the above figures were combined in a number of situations. Links were made between a specific situation, a persona's character, other physical, social and individual characteristics and possible designs and functionalities of the heart manager.

The combinations of attributes led to different scenarios.

**Example 1: Mountaineer John is seeking new thrills**  
**Screenplay:** John (individual), influence of friends (social), holiday in Austria (physical context), the heart manager emits a sound as soon as he develops problems with his heart and then the emergency departments are sent an automatic message with his gps coordinates (technical attributes).  
**Scenario:** John has developed heart problems at the age of 62 and is really confused. He has always been an active man and had assumed that he would remain in good health well into old age. He has gone mountaineering his whole life. Now John, his wife Jane and some friends were on their way for a pretty standard expedition in the Austrian Alps. His friends (with whom he had been climbing for many years) have joined them and are teasing him about his new situation. John has always been very competitive, and his friend secretly hopes that he will be forced to tone down his views during this trip. During the holiday, he is hardly aware of the heart manager; it is so small (the sensors have been inserted under his skin) that he tends to forget about his situation.  
 During one of their climbing expeditions, the heart manager suddenly starts to beep. John is experiencing heart problems. An automatic message is sent to nearby rescue teams with gps data and information about his condition. Unfortunately, John and his friends are in an area where an alerted helicopter is not able to land and his friends have to carry him to a different location. The helicopter arrives just in time and takes him to a hospital in a city nearby. John survives, but his heart problems have worsened.  
 The Austrian authorities are not pleased about John's expedition and intend to recover the costs of the rescue from John's insurance company. Over the past years, there have been too many daredevils like John in these mountains, which has saddled the Austrian government with considerable extra costs.

The next example is a variation on the first: now, John's heart manager has been replaced by a more visual device, whose constant presence influences his daily behaviour.

**Example 2: The influence of the physical design of the heart manager on John's behaviour**  
**Screenplay:** John (individual), friends and wife (social), restaurant (physical context), heart manager is visible under shirt (technical characteristics).  
**Scenario:** Everything is going well on John and Jane's holiday. They are very happy climbing together during the day and socializing with their friends in the afternoons. However, one thing is bothering John: the physical design of his heart manager. It looks like a small mobile phone and is attached to his chest. It is constantly bothering him (he feels it all the time) and when he wears a thin shirt, other people can see it. He has always been a very handsome man and still looks not a day over than 50. Unfortunately, the temperature in the restaurant forces him to take off his jacket. People ask him questions about his heart manager, while he was trying to forget his heart condition during his holiday. Although the evening is a pleasant one, he would actually prefer to go back to his hotel.

The next example introduces Patrick, who is a totally different person (see table 1 for characteristics). He has a device that allows him to monitor his heart condition constantly.

**Example 3: the influence of new availability of information about his heart condition on Patrick's behaviour**  
**Screenplay:** Patrick with concerns (individual) worried children (social), at home (physical context) and a technology that provides constant information and that can be consulted through a smart phone; furthermore a daily summary of the information is available for his children (technical characteristics).  
**Scenario:** Patrick is having a difficult time adjusting to his heart condition. He is afraid to exercise (although the doctor has strongly recommended him to do so). Whenever his heart skips a beat, he worries that his heart problems have returned. His daughter has arranged for him to be fitted with a 'heart manager'. This device will provide him with information about his condition and make him feel more secure. He can monitor his heart rhythm on his mobile phone and he will receive extra warnings in critical situations. Patrick continuously checks the information provided by the device. After finishing a light task for his wife, he checks to see whether his data has changed. His children (who can read a blog with a summary about his condition during the day) add to his concerns by confronting him with variations in his heart rhythm. His doctor, however, assures him that these variations are normal. Since he has gotten his heart manager, Patrick has rarely left his house anymore.

*Step 3: construction and interpretation of social mediations.*

For this step social mediations need to be identified. These will be derived from the scenarios in step two. Several mediations can be identified:

- In the first example, the technology did not mediate the direct practices of John: the device was invisible and therefore disappeared to the back of his mind rather quickly, so John received no feedback on his expeditions in the mountains. The fact that he would receive help whenever needed, together with the social pressure of his friends, increased the risks he was taking.
- The second example illustrates how the technology of the heart manager impacted on the wellbeing of a person. In this case, mediations of the heart manager with other visitors of this restaurant will influence John's behaviour in future situations.
- In the third example, the mediation of the availability of information on the behaviour of Patrick is discussed. The constant availability of information and the interpretation of data is another complex issue.

The mediations derived from the scenarios need to be interpreted to understand how these lead to harmful social impacts. Two questions are essential to this: Is the social impact likely to happen? Is the social impact harmful? These two questions are foremost in interpreting the impacts found for the heart manager. The likeliness of the impact should be analyzed in the light of comparable situations:

- Literature on the influence of social norms on our behaviour can validate whether social groups have major influence on our mountaineer John (Steg and Vlek, 2009).
- Risky behaviour, for instance in cars: sensation-seekers are known to exhibit more risky behaviour in vehicles equipped with anti-lock brakes (Jonah et al., 2001).
- Impacts of background and foreground positions of technologies (Ihde, 1991).
- Information about the psychological consequences of e.g. wearing hearing aids could provide information about whether the visibility of a heart manager is an important factor that might influence John's behaviour.
- For John, being confronted with the heart manager could also have a positive effect, in that it might function as a nudge to remind him of his heart problems (Sunstein and Thaler, 2008). It is questionable whether in that scenario John would undertake the same risky expeditions as in example 1. The probability of this impact needs to be considered as well.

The possible harmful impact is related to generic social goals:

- John may be ashamed of his heart manager; he will isolate himself.
- The relation between Patrick and his children changes; they act as if they were his minders, which could cause the relationship to deteriorate.
- Etc.

*Step 4: Identification of contextual characteristics.*

Based on step 3, characteristics of technologies can be linked to possible impacts. This can help in the evaluation of functions of new products.

Contextual characteristics	Factors of influence	Social impact
Availability of technology.	Influence of social norms. Risky behaviour with ABS.	Might lead to increased risks.
Visibility of technology.	Influence of social norms. Impact of foreground and background positions of technology. Nudge to increase awareness.	Might lead to social withdrawal and increased safety behaviour.
Constant availability of data.	Impact of direct feedback on behaviour. Influence of social norms. Impact of foreground and background positions of technology. Nudge to increase awareness.	Individual and social behaviour may be adapted to control the data from the product.

Table 2 contextual characteristics linked to social impacts

In step 4, factors of importance (from the analysis in step 3) must be linked to contextual characteristics and possible social impacts. Obviously, only impacts will be used which are likely to occur and which lead to wanted or unwanted impacts. Based on this overview, a designer can reflect on the desired functionalities of a heart manager.

## DISCUSSION

Compared with research performed to identify social impacts (original working model) it is found that the focus of attention has shifted. To ensure validity in the case of identifying social impacts it is important to have a solid understanding of the social ecology and the observation of changed social practices. The found social impacts are depending on the quality of the first steps of the working model. In the case of simulating social impacts with the screenplay approach the validity of outcomes is defined in the last two steps: the construction and interpretation of social mediations and the identification of contextual characteristics. This is in accordance with a Failure Mode and Effect Analysis. FMEA focuses on processes that manufacture products and involves the calculation of a risk (severance and occurrence) (Arabian-Hoseynabadi et al., 2010). The screenplay approach, as it has been applied in this case, can be considered a way to calculate risks as well.

The main difference between the screenplay approach and the persona approach is a shift from the use level towards the social level. For this purpose a focus on the use of a product has been replaced by a focus on social practices. In previous research I have concluded that this is a necessary step in order to find social consequences of technology (Bouma, 2013). To emphasize this shift I have decided to use the term screenplay approach to explain the broader context of this approach.

For the case described in this paper screenplays have been constructed based on common sense, as its purpose is to explain the tool and to show that an increase of impacts can be found. When applied in health care practices it might be wise to put more attention on the formation of the screenplays, otherwise important impacts might be missed. The validity might be improved by incorporating real data about users and social environments, as is recommended in the persona approach.

Variations in technical functionalities of the proposed new product proved helpful in providing information about the relation between functionalities and social impacts. This seems to be an interesting option for designers of new products.

For the screenplay approach to be successful it is important to determine whether it leads to a systematic and thorough anticipation of social impact. The use of screenplays helps in creating a variety of social environments which leads to an increase of social impacts. Whether the found impacts are sufficient for the development of a new product with presumed impact remains a subjective discussion.

In the introduction I mentioned that designers have grown increasingly interested in social innovations and therefore become responsible for social outcomes as well. In the case of health care practices the responsibility of a designer is also linked to vulnerable

patients that may have problems to adapt to new situations. As social mediation come about in a complex interplay between a social environment and a technology it is always unsure what outcomes of a new technology can be expected in real life. The screenplay approach can be a tool to help designers in gaining more understanding of anticipated impacts and related contextual characteristics.

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