Improving knowledge through design

Designing interactive solutions, nowadays, means facing the diffusion of systems that integrated sensors that create a hyper-connected world (Mitchell, 2010). These sensors detect, gather collect, store and use data about people and their behaviors. The use of personal data and information that derives has become a critical point in the creation of solutions that use them to create additional knowledge and value within the provided service (Greengard, 2015). Considering design artefacts and political elements (Winner, 1980) that act and react in the society in which they are embedded in, designers have the responsibility of considering and be aware of possible consequences of their design choices (Pillan et al., 2017).
While in the design process designers tends toward utopian objectives, the formalized results integrate non only functional solutions to problems, but also possible individual and social consequences in terms of both possibilities and problems (Varisco et al., 2019a; Varisco, 2020). Aiming at fostering awareness of designers in the consequences of their design choices and at promoting ethical discussions on the ethical issues connected to the use of personal information in interactive solutions, this paper discusses the possibilities of using an original method within the assessment phase of the design process so to formalize new knowledge related to critical themes for individuals and society. From the analysis of sci-fi storytelling artefacts that imagine the future together with the identification of contemporary elements from online news, the method extracts a representation of current hopes and fears regarding the use of personal information in digital interactive solutions. The article reports and describes twelve critical themes that have been formalized during the application of the method on different proof of concepts of solution that imply the use of personal information.

[service design, personal information, design process, knowledge, critical themes]

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Using personal data and information

Many solutions rely of personal data (by-product of digital services) (Schneier, 2016) as carriers of knowledge about body parameters and behaviors, actions performed in physical and digital spaces, interactions with digital interfaces and with people. By processing and merging data, valuable information is created (Boyd & Crawford, 2011) for both individuals, and companies that uses it to provide meaningful services allowing the creation of innovative systems and new modalities of interaction with different purposes such as security, home automation, health monitoring, fitness tracking and intelligent agents. Private and public companies, governments and other actors have the power of collecting this data and use it to enable service functions, personalize user experience, create legitimacy through identity verification, allow access and authentication, create new services and improve already the existing ones (Joinson et al., 2010).
When embedded in social organizations, the services that use personal information as carrier of meaning, shape social dynamics and impact on users (Colombo, 2018; Trist 1981; Polgar, 2011; Winner 1980) providing an increasing amount of detailed information about their characteristics, parameter, behaviours, activities and actions. These impacts concern not only individuals; companies and governments are also perturbed in their identities, strategies and politics.
The elaborations of provided data and its return to the users in the form of feedback, provides awareness about behaviours and actions that affects the perception of self, the actions that will be performed in the future, the interpersonal relationships and the contribution that the individual have on a social level. (Young, 2013; Li et al., 2011; Varisco et al., 2019b)

Storytelling artefacts and news as a source of knowledge

New services and innovative solutions bring changes that can be perceived as utopian for somebody and completely dystopian for somebody else. In the creation of such innovative services, designers should orient design choices embracing the contradictions implied by the changes they can produce, as well as deal with the complex issues that goes beyond utility (Joinson et al., 2010; Hughes et al., 2008). While designing digital services, designers deal with the inconsistency, variability and variety of the human perception. By pointing out and focusing on the tangle of issues involved in the use of personal information, it is possible to better understand what is at stake.
As scenario development during design teach us, (Selin et al., 2015; Sterling, 2009), the imagination of a future in which the solution is embedded that considers possible problematics that are worth of discussion, allow to create solid and reliable solutions (Linehan et al., 2014; Blythe, 2014). Following this concept, this research shifts the analytic focus from the solution already employed publicly, to the moment in which critical decision are made, thus anticipating opportunities and problems related to the use of personal information. Taking inspiration from sci-fi narratives for a deep comprehension of the consequences of the application of technologies in contexts

that are no (yet) real, the research sees these narratives as representation of hopes (opportunities) and fears (criticalities) currently perceived by the society (Shapiro, 2004; Shapiro, 2016) and as a source of knowledge about the current perception of the technological future from a societal point of view in both its positive and negative aspects (Pillan et l., 2017). Data extracted from "imbd.com" (an online database of information about movies, TV series, home videos and videogames) has been collected and analyzed so to merge it with elements coming from a qualitative analysis performed on current news, products and ongoing researches as they have been spread by online magazines. This content has been considered as a suitable source to identify possible issues related to the use of personal information in digital solutions and services allowing the creation of a set of useful ideas, opinions and visions that could envision possibilities avoiding being too futuristic. The communication of scientific progress through media, is seen as a mean to picture not only the advancement of a technology, but also its potentials in terms of applications, and its critical points in terms of ethical issues (Magaudda, 2012).

Formalizing new knowledge through design processes

The knowledge extracted has been collected and organized in an open-access *Potential Issues Database* (PID) clustering it in eight *Ethic-oriented Reference Scenarios* (ERS) emerged from the double analysis of science fiction narratives and online news. The ERS represent a synthesis of hopes and fears currently perceived by the society (Varisco et al. 2017). Each of the ERS contains the emerged issues and the related news quotes (Figure 1). The aim of the PID is to nourish design processes with a point of view of the society so to foster and support ethical discussions on future impacts of the solutions that imply the use of personal information fir 1) identify insights; ii) raise awareness and iii) stimulate critical thinking during design phases enabling the identification of potential impacts.

The PID has been used as a validation tool for proof of concepts in research projects (Varisco et al., 2019c; Varisco et al., 2019a) and academic courses within the MsC in Digital and Interaction Design at Politecnico di Milano (Varisco et al., 2019b) through its exploration to identify possibilities and criticalities related to the various issues with the support of the news quotes as clarifiers of concepts.

Starting from the selection of scenarios that better reflect the one of the designed solution, the designers identify the relevant issues and navigate the related quotes, then they discuss them within the design team, identifying the impacts that are strictly related to the characteristics of the design solution formalizing critical themes. The exploration of the PID during design processes allowed to increase the awareness about the consequences of the use of personal data in the designed solution, but also the creation of new knowledge thanks to the issue clustering and the formalization of the critical themes as drivers for future design iterations. Through the re-elaboration of previous knowledge, new knowledge has been created. This re-elaboration formalized twelve critical themes that represents current challenges for the design of interactive artefacts that revolves around possibilities and criticalities connected to the use of personal information.

Figure 1. The PID (Tableau Public data visualization). For each issue, the single dot represents a unique quote assigned to it. On the right side is possible to filter the issues by selecting the ERS that have been identified as relevant for the solution object of the assessment, Varisco, 2018.

Twelve critical themes of the use of personal information

To conclude, I report the description of the emerged critical themes that represent a second-hand knowledge that carries meaning related to the re-elaboration of the database's knowledge according to the designers' expertise and sensibility. The themes point out the sensibility and ability of designers in the extraction of new knowledge from the exploration of content enriching it with solution-oriented concepts. Designers have an active role in the design of innovative solutions and their aware choices coming from discussions within design teams can produce a valuable contribution to the identification and formalization of discussion topics that can be shared within the design community as activators of critical thinking.

Consent or denial of access

The grant or deny the access to services, are decided according to the information about the individual; it results a decreasing of time and effort spent on professional tasks. The elaboration of personal records can allow direct access to services or functions that are specifics for the user and the convenience of this control resides in the reduction of time for both users and providers (e.g. an AI can automatically detect evidences to grant access to specific services in real-time). However, some critical points emerge: i) the users must provide data so to allow the service to check their right to access and if the users refuse to provide data, the service could deny the access; ii) the automatic collection of data could result in totalitarian surveillance mechanisms; iii) data can be used by third parties without giving the user the power to refuse; iv) the accuracy of the provided data and its interpretation are critical points and a misinterpretation of data can lead to rights violations.

Awareness of data tracking, sharing and use

Although most of the time the user is well aware of the tracked data is also true that some issues arise when the individual is not completely conscious of when the tracking occurs, what data is collected, with whom is shared or sold, who is using it and what kind of profit they make. When users sign and agree to terms and conditions for the services they subscribe, they rarely deeply understand them although providers consider the agreement as a green light on the use of personal information as the contracts establish (they rarely provide additional information). Unawareness of the user in the occurring of tracking and the related impossibility to hide from it,

causes lack of individual power on controlling the exposition of personal and intimate information. Service providers (and third parties) could gain profit from users' data without involving the users in the trading and even without letting them know about the use of their information for a specific purpose.

Rights on data access management

Data ownership and control of access concerns the user's right in deciding who can see or use the information, which kind of information is used, its granularity and the level of service personalization. The increasing tailoring and optimization of tasks and services requires big amount of data and its use from third parties. Being the users' power in denying access not always clear (especially for requests coming from authorities and governments), individual freedom and privacy are influenced. Hidden tracking as well as pervasive availability of data thanks to its sharing on the web, make the control on the use of information difficult.

Automation of actions and services

Suggestions and filtering options provided by tailored services using algorithms that analyse personal data, create the mechanisms called '*filter bubble*' and '*echo chamber*' (selective exposure to online contents) (Liao & Fu, 2013). While tailoring and proactivity are changing the paradigms of services such as the case of self-care for healthcare (Hughes et al., 2018), the automation of analysis of personal data bring up doubts about how AI technologies can be used. Persuasion and decision-making based on personal data analysis is nothing new, and the perfection of collection as well as the automation of the analysis, raise several issues especially when services imply AI to automate procedures and manage complexity. Biases and prejudices in learning algorithms become particularly critical when AI is applied to the field of justice because of its socio-political implications. Being how algorithms make decisions, not always clear even for the programmers, it is even harder for non-technicians to understand the decision-making processes results in their cause-effect inferences.

Cognitive load

The cognitive load on decision-making and task completion can be both lowered and raised due to automation. Reactive and proactive services can lower cognitive load allowing the user to focus on experiences instead of on repetitive tasks. However, the return of information and knowledge in the form of visual feedback or insights and suggestions can raise the cognitive load related to burdens on new issues that have psychological effects (e.g. raise users expectations) creating new problems that can be brought up by the invasiveness of the service or can be created by the return of too many details due to the information granularity.

Risk of judgment

Automatic detection and analysis are moving the burden on tasks completion from the humans to the machine, and the analysis is performed mostly on automatic detected data instead of data that is actively provided the human. While automation of processes through AI makes choices and task completion easier, it also removes the effort for judgment from human, raising risks of inattentiveness and passiveness in decision-making processes in which systems take decisions while humans mentally *switch off* (Greengard, 2015) opening to new perspective of discrimination. Decision making tasks based on personal information as well as judgments made by machines, could open new perspectives of discriminations. However, changing the attitude of the users during the experience, the interaction with bots and AI can make people feel less judged than if interacting with other human beings. Moreover, the difference between human-human interaction and human-machine interaction through technologies is blending and technological advancement is making difficult for the users to distinguish between humans and chatbots.

Self-mirroring into data

The users' self-perception changes and relates to the self-knowledge they acquire while understanding their own's data. When the user receives the information back from the service, the feedback can be return in the form of information visualization (with different levels of granularity) or in the form of insights, suggestions and tailored proactivity. The return of information about hidden mechanisms such as inner body functions and behavioural patterns, is making visible something that we are usually unaware of. By analysing the received feedback, we experience disembodiment: knowing themselves through data creates disconnection between the knowledge and the physical. The users can self-reflect as well as being misrepresented in their digital identity.

Information overload

The details and granularity of data gathered by sensors can be useful for the precision of the information extracted. It is, however, important to consider the psychological impacts the information has when is received by the user. Self-knowledge can be negatively perturbed by an overload of irrelevant or too detailed information. An overexposure of information for the users could be misleading, or even make them bother about irrelevant knowledge leading to further consequences such as control addiction. The increasing amount of available data is raising questions about its usefulness and about the possibilities to extract valuable knowledge from it.

Attitude and quality of life

The increasing availability and pervasive use of sensors to detect data bring consequences in terms of changes in the users' attitude toward actions and in quality of life for everyday behaviours due to a conscious or unconscious "observer effect" (McCa-

rney et al., 2007). People behave in a different way when they know (or think) they are being observed. Systems can take advantages from this effect for the user's good aiming at changing a wrong behaviour according to goal settings. The ubiquitous and pervasive connectivity allows the users to be always present in their digital representations, however the impossibility to hide and disconnect can raise concerning on changes it brings (e.g. changing in the way people work by being always connected).

Data use for public benefit

A utilitarian ethical approach applied on the use of personal information as a benefit for the whole society impacts on individuals and on the society itself. While the gathered data can be used for public services and for increasing public knowledge so to drive to better decision such as for creation of policies, or energy saving strategies (Marr, 2015), massive amount of data about people can make them become targets for massive surveillance and deny access to services according to their and other people's data.

Creation of communities of value

The interaction of people through their data often creates a community by itself thanks to the sharing of values connected to the purpose of data tracking that are common all members. It is however important to consider that the exposition of data among the community should be volunteer and limited to the purpose of the service. Furthermore, people that share values not always track their data, thus their representation among the community of values can be hidden to the other members. Even if the amount of data is big enough to make decisions, only the collected data contributes to the decision-making process, while the "*voice*" of non-tracked people is cut out and is not represented in the results.

Democratization of services

The use of personal data to enable remote interaction allows to provide free or affordable services aiming at increasing the plateau of users or grant access to low-income people. The democratization of services, however, is granted for the people that can provide their data while who does not have access to the internet or can't afford the necessary devices, is cut out. One other element that can hinder the access to services is the user's unwilling to share data due to not being part of a specific interest group or community, due to unknowing about the availability of the service, or due to doubts about the use of the data by the provider.

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