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Improving Healthcare through Human City Interaction

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Abstract: The study of information technology has given insufficient focus to a) the structural factors and b) the community perspective. As information systems become increasingly integrated with human systems these wider influences are more important than ever. Human city interaction concepts including their interplay with cyber-physical systems and social computing are appropriated to healthcare. Through Structuration Theory, insights are given into how healthcare through the human city interaction lens can most effectively be improved.

1 INTRODUCTION

This paper explores how the concept of human computer interaction and its notions of social computing and cyber-physical systems can improve the efficiency of healthcare. Human city interaction moves the conceptual basis of human computer interaction from the micro, individual user scale towards a macro, city wide scale. As such it can also impact healthcare practices given they are inherently community-based.

As NHS digitisation continues to meet resistance, we argue that greater focus needs to be given to the social aspects involved. Indeed, two-thirds of potential health information systems have not yet materialised (House of Commons, 2013; Watson, 2014). We postulate that a greater focus on the structural factors might have had a different result.

The paper is laid out as follows: Structuration Theory is used to appropriate human city interaction concepts to healthcare. Based on this approach, the human social challenges are highlighted and the research gap addressed including the system design issues. The paper concludes with the insights that human city interaction can bring to improving healthcare.

2 STRUCTURATION

Structuration Theory is a theory of agency and structure to help understand how people behave (Giddens, 1984). Agency and structure is the extent to which people are free independent agents or are agents whose behaviour is socially determined. Structuration Theory emphasises the role of everyday social practice in consistently recreating social structure (Jones and Karsten, 2008). Structuration Theory is often argued as relevant to dealing with ‘wicked’ unstructured problems in the public sector (van Veenstra et al., 2014).

Structuration Theory has frequently been applied to information systems research to help understand the relationship between information systems and the people using them including the surrounding social context and social processes (Jones and Karsten, 2008; Checkland and Holwell, 1997). The need for this approach is evident from the seismic impact that information technology is already having on human computer interaction by extending it beyond individual users interacting with individual computers towards interaction between many people and many computers across the internet.

3 HUMAN CITY INTERACTION

The idea of human city interaction emerges from smart cities literature, connecting it to cyber-physical systems and the internet of things (Naphade et al., 2011; Jin et al., 2014). Human city interaction is distinct from the idea of the smart city, in that the smart city describes the urban environment whereas
we define the concept of human city interaction as the complex web of human computer interaction in the smart city environment. Smartness is proportional to the increased awareness that these digital technologies bring in as they extract this information from the physical environment (Gurgen et al., 2013). Human city interaction emphasises the complex web of human computer interaction in the smart city environment. Over the next few subsections we outline several key important concepts the building blocks of human city interaction and its relevance to healthcare.

### 3.1 Smart Communities

A smart community brings together the interplay of the cyber, physical, and social worlds; within this environment humans and physical things will interact with each other through ubiquitous networks (Xia and Ma, 2011). The combination of a focus on human interactions and a connection with cyber-physical systems connects the concept of human city interaction with the concept of smart community (Li et al., 2011; Xia and Ma, 2011). These communities are also connected with social computing and finding solutions to societal problems including healthcare.

### 3.2 Social Computing

Social computing includes human social dynamics connected to ICT technologies, with theoretical underpinnings in both computational and social sciences (Wang et al., 2007). Although the idea is usually associated with social media the origin of the term can be traced back to the 1940’s to a paper by Vannevar Bush that predicted many changes that have now become reality, such as computer-supported collaboration (Wang et al., 2007). There are specific examples of some of the components of social computing including blogs, wikis, social bookmarking, peer-to-peer networks, open source communities, photo and video sharing communities, and online business networks (Parameswaran and Whinston, 2007). Social computing is shifting computing to the edge of the network where individuals with relatively low technical skills can apply their creativity and work collectively with others (Wang et al., 2007; Parameswaran and Whinston, 2007).

### 3.3 Web 2.0

Definitions of Web 2.0 are very similar to that of social computing. Both emphasise collaboration and the ability of users to interact with each other. Web 2.0 includes features that enable collaboration including well-known examples such as wikis and blogs (Aghaei et al., 2012). The collaborative nature of Web 2.0 has been emphasised by the phrase *prosumers*, which emphasises that users of 2.0 are both consumers of it and producers of it (Lupton, 2015). The key difference between Web 2.0 and social computing however is the emergence of terms including Web 3.0 and Web 4.0. As such, Web 2.0 is becoming associated with a point in time that we are moving beyond (Aghaei et al., 2012).

### 3.4 Medicine 2.0 and Health 2.0

The terms Medicine 2.0 and Health 2.0 have been coined to describe the application of Web 2.0 to the healthcare arena. Some however have gone further than this and suggest a movement towards a different more equal relationship between patients and healthcare professionals (Bos et al., 2008). Given the collaborative nature of the Web’s evolution, information technology will change healthcare significantly; Web 2.0 technology in the form of Medicine 2.0 will impact on all areas of medical practice (Hughes et al., 2008). Similarly, Health 2.0 is shaping health care with Web 2.0 tools with the result being a whole new way of involving consumers in the health care system including the transition towards participatory health care (Belt et al., 2010; Bos et al., 2008). Collaboration, participation, openness and change are common themes in the Health 2.0 literature (Belt et al., 2010; Eysenbach, 2008). These ideas of collaboration and change are key components of effective human city interaction.

### 3.5 Collaborative Intelligence

Collaboration is a central theme in social computing, Web 2.0 and Medicine 2.0 literature. The term collaborative intelligence however builds on this and suggests a shift into a deeper form of collaboration that is often referred to as collective or collaborative intelligence. Collaborative intelligence has the potential to result in positive change, extending into a claim that mass collaboration changes everything (Tapscott and Williams, 2008).

### 3.6 Collective Intelligence

There is a subtle distinction between collective or collaborative intelligence. Collaborative intelligence is a system where each person or machine interacts autonomously as part of decision making network. Collective intelligence takes this idea a step further with
a shift in power from the individual to the collective. Collective intelligence is not a new idea, but it has received a new meaning through the emergence of Web 2.0 applications (Leimeister, 2010). This new meaning depicts the ability for people digitally connected by the internet collectively to create knowledge. There have been instances of amateur knowledge surpassing professional knowledge, and Wikipedia is given as the most recognised example of this (Surowiecki, 2005; Boulos and Wheeler, 2007).

In relation to healthcare, collective intelligence can improve evidence based medicine by drawing on a larger knowledge base (Tapscott and Williams, 2008). Online networks enrich and contextualise health information and reduce misinformation (Aghaei et al., 2012; Boulos and Wheeler, 2007; Hughes et al., 2008). Similarly, collective intelligence might be the solution to concerns about health information quality. As thousands of bloggers exchange ideas daily they are effectively acting as filters for information-overloaded Web surfers (Boulos and Wheeler, 2007).

Mass participation is central to the ideas of social computing and collective intelligence. This assumption is however subject to criticism. In reality only a small proportion of users may actually be active producers (Dijck and Nieborg, 2009). Also, mass participation must ensure that the individual is not hypnosed by the crowd (Le Bon, 1897).

3.7 Web 4.0

The Web is evolving far beyond Web 2.0 to Web 4.0 (Aghaei et al., 2012; Patel, 2013; Choudhury, 2014). Web 4.0 is described as the symbiotic Web in which the human mind and machines can interact symbiotically, including Medicine 4.0 and its links to human city interaction (Choudhury, 2014; Naphade et al., 2011; Roche and Rajabifard, 2012).

4 HUMAN-SOCIAL CHALLENGE

Certain social system problems are ill formulated, have many different clients or agencies with conflicting values, and have been referred to as ‘wicked problems’ (Churchman, 1967; Rittel and Webber, 1973). Health services (in particular cancer services) are such a wicked problem (Ferlie, 2013). Human city interaction and its interplay with cyber-physical systems realises the collaborative user interactions that are similarly of benefit to healthcare (Xia and Ma, 2011; Cockerham, 2005). The wicked problems however present number of human social challenges that can be usefully considered by referring to the theory of structurisation that we met earlier.

4.1 Structuration and Wicked Problems

Structuration Theory connects directly to the idea of addressing wicked problems (van Veenstra et al., 2014). Structuration uses the term routinization to describe the idea of structure being continuously produced and reproduced through action. Through repeated actions a social order is established and certain patterns of behaviour and ways of engaging in tasks become institutionalised (Giddens, 1984). From routinization in healthcare we might conclude that there are necessary structural constraints upon both patients and professionals that might be preventing them from moving towards a perfectly collaborative position.

Medicine 2.0 introduced the idea of including patients and professionals working more closely together, but routinization may still be evident in the cyber-physical models of healthcare. It has been assumed that patients will simply behave as required for the efficiency gains from healthcare cyber-physical systems to be achieved (Broy et al., 2012). However, for the efficiency to be harnessed a wide variety of complex social factors need to be considered including psychological factors linked to human interactions and lifestyle habits that have developed over time. This assertion is supported elsewhere, as health lifestyles are not the uncoordinated behaviours of disconnected individuals, but are routines linked to interactions within groups (Cockerham, 2005).

After IT systems have been adopted, they need to be assimilated to change existing work practices. Until this has happened productivity may decline and if innovation is not successfully assimilated they could be worse off as previous successful routines will have been lost (Setia et al., 2011). Further support arises from social constraints, both in relation to cyber-physical systems and IT artefacts that are shaped by messy processes. Rather they are influenced by the social system they are embedded in. Furthermore cyber-physical systems are particularly uncontrollable due to feed-back loops and the behaviour of some parts of the system being difficult to predict (Beverungen, 2013).

Perhaps more significant than the issue of integrating patients into a new health system based on human city interaction are the cultural factors that impact on the behaviour of healthcare professionals. Resistance to change and conformity to routinization may emerge from the desire to hang onto power and status linked to current structures, reinforced by the perception that change is just part of the government’s
agenda to cut services or it might be based on uncon-
scious ideas about how things have always been done.

5 ADDRESSING THE GAP

Failure to consider wider structural factors in infor-
mation technology, health and health economics re-
search is far from superficial oversight. This goes
right to the heart of the philosophical assumptions of
most researchers in these fields. Health economics
has remained insulated from theoretical debates that
have taken place in other areas of the social sciences
(Rickles et al., 2007; Lessard, 2007; Giddings, 2006).
Helpfully though, Structuration Theory has been in-
terrelated with other approaches, including a useful
study where this theory meets actor-network theory
(Greenhalgh and Stones, 2010).

Whatever the merits and demerits of the various
approaches, in the realm of healthcare technology
there is rarely sufficient consideration of social con-
text. As we’ve previously stated, information tech-
nology has evolved far beyond a system of individ-
ual people interacting with individual computers; it
is now increasingly a complex Web of many peo-
ple interacting with a complex Web of digital devices
through the internet. Structuration Theory and hu-
man city interaction at least provides a fulcrum for
improving healthcare given its community-oriented
approach. Human agent collectives are described
as systems where people routinely collaborate with
autonomous software (Jennings et al., 2014). That
work highlights flexible social interactions between
humans and the computers as they engage in synergis-
tic human computer collaboration, neatly fitting with
the idea of human city interaction. This area how-
ever has also been under-researched; although some
research domains are beginning to explore aspects of
this area, none are dealing with it in its totality (Jen-
nings et al., 2014). Perhaps the time to emphasise
the community context in human-computer interac-
tion and the consequent effects on the associated tech-
nologies as we have described has arrived.

5.1 Design Issues

Human city interaction raises the challenge of influ-
encing human behaviour and the use of design as a
tool (Naphade et al., 2011). Given that human city
interaction includes a complex Web of interactions
between people as well as machines, system design
in this area is not straightforward. Most current sys-
tems assume altruistic and benevolent behaviour from
users and fail to consider behavioural issues such as
the need to provide other pertinent aspects such as in-
centives in a collective context (Jennings et al., 2014).
The ethical issue of accountability also emerges from
the fact that the systems at times instruct us and at
other times are instructed by us, thus heightening the
potential tension between the human and computer
agents in the collective (Jennings et al., 2014). Enter-
prise Architecture however might be a useful frame-
work to help overcome some of these design chal-
lenges. It offers a perspective that holistically brings
together the myriad human and technological agents
needed to fulfil the collective purpose of the city,
including its provision of healthcare (van der Weel,
2017).

In linking the ideas of design to Structuration The-
ory for healthcare efficiency the process of design
needs to be applied akin to the complex web of city
structures. As people are as much the fabric of a city
as the technology, a change programme would involve
the people in designing the information technology
rather than changing peoples’ behaviour to fit it. At
the same time, at a higher layer of conceptualisation
the people as well as the technology should be con-
sidered as components that need to be factored into
the system design.

Our approach is represented in Figure 1. Essential-
ly, this figure depicts the concepts and their direct
and indirect relationships from human city interaction
to improving healthcare.

6 CONCLUSION

The appropriation of human city interaction to health-
care could improve its efficiency. Ideally, it would
address the present healthcare information systems
failures as illustrated at the beginning of this paper
(House of Commons, 2013; Waterson, 2014). It is not
however that simple and difficulties can be expected
along the way. Introducing the technology that could
enable the improvements as we’ve described are as
likely to reduce efficiency as to increase it especially
at least in the short term. At least as much attention is
needed in creating the human conditions as the tech-
nology.

Social theory including Structuration Theory as
we have highlighted can highlight the social issues
that need to be considered to achieve the necessary
efficiency improvements. The ideas of routinization
and structural influences contained within Structura-
tion Theory we suggest contain insights that can make
efficiency improvement more likely. In short, greater
consideration of the structural factors that impact on
how people interact with each other and with the com-
computing power that is increasingly interwoven into the fabric akin to that of a smart city.

We have only ‘scratched the surface’ so to speak of the complex social analysis that is required, and we are not suggesting that Structuration Theory is the only theory that can help understand this issue. Rather, this theory articulates the probable challenges and the ways to address them in the effective human-computer interactions for improving healthcare.

REFERENCES


