Understanding human connectivity and the Quantified Self

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Summary

The phenomenon known as the *Quantified Self* has arisen out of technological developments being adopted initially by enthusiasts and then by a wider market, particularly in fitness self-tracking through wearables. However, human interaction with quantified self technologies (QST) involves a number of dimensions worth further investigation, such as the mechanics of collection and reflection, the design and effectiveness of different kinds of feedback, how presentation affects understanding, the effects of increased connectivity and how users understand wider networks, and the potential societal and economic impacts of QSTs. We call for research to consider three important factors and the links between them, and conclude by considering the scope of the call and suggested call criteria.

Description of the call

To maximize the potential for QST to result in both individual and societal benefits we call for multidisciplinary projects to submit proposals that consider the following three factors and the relations between them: (i) **the design of QST**; (ii) **how people use QSTs in practice**; and (iii) **the psychological factors involved**.

Acknowledgements

This paper was commissioned by the Sustainable Society Network+, funded by the EPSRC's Digital Economy programme. It follows a 1-day workshop, 'Quantified Self in a Sustainable Society', held at Somerset House, London, on 13 November 2014. The event explored ways in which Quantified Self technology creates opportunities to increase sustainability, and aimed to stimulate dialogue between academics, practitioners and industry to provide opportunities for researchers to contribute to a future research funding agenda on the Quantified Self. For more information, please see http://sustainablesocietynetwork.net

Background

Quantified self refers to the self-tracking of any kind of biological, physical, behavioural, or environmental information (Swan, 2013). Coined by Gary Wolf and Kevin Kelly in 2007 when they founded a specialist website[1] to "help people get meaning out of their personal data", the term has been increasingly used (Lupton, 2013) alongside development of consumer products and technologies specifically aimed at this market. A Google trends analysis reveals an increasing interest in the topic that has spread from the United States to Europe[2].

[1] http://www.quantifiedself.com
[2] http://www.google.co.uk/trends/explore#q=quantified%20self

Quantified self technologies (QST) have gathered traction in the media—with recent articles headlining, for example, "10 year old logs 100,000 steps on his Fitbit"—and attention in social media with people using and sharing data in imaginative ways. For instance, one user shared a graph of his heart rate during a marriage proposal[3]. The increasing popularity of self-tracking and *lifelogging* is also evident on the market, with the number of wearable devices, used for capturing consumer-generated health data, predicted to rise from 15 million shipped in 2014 to 70 million in 2017 (Juniper Research, 2014). Indeed, the current scope of QSTs is considerable and an impressive variety of areas can be tracked such as happiness, personal exposure to pollution, sleep quality, nutrition, activity levels and athletic performance.

Collection and reflection

Underpinning most QSTs are two core functions: *collection* and *reflection* (Li et al, 2010). For instance, wearable electronics and biometric sensors enable objective data collection (Swan, 2013). However, for many enthusiasts, QSTs are not simply about data collection but are about gaining "self knowledge through numbers"—going beyond *personal informatics* (Elsden et al, 2015). QST's can be used to "reflect, learn, remember and want to improve" (Wolf, 2010), and this is the motivation behind much academic research into the effectiveness of QST, largely in human-computer interaction (HCI) but also in particular domains such as digital healthcare. However, the mechanics of these reflective processes are worth further investigation—how do people fit QSTs into their lives? How do they make decisions using QSTs?

The dimensions of feedback

QSTs are often marketed as a way of encouraging self-directed behaviour change—from exercise and health to environmentally related behaviours. The rise of QST for these purposes has coincided with the growth of *design for behaviour change* (Lockton et al, 2010; Niedderer et al, 2014) and *persuasive technology* (Fogg, 2003) more widely. This parallels an increased focus on exploring the effectiveness of feedback on behaviour, especially in contexts such as energy use (Buchanan et al, 2015)—data which may be generated through social practices constructed at a higher level than individuals' actions, for example at household level (Strengers, 2011). While "self" implies focus on the individual, engaging in self-tracking can be social and collaborative (Rooksby et al, 2014), and has the capacity for involving multiple selves (Elsden & Kirk, 2014). Many tracking devices and applications actively encourage users to share and compare their tracked activities, bringing a social norms approach (Cialdini & Goldstein, 2004) and elements of gamification (Deterding et al, 2011) into the mix.

There are also online communities and "real-world" meetups, where self-trackers convene to discuss quantified self-projects, tools, techniques and experiences. In the wider context of QST's effects on behaviour, it would be valuable to characterise and examine the effectiveness in practice of the different dimensions of feedback which it enables.

Presentation and understanding

By enabling us to understand previously invisible aspects of our lives—and connecting us to others doing likewise—we become part of gigantic feedback networks, whether or not we are actively "using" QST for behaviour change. Much of this feedback involves presenting *numbers* in different ways, with the assumption that they are seen as actionable—thresholds or targets, with higher or lower values being the only dimensions present. These can become effectively *algedonic* alerts in Stafford Beer's (1972) terminology: pleasure or pain signals, without an analysis of how the state came to be. But arguably, from exercise to productivity, many people are trying to understand "what's going on", and how and why they can do better. This requires users to

[3] http://imgur.com/mbOPX2L

engage with their data—viewing (or otherwise accessing), interpreting, and evaluating them. While typically QSTs have tended to present data numerically, presenting it in more specialised and compelling ways using visualisations or other sensory translations may equip people with better tools for understanding their lives. There are opportunities for investigating the use and effectiveness of non-numerical feedback in QST, drawing on research from fields such as pattern recognition in decision-making (e.g. Klein, 1998) as well as HCI.

Connectivity, networks and understanding

Regardless of whether end users actively *choose* to monitor various aspects of their lives, increasingly the products, services and systems we use every day are gathering data about the way we use them, and algorithms used to profile and make inferences about us (Gillespie, 2014): we are being drawn into QST, in a sense, whether we like it or not (Schneier, 2015). For instance, Google uses geotagging to produce more relevant search results based on end users' past and present geographical location; Target gained some notoriety for its profiling of pregnant women (Duhigg, 2012) based on a combination of sales and demographic data; while the implementation of smart meters in residential homes will enable details of occupants' energy use to be analysed, and tailored advice given (e.g. Leighton et al, 2014).

Current projects such as the EPSRC-funded *Hub of All Things* (Ng et al, 2014) propose enabling consumers to have some control over the market for their own data—also suggested for QST more widely (Fotopoulou, 2014)—and, combined with prospects of 'smart homes' appearing, piecemeal, in our lives, from smart meters to smart fridges, the lines between what we *choose* to track and what systems are tracking anyway—and how we, or others, use the data—are blurring. QST can be seen as one facet of the Internet of Things (Swan, 2012), in the sense that people are being, effectively, connected into the network as data providers and receivers, exchanging data not only with other humans but also objects, material environments and companies. We are part of the network. But how well do people understand the ways in which this connectivity manifests? Is it possible for new forms of QST feedback to help people understand their place within these wider systems, and how—for example—their own bodies work? Can QST change people's understanding of the world around them?

Societal impacts

As Rooksby et al (2014) contend, "lived informatics" is increasingly "enmeshed with everyday life". Beyond individuals' daily lives, it is clear that there are broader societal implication, with the concepts of QS and self management "entering larger discussions, policies, and practices; for example, in relation to healthcare, health insurance, and health promotion" (Lupton, 2013). Big data analysis can provide invaluable information about general economic or societal trends (Lohr, 2012) For example, Stephan et al (2012) note that big data may facilitate sustainability by gathering knowledge about societal or group behaviours that could allow strategies to be formulated surrounding, resource allocation, waste management and growth planning. As such, it is clear that while QST is about individuals it is also evolving to become part of major commercial enterprises, the digital data economy, and government (Lupton, 2013). Understanding the potential societal benefits of QST, in a policy sense and how technology development can contribute, will be an important step in the field's maturity.

Emerging questions: Rationale for the call

Given the anticipated growth of QST and the potential for it to impact individuals and society, our call for a better understanding of QST is both timely and relevant. Currently, advances in technology are far outstripping our understanding of how it might affect people and society. As

such, there is a real need to gain a deeper—but systematic—understanding of the human factors, and psychological and sociotechnical processes involved in QST, especially if we are to optimise the opportunities that QST offers. Recent and current academic research on QST is largely focused on small trials in HCI, or is summarising the state of the movement and arguing for its potential (e.g., Elsden & Kirk, 2014; Lupton, 2013; Swan, 2013), but little work has systematically examined the capacity for QSTs to result in lasting behaviour changes or considered how QST may be used to benefit society.

We suggest that in order to realise fully the potentials that QST may offer individuals and society it is necessary to consider 3 components inherently involved in QST, and the links between them:

(i) the design of QST (i.e. available features, how information is made available, customisation)
(ii) how people use QSTs (to compete, to collaborate, to attend to, or to improve)
(iii) the psychological factors involved (e.g., motivation, habits, affect, self-perception).

Published articles have variously recognised the importance of these three factors. Specifically, the importance of design in QSTs, in particular the need for appropriate data visualisations (Yang, Lee & Gurrin, 2013) has been acknowledged and researchers have started to explore how and why people use QSTs (Li et al, 2011; Rooskby et al, 2014). Authors have also called for the need to understand the underlying psychological processes involved in QST, noting that their design has yet to be derived from established knowledge or theories about behaviour change (Marcengo & Rapp, 2013). However, despite recognition of these factors' importance, research into QST is still in its infancy and little is known about the factors and relations between them. Yet, such a framework has the potential to enable a more holistic understanding of how QSTs impact people and society, by enabling a wide range of research questions to be addressed, including:

- How do people fit QSTs into their lives?
- How do people make decisions using QSTs?
- How could design facilitate enhanced self-knowledge, informed decision making, and behaviour change, through the use of visual/sensory/non-numerical feedback?
- What motivates people to adopt QSTs, and how does this influence the ways in which QSTs are used and the outcomes obtained?
- How does using QST and the wider Internet of Things context influence our perception and understanding of connectivity?
- Can QST change people's understanding of the world (and their place in it)?

Scope of the call: key areas and opportunities

Aside from enabling research questions with applied implications to be addressed, the suggested framework cuts across a number of the EPSRC's themes. In particular, the three components we have outlined align with several Digital Economy sub-themes, in particular; behavioural change, design, human computer interaction & social computing interactions. Our framework also has implications for one of the key challenge areas within the digital economy theme: "sustainable society"—understanding how the improved delivery of information and services will enable people to make informed choices.

Research into QSTs offers substantial opportunities across different disciplines. For instance, collaborations between computer science and design could develop new forms of data visualisation to explore how effective QSTs are in instigating self-knowledge and behavioural change. QSTs also offer opportunities for the social sciences to work together with design and computer science, as they allow behavioural data to be directly measured, enabling the discipline to move beyond "introspective self-reports, hypothetical scenarios and questionnaire ratings" (Baumeister et al, 2007) and towards an understanding of both individual and societal trends.

Suggested call criteria

- Multidisciplinary project involving researchers from social sciences (sociologists, behavioural scientists and ethnographers), design, HCI/computer science and engineering. Big Data Enthusiasts. Technology strategists.
- The proposed project should enable a wide arena of research questions to be addressed with clear applied implications. However, the main focus should be on using QSTs to optimise the opportunities afforded to individuals and society more widely.
- Potential for engaging with stakeholders—industry and public sector, including those that have already implemented QSTs and those who could benefit—but also working with users themselves to understand their needs and priorities.

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