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Does the Quantified-Self Lead to Behaviour Change?

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In 2006, marketing commentator, Michael Palmer said "Data is just like crude. It's valuable, but if unrefined it cannot really be used" [15]. Over a decade on, our lives are more saturated with data than ever, but we still seem far from harnessing its full potential.

Health and well-being is one area is very prevalent. In recent years, produced a plethora of data for ir

abandon, or adopt particular habits related to their health. Just like crude oil, health data has subsequently become hugely abundant.

However, if we don't learn how to best navigate and refine the large amounts of data offered by this technology, then it will be difficult to help people use it for the betterment of their health and well-being. This article explores how these difficulties can be overcome, and highlights how behavioural science can untangle the complex relationship between technology and long-lasting behaviour change.

The Quantified Self

In the context of health, a habit is defined as an automatic response to a contextual cue (e.g. location, object, or preceding action), which forms when the response is repeated in a stable context [22]. When it comes to overcoming bad habits and continuing good ones, people have come to rely on new developments in fitness and app technology. For example, apps such as *MyFitnessPal* allows users to track what they eat to develop healthy nutrition habits, [illegible] users build mindfulness habits to [illegible] being.

Using such technology to track or [illegible] been referred to as the Quantified through numbers") – a term coin[illegible]

Gary Wolf and writer Kevin Kelly. Other definitions include "personal informatics," "lifelogging," and "self-tracking" [12]. The explosion in the QS has been characterised by the growing development and use of wearable devices and apps *(Fitbit, Sleep Cycle, Fooducate, Happify),* and has meant that individuals can access information about many of their behaviours such as stress, menstruation, mood, heart rate, sleeping patterns, diet, mental attention, and physical activity.

Such is the rising popularity of the QS, that the wearable electronics business is expected to reach over 150 billion dollars annually by 2027 [9]. But how exactly does it affect behaviours related to health?

The importance of feedback

Research suggests that there are many ways in which QS can create positive user experiences and influence behaviours. One of these involves the importance of user feedback. Fritz et al. (2013) conducted interviews with 30 participants who had used a *FuelBand, Fitbit, Jawbone*, or a *Striiv* for a minimum of 3 months to understand their value [illegible] that numerical feedback motivate activities, because it created a sen them to reach their goals. Meanwhile, Renfree et al. (2016) app *Lift*, which allows users to sel wish to develop [18]. The numbe

behaviour has been performed – called 'streaks' – are used to reward app users. This received positive reactions as it helped support behavioural repetition, and participants were reluctant to lose streaks. For example, one recipient was motivated to keep up a particular habit, because they wanted to maintain their long streak, and that "having a big number is helpful in that you don't want to break it."

However, despite these positive reactions and the rapid growth in the industry, new evidence suggests that the presence of data concerning one's habits is often ineffective in instilling long-lasting behaviour change. Researchers are finally beginning to explain exactly why this may be, and have started providing possible solutions. For instance, Patel, Asch and Volpp (2015) argue that wearable devices are merely facilitators, rather than drivers of behaviour change [16]. They believe that technology companies should focus on engagement strategies, rather than features, to help bridge the gap between recording information and long term behaviour change. Fortunately, a wave of further research is examining this issue both empirically and theoretically.

The bothersome natu

Firstly, studies suggest that wearal
ways. For example, Harrison et al
with 24 users of wearable devices

wristband was "pretty ugly," while another said, "it wasn't practical for wearing all the time." Another inconvenience was battery life, leading users to abandon the app entirely [8].

Furthermore, in Renfree et al.'s (2016) study on *Lift*, the reminders sometimes caused negative affect because they were deemed annoying, particularly when participants were going through busy or stressful periods [18]. Sjöklint, Constantiou and Trier (2015) interviewed 42 users of devices which track moving and sleeping activities, and uncovered similar findings, where one participant reported, "I sometimes got upset about the fact that I couldn't always achieve my goal" [19]. Further still, they argued that despite being marketed as enabling devices which support the "rational self (the planner)," they actually attract "the emotional self (the doer)." This is because unsatisfactory results, such as underachievement, do not lead to behaviour change but rather the emergence of coping tactics: disregard, procrastination, selective attention, and neglect.

The difficulties of interpreting the data

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problem in the QS movement. In
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In addition, the precision of this available information has also caused concern. Yang et al. (2015) analysed 600 product reviews, and conducted interviews with users of devices such as *Jawbone, Fitbit, Basis*, and *Nike + Fuelband* [23], finding that users were not satisfied with the accuracy of their device. For example, some users had multiple devices, and would compare the accuracy, but there was no absolute standard which made it difficult to resolve discrepancies.

Users also liked to test the accuracy of the device with different movements, but those that they tested were not reflective of a realistic scenario. In one instance, one participant wanted to test the sensitivity of his Basis B1 fitness watch, so he tried "jumping," "punching," "swinging around," and "tapping it on things." However, the authors note that these were not ordinary movements that users would do in daily life. Finally, participants complained that the units of measurement driving their behaviour were not clearly defined, such as a calorie, a step, or sleep.

Along with the accuracy of the device, users also did not have sufficient understanding of how th
theories' to make sense of the data
found that the device was over-ra

unaware that the issue could be s
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assessment by comparing measurements taken in different physical conditions. They concluded that a user's understanding of how the device or app works is crucial, and suggest supporting testability, allowing greater end-user calibration, and increasing transparency will improve users' experience.

Habit formation theory

Considering all these issues, how is it that so many fitness and health apps fail to counter-act them, and fall short of satisfying customers by fostering long term behaviour change? From a theoretical perspective, researchers have uncovered issues concerning the QS and its lack of grounding in habit formation literature.

Adopting a habit relies on repeatedly performing a specific action in a stable context, because this allows the action to become automatic [22]. Stawarz, Cox and Blandford (2015) reviewed the functionality of 115 habit formation apps [20]. They listed the app features, which resulted in 14 app feature categories, such as task tracking or rewards, and then coded each app for habit formation featu[illegible] the use of contextual cues. It was

feature categories supported habi[illegible] routine creation – could help use[illegible] behaviour in question.

The research concluded that these apps are not supported by habit formation theory, and only "provide functionality to enable tackling of task completion and reminders." While monitoring one's behaviour is initially important, it leads to a dependency on reminders and does not support the development of automaticity, which is crucial in behaviour change. It is suggested that apps and devices would benefit from supporting trigger events, using reminders to reinforce implementation intentions, and avoiding features which cause a reliance on technology.

Pinder et al. (2015) took another approach, and argue that persuasive technology, such as the QS, should target the nonconscious system [17]. Outlining dual process theory, they note that habits are not consciously motivated, chosen or monitored. This is because a habit is an association between a situation and an action that has become established in memory [22], so many habits are triggered automatically, outside of our awareness [1]. Current behaviour change interventions, however, use many conscious behaviour change strategies, which result in users ignoring prompts or unwanted interruptions.

They offer two solutions, the first
the nonconscious system to behav
example, the exercise game *Zomb*

running from fear as a trigger for physical activity. The second solution involves "retraining the nonconscious system such that the user is more likely to behave in the desired way." They argue that this can be done through nonconscious goal priming, where the new behaviour masks the existing unwanted behaviour.

One example of this is glanceable persuasion, which presents a user's physical activities in a subtle and abstract manner. Klasnja et al. (2009) investigated users' physical activity with *UbiFit's* garden display, which grows different flowers depending on the activity performed [10]. The researchers found that weekly activity level was higher for participants with the glanceable display than those without the display. They argued that this was because it kept physical activity goals "chronically activated," which reminded users of their commitment to stay fit. One participant said: "[With the garden] I think about it maybe subconsciously every time I look at my phone." It should be noted, however, that they did not monitor conscious level of attention on goal feedback [17], which could be a fruitful avenue for future research.

Along similar lines, Calvo and Peters (2013) call for designers to be aware that we are not always r
and are subject to complex psych
argue that reflecting on our past

behaviour, for example, by under
oral hygiene, we brush our teeth
on the past is determined by vari

remember an experience based on what happened at the beginning and end. This reinterpretation of events is influenced by the primacy and recency effect, which is the psychological tendency to recall the first and last items in a list [3].

To create effective technologies, app designers are therefore advised to take into account how this affects subjective interpretation of past experiences. For example, end rewards such as badges, achievements, and motivational messages provide intrinsic value for users, which fosters positive emotions [5]. This means that the user reinterprets the end of an event, such as physical activity, as positive, and they are motivated to repeat the behaviour again [2].

The authors also warn against systems designed to change behaviour because they may have opposite results. This is known as "ironic effects," which is when attempts to convince ourselves to do or think something backfire. For example, a study on smoking cessation found that when participants tried to stop thinking about cigarettes, they smoked more than those who did not attempt thought suppression [6]. Calvo and Peters suggest that motivational messages which ask users to focus on a certain goal should be carefully tailored, avoid unexpected results.

Conclusion

In summary, the progress of our u

effectiveness of the QS is promising, but further work is required. Perhaps the most important observation in many of these studies on the effectiveness of QS devices and apps is the notion of dynamism; not only do designers need to understand that individuals have different needs but that these needs are constantly evolving.

The theoretical and empirical issues raise seemingly insurmountable obstacles in the search of understanding how persuasive technology can motivate and maintain behaviour change. Yet, this challenge is offset by the value of the answer, because if such concerns can be addressed, then the Quantified Self could have a life changing impact on the health and well-being of millions.

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