Reaching the finish line: Analysis of the differences between active participants and drop-outs in a behaviour change intervention

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Abstract

Living Lab research faces high participant drop-out rates during prolonged engagement in interventions. In a recent study, approximately 55 % of the 104 voluntary participants dropped out. Although drop-out occurs, interventions show positive behavioural impacts for the participants who remain. Therein exists the need to understand what differs between people who 'stay in the race' and those who become inactive. A 3-month field trial in Spring 2016 comparing the effectiveness of a gamified household-level electricity savings challenge provided hourly electricity consumption data and savings activities to participants. Pre- and post-intervention surveys sent to the 104 participants collected data on the reported behaviour and perception of social norms of the two groups: active (n=44) and inactive (n=22), thus N=66 completed both surveys. Thus, it was possible to differentiate the experience of the two groups to determine the impactful components of the intervention.

As reported electricity use differed significantly between the active and inactive participants, this indicated that the desired behaviour change was connected to participation. As well, the feeling of being socially supported with guidance and information during the intervention was found to relate to participants' change of behaviour towards more sustainable patterns over time with the active participants reporting a significantly increased feeling of being supported to save electricity.

This study underlines the importance of having informational social support as an intervention component to induce the behaviour change, but still asks whether informational support is a precondition to a successful behaviour change or whether it is an outcome of remaining active in an intervention. But whether the first or second statement is true, we assume that informational social support encourages participation over a longer time period.

Introduction

It has been widely acknowledged that tackling society's contemporary energy-related problems requires not only technological advances, but also initiating a deep change in human behaviour (Gardner & Stern, 2008). As such, understanding the factors underlying and shaping energy-related consumption behaviour becomes pivotal for the design of successful behaviour change interventions.

In this context, much research and practical experimentation has been focusing on studying the effect of different forms of energy feedback on consumption behaviour (Abrahamse, Steg, Vlek, & Rothengatter, 2005; Darby, 2006; Hargreaves, Nye, & Burgess, 2010). The underlying idea is that by providing improved information feedback, it is possible to raise user's awareness and to trigger rational decision-making in favour of energy-saving (Wilhite & Ling, 1995). Real-time electricity consumption feedback is a necessary starting point for bridging the understanding gap between how much electricity is consumed and when, and relating this to daily habits (Abrahamse et al., 2005; Attari, 2010; Schley & DeKay, 2015). However, generating knowledge alone, seems not to be sufficient to trigger behavioural change, as a multiplicity of other factors also come into play when dealing with practices of energy consumption

and conservation (Darby, 2010; Frederiks, Stenner, & Hobman, 2015; Hargreaves et al., 2010). For instance, a growing body of literature suggests that the inclusion of socially-based comparative feedback is more effective in reducing individual energy consumption compared to more generalized and non-targeted information (Abrahamse et al., 2005; Carrico & Riemer, 2011; Darby, 2006; Degen et al., 2013; Fischer, 2008; Schultz, Nolan, Cialdini, Goldstein, & Griskevicius, 2007; Vine, Buys, & Morris, 2013). Indeed, it is being increasingly acknowledged that multiple factors, ranging from individual (socio-demographic and psychological) to situational (contextual and structural) elements are jointly at work in shaping energy-related behaviour (Frederiks et al., 2015). As such, interventions may try to use social norms to impact behaviour of individuals who belong to a social group, such as in the family, a sports team or in the neighbourhood, where expectations create external pressure to change behaviour, e.g. (Moser, Blumer, Seidl, Carabias-Hütter, & Furrer, 2015). Alternatively, communities of practice of intrinsically motivated people can form and diffuse new behaviour by engaging households within a pre-existing, or newly forming, social setting (Kurz, Gardner, Verplanken, & Abraham, 2015). At the individual level, personal norms can drive behavioural change through a sense of responsibility and ability to make an energy-related decision and related action (Stern, 2000).

Interlinked to the factors impacting behaviour change are also the factors that hold a participant engaged in a behaviour change intervention. It is assumed that engagement in the intervention is a prerequisite for the desired behaviour change; however, engagement may also be an inherent motivation with respect to social norms, supporting research studies, or general satisfaction with the innovative product or service, etc.

Here we present the Social Power project, a behaviour change intervention exploring the potential of both psychological and social triggers (social norms, social comparison, support, knowledge, intentions, etc.) and game mechanics in driving a neighbourhood community towards long-term energy-related behaviour change. A game (and gamification) has the virtue of enhancing an individual's active interest and learning capacity not only for entertainment reasons but also for a more meaningful purpose (in our case energy-saving practices at home). The aim is to leverage on factors that have been identified as increasing intrinsic motivation of human behaviour as a means to enhance user's engagement and learning and the attainment of a collective energy reduction goal and long term behavioural change (Malone & Lepper, 1987; McGonigal, 2011).

Likewise, as to better understand how the intervention itself impacts users, it is not enough to simply measure energy-related behaviour in terms of overall household energy consumption (kWh). An integrative approach is needed, capable of capturing the ongoing interaction of multiple factors (both psychological and contextual) jointly influencing the observed findings (Scheuthle, Carabias-Hütter, & Kaiser, 2005). In the Social Power project, this information is collected by means of a pre- and post- intervention survey, explicitly focusing on the following factors at work during the field trial: reported electricity-use behaviour (Sütterlin, Brunner, & Siegrist, 2011), social support (Molloy, Dixon, Hamer, & Sniehotta, 2010), motivations, social identity (Peterson, Speer, & McMillan, 2008), self-efficacy (DeWaters & Powers, 2011; Sütterlin et al., 2011) and technical competence. The aim is to determine a baseline and to identify possible changes over time, as to help evaluate the effectiveness of the present intervention and to possibly suggest improvements to be considered in the design of future, similar behaviour change interventions.

To start with, the following analysis uses data from Social Power to uncover where differences, if any, exist between participants who remained active and those that did not manage to make it to the end of the intervention, then 'finish line'. After a delineation of active and inactive participants, an initial review of significant differences between the groups for the factors mentioned previously is completed. Differences thus beg the question of why they exist, which will be attempted to be answered considering the available data. Thus, the main results of this paper focus on answering the following questions:

1. How can activity on the Social Power app be defined?
2. Where do active participants differ in their interaction with and perception of the intervention as compared to inactive participants?
3. What are possible explanations and implications of the differences?

Intervention approach

Social Power is a behaviour change intervention aimed at reducing household electricity consumption using a mobile application visualizing hourly electricity data from smart-meters and presenting the performance of a gamified team challenge over a three-month period, as seen in Figure 1. This approach is chosen to stimulate collective action by the comparison of oneself with others who are also engaged as stated in social proof theory (Cialdini, 2001).

The intervention was established as a field experiment during February to May 2016 in two cities in Switzerland. 104 voluntary household participants were registered at the beginning, however more than half of the participants dropped out and became inactive, thus leaving only 47 active participants at the end of the three months. All selected households have no electrical heating (no heat pumps, no boilers for hot water, and no other electricity-based heating systems). Therefore, all electricity consumptions are only due to electrical appliances and lightings. The visualisation of weekly electricity use in the "Energy Diary" is shown in the second screen shot from the left in Figure 1.

During the intervention period, participants were provided with the Social Power app and were randomly assigned to either a collaborative or competitive team. The competitive gameplay context places two teams against each other with the goal of reducing more electricity, as a team, as compared to the opponent. The collaborative game promotes reaching a collective electricity savings of 10 % for the whole team, thus participants can see how their teammates are performing, but there is no direct opposing team. Screenshots from the game screens for each context are shown on the two right-hand screenshots in Figure 1. The competitive game compares the progress in savings, points earned, and number of challenges completed between the two teams. The collaborative game shows a comparison between the individual household savings progress to

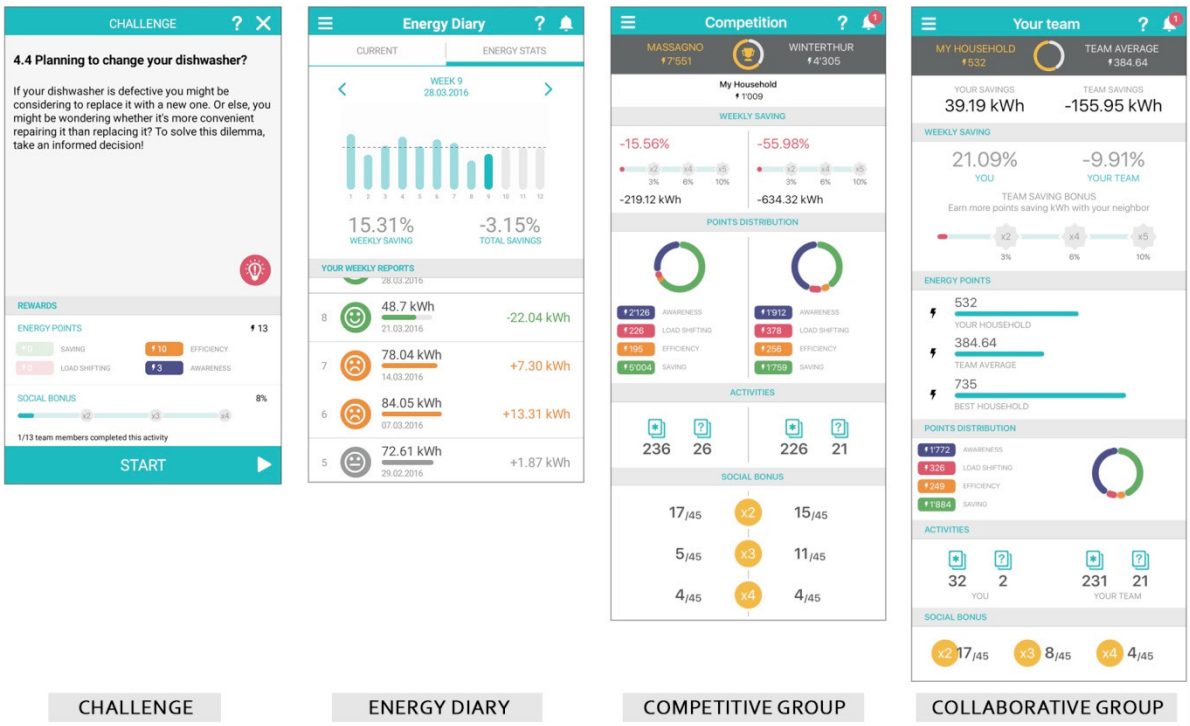

Figure 1. Screenshots of the Social Power app (l-r): First step of a challenge, Energy Diary with weekly consumption reports, Competitive team interface, Collaborative team interface.

the team's, how close they are to milestone targets, as well as the points earned and challenges completed. The two gameplay contexts present similar motivations for engagement and long term behaviour change, and in another analysis they are found to both be equally effective in reducing household electricity use (Wemyss et al., 2016).

For both gameplay contexts, weekly activities are presented for each of the 12 intervention weeks, related to a specific weekly theme, totalling approximately 50 electricity-saving related challenges (an example is shown on the far left in Figure 1). Each challenge, when completed, can earn the participant points, which are part of the evaluation of performance in the collaborative and competitive games, alongside electricity savings. The challenges lead a participant step-by-step through different household activities to save electricity and are presented using informative steps, multiple choice questions, numeric and text inputs, or a photo upload, and are supplemented by a series of related energy tips. Finally, once a month participants could test their knowledge in a quiz where prizes could be won. Through the combination of learning about the benefits of taking an action, providing additional gamified incentives to act, and a social context for the action, a motivational environment is created with the aim to develop new and lasting sustainable habits (Kurz et al., 2015; Stern, 2000).

Regardless of whether participants are in a collaborative or competitive team, ultimately all participants seek cooperation at an intra-group level in order to attain the team's collective electricity reduction goal set by the game. Within this framework, researchers and developers envisioned sustaining intra-group social support and interaction by involving participants either in an individual-to-group comparison (collaborative gameplay) or group-to-group comparison (competitive gameplay) in terms of (i) number of completed challenges, (ii) point attribution and (iii) energy-savings as triggers. Therefore, in both cases individuals evaluate their performance based on the performance of a group, a condition that has shown to enhance social identity (Brewer & Weber, 1994). Also, comparing people on a set of single performances (energy saving, points, etc.) is what Grevet and Mankoff (2009) describe as one-dimensional or explicit social comparison, which leads to assimilation with others, meaning that the person being compared wishes to be similar to others (Feldman, 1984). In addition to the points earned through challenges, a team electricity-savings bonus and social bonus are allocated whenever the team reaches a savings goal or when more participants complete the same challenge, respectively - the primary message is that playing actively and strategically with your team pays off.

Working with social feedback as a means to trigger behavioural change leads spontaneously to potential concerns about privacy, as the participant may receive information deemed sensitive about other participants. In the Social Power project this problem is overcome by displaying only aggregate social group feedback. Researchers and developers opted to keep the identity of the information of individuals anonymous and private. In fact, no identification – not even by an avatar – of other team members is featured in the Social Power app. It is assumed that the sole provision of social group feedback specifically aiming at yielding strong identification of participants with their virtual social group, as well as triggering the phenomenon of assimilation, would be sufficient to generate real-world intra-group social support and interaction, leading to a manifestation of behaviour change at the neighbourhood community level.

To aid this predicted group dynamic and promote social networking, outside the app, a Facebook page and blog ex-

ist to allow for participant interaction. In addition to being a forum for participants to discuss their progress, both the Facebook and blog are maintained by the project team to provide additional information about the energy-related theme of the week, tips, and answers to questions from participants. In fact, it was expected that in the Social Power project, people's awareness would not be built by means of traditional one-way information, but rather by means of a bottom-up process of social learning, continuously fuelled by the exchange of experiences between participants and shared on a social platform. In other words, social relations were meant to be the grounding stone generating social change. However, throughout the game intervention period, social interaction on these communication channels was minimal. This latter finding demands a revisit to the definition of "social support" that was theoretically envisaged for this field experiment and the social support that test users actually experienced during the intervention phase.

Method

In order to look into what differences may exist between initially interested participants and those that finally make it to the 'finish line' of the intervention, a first look at how many participants were retained throughout the period, as well as their level of engagement is necessary. After the two groups, active and inactive participants, are defined, an analysis of their differences follows.

MEASURING PARTICIPANT RETENTION

Retention rates refer to the percentage of users a mobile app has retained over a certain time period: if the provided app offers added value to a users' life, the probability of them returning and engaging with the provided innovation will be higher. Attrition rate measures the exact opposite, and in this context refers to the measure of the number of individuals leaving a collective group over a specific period of time.

In order to perceive the actual retention and/or attrition rates over time, weekly app access over a period of four months (February - June 2016) is tracked.

MEASURING PARTICIPATION ENGAGEMENT – ACTIVE VS. INACTIVE

In a field trial, lack of full participation impacts research findings. Additionally, the setup of the Social Power project was particularly subject to attrition bias: the social group feedback and game design inside the gameplay is dependent on participation by all team members. Thus, inactive players impact the gameplay for the active players and represent a passive burden. Halfway through the Social Power game, eliminating those participants that were not contributing to the game emerged as a necessity to be able to rebalance the game dynamics of the active participants. Starting in week 10, a game re-set was launched. Table 3 defines the criteria with which researchers classified "active" and "inactive" players in the Social Power game.

MEASURING DIFFERENCE – PRE- VS. POST-INTERVENTION SURVEYS

Accompanying the project, pre- and post-intervention surveys were sent to participants in order to quantify and qualify the perception of the aforementioned intervention approach. The first survey explicitly asked the participant's motivations and technical competence for using new technologies and the app in advance of the intervention, as shown in Table 2. Sets of questions on social processes (Cialdini, 2003), self-efficacy (DeWaters & Powers, 2011; Sütterlin et al., 2011), reported electricity-use behaviour (Sütterlin et al., 2011), and social support (Molloy et al., 2010) are asked in both the pre- and post-intervention surveys, and are thus used for drawing conclusions on the change that took place due to the intervention. Specific items for these variables are not explicitly described here due to space limitations; please refer to the referenced source. T-tests are used to compare the means between the active and inactive groups.

Results

RETENTION

Figure 2 shows the progress of change. Calculations did not take into account the category of participants that never downloaded the app (Category 4 in Table 1). According to annual retention analytics run by Localytics (Localytics.com) retrieving data from over 37,000 apps, the average retention rate for a mobile application one month after download is 39 %, a figure that falls to 20 % by the time 3 months have passed. Gaming apps register even lower average retention rates: 27 % after one month, falling to 10 % after 3 months.

In comparison to typical mobile app retention rates, values are above average, registering after one month (Week 4) a retention rate of 82 % and at the end of the 3-month game period (Week 13), a retention rate of 58 %.

In Figure 3, the retention rate over time is differentiated by the active and inactive participants considering activity on the app (i.e. opening the app, challenges completed, photos uploaded etc.). Measurement error from app malfunction or re-login can be excluded as data was collected for broader general activity which is assumed to be too complex to be a malfunction. During the game re-set period (week 10–13), boxed in, engagement slightly increases as there was more communication between the project team and the participants concerning the re-

Table 1. Criteria for delimiting the level of participant engagement.

Category: engagement criteria
0: Inactive – access occurred in less than 5 different days
1: Initial activity – access only at the beginning of the game, and subsequently no access
2: Moderate activity – regular access, but less than 70 occurrences
3: Good activity – consistent access, more than 70 occurrences
4: App was not downloaded

Table 2. Items defining technical competence and motivation in the pre-intervention survey.

Item	Survey statements
Technical competence	– I like using new gadgets and apps – I have a difficult time understanding how to use apps – I use office electronic devices (computer, printer, etc.) for my work or at home on a daily basis – I know how to use all the appliances that I own – I regularly maintain my appliances – When an appliance is broken, I replace it with a new version
Motivations	– I want to reduce my environmental impact – I want to reduce my electricity costs – I participate because it is free and/or the prizes are attractive – I want to contribute to a relevant scientific project – I like trying out new mobile phone/tablet apps – I like the idea of playing in a game – I like to support community initiatives

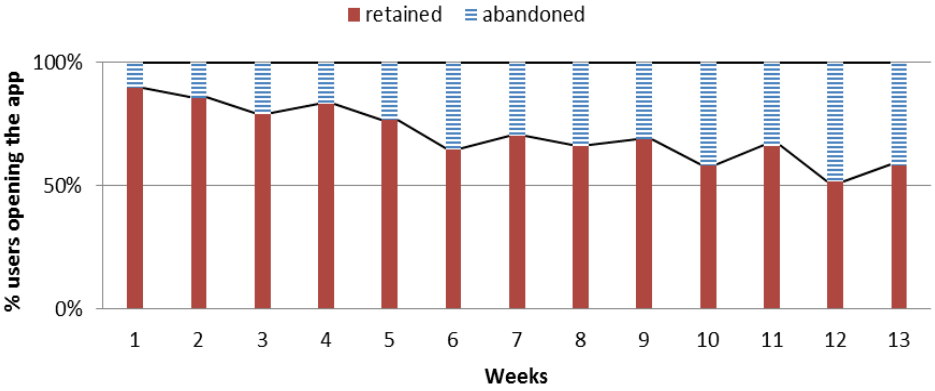

Figure 2. Retention rate of Social Power participants over time.

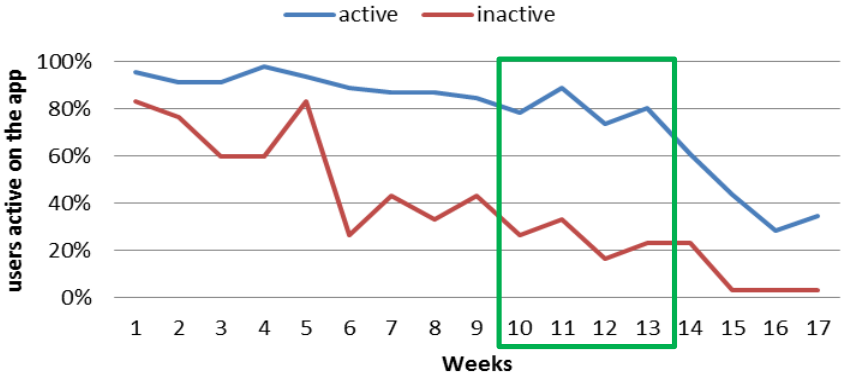

Figure 3. Retention rate of Social Power participants over time differentiated by activity level (active vs. inactive).

moval of the non-active players, a reset of the points, as well as the final quiz.

It is noticeable that even though inactive participants are no longer part of the game starting form week 10, activity on the app remains at 27 % in week 10 and participants continue to access the Social Power app until the end of the game period, registering a final drastic drop after week 14. However, a closer look at the number of app openings during this entire period (Week 1–17), shows that inactive participants totalled an average of 42 openings compared with an average of 190 app openings by the active participants. These findings seem to reflect a "passive", rather than "inactive" presence of a particular segment of participants.

ENGAGEMENT

Out of the 104 participants that had registered voluntarily to join the project, 45 % were classified as active (Categories 2, 3) and remained in the game. The rest of the participants were excluded from the game, however they could still continue to access the app to see their personal electricity consumption in the

Table 3. Distribution of participant's activity level in week 10/13 (N=104).

Category: engagement criteria	% of participants
0: Inactive – access occurred in less than 5 different days	25.0 % (n=26)
1: Initial activity – access only at the beginning of the game, no access during the previous four weeks	3.8 % (n=4)
2: Moderate activity – regular access, but less than 70 occurrences	10.6 % (n=11)
3: Good activity – consistent access, more than 70 occurrences	34.6 % (n=36)
4: App was not downloaded	26.0 % (n=27)

Table 4. Completion of pre- and post-intervention surveys by activity level.

Category	0 (n=26)	1 (n=4)	2 (n=11)	3 (n=36)	Total (N=77)
Participants completing both surveys	19	3	11	33	66
Percentage responses of total sample, N=77	18 %	3 %	11 %	32 %	86 %
Percentage response in each single category	73 %	75 %	100 %	92 %	86 %

Table 5. Differences of means tests between the active (n=44) and inactive (n=22) participants. Responses on a 7-point Likert scale, 1 = disagree or low competence, 7 = agree or high competence.

	Active participants			Inactive participants		
Item	Mean	SD	Median	Mean	SD	Median
Technical competence[1]	5.98	0.88	6.30	5.81	1.11	6.30
Motivation: I want to reduce my negative impact on the environment	5.89	1.83	7.00	6.23	1.15	7.00
Motivation: I want to reduce my electricity costs	5.48	1.80	6.00	5.32	1.25	5.00
Motivation: I participate because it is free and/or the prizes are attractive	3.14	1.95	3.00	3.32	1.99	3.00
Motivation: I want to contribute to a relevant scientific project	6.14	1.34	7.00	5.91	1.51	6.00
Motivation: I like trying out new mobile phone/tablet apps	4.20	2.09	4.00	4.14	1.98	4.00
Motivation: I like the idea of playing in a game	5.05	1.82	5.00	4.45	1.77	5.00
Motivation: I like to support community initiatives	5.68	1.67	6.00	5.36	1.26	5.00

[1] Combined response of all technical competence statements.

energy diary and read the energy-saving tips. Thus, the active participants are those in categories 2 and 3 (n=47), the inactive participants are those in categories 0 and 1 (n=30). Participants that officially dropped out or did not download the app are excluded from the further analysis.

SURVEY RESULTS

The pre-intervention survey was completed two weeks before the intervention period, and the post-intervention survey was completed up to one month after the end of the intervention. 104 were sent the survey which includes both active and inactive participants, as well as late dropouts. Ultimately 44 active participants (of 47 total) and 27 inactive participants (of 30 total) completed both the pre- and post-intervention surveys.

Of the group of participants that answered both the pre- and post-survey, it emerges that overall commitment to the field experiment was very high with 86 % completing both surveys (see Table 4). Interestingly, although engagement of the inactive participants in the game was rather low, they appear nevertheless committed to the field experiment, providing high response rates to the survey (Category 0 = 73 %; Category 1 = 75 %).

The survey results are non-parametric in nature, and thus the Mann-Whitney non-parametric test of differences in means is used for comparing between the active and inactive groups. Table 5 presents the results of the testing for significant differences of the variables tested prior to the intervention. Comparing the active to the inactive group, there are no significant differences in terms of their motivations or technical competences, thus they are similar considering these characteristics.

The changes in variables that were expected to be affected by the intervention are presented in Table 6. Of the variables tested, the change in reported electricity use behaviour in active participants ($Mdn = 0.74$) differs significantly from the inactive participants ($Mdn = 0.11$) after the intervention, $U = 223.50$, $z = -3.73$, $p < .05$, which implies that the active participants have more sustainable electricity use behaviour after the intervention. Additionally, the change in perceived social support of the active participants ($Mdn = 2.05$) is significantly higher than the inactive participants ($Mdn = 0.68$), $U = 338.00$, $z = -2.02$, $p < .001$.

Looking closer at these two significant variables, the statement in the survey defining perceived social support is "In the last 3 months, I had someone to encourage me to save energy",

as adapted from Molloy, Dixon, Hamer, & Sniehotta (2010). To assess the electricity use-related behaviour of the participants, the items from Sütterlin, Brunner, & Siegrist (2011) question the frequency of primarily energy curtailment actions, as well as an energy efficiency purchase decision.

Discussion

RETENTION & ENGAGEMENT

Overall retention rates registered in the Social Power project are rather high (82 %, one month after download). Even the inactive participants still register a high retention rate (60 %) one month after the download. It is in this period that most app accesses occur (on average 31 app openings). After week 5, weekly activity decreases to an average of 7 app openings between weeks 5 to 9. Week 1 to 5 probably roughly corresponds to the so-called onboarding period, where users gradually get acquainted with the innovation product provided. If they struggle using the app and the time cost on the users is too high, the probability that they withdraw their participation and abandon the experiment are higher.

These particular trends in the Social Power project bring into question possible factors of attrition as a result of the proposed research methodology, in particular the recruitment phase. As users are a critical element of field research, it is essential (though not always easy) to be able to successfully recruit, motivate and engage users to participate and keep participating. Consequently, one main task of researchers and developers is to thoroughly understand the behaver's perspective (Stern, 2000). Indeed, next to applying social research techniques (e.g. survey, focus groups, semi-structured interviews, etc.), a new form of field research has emerged in recent years, combining a high degree of realism with a more active user involvement in the co-design of an innovation as a mean to include and iterate the needs, aspirations, and motives of test users in their everyday context in an active way (Schuurman & De Marez, 2012; Webb et al., 2016). It is the so-called Living Lab methodology (Bergvall-Kåreborn, Howcroft, Ståhlbröst, & Wikman, 2010). This methodology can be further enhanced by integrating action research as a framework to improve Living Lab research in a way that both participants and researchers themselves became part of the reflection process (Logghe & Schuurman, 2016).

Another important element could be the recruitment methodology applied. According to Schuurmann & De Marez (2012), a structured, panel-based Living Lab facilitates user recruitment based on specific characteristics related to the innovation being developed and tested in the Living Lab. Indeed, intrinsic motivation is essential for Living Lab participants' active and enduring participation (Baccarne, Logghe, Veeckman, & Schuurman, 2013; Ståhlbröst & Bergvall-Kåreborn, 2011).

Communication and on-boarding might be also a decisive factor for boosting retention rates. For example, as activity begins to lapse, the app can send push notifications with exclusive offers to that segment to draw them back to the app. According to an analysis run by Appboy (Appboy.com) between 2013–2015, reminder push notifications to users that have not completed the on-boarding process have proven to raise two-month retention by 71 %. That percentage rises if they pair the push with outreach in a second messaging channel (like in-app messages or email) as part of a multi-channel campaign. Also, consider rewarding active participants for their loyalty and consistent engagement.

SOCIAL SUPPORT

Considering the Social power design, it is necessary to reflect on what "social support" looked like during the intervention, and specifically who did the encouraging. In social support theory we can distinguish between different forms of social support.

For instance, Uchino (2009) differentiates between "received" and "perceived" social support and their effects measured on individuals' well-being over time. Received support refers to a form of backing from other people by means of an inter-personal process. Instead, perceived support refers to one's perception of potential access to social support and impacts more on an intra-personal level. Even though these definitions of social support link more to health-related social psychology literature, they show that social relations can impact an individual's interpersonal, as well as intrapersonal sphere. This is also one of the many reasons why the concept underlying the Social Power project focuses on interactive, social gameplay: the idea is that social sharing of good practices in the sustainability domain may lead to what Langston (1994) calls 'capitalization' and that it may help participants experience greater positive affect, cultivate positive "fun" emotions, enhance social bonds and ultimately trigger transformational behaviour change at the community level.

Social support can also take the form of informational support in order to bridge knowledge gaps that inhibit taking ac-

Table 6. Differences of means tests of changes in the variables for the active (n=44) and inactive (n=22) participants. Change refers to the response post-intervention compared to the pre-intervention response. Responses were on a 7-point Likert scale. Mann-Whitney test significances are shown with asterisks.

	Active participants			Inactive participants		
Item	**Mean**	**SD**	**Median**	**Mean**	**SD**	**Median**
Change in descriptive norms	0.45	1.35	0.00	0.27	1.38	0.50
Change in injunctive norms	0.78	1.69	0.50	0.84	1.64	1.00
Change in self-efficacy	0.20	1.34	0.33	0.21	1.51	0.00
Change in reported behaviour *	0.74	0.59	0.75	0.11	0.69	0.07
Change in perceived social support **	2.05	2.67	2.00	0.68	2.06	0.00

*Mann-Whitney Test (1-tailed significance): * p<.05; ** p<.001.*

tion, however this is not known to be a significant contribution to behaviour change but may be relevant for assessing one's own impact (Frederiks et al., 2015). Alternatively, information can be a powerful influence when it is coming through social diffusion, therein social norms are activated (Costanzo, Archer, Aronson, & Pettigrew, 1986), even when the information may not come from a source that is as well informed as an expert (Stern, 1992).

In Social Power, however, due to the lack of intra-group communication, it is assumed that the social support did not come from the team, nor from the immediate real-world social circle of the participant. This reduces the so-called social support to the guidance, suggestions and information that was passed on to participants exclusively by means of the gamified context of ICT-mediated real-time energy and social group feedback, coupled with hands-on learning elements and tips to raise users' problem-solving capacity. This is analogous to personalized descriptive norms which allow the participant to compare themselves to their group, and which have been found to be strongly influential on impacting energy-related behaviour (Frederiks et al., 2015). Thus, the survey statement "In the last 3 months, I had someone to encourage me to save energy" is rather ambiguous: the "someone" could be interpreted as the app itself, the project team or someone in their environment.

Interestingly, even though the kind of social support activated during the project does not correspond to researchers' intentions, it still has a significant and positive impact on the active participants in supporting them to reach the finish line. This ultimately positively correlates to their reported intention to change their energy usage behaviour. In contrast, the inactive participants did not get supported to change their behaviour from the app or elsewhere. One explanation for this finding may be that by not actively engaging in the gameplay context offered by the Social Power app, participants do not access the informational support system provided and consequently do neither perceive an increased sense of social support, nor report an increased intention to change their energy usage behaviour.

REPORTED BEHAVIOUR

Importantly the behavioural items asked in the surveys correspond to challenges presented in the Social Power app. Thus, it could be assumed that, in the best case scenario, after the intervention the participant knows what is the most sustainable action, has completed this action at least once, and understands the impact of the action.

The increase in sustainable behaviour is almost one whole point on the 7-point scale for the active participants after the intervention (M = 0.74, SD = 0.59). It is not possible to ascertain whether the information during the challenges filled a knowledge gap or the action was made due to motivation from the gameplay context, however all these possible forms of engagement in the app speak to the need for a multi-pronged approach.

As it is seen that use of the app results in higher sustainable reported behaviour, it remains true that involvement in the intervention results in the desired behaviour change. This is shown, at least in the short term. A follow-up survey one year after the survey (planned for Spring 2017) will assess whether the habits were embedded in the household participants and thus still remain in the long term. Considering the interplay between behavioural intention with the social support of the app, it will be possible to delimit the impact after having no app "social support".

Conclusions

Ultimately the goal of any intervention is to retain participants, particularly if it is known that participation results in a positive outcome, i.e. a change to a more sustainable behaviour. Of course, there are a variety of reasons for participant attrition, some of which represent factors that go beyond a researcher's control (e.g. participants may decide they do not like the course of the research, do not have the time to dedicate to the project or are simply no longer interested in continuing their involvement). Designing the project to anticipate attrition is possible, for example: recruitment can be targeted to attain desired participants, the kick-off phase of a project can ensure that participants are fully educated about the need for full participation, and understand and agree to the commitment requirements of the project on a signed document, and the design of the intervention can occur in a co-creation setting thus addressing participant's motivation explicitly. Economic incentives may work to reduce attrition rates in certain contexts, however the prize associated to the Social Power game, while substantial (worth around 800 CHF/750 EUR) and personal (choice between three prizes) is the lowest motivator of all motivations rated.

Finally, other forms of social support (e.g. intra-group digital and real-life interactions) can be developed in the Social Power context, such as: teams could be formed organically by participants, thus supporting existing relationships; anonymity could be reduced by using avatars and nicknames; and, as mentioned, developing intervention methodologies with the participants develops intrinsic engagement. Such user-centered design and recruitment phases are lacking in the Social Power project and lead to the conclusion that certain elements of the Living Lab methodology remain to improve in further iterations of Social Power.

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