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Curiosity to cupboard- self reported disengagement with energy use feedback over time

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ABSTRACT
This paper discusses findings made during a study of energy use feedback in the home (eco-feedback), well after the novelty has worn off. Contributing towards four important knowledge gaps in the research, we explore eco-feedback over longer time scales, focusing on instances where the feedback was not of lasting benefit to users rather than when it was. Drawing from 23 semi-structured interviews with Australian householders, we found that an initially high level of engagement gave way over time to disinterest, neglect and in certain cases, technical malfunction. Additionally, preconceptions concerned with the "purpose" of the feedback were found to affect use. We propose expanding the scope of enquiry for eco-feedback in several ways, and describe how eco-feedback that better supports decision-making in the "maintenance phase", i.e. once the initial novelty has worn off, may be key to longer term engagement.

Author Keywords
Eco-feedback; engagement; long-term; discovery; maintenance; energy literacy

ACM Classification Keywords
H5.3. Information interfaces and presentation

INTRODUCTION
Reducing domestic energy consumption represents a key challenge for CHI practitioners and policymakers alike. Providing households with better feedback on their energy consumption (eco-feedback) has been identified as an important tool for achieving sustainable behaviour change (Froehlich et al. 2010) and represents a popular target for interaction design (Schwartz et al. 2013).

Eco-feedback has also emerged as a policy response aimed at helping consumers adjust to escalating energy prices and alternative tariff structures in Australia and the UK (LGIS 2012, Hargreaves et al. 2013). For instance every household in Great Britain will be offered a simple energy monitor as part of the nation-wide smart meter roll-out (DECC 2013). Already, one in five households in Queensland, Australia took the initiative to apply for a simple energy monitor offered through a subsidised government sustainability program (LGIS 2013). Yet despite this apparent expectation that eco-feedback will provide consumers with a smooth transition to the temporally flexible electricity tariffs of the future, questions remain as to exactly how people use and appropriate this technology in the home (Hargreaves et al. 2013, Schwartz et al. 2013).

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Modern eco-feedback technology now affords near real-time information on a growing range of parameters concerning household energy usage such as temporal, social, fixture-specific and appliance-specific comparisons of consumption (Hargreaves et al. 2010, Froehlich et al. 2012, Schwartz et al. 2013). CHI designers have been integral in pushing the boundaries of design in this field, including designing more artistic and unconventional forms of eco-feedback (Froehlich et al. 2010), situating feedback research in more user-centred contexts (Schwartz et al. 2013) and the integration of comparative, competitive and social features in eco-feedback (Petkov et al. 2011, Gambarini et al. 2012).

Comprehensive meta-reviews of eco-feedback literature, covering both real time (e.g. in-home displays) and delayed feedback (e.g. alternative bill design/frequency) have proven eco-feedback to be highly effective in reducing household energy consumption (Fischer 2008, Faruqui et al. 2010). However, despite this proven track record and many years of attention by academics, several knowledge gaps still exist in the literature.

Firstly, due to the relative abundance of positive results, where eco-feedback has lowered household consumption or provided user engagement, discussion of the factors underpinning these positive results are understandably more common in the literature than instances in which a device was ignored or did not deliver energy savings (Pierce et al. 2010).

Secondly, many contributors to eco-feedback literature suggest implications and recommendations for design. While there is no shortage of design implications in the literature regarding what feedback attributes best facilitate lowering consumption (Fischer 2008, Froehlich et al. 2010), less common is researchers expressly questioning users on what attributes they desire themselves (Riche et al. 2010, Karjalainen 2011, Froehlich et al. 2012).

Thirdly, time constraints with eco-feedback deployment trials do not always allow for observation of use to continue over extended periods of time (Wallenborn et al. 2011). As such, while many trials yield generally positive results, at least over the short term (Fischer 2008), aspects associated with longer-term use, for instance the persistence of the initial energy savings made, remain imperfectly understood (Darby 2006, Strengers 2011, Hargreaves et al. 2013).

Finally, eco-feedback devices such as wireless energy monitors have only recently become widely available and affordable to consumers. As a result, many of the eco-feedback artefacts studied previously represent research deployments rather than independently acquired pieces of technology. How eco-feedback becomes integrated (or not) in the home and how the concept of ownership affects this, is of value to designers (Tolmie and Crabtree 2008, Schwartz et al. 2013).

The purpose of this paper is to address these knowledge gaps in an exploration of the relationships between householders and their eco-feedback; how the technology is used and appropriated and how this relationship changes over time. Contributing towards the knowledge gap highlighted by Pierce et al. (2010), we focus deliberately on examples where feedback has not been of value to its hosts rather than where it has. Initially the paper reviews literature concerned with the scope of eco-feedback design, the interrelationships between engagement, persuasion, appropriation and how these may change over time. We then present findings from 23 qualitative interviews regarding participants' attitudes towards eco-feedback, self reported changes in these attitudes over time and the desirable attributes of their "ideal" eco-feedback system. In conclusion, we offer several implications for the future design of eco-feedback based on our findings and outline related areas ripe for further research. The overarching argument here is the importance of a holistic approach to eco-feedback research and design.

PREVIOUS WORK

Broadening the scope of "success" in eco-feedback

Several meta-reviews of eco-feedback trials report typical energy saving results of between 3 and 15% for the duration of the trials (Darby 2006, Fischer 2008, Faruqui et al. 2010). However there has been a tendency in the literature to define the "success" or "effectiveness" of eco-feedback only in terms of the quantitative energy savings they produce (Fischer 2008, Schwartz et al. 2013). As a result of this, design implications for eco-feedback have traditionally tended towards ways to change behaviour and achieve a conservation effect, rather than discussion of more social or use-based implications for design (Fischer 2008, Froehlich et al. 2010).

Certain CHI authors question this somewhat implicit positioning of eco-feedback as a persuasive technology- i.e. technology designed with the express intention of shaping user behaviour (Brynjarsdottir 2012, Schwartz et al. 2013). Schwartz et al. (2013, pp.1193) argue that: "studying 'what systems do to people'...cannot account for 'what people do with systems'". In our previous work we suggest that a reliance on traditional metrics for "success", such as quantitative energy saving results, serve to limit the scope for potential eco-feedback design opportunities (Snow and Brereton 2012).

Recent CHI contributions broaden the scope of eco-feedback enquiry towards explorations of more socially-related aspects such as energy literacy (Schwartz et al. 2013), user-engagement (Hargreaves et al 2010, Wallenborn et al. 2011) and use by the whole family (Grønhøj and Thøgersen 2011). Eco-feedback demonstrates a strong potential to engage householders with their electricity consumption, stimulate energy-centric conversations and influence social processes between family members in regards to conserving energy (Grønhøj and Thøgersen 2011). The ways in which people learn about their electricity consumption and use their eco-feedback system is of value to designers on its own, in the absence of a persuasive framing (Schwartz et al. 2013).

However, despite this considerable broadening of the scope of eco-feedback enquiry in recent years, Pierce et al. (2010) highlight a knowledge gap in the literature which is still largely present today. This is described as a "subtle yet critical bias" toward the discussion of instances in which feedback effectively engaged its hosts or provided energy savings, over instances in which it did not (Pierce et al. 2010). This suggests somewhat of a black-box approach; attempting to optimise a problem without fully appreciating the intrinsic aspects of what is a complex socio-technical issue. CHI authors may also be missing opportunities to discuss shortcomings in design and allow others to avoid similar mistakes.

Eco-feedback attributes- top down versus bottom up

Perhaps due in part to the tendency for eco-feedback research to be framed by persuasion theory (Brynjarsdottir 2012, Schwartz et al. 2013), CHI authors are armed with a robust set of design requirements for eco-feedback towards achieving behaviour change. In a comprehensive review of 26 original feedback projects, Fischer (2008) highlights design features common to the best performing projects reviewed. These include (1) computerised feedback capable of temporal comparisons, providing information on environmental impact or energy savings tips; (2) designs offering an interactive element- such as interaction with computerised feedback or activities such as self-meter reading or self-feedback; and (3) designs capable of appliance-specific breakdown. In addition Froehlich et al. (2010) highlight examples from the rich environmental psychology literature available to CHI designers regarding effectively provoking behaviour change.

On the other hand, bottom-up appraisals of what attributes users actually desire themselves in feedback systems are less common. Consistent with Fischer (2008), different temporal comparisons of consumption, as well as appliances specific consumption have been found to be the most widely desired attributes of eco-feedback (Karjalainen 2011, Froehlich et al. 2012). Comparison with friends or a local average has also been reported as popular (Froehlich et al. 2012), however not everyone in this study's sample was willing to share their own consumption information. Aesthetic aspects of eco-feedback placement are also not widely discussed in the literature. Riche et al. (2010) found aesthetic aspects of eco-feedback were likely to influence decisions over placement and potentially impact upon use, while Froehlich et al. (2012) report their highly visual and playful "aquatic ecosystem" eco-feedback prototype was well received.

Engagement with eco-feedback over time

How users reflect upon and adapt their use of eco-feedback over extended time periods represents a nascent area of enquiry. Relatively few longitudinal studies concerning eco-feedback use exist to date (van Dam et al. 2010, Grønhøj and Thøgersen 2011, Hargreaves et al. 2013, Erickson et al. 2013, Schwartz et al. 2013). This body of work suggests that that in many cases eco-feedback is responsible for a rise in energy-literacy, but how participants access and use the device changes over time (Grønhøj and Thøgersen 2011, Hargreaves et al. 2013, Schwartz et al. 2013).

Hargreaves et al. (2013) for example studied the change in user engagement with eco-feedback over a 12 month period. This period was characterised by an initial interest in the device followed by a decline in engagement whereby the appeal was lost. Participants reported that the device failed to provide any new information once they became aware of the factors affecting their consumption. On the other hand, while Grønhøj and Thøgersen (2011) report a change in interactions with the eco-feedback device from initial fascination and high usage toward less frequent "glances", these authors report engagement with the device was largely maintained over five months. Over a 13 month deployment, Schwartz et al. (2013) report learning was a continuous process throughout the deployment period with no mention of a change in the nature of engagement. In these studies use is described more as a transition from novelty to utility rather than novelty to disregard, as reported by Hargreaves et al. (2013).

Related CHI work in Personal Informatics describes these changes in usage in terms of two key phases of reflection upon personal data: "discovery" and "maintenance" (Li et al. 2011). The discovery phase is characterised by people exploring, learning and discussing their data, setting personal goals and seeking further information. The maintenance phase on the other hand is when people become more aware of the factors affecting their data and refer to the feedback less often, more for the purpose of checking nothing is out of the ordinary (Li et al. 2011). While users generally transition over time from discovery to maintenance, events such as the purchase of a new appliance or an inability to meet a personal goal may lead to a transition from maintenance back into discovery (Li et al. 2011).

Whether or not eco-feedback related energy savings persist over time, or after the feedback trial has been terminated is questionable (van Dam et al. 2010). Even if the feedback is not removed, there is the concern that once "wasteful" consumption is addressed, simple energy monitors may in fact cause households to accept a level of "necessary" or "normal" consumption, regardless of how excessive that may be. Understandings of the use and effect of eco-feedback over time are considered to be inadequate and to warrant further research (Hargreaves et al. 2013, Schwartz et al. 2013)

Eco-feedback appropriation in the home

Finally, the circumstances in which participants receive their eco-feedback device represent an important consideration when examining use. For instance in the deployment of a research technology, participants are aware they are being studied and that they might be asked questions about their experiences of the device (Tolmie and Crabtree 2008). Therefore how people appropriate, use and accept a research deployment may differ considerably when compared to a piece of independently acquired technology (Tolmie and Crabtree 2008).

This is of significance to the study of eco-feedback, given that the majority of academic studies investigate eco-feedback in the context of its deployment into the home as a research artefact (Grønhøj and Thøgersen 2011, Petkov et al. 2011) rather than an independent acquisition by the family (Strengers 2011). In terms of behaviour change and energy savings, this amounts to a very real potential for the occurrence of the Hawthorne effect[1] (Pierce et al. 2010, van Dam et al. 2010, Wallenborn et al. 2011). Aside from these authors however, to the best of our knowledge the concept is otherwise seldom discussed in the eco-feedback literature.

METHOD

This study represents a somewhat unconventional appraisal of an eco-feedback device insofar as we had no involvement in the design or deployment of the energy monitors that we observed in peoples' homes and little or no access to 'before', 'during' or 'after' consumption data from participants. The device in question represented an independent acquisition for the family, rather than a deployment of research technology.

Our focus here is instead on the social issues concerned with use, engagement and attitudes toward the device and how these changed over time. We rely on the accounts given by our participants of their interactions with their energy monitors; accounts we consider to be relatively unbiased considering our position as an impartial third party unrelated to the devices' design or deployment.

Following on from Pierce et al. (2010), we also concentrate on the instances in which the eco-feedback in question was not of lasting benefit to its hosts as opposed to the more commonly researched instances in which it was. Our findings represent important insights into how and why eco-feedback can be ineffective as well as effective and what can be learnt from these examples.

Participants

The participants contributed to 23 interviews; 17 were female, three were male and in three interviews the husband and wife were simultaneously present

[1] The Hawthorne effect relates to research participants acting differently to what they might normally on account of knowing they are being observed by researchers (Wallenborn et al. 2011).

throughout the whole interview. In two instances, adult children who were still living at home also contributed.

The only pre-requisites for participants were that they were permanent residents of the dwelling and were involved to a degree with the management of their utility bills and of their home (e.g. cleaning, washing or cooking). The majority of participants were in their 30's or 40's (17 participants) and owned their house (17 participants). One participant lived in a house that was shared by two separate families. Twenty participants were married or living in a de facto relationship, two were single parents and only one was a sole occupant. Seventeen had children living at home, five had children who had left home and one had never had children.

Participants were recruited via a local community Facebook page, a letterbox drop and via a third-party contact. All of the interviews were conducted with residents of Brisbane, Australia, with 18 of the 23 participants located in two adjoining suburbs. The focus on this specific area was due in part to our related studies into sharing and comparing electricity information which will be published subsequently.

The device

Almost 80% of the participants (18 of the 23) had an energy monitor installed in their house between January 2009 and April 2012. In all cases the energy monitor ("the monitor") represented a simple wireless 'cent-a-meter' which had been installed alongside other energy saving products as part of a popular subsidised sustainability initiative (refer Figure 1). The service cost was \$50; however residents of Brisbane City Council were offered a full rebate for this cost during part of the trial period. Approximately 336,196 monitors were installed throughout the state of Queensland during this time, representing one in every five households (LGIS 2013). Our focus on this particular monitor follows our discovery of the ubiquity of the device during the interviews; through questions related to what feedback, if any, did the participants have on their electricity consumption. The monitor was one of several topics discussed in the interviews.

Figure 1. The energy monitor

The monitor consists of a current clamp device installed in the meter box that transmits information wirelessly to a portable battery-powered monitor in the home (pictured in Figure 1). On the default screen the monitor shows near-instantaneous figures for immediate whole-of-house consumption in kilowatt hours (kWh) as well as dollars (\$AUD). Weekly and monthly comparisons as well as the option to express electricity use in terms of kilograms of carbon dioxide (kg of CO_2) can be accessed via buttons on the top of the device. The amount of time each household had owned their monitor was not recorded, however none of the participants described it as a recent fixture; with the majority of the monitors having been installed for at least 12-24 months. Two participants had moved into a house where a monitor was already fitted, one of whom did not have one installed at their previous residence.

Study design

In 20 of the 23 interviews, a short energy audit 'tour' of the dwelling was conducted initially in order to gather information on the main contributors to electricity consumption in each house. Semi-structured interviews were then conducted with all participants, covering topics of electricity usage behaviour, electricity feedback and issues concerned with sharing feedback information. The remaining three interviews were restricted to the semi-structured interview only.

Interviews were transcribed verbatim from the audio along with any visual data gathered. A thematic approach to analysis was employed, with themes and sub-themes being identified from the transcriptions throughout an iterative process of reading, re-reading and categorising data from the transcripts. This process facilitated an in-depth appreciation of the use, attitudes toward and desired features of eco-feedback.

FINDINGS

Condition and location of the monitors

Despite 18 of the 23 participants having had an energy monitor installed, half of the monitors were found to be inoperable at the time of the interview. The reasons for this inoperability varied; for instance four monitors failed due to the (subsequent) installation of solar panels, affecting the monitors' readings. While the monitor measures the flow of power, it cannot measure the direction of flow, thus resulting in high readings during the day when the solar panels are exporting power to the grid. Only one of these four participants made any attempt to address the problem; with the three others simply accepting that it had died.

Additional to this, two monitors failed due to preventable reasons (participants had not replaced the AA batteries); three participants could not explain why their monitor did not work and one participant whose monitor was working satisfactorily during the interview said it did not always work. In this case the participant claimed it had connectivity issues due to the long distance between the meter box and the kitchen and it would not always display a reading when she wanted to look at it.

During the interviews, working monitors were found in various locations indicative of their limited use: two were obscured by other items (refer Figures 2 and 3), two were stored in a cupboard and one was placed out of sight behind a computer desk.

> *"I can't remember where I put it! (laughs) Hang on a minute. Is it in the lounge room? Do you know what, I don't know where it is… Oh my God isn't that embarrassing!"* (P21, monitor working but has connectivity issues)

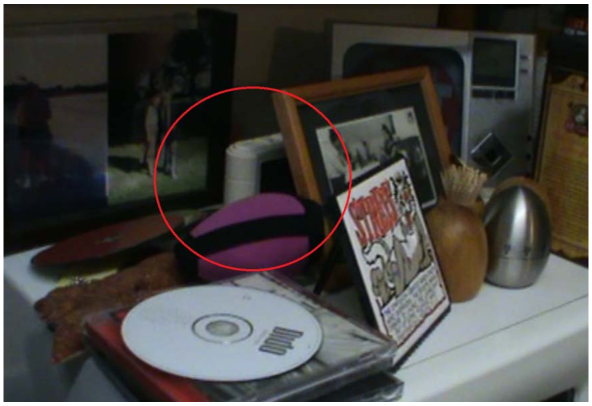

Figure 2: Monitor obscured behind other items

Figure 3: Monitor obscured behind other items

Despite this, the majority of participants claimed to have been interested in their monitor or had drawn benefit from it at some stage. Four still referred to their monitor on either an occasional or regular basis, generally to "see if there's anything on it" (P10). Two of the four participants whose monitors stopped working following their solar install claimed they missed it now that it was not there. One of these two had even gone out to the meter box and attempted (unsuccessfully) to fix the problem himself.

Ineffective feedback- failure to maintain interest

For a number of participants who had installed the monitor, a pattern emerged in conversations where participants spoke of an initial interest in the device, followed by either a technical malfunction, or a loss of interest. Of the nine participants whose monitors were still working at the time of the interview, only four of these were still referred to on a regular basis.

Five participants spoke explicitly of being initially interested in the monitors, but losing this interest over time. For two of these participants, this was due to an inability to relate their monitor's readings to everyday practices.

> *"I did use it for maybe a week when we got it... I think that with these things, the representations aren't right. You just see a number but you don't see...how much you're wasting"* (P7, monitor not working- neglect)

> *"I couldn't understand it... I know obviously the lesser the figure the better it is, but that's all. It didn't really prompt me to turn anything off"* – (P20, monitor working).

For another two participants, the reason related to their monitor failing to maintain their engagement beyond the initial discovery phase. For these participants there was a sense that the monitor had "served its purpose"; concluding that once the monitor had made them aware of the factors affecting their consumption they lost interest.

For four of the 18 participants with monitors however, the monitors not been of any interest to them from the outset. These participants (two male and two female) all reported to be comfortable with the amount of electricity they were using. The female participants, both with teenage children, spoke of being busy with other things and did not need *"another gadget to look at"* (P22, monitor working). On the other hand, the two male participants did not use the device because they felt as if they did not need to use it. While the word "patronising" was not used in relation to the monitor, both conveyed this sentiment when speaking about why it hadn't been of use to them:

> *"We weren't interested in the readings. We were certainly interested in conserving power, but we didn't need an instrument to tell us we were conserving us because we knew we had everything switched off"* (P23, monitor working but stored in cupboard)

In two of these cases, while the monitor had never engaged the participants themselves, it had provided some interest to their university-aged children. In these examples, the interest of the child was not reported to have impacted upon the consumption patterns of the household.

Ineffective feedback- failure to motivate pro-environmental behaviour

Regardless of whether or when the device had interested or engaged participants with their electricity consumption, this engagement or interest did not often translate into pro-environmental behaviour changes. While many participants described things they had learnt from the device, such as how much power certain items drew, only three of the 18 participants with monitors related stories of their monitor instigating pro-environmental behaviour in the household. These behaviour changes included filling up the kettle less (P12), "turning things off at the wall more" (P21) and limiting the use of the halogen lights in the kitchen (P9).

Far more common was a perception that it may have been interesting to learn how much energy different appliances used, but that this knowledge did not constitute a reason to change practices or reconsider "non negotiable" usage.

> *"Yeah when we turned the air con on it went up. I saw that, but I wasn't going to turn the air con*

> *off just because the number went up, it was hot!"* (P20, monitor working)

Curiously, this inability or unwillingness to change behaviour based on the readings from the device was despite an equally common perception among the participants that the monitor was something that was supposed to save them energy. One participant spoke of "adhering" to the feedback despite the monitor itself not providing any advice, rules or goals to "adhere" to.

> *"Yes, I look at it all the time. Do I adhere to it? No!!" (laughs)* (P5, monitor working)

> *"When the dryer's running it goes through the roof, but then you know that already 'cos you've already had the bill. So it's interesting to see what you're using and it's supposed to make you more energy efficient but I didn't know what else we could cut back on"* (P15, monitor no longer working- neglect).

Desirable feedback

All participants were questioned whether they would like some form of feedback (or additional feedback) on their energy consumption or some form of early warning system for their bills. Despite the limited use and interest in the monitor, of the 23 participants, 16 were receptive to feedback (or additional feedback) and described features that would be desirable to them. Four mentioned they did not want any type of further feedback and three did not give a definitive answer either way. Notably, four of the five people who had never had a monitor installed were receptive to the idea of some form of feedback on their electricity use.

Although the majority of participants were receptive to further feedback, responses detailing the most desirable features of their "ideal" eco-feedback varied. For instance, there was little consensus among the participants on how information should be accessed (wall-mounted or portable display, computer application or smart phone app) and (if wall-mounted), where it should be mounted.

While most participants noted that an eco-feedback system should offer some form of comparison, descriptions of exactly what should be compared varied widely. Reported desirable consumption comparisons included: comparing average usage per day / per month / per season; comparing their dwelling's consumption to a city / suburb / street average; to other similar sized households / to a specific friend's household / to households with similar infrastructure (such as other owners of solar panels); comparing consumption within the home, for instance comparing rooms or appliances.

The only comparison which was consistently noted as desirable among participants and was not noted as undesirable by anyone was appliance-specific feedback. Although historical usage comparisons were also widely described as desirable, this was not ubiquitous. Certain comparisons, particularly comparisons with other people or other groups of people were found to be polarising; i.e. desirable to some while completely undesirable to others.

> *"I'd like to compare to people of the same age and ability. Large families or people who have parties just won't equate, but if I could compare to people of the same type of living standards, abilities, I'd like to see how my bill compares to theirs"* (P10, monitor working)

> *"It's all about me! I couldn't care about anybody else, I mean they're not paying my bills for me are they?! So no, I can't see the point (of social comparison)"* (P21, monitor working intermittently)

Additionally, two participants, both with young children, noted that what they considered to be 'desirable' attributes of a feedback system would change over time as their children grew older.

DISCUSSION

Our findings describe a cross-sectional snapshot of usage and engagement with a simple eco-feedback device well after the novelty has worn off. In general, participant reports of usage point to a trend of initial interest, followed by a decline in engagement or malfunction of the device. Considering the apparent reliance by policymakers on similar real-time eco-feedback devices as transitional aides for consumers toward smart metering roll-outs and alternative tariff structures (DECC 2013), these results are highly relevant. Investigating the contributing factors behind these findings and how they might be addressed is of value to policymakers and CHI designers alike.

In general we found that: (1) the energy monitors did not motivate pro-environmental behaviour change; (2) while most participants reported an initial interest, the monitors failed to maintain engagement over longer timescales, however; (3) the majority of participants still desired further feedback on their resource consumption. We discuss these issues in turn below, outlining opportunities and implications for design in the field.

"Do I adhere to it? No!" - Failure to motivate environmental behaviour change

While participants were drawn to the devices with the hope of saving power and thus saving money, this was seldom translated into modes of behaviour that would facilitate the presumed benefits. Where examples of behaviour change were reported (for instance: filling up the kettle less (P12), or "turning things off at the wall more" (P21)), we considered these may have relatively little overall effect on the participants' energy use compared to other potential savings.

Our findings closely resemble those of Pierce et al. (2010) and Hargreaves et al. (2013) in that the device did not prompt participants to question their "normal" or "non-negotiable" consumption. For instance seeing the number on the device go up did not prompt a reconsideration of turning on the air conditioning if they felt it was hot. This finding lends further support to the supposition that awareness of energy consumption alone is not sufficient to motivate behaviour change (Pierce et al. 2010). The issue was further compounded in our study by the difficulty some participants had in making sense of the numbers on their display or relating the feedback to everyday practices.

On the other hand, in these instances where eco-feedback does not provide engagement or energy savings, it is easy to blame the device itself, without addressing the attitudes and motivations of the user with respect to monitoring their use. While our participants wanted to spend less on their electricity, they did not necessarily want to *use* less electricity, nor did many demonstrate any great desire to alter their behaviour. As such, while it appears the monitor did broadly fail to engage participants, we consider that an underlying indifference or unwillingness among participants towards changing behaviour contributed to a degree.

This apathy or unwillingness to engage with eco-feedback represents a concern among designers, considering the impact of eco-feedback may be downgraded when a user feels no need to monitor their behaviour or is unmotivated to change it. Further work is required here, exploring how underlying attitudes and values towards saving energy in general affect the use and energy saving potential of eco-feedback interfaces.

The "purpose" of the monitor

Our findings suggest that users' attitudes regarding the "purpose" of their device may have influenced their use of it. The quote: "it's supposed to make you more energy efficient" (P15) exemplifies the perception among many participants that the purpose of the device was to make them change their behaviour; in other words, it was conceptualised as persuasive technology. This was despite the complete absence of any persuasive features on the device such as goal-setting, energy saving messages or competition (Petkov et al. 2011, Gambarini et al. 2012) and no mention of its "purpose" by the researchers.

Hargreaves et al. (2013) describe their participants' consideration of the eco-feedback device as a "nagging presence", whereby over time the monitors began to represent a constant (sometimes unwanted) reminder to turn things off. However, in our study, rather than reminding or persuading participants to use less, the conceptualisation of the technology as persuasive appeared to in fact *reduce* the potential for behaviour change or engagement. The device inadvertently took on a patronising quality for some participants who did not want to be told what to do. Similarly, some who felt they were already energy efficient enough, or were comfortable with the amount they were using felt like they had no reason to look at it. We do not dispute the fact that persuasion, when well designed and executed, has tremendous potential for pro-environmental behaviour change, at least in the short term; see for example Petkov et al. (2011). Rather, what we aim to highlight here, is that perceptions and preconceptions by consumers have the potential to significantly influence the use and acceptance of an eco-feedback device.

The extent to which factors such as the initial marketing of the device or conversations with the installer affected attitudes or acceptance is difficult to determine. Given our disconnection from these processes, this is not something we can authoritatively provide comment on. We suspect however, that these factors may be of reasonable influence to participants' attitudes toward their monitor. As such, further work exploring (1) how the marketing and installation process of eco-feedback affects users' preconceptions of the device and (2) how these preconceptions influence use, would be valuable to eco-feedback designers regardless of the frame of reference for design (i.e. persuasive or otherwise).

Technical malfunction

One of the contributing factors behind the energy monitors not producing environmental behaviour change was that a number of them simply stopped working. While we do not speculate about the instances where the participants could not explain why their monitors stopped working, the instances of malfunction due to the subsequent install of solar panels can be put in some context.

The period during which the monitors were installed (January 2009 – April 2012) coincided with a significant increase in homes with rooftop solar. Anecdotal reports suggest that the issue of energy monitors malfunctioning in this manner was widely replicated. Although this particular issue may not have occurred had the eco-feedback device been capable of measuring more than one power circuit, this example highlights the possibility of eco-feedback failing to produce engagement or environmental behaviour change for reasons almost completely unrelated to use, or the user. Consumers who have had a bad experience with eco-feedback such as technical malfunction may be more reluctant or sceptical of eco-feedback purchase or participation in the future. It is important therefore that CHI designers take a holistic view of eco-feedback design and expand the scope of reference to consideration of these physical and practical factors, outside of the traditional user-device interaction boundaries.

Curiosity to cupboard: Failure to maintain engagement over time

Aside from technical malfunction, the energy monitor studied was found to be generally ineffective in engaging our participants with their energy consumption over long timescales.

Our findings support those of Hargreaves et al. (2013), in that: (1) interactions with the eco-feedback device tended to consist of an initial period of engagement, followed by a gradual loss of interest; and (2) the main reason for this loss of interest was the device failing to provide them with new information. In both cases, the portable devices ended up getting "backgrounded" over time. Our findings differ however from Grønhøj and Thøgersen (2011) and Schwartz et al. (2013), both of whom reported a more lasting engagement. The devices studied by these authors both represented more technically advanced devices capable of a range of visualisation options, goal-setting, appliance-specific consumption breakdowns and were not portable. One was a wall mounted 7 inch tablet, while the other (Schwartz et al. 2013) was accessible through the TV, personal computer and smart phone.

There is relatively little distinction made between portable, wall-mounted and remotely accessed (i.e. computer/smart phone) eco-feedback systems and we suggest that further research needs to examine the relationship between portability, appropriation and use more closely. Through our interviews, we found that despite an initially high interest, several of the monitors had progressively fallen into the background, or had been relegated to another room or a cupboard. However, the extent to which this was a product of the portability of the device as distinct from its unengaging nature is unclear. For instance does being portable lead to being stored away and forgotten about? Does an engaging wall-mounted device deliver more lasting engagement than an identical portable device? Portability may even be an asset in the discovery phase (i.e. allowing people to carry it around while turning different appliances on and off), but a negative attribute in the maintenance phase (where it lends itself to being 'cleaned up').

This also raises larger ethical questions relating back to the purpose of the device; should the eco-feedback necessarily represent a constant presence in the home or should participants have more control over its presence or placement? Is relegation of a portable device 'out of the way' inevitable? More broadly, how can eco-feedback best hold relevance within a society already saturated with ubiquitous computing artefacts in the home, all vying for the user's attention? These questions present opportunities for further CHI research.

Lasting engagement in the maintenance phase

We suggest that eco-feedback designers have much to learn from a growing body of Personal Informatics literature discussing the stages of reflection and engagement with feedback over longer time periods (Li et al. 2011). While many eco-feedback authors speak of a change in user interactions with their device over time, a common identification for these phases, namely 'discovery' and 'maintenance' (Li et al. 2011), is missing from the eco-feedback literature to date. This model identifies peoples' information needs as fluid, over both long and short timeframes; a sentiment which was also identified in our interviews in respect two participants' "ideal" eco-feedback attributes changing as their children grew older.

Real-time eco-feedback afforded by modern technology provides significant support for users in the discovery phase (Fujinami and Riekki 2008, Petkov et al. 2011), but is not always capable of maintaining engagement once the user identifies the factors affecting their consumption (van Dam et al. 2010, Hargreaves et al. 2013). Few studies outline specific design features or intents aimed at retaining engagement in the maintenance phase (Gambarini et al. 2012), or for supporting transitions between phases. We found that regardless of the presence of the energy monitor in participants' homes, the three-monthly "shock" (P14) provided by the electricity bill was more likely to create a desire to change behaviour than the more regular consumption information provided by the energy monitor.

While more motivated users may continue to refer to and draw benefit from the eco-feedback unit itself, retaining engagement by less motivated participants throughout the maintenance phase may be more difficult. One means of achieving this may be the integration of *less* frequent forms of feedback along with computerised real-time eco-feedback. This could include eco-feedback triggering fortnightly consumption information bulletins by email in addition to normal operation. Users could then troubleshoot an unexpected rise or drop in aggregate fortnightly consumption by accessing the more granular disaggregated information provided by the eco-feedback unit. Allowing users to access and re-analyse old data is important for this purpose and in agreement with Barua et al. (2013), we consider that the ability for eco-feedback to record and store data long term for later retrieval and analysis by users is an important attribute of design.

The maintenance phase corresponds to less regular monitoring of personal data to make sure values are in accordance with expectations, rather than learning new information about the data (Li et al. 2011). In this way, the nature of interaction with the data changes and so too does the nature of interaction with the device providing that information. We do not expect, therefore, that simply increasing the amount of information provided to households, or trying to prolong the discovery phase is necessarily the key to engagement in the maintenance phase. Instead we draw the analogy to the dashboard of a car. The dashboard represents a concise display panel that provides information necessary for operating a car within appropriate external and user-defined constraints. The utility provided by the dashboard persists long after the factors affecting the operation and performance of the car have been learned. We therefore suggest that a useful focus for design may be on developing and optimising the ability for eco-feedback devices to transition back and forth between complex tools for learning, comparison, discovery and diagnosis, into simpler ambient dashboard type displays (see for example the 'Solo' and 'Duet' devices reported in Hargreaves et al. 2013).

Notwithstanding the above, retaining engagement with eco-feedback over longer timescales remains a compelling gap in the literature (Hargreaves et al. 2013) and we outline this space as an important avenue for further CHI research.

A degree of separation

Considering our disconnection from the processes of acquisition and installation of the monitors, these results provide an interesting snapshot of energy monitors in their natural state. Representing somewhat of an independent third party, participants provided us with candid accounts of their experiences and in some cases their frustrations with the monitor during the semi-structured interviews.

We question however, whether our findings would have been the same if the participants identified us as the designers or developers of the technology. Would participants have taken the time to replace batteries or locate their misplaced device if it were the designers of the device visiting them? Tolmie and Crabtree (2008) suggest that technology deployed by researchers is likely to be integrated into the home in a different manner to technology that is independently acquired. Differences include feelings of ownership and expectations from the researchers regarding how the technology "should" be used. This is not to suggest that positive energy saving results in previous eco-feedback literature should necessarily be attributed to these types of expectations or the Hawthorne Effect in any way. Rather, that the relationship between the researchers and participants in eco-feedback trials is an important and potentially influential aspect of eco-feedback use worthy of further discussion. We also suggest that the increasing availability and affordability of off-the-shelf eco-feedback presents a compelling opportunity for further research into how householders use and appropriate independently acquired eco-feedback units (e.g. Strengers 2011), which is currently scarce.

Ideal feedback: what do users want?

Finally, perhaps one of the most important findings of this study is that despite the low levels of engagement observed with this particular device, only four of the 23 participants did not want any additional form of feedback on their electricity consumption. Many of the others (particularly when eco-feedback was discussed in terms of its potential role as an "early warning system" for their bills) were very receptive to the idea of more feedback on electricity consumption. Our finding regarding the near-ubiquitous desirability of eco-feedback attributes such as appliance-specific breakdown and temporal comparison are supported by the literature which also finds these attributes to be the most effective in reducing consumption (Darby 2006, Fischer 2008) and the most desired by users (Karjalainen 2011). On the other hand however, we found that the desirability of many other eco-feedback attributes was highly variable. This lends further support to the notion that one size certainly does not fit all in regard to eco-feedback (van Dam et al. 2010, Hargreaves et al. 2013). This in turn raises concerns over the wisdom of large-scale deployments of simple and ubiquitous energy monitors (DECC 2013).

CONCLUSIONS

In summary, through 23 semi-structured interviews with Brisbane householders, we have attempted to address four important knowledge gaps in the literature which are outlined above. Through our unique study of ineffective eco-feedback over longer time scales, we have highlighted some opportunities and implications for design which are summarised below:

(1) There is potential to broaden the scope of enquiry on eco-feedback in three ways: (a) further studying the effect of people on eco-feedback use, rather than the effect of the eco-feedback on people (see Schwartz et al. 2013); (b) the effect of preconceptions associated with eco-feedback on engagement and use; (c) practical and physical considerations of design, for instance compatibility with current and future technology in the home.

(2) Eco-feedback design has much to gain by incorporating learnings from related literature regarding the phases of reflection on personal information. In particular, further work is required in designing eco-feedback that better supports users in the maintenance phase and the transitions between the maintenance and discovery phases. Two means of achieving this may be the integration of less frequent summative feedback (for example fortnightly usage bulletins) with real-time computerised eco-feedback; and by focusing design attention on the ability of eco-feedback devices to transition between more complex tools for discovery and diagnosis to more concise, ambient dashboards.

Although the relatively simple device we studied was not effective in providing lasting engagement in the maintenance phase, and although more detailed and configurable models of eco-feedback have been more effective in this regard (Schwartz et al. 2013), we do not believe that lasting engagement is necessarily correlated to complexity. For instance we do not believe that simply increasing the quantity and variety of information provided to households by eco-feedback will automatically equate to long term engagement and energy savings. More important is the usability of the device and its ability to provide meaningful information to the householder on their practices and actions over time. We echo calls made by Strengers (2011) that eco-feedback represents only one instrument in a much larger suite of measures, rather than a stand-alone solution to problems of energy literacy, engagement and sustainable behaviour change.

Limitations to this paper include a limited geographical range of participants, a gender bias towards female participants and in most cases only one family member present in the interviews. As we were not involved in the design, procurement or installation of the device, we cannot provide quantitative data on energy savings over time, nor assess trends of use over time; relying instead on participants' reports. However, for the intended purpose of this study as a snapshot of reported engagement with an independently acquired eco-feedback device after many months of ownership, we do not consider the limitations of the study to be significant. Instead this particular method of enquiry contributes towards addressing important knowledge gaps highlighted in the literature. We close by urging policymakers to carefully consider these findings and those made by other contributors to the rich literature available on eco-feedback, when planning for large scale deployments.

RELATED WORK

A subset of the data used in this study has been used to inform a related publication investigating what lessons may be learned from resource use in the developing world in terms of better engaging Western consumers with their energy (Snow and Brereton 2013).

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REFERENCES

Barua, D., Kay, J., Paris, C.: Viewing and controlling personal sensor data: What do users want? In Proc: PERSUASIVE 2013, Sydney, Australia (2013)

Brynjarsdottir, H., Hakansson, M., Pierce, J., Baumer, E., DiSalvo, C., and Sengers, P.: Sustainably unpersuaded: how persuasion narrows our vision of sustainability, In Proc: CHI 2012, Austin, USA. (2012)

Darby, S. The effectiveness of feedback on energy consumption. A review for DEFRA of the literature on metering, billing, and direct displays. (2006). Available at: http://www.eci.ox.ac.uk/research/energy/downloads/smart-metering-report.pdf. Accessed: 30/9/13

Department of Energy and Climate Change (DECC): Smart meters: A guide (2013) Available at: https://www.gov.uk/smart-meters-how-they-work. Accessed 24/6/13.

Erickson, T., Li, M., Kim, Y., Deshpande, A., Sahu, S., Chao, T., Sukaviriya, P., and Naphade, M.: The dubuque electricity portal: evaluation of a city-scale residential electricity consumption feedback system. In Proc: CHI 2013, Paris, France (2013)

Faruqui, A., S. Sergici, and Sharif, A.: The impact of informational feedback on energy consumption-A survey of the experimental evidence. Energy 35 (4):1598-1608 (2010)

Fischer, C.: Feedback on household electricity consumption: a tool for saving energy? Energy Efficiency 1 (1):79-104 (2008).

Froehlich, J., Findlater, L and Landay, J.: The design of eco-feedback technology. In Proc: CHI 2010, Atlanta, USA (2010).

Froehlich, J., Findlater, L., Ostergren, M., Ramanathan, S., Peterson, J., Wragg, I., Larson, Fu, F., Bai, M., Patel, S.H., and Landay J.: The design and evaluation of prototype eco-feedback displays for fixture-level water use data. In: Proc: CHI 2012, Austin, USA, (2012)

Fujinami, K., and Riekki, J.: A case study on an ambient display as a persuasive medium for exercise awareness. In H. Oinas-Kukkonen et al. (Eds): Persuasive 2008: San Diego, USA (2008)

Gamberini, L., Spagnolli, A., Corradi, N., Jacucci, G., Tusa, G., Mikkola, T., Zamboni, L., Hoggan E.: Tailoring feedback to users' actions in a persuasive game for household electricity consumption. In M. Bang and E.L Ragnemalm (Eds.): Persuasive 2012, Linköping, Sweden (2012)

Grønhøj, A, and J Thøgersen. Feedback on household electricity consumption: learning and social influence processes. International Journal of Consumer Studies 35 (2):138-145 (2011)

Hargreaves, T., Nye, M., and Burgess, J.: Making energy visible: A qualitative field study of how householders interact with feedback from smart energy monitors. Energy Policy 38 (10):6111-6119 (2010)

Hargreaves, T., Nye, M., and Burgess, J.: Keeping energy visible: Exploring how householders interact with feedback from smart energy monitors in the longer term. Energy Policy 52:126-134 (2013)

Karjalainen, S.: Consumer preferences for feedback on household electricity consumption. Energy and Buildings 43 (2-3): 458-467 (2011)

Petkov, P., Köbler, F., Foth, M., Krcmar, H.: Motivating domestic energy conservation through comparative, community based feedback in mobile and social media. In Proc: C&T 2011, Brisbane, Australia (2011).

Pierce, J., Fan, C., Lomas, D., Marcu, G., Paulos, E.: Some considerations on the (in)effectiveness of residential energy feedback systems. In Proc: DIS 2010, Aarhus, Denmark (2010)

Li, I., Dey, D.K., Forlizzi, J.: Understanding my data, myself: Supporting self-reflection with Ubicomp technologies. In Proc: UbiComp 2011, Beijing, China (2011).

Local Government Infrastructure Services (LGIS: Climate Smart Home Service, Queensland Government, (2013). Available at: http://www.climatesmarthome.com/what-was.html. Accessed: 24/6/13.

Riche, Y., Dodge, J., Metoyer, R., Studying always-on electricity feedback in the home. In Proc: CHI 2010, Atlanta, USA (2010)

Schwartz, T., Denef, S., Stevens, G., Ramirez, L., Wulf, V.: Cultivating energy literacy- Results from a longitudinal living lab study of a home energy management system. In Proc: CHI 2013, Paris, France (2013)

Snow, S., and Brereton, M.: Beyond demand management: The value of sharing electricity information. In Proc: 26th British Computer Society HCI Conference, Birmingham, UK (2012)

Snow, S., and Brereton, M.: Towards engaged consumption: new sources of inspiration for eco-feedback design. Proc: Interact 2013: *Lecture Notes in Computer Science*, *8120*, pp. 117-124. (2013)

Strengers, Y. Beyond demand management: co-managing energy and water practices with Australian households. Policy Studies 32 (1):35-58. (2011)

Tolmie, P., and Crabtree, A. Deploying research technology in the home. In Proc: Computer Supported Cooperative Work 2008, San Diego, USA (2008)

van Dam, S., Bakker, C. A., and van Hal, J. D. M.: Home energy monitors: impact over the medium-term, Building Research & Information, 38: 458-469 (2010).

Wallenborn, G., M. Orsini, and J. Vanhaverbeke.: Household appropriation of electricity monitors. International Journal of Consumer Studies 35 (2): 146-152, (2011)

Proceedings of the 25th Australian Computer-Human Interaction Conference: Augmentation, Application, Innovation, Collaboration

Editors: Haifeng Shen
Ross Smith
Jeni Paay
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2013 Proceeding

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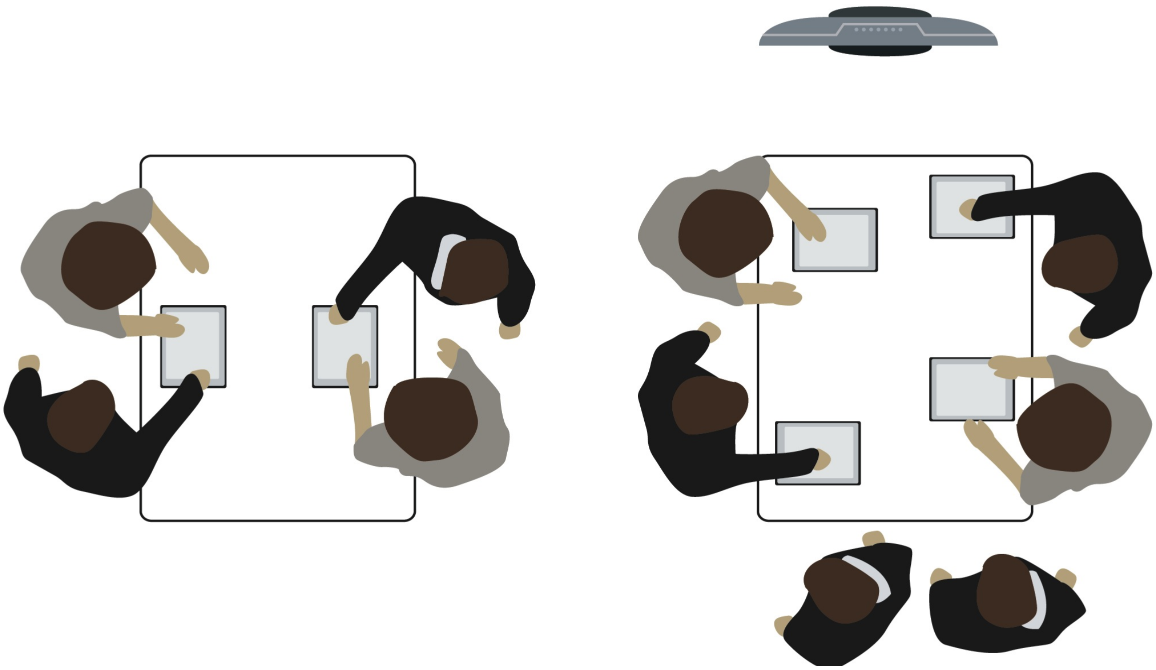

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Edited by:

Haifeng Shen, Ross Smith, Jeni Paay, Paul Calder and Theodor Wyeld

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Table of Contents

Message from the Technical Program Committee

Welcome to Adelaide and OzCHI 2013, the annual conference of the Computer-Human Interaction Special Interest Group (CHISIG) of the Human Factors and Ergonomics Society of Australia (HFSA) and Australia's leading forum for a growing international community of practitioners, researchers, academics and students to exchange work in all areas of Human-Computer Interaction.

The technical program committee was comprised of 142 researchers, among whom 77 were from Australia and 65 were from overseas. All long and short papers were subject to double-blind peer review with each long paper reviewed by at least three committee members and each short paper reviewed by at least two committee members. Student design challenge, flash talk, and interactive poster submission were reviewed by their respective track chairs and committee members. This year we received 71 long papers, 83 short papers, and 38 student design challenge submissions from 30 countries, including Asia-Pacific, Europe, North Europe, North America, and South America. After the rigorous peer review process, we accepted 34 long and 45 short papers, and 9 student design challenge finalists, overall 46% of submissions. The OzCHI proceedings are a publication of CHISIG, and also appear in the ACM (the Association for Computing Machinery) Digital Library (dl.acm.org).

The theme of this year's conference is Augmentation, Application, Innovation, and Collaboration, which reflects a variety of technical and social challenges in designing and deploying human-centred computer applications through augmenting our daily lives with innovative interaction and collaboration technologies. The programme covers a wide range of topics around this theme, including "Ubiquitous Computing", "Interface, Interaction, and Visualisation", "Health and Welfare", "Learning Environments", "Gaming", "Mobile and Touch Interaction", and "Social and Collaboration Technologies". We have organised 79 paper presentations in 18 sessions as well as a number of flash talks and an exhibition of interactive posters.

It is our pleasure and honour to have as our invited keynote speakers Kenton O'Hara from Microsoft Research Cambridge, UK, Bruce Thomas from UniSA, Australia, and Ben Kilsby from Holopoint Interactive, Adelaide, Australia. They will each give a talk addressing aspects of the conference theme. In Particular, Dr. O'Hara's talk on Interaction Proxemics addresses aspects of Innovation and Collaboration, Prof. Thomas' talk on Augmented Reality addresses aspects of Augmentation, and Mr. Kilsby's talk on Gaming addresses aspects of Application and Innovation. In addition, this year's conference also hosts interesting workshops, tutorials, and a doctoral consortium.

We hope you enjoy the programme of OzCHI 2013. Remember to take some time to enjoy the beauty and hospitality of the great city of Adelaide, which was recently voted by the Lonely Planet as one of the top ten cities to visit!

Haifeng Shen, Ross Smith, Jeni Paay & Paul Calder

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