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EVALUATION USING CUED-RECALL DEBRIEF TO ELICIT INFORMATION ABOUT A USER'S AFFECTIVE EXPERIENCES

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ABSTRACT

While affect and emotion are recognised as important factors in the success of many systems, there is a lack of methods to effectively address these during evaluation. The present study explores the use of the cued-recall debrief methodology, a form of situated recall, as a method to elicit information about user affect during system use. The results indicate that the cued-recall debrief can successfully elicit information about user affect while playing computer games. The cued-recall debrief methodology requires minimal equipment, and is easy to apply – both factors that enhance its viability for use in industry.

KEYWORDS: *cued recall, affect, evaluation, games*

1. INTRODUCTION

According to Norman (2002) colour monitors, when first introduced, offered no performance benefit over the then common monochrome displays. Norman argued that colour monitors actually decreased performance due to their low resolution in comparison to monochrome displays. Despite this loss of performance, people who were exposed to and given the choice selected the colour monitor. Why, when colour monitors decreased user performance, did users prefer them? More recently Norman (2004) has discussed his three unique teapots – one is impossible to use, one works well and looks very nice, and the third was the best to make tea with but is most arduous to use. However, Norman chooses to use a fourth 'normal' teapot, and indicates that he keeps the other teapots because he simply likes them and has an emotional attachment with them. In the case of the colour monitors – since performance factors could not be the reason for preference – perhaps the users also experienced some sort of affective or emotional reaction when using them.

Traditional system development and evaluation methods tend to focus on the performance-based factors (Hassenzahl *et al.* 2000; Bentley *et al.*, 2003), and neglect the factors related to affect and emotion. This focus on performance can be justified when performance factors are the prime determinants of user perceived system quality, alternatively called quality in use (see Bevan, 1999). For example, performance related factors could be considered a prime determinant of quality in use for an aircraft cockpit. It is not important if the pilot 'likes' the system they must work with, what matters is that the pilot can perform well enough to ensure the safety of the aircraft and, more importantly, the passengers aboard. However, this performance orientation is not compatible with many systems or products generally available today. Lindgaard (2001), for example, has suggested that most mobile phones are equivalent in terms of the functionality and performance offered, and that there must be other factors beyond performance and usability that influence the quality in use

Hassenzahl *et al.* (2000) suggest that both ergonomic and hedonic qualities are perceived and combined in order for the user to make an overall judgement of quality in use, where ergonomic qualities are related to traditional usability (efficiency and effectiveness), and hedonic qualities are aspects of the system that

have no obvious relation to the task the user wants to achieve. The user's judgement may be formed by placing greater weight on specific ergonomic or hedonic qualities. Hassenzahl *et al.* (2001) do provide an additional caveat to this quality duality – hedonic qualities within an interface may be at the cost of performance qualities.

In a similar vein, Bentley *et al.* (2002) proposed the conceptual model in Figure 1, showing that user experience is influenced by both performance- and affective-based factors (user experience can generally be considered equivalent to quality in use). Similar to Hassenzahl *et al.*, Bentley *et al.* also recognised that user will place greater importance on certain factors (affective or performance) depending on the type of system being used. In Figure 1 it suggests that the user experience for office-based systems (e.g. word processors or database programs) are largely determined by the performance-based factors, and for computer games it is largely the product of affective factors.

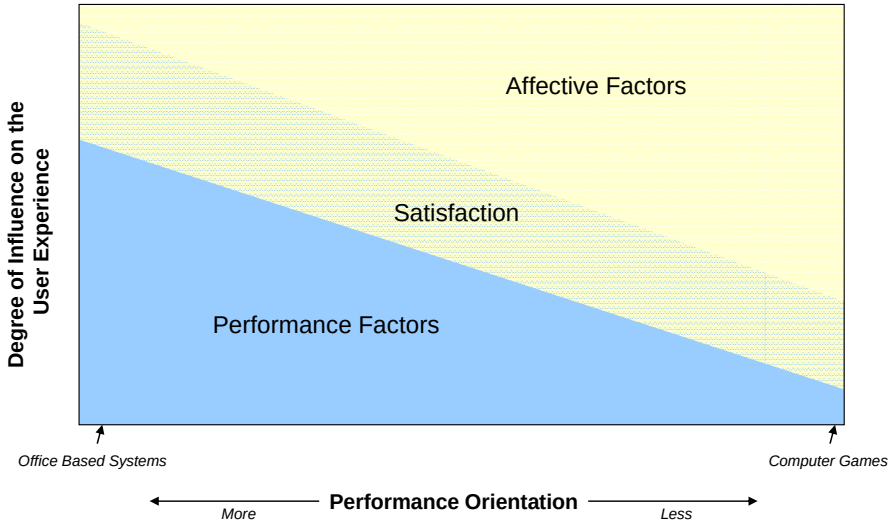

Figure 1: Conceptual Model of User Experience

A key difference between the work of Hassenzahl *et al.* and Bentley *et al.* is the identified role of affect and emotion. The former conceptualises affect and emotion as a consequence of using a system, and is not be considered a design goal itself (thus they focus on 'hedonic qualities' which can be design goals). The latter views emotion and affect as a possible design goal, which is why they include affective factors as an explicit component of the user experience, and they recognise that one way to achieve this goal may be by applying hedonic characteristics within the interface. Both views have merit and support. Hollnagel (1999), for instance, argues that system interaction is about efficiency and control, and that focussing on emotions may interfere with these (in support of Hassenzahl *et al.*). In contrast Glass (1997) and Carroll and Thomas (1988) have argued that specific affective and emotional experiences should be considered valid design goals (in support of Bentley *et al.*). Within this paper, affect and emotion are treated as valid design goals.

2. AFFECT AND EMOTION

The terms affect and emotion are frequently considered synonyms. For instance, Hayes-Roth *et al.* (1998) and Arnold (1960) use the terms affect and emotion interchangeably within the same articles. Norman *et al.* (2003) write about 'the system of affect and emotion' and also include the phrase 'emotional (affective) systems' suggesting that affect and emotion are synonymous. However, others do make a distinction between affect and emotion, and this distinction can lend value to research in the area of affect and emotion within the context of HCI.

Plutchik (1980), for instance, defines emotion as "*the person's overall feeling and can be influenced by (among others) context, past experience, recent experiences, personality, affect, and the net cognitive interpretation of these influences*". Similar definitions of emotion are provided by Bindra, 1970, and

Lazarus, 1982. Affect, on the other hand, can be defined as "*a short term, discrete, conscious subjective feeling that may have an influence upon a person's overall emotion*" (this definition integrates research by Scherer, 1994, Russel, 2003, and Tomkin, 1981).

2.1. Role of Affect and Emotion in HCI

Distinguishing between affect and emotion can add value to HCI research because it acknowledges that immediate feelings will occur while using a system (affect) and that there are summative feelings after system use (emotion). Both can be important depending upon the circumstance. For example, if the concern is whether the users have an overall positive experience then emotion may be the better indication of this. However, if the concern is to identify specific aspects of the system that caused frustration or joy, then affect be more appropriate to target.

To demonstrate, Figure 2 shows a theoretical tracing of a user's emotion and affect during interaction with a system. There are two times during the interaction (**A** and **B**) where the affective experiences showed a large deviation. User emotion also changed at those times but not to the same degree as affect – affect is more sensitive to short term changes because emotion can be tempered by its many influences, whereas affect is only the immediate feeling. It may be of interest during an evaluation to be able to identify what specific aspects of the system the user was interacting with at the times **A** and **B** to cause these affect deviations. If known, it would be possible to feedback to the design process not to change the system in relation to **A**, but that it may be necessary to change the system with respect to **B**. The user emotion remained positive throughout (and actually became more positive after the interaction), and it is possible that if **B** was changed the resulting emotion after use would have been even more positive.

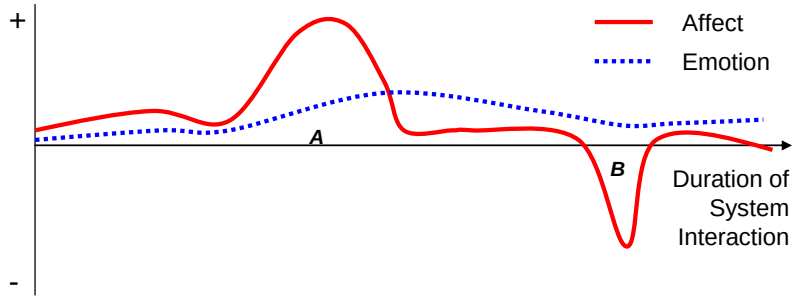

Figure 2: Theoretical Tracing of Affect and Emotion during System Interaction

Both affect and emotion in relation to system use are important. Affect because of its sensitivity and ability to feedback to the design process. Emotion because it can be argued that regardless of the affective experiences during use, the resulting emotion is what people will walk away with and will determine whether or not they will continue to use the system (assuming they have a choice).

2.2. Addressing Affect and Emotion and System Use – Current Practice

In practice, many system evaluations can account for emotion by asking the user their overall feelings regarding the system after use. This could be done through a post-use interview or questionnaire. However, affect is not as easy to account for during an evaluation because any change in behaviour can alter a person's affect (Fishbein and Ajzen, 1975; Omodie *et al*, 1994). As such, to account for affect during an evaluation it is necessary to select an evaluation technique that will not impact or interrupt user behaviour. This includes interrupting the user during system interaction, which is commonly used during evaluation (e.g. think-aloud evaluation protocols). Further, it is necessary to elicit information about user affect as it occurs, as recollection of past affect will probably be less accurate – particularly if the evaluation session is long (e.g. asking a user what their affect was at 5 minutes into the session which lasted 30 minutes).

Psycho-physiology, the use of physiological measures to gain insight into the psychological processes, has successfully been used as an indicator of user affective experiences during use (see Picard, 1995, Ward *et al.* 2003, or Bentley *et al.*, 2003). While psycho-physiology does show promise in the identification of

user affective experiences, it can not distinguish between specific affects – that is, it can not tell the difference between joy and anger (Coles, 1983; Healey *et al.*, 1998). Further, it can not be expected that the equipment, software, and expertise required to obtain and process physiological data will be generally available in an industrial context for system evaluation. Ensuring methods are accessible to industry is important because that is where most systems for public use are developed and evaluated.

An alternative is to use a video situated recall methodology, as successfully applied within naturalistic decision making research. Video situated recall methods encourage a user, after completing an activity, to recall their thoughts, feelings, and experiences retrospectively as prompted by a video replay of the activity (Lyle, 2003). The underlying assumption in regards to situated recall is that the person will be re-immersed in the situation via the video, and therefore will accurately recall thoughts, feelings, and experiences as they are actually experiencing these again. Situated recall methods work best when there is immediacy of recall – that is the video is replayed as soon as possible after the activity takes place. There are many different situated recall methods (see Lyle, 2003 for a review), and the authors chose to apply the cued-recall debrief (CRD) developed by Omodei *et al*. (1998) because affect is explicitly identified as information elicited.

The remainder of this paper discusses the CRD, how it may be applied during a system evaluation, and describes a study which explores the use of the CRD to elicit information regarding user affect during a system evaluation setting. User emotion was not addressed because current system evaluation methods can already provide an indication of user emotion, and also because affect appears to have a greater ability to feedback to the design process (as previously discussed in section 2.1).

3. CUED-RECALL DEBRIEF BACKGROUND

The CRD is one of many situated recall methods. CRD requires the activity being performed to be videotaped from a first-person's point of view and replaying this back to the participant immediately after the activity. The justification for videotaping from the user's point of view is that this will enhance the ability of the user to become re-immersed in the activity because the replay is exactly what the person previously saw. In static activities (i.e. working at a computer) the first-person point of view can be obtained by videoing the screen or using screen-capture technologies, whereas in dynamic activities (i.e. the user moving around) a head mounted camera can be used to video whatever the participant is looking at.

The CRD method was developed by Omodei *et al*. (1994). It was originally applied to assess decision making in a sporting context (Omodei *et al*., 1994), and has recently been applied to the complex decisions made by fire-fighter personnel dealing with large bush fires in rural Australia (Omodei *et al.*, 1998; Bushfire CRC, 2005). The method was developed as one that can elicit thoughts, affect, emotion, and cognitive experiences without interfering with a person's behaviour in a naturalistic setting – that is a setting which mimics the setting that would exist without any additional people present. Omodei *et al.* (1994) found that the CRD can create up to four times the number of recall responses as opposed to free recall, and have also found that the cued recall responses provide a better representation of the actual thoughts and feelings of an individual, as opposed to free recall where an individual has a tendency to change and organise their responses into some logical form (thus not reporting what actually occurred).

3.1. Cued Recall Debrief Method

The CRD methodology is straightforward to apply, and requires minimal equipment. The CRD requires the activity be performed without any interruption or change from the naturalistic setting – with the exception of video being taken from a first-person point of view. As soon as possible after the activity has been completed, the debrief facilitator and the participant sit down and watch the activity take place. The participant is encouraged to freely voice his/her thoughts and feelings during this process. The facilitator observes the participant to see if there is any subtle reaction to the video by the participant, and if a reaction is noticed but the participant does not comment the facilitator may, at his/her discretion, query the participant what they were thinking or feeling at that time. The facilitator may choose to pause the video replay to allow the participant time to comment fully on a particular moment in time. With experience, a facilitator of the CRD session will become better at eliciting responses from participants.

The data collected (debrief comments) through the CRD is considered 'psychologically rich' as it contains a large amount of information regarding the psychological processes of an individual during an activity (Omodei *et al.*, in press). Each debrief comment must be critically examined, with key points identified in order to construct an overall view of the users thoughts, emotions, and affect, what influences were acting upon these, and how this impacted behaviour and choices. While the comments can be quantified (e.g. grouping words into categories and comparing number of responses in each category), Omodei *et al.* (in press) encourage the qualitative analysis of this data in order to gain a greater insight into the overall psychological processes and strategies that an individual applies.

3.2. Possible Applications of Cued Recall Debrief in HCI

CRD, as it has been identified to elicit information about affect, can theoretically be used to gain insight into user affect while they were using a system. This may provide insights regarding what aspects of design are creating user affective experiences and what the affective experience actually is. This information can then be fed back to the system designers to effect change if required (i.e. the experience is undesired), or to ensure change doesn't occur (i.e. the experience is desired).

CRD can also be applied more generally to evaluate all aspects of user experience – their thoughts, affect and emotion – to gain an overall view of how the user was interpreting information presented to them and how they made their decisions in regards to what to do next. Thus CRD can potentially be used as an overall system evaluation technique.

4. EXPLORATORY STUDY: CUED RECALL DEBRIEF AND AFFECT

Part of a larger research program to examine affect in the context of system use and system quality, this specific study explored CRD as a method to elicit information regarding user affect during use of a computer-based system. The primary goal of this study was to determine if CRD could successfully elicit affective experiences from a user during system use.

Since this was an exploratory study, the authors chose to use computer games to help create user affect. User affect has been suggested to be the primary motivator for people playing games (Csikszentmihaly, 1992; Draper, 1999) and therefore it was assumed that computer games would have the greatest probability of creating affective experiences in users, and therefore enhancing the likelihood that CRD will elicit affective information. This would satisfy the goal of this exploratory study (to see if CRD can elicit affective information), however it also places some limitations on the generalisability of results.

4.1. Participants

Ten participants were recruited through paper-based advertisements posted in buildings at an Australian University. These advertisements informed potential participants that they would receive $40 remuneration, and that the study would take approximately two hours. Upon arrival, participants completed a consent form which outlined the study goals, methods, and participant requirements. Participants then completed a pre-test questionnaire to obtain demographic data, including questions related to the participant's computing habits and computer game playing preferences (see Table 1).

Table 1: Key Participant Details

ID	*Gender*	*Occupation*	*Computer Use* *(hours/week)*	** Leisure Computing* *(hours/week)*
1	Male	Student	> 10	> 10
2	Male	Student	> 10	> 10
3	Male	Musician	> 10	2-5
4	Female	Education	> 10	> 10
5	Male	Chef	< 1	< 1
6	Female	Student	> 10	> 10
7	Male	Student	> 10	< 1
8	Male	IT industry	> 10	6-10
9	Female	Student	> 10	2-5
10	Male	Education	> 10	> 10

** Leisure computing was defined as the amount of time that participants used a computer for non-work purposes. Examples provided to the participant included surfing the internet for fun, playing games, etc.*

4.2. Method

An overview of the study timeline for each participant is shown in Figure 3. Participants played two games, each session immediately followed by a debrief session. One game was a puzzle oriented game, and the other an action oriented game. The order which participants played these games was random.

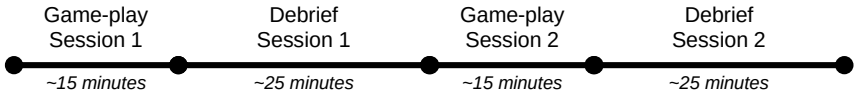

Figure 3: Study Timeline

The game-play sessions took between ten to twenty minutes, with the exact duration of the game-play session reflecting how long it took a participant to complete a game as the researchers did not want to interrupt the participant mid-way through a game. The game-play sessions were recorded from the participants point of view with audio (screen recording as the participants focus remained on screen). During the game-play sessions, heart rate, skin perfusion (similar to galvanic skin response), and breath rate were recorded as these measures have previously been used to identify when a user is experiencing affect (see Picard, 1995, Ward *et al.* 2003, or Bentley *et al.*, 2003).

Debrief sessions took between twenty and thirty minutes, depending upon how many and the extent of comments made by the participant. The participant was encouraged to speak freely regarding all aspects of their interaction and was not censored in any way during the debriefing process. However, with respect to the goals of the study, only comments related to affective experiences were of interest. The CRD session was video-taped with audio for later data extraction and interpretation.

4.3. Results

All debrief comments were encouraged, although the focus of the study was on affect. Many comments unrelated to affect were made, but are not included in this analysis. A total of 176 comments related to affect were made by the participants. Each participant made on average 17.6 comments in total (SD=5.15), reflecting an average of one affect related comment every 102 seconds. At the extremes one participant made only seven affective comments throughout the two game-play, and one participant made 25 for the two game-play sessions.

All affect related comments were identified as positive affective experience (e.g. "*I was happy there*"), negative affective experiences (e.g. "*That was frustrating*"), and neutral affective experiences (e.g. "*I wasn't really feeling anything at this point*"). The identification of positive, negative, or neutral comments were independently rated by four individuals showing very high inter-rater reliability (R=0.9831). A total of 57 positive, 54 negative, and 64 neutral affective comments were made.

With regards to the physiological measures, positive and negative affective experiences identified through the debrief session were represented by a significant increase in heart rate and skin perfusion variability immediately prior to the affective experience itself, with physiological patterns returning to normal level approximately 20 seconds after the affective event ([$F(4,27)=4.016$, $p<0.05$, $eta^2=0.373$] and [$F(4,28)=4.954$, $p<0.01$, $eta^2=0.414$] for heart rate and skin perfusion respectively). The stereotypical patterns observed are represented in Figure 4. Neutral affect showed no change in physiological patterns ([$F(4,27)=0.283$, $p>0.05$] and [$F(4,30)=0.477$, $p>0.05$] for heart rate and skin perfusion respectively). *More detailed findings related to the physiological measures are available in Bentley et al., 2003.*

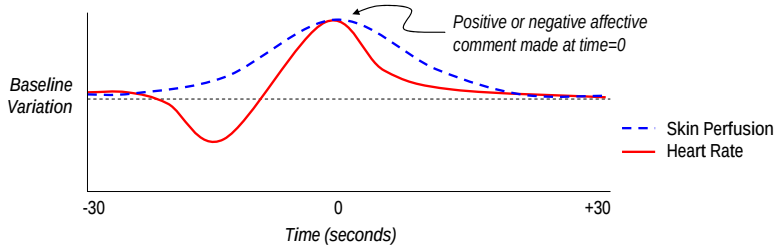

Figure 4: Representation of heart rate and skin perfusion variability before and after an affective comment

5. DISCUSSION

The results of the study suggest that CRD can effectively elicit information regarding user affective experiences. While Omodei *et al.* (in press) encourage the qualitative analysis of this data in order to gain a deeper understanding of the psychological processes of an individual, quantitative analysis was used in this study as the goal was to determine if CRD could successfully elicit affective information – the goal was not to gain a deeper understanding of the psychological processes involved.

Omodei *et al.* (1998) have suggested that the CRD can elicit information about affect, however proof of this is lacking. For example, it is possible that a person will simply say things that they believe the facilitator wishes to hear. It is also possible that the participant, during the CRD session, will actually have different affective experiences at different times when compared to the original activity. All situated recall methods (CRD included) have these limitations, although the accepted theories that underpin situated recall do support the fact that they will indeed elicit information about affect. However, within this study the fact that the physiological indicators of affective experiences matched in time to the cued-recall comments provides confirmation that the CRD comments are related to affective experiences. This lends some support to the theoretical claims of CRD and situated recall methods in general.

In this study physiological patterns were used to confirm whether or not the affective comments elicited through the CRD were 'true'. Physiological identification of affective experiences has one significant benefit over CRD – it is able to identify when an affective response even if the user does not comment at that time during the debrief. This can be truly beneficial, particularly when dealing with participants reluctant to discuss their feelings. If it was possible for the facilitator of the CRD session to have identified points in time when the physiological measures indicate an affective experience, the facilitator could then prompt the participant to elicit information about that time. This would greatly aid in generating debrief data that is representative of the overall psychological processes that occurred during the activity.

It was noted that some participants showed a much greater inclination to provide insight into their affective experiences than others. At the extremes, one participant made seven comments related to affect (one affect related comment every two hundred and fifty-seven seconds), whereas another participant made twenty-five (one affect related comment every seventy-two seconds). This highlights one potential limitation of the CRD – it is dependent upon the participant's willingness to divulge information about their psychological processes. It is accepted that many people will have difficulty discussing their feelings, and to this end, it is very important to make the participant feel comfortable and at ease during a CRD session. It should also be noted that the experience of the facilitator may have an impact when dealing with participants who are reluctant to make comments. In this study the facilitator had some prior experience with CRD, however with greater experience the facilitator does believe that more comments could have been elicited through improved prompting of the participant (both timing and nature of prompts).

This study focused on the elicitation of affective experiences, and did not attempt to link affective experiences with particular aspects of the interface. If CRD was to be used during an evaluation of a system (rather than during an exploratory study) this would be the next required step. To achieve this, it would be necessary to associate what each of the users were doing at the time of their affective experiences, and to then determine if there are any trends between participants (i.e. did all participants experience negative affect at a particular point). While it is possible to associate a single user's affect with the interface this affect may not be generally representative.

5.1. Industry Uptake for System Evaluation

CRD could easily be taken up by industry to assist with system evaluations. It requires minimal equipment (mainly a video camera or screen-capture ability if using a single computer), the method itself is easy to apply, and as the facilitator gains experience using CRD the quality of information will improve. Another benefit of the CRD is that it can be applied to a variety of systems for evaluation with minimal change to the actual methodology. For instance, for a performance oriented system it may be important to understand how the user interprets information in order to use the system in an effective and efficient

manner. In non-performance oriented systems it may be more important to elicit information about affect and emotions. The CRD can elicit appropriate information for both types of systems.

There are some limitations with the CRD. The first practical limitation is that it does require more time to perform than traditional system evaluation methods. Normally, the information regarding the activity would be extracted while the user is actually performing the activity. With CRD it is necessary to allow the user to perform the activity without interruption, and then playback the activity and then allow the user to comment. This effectively doubles (at a minimum) the duration of the evaluation session.

Another limitation to CRD uptake is that it is incompatible with some other successful system evaluation methods. For example, think-aloud protocols require the user to speak while they are performing an activity. Omodei *et al*. (1994) suggest that this will alter the naturalistic setting, and therefore alter affect and potentially other psychological processes of the individual. However, it could be argued that the CRD would supplant the need for the think-aloud methods, and may actually be a better representation of the 'real-world' activity.

5.2. Further Research

While the results showed that the cued-recall debrief method can elicit information about user affect during system use, the next required step during an evaluation would be to see if there is any pattern of affect across users with respect to particular aspects of system interaction. Future research should also determine whether the CRD methodology will successfully elicit affect in systems that are less affect-oriented in comparison to computer games.

An interesting study would be to compare physiological patterns elicited during actual system use and compare these to the physiological patterns elicited during the CRD session. According to theories underlying psycho-physiology these patterns should be similar. If they are not, then this may suggest that the CRD session is not actually eliciting the same thoughts, emotions, and affect as originally experienced.

6. SUMMARY

Affect and emotion are important factors to address during the design and evaluation of a system. This is particularly true when considering that the success of some modern systems are based almost entirely upon how a user feels while using it and after using it (e.g. computer games). However, affect and emotion could have a significant contribution to performance as well. Igbaria *et al.* (1994) point out that if a system is fun, then a user will likely spend more time interacting with it, therefore becoming more familiar and comfortable with how it works, which can ultimately lead to increased performance.

It is important to note that affect and emotion, even though they may be used synonymously, have had important distinctions made within psychological literature and these distinctions can benefit HCI research and application. Emotion is a longer term feeling, with a variety of influences cognitively interpreted which then results in an emotion. Affect, on the other hand, is a short term feeling that is non-reflective. Affect is more sensitive to change compared to emotion, and therefore has greater potential to feedback to the design and development of systems (recall section 2.1). Emotion can be addressed using current system evaluation methods such as post-use interviews or questionnaires. However, these methods can not be applied to affect because it requires a user to retrospectively recall a information about a brief moment in time, and this sort of recall will be more logical, organised, and objective than what truly occurred and therefore not representative of the true affective experiences (Omodei *et al*., 1994).

The study described within this paper explored the cued-recall debrief method to determine if it is a viable method to address affect during system evaluation. The results of the exploratory study suggest that the cued-recall debrief method does hold promise for eliciting comments related to affective experiences in the context of system use. The cued-recall debrief allows for greater insight into user affect than other reported methods, such as psycho-physiology which is only able to indicate when a person is experiencing affect and is unable to distinguish between different affective experiences. The cued-recall debrief can identify and distinguish between specific affective experiences. However, the cued-recall debrief method does require a lot more time to complete and is subject to the willingness of the participant to speak about their thoughts and feelings.

There are no barriers to industry uptake of the cued-recall method to elicit affective information as it requires minimal equipment, the method is easy to apply, and although the experience of the facilitator can enhance the debrief session it is possible to gather useful and valuable data even when the facilitator is not an expert. The cued-recall method may also be useful for more general system evaluations, and may be used in place of many of the traditional evaluation techniques.

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