Measuring Affective Benefits and Costs of Awareness Systems Supporting Intimate Social Networks *

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Abstract

Human beings are social beings. We have a fundamental need to communicate - to form, maintain and enhance social relationships. Members of intimate social networks (e.g. family members, close friends) that live apart, stay in touch with each other through a range of synchronous and asynchronous communication media. This paper describes research focused at developing and testing a questionnaire measure that is sensitive to the affective benefits and costs that communication media may have for their users. First, a requirements study is reported, investigating real-life communication between family members, in order to identify their various communication needs and patterns, as well as their use of various existing communication media. We subsequently describe the development of a new questionnaire measure, the Affective Benefits and Costs in Communication Questionnaire (ABC-Q), that is aimed to assess the affective characteristics of communications, which were hitherto largely ignored in measures of social presence or communication effectiveness. We conclude this paper by describing a field study, evaluating the ASTRA awareness system that is specifically aimed at supporting intimate social networks. During this study the ABC-Q was first applied. Results in terms of reliability and validity of the questionnaire show that the ABC-Q is a promising measure.

Keywords: Affective Benefits, Awareness Systems, Communications Systems, Questionnaire Development, User-Centred Design

1 Introduction

The interactions and relationships we have with other people form an essential social network that supports us and adds meaning to our lives. This well-known fact is illustrated by the massive success of recent communication media such as email, mobile telephony, and SMS, but the basic insight can be traced back to the days of Aristotle, or even earlier. Maslov's theory of human needs, formulated in the 1950s, illustrates that social interaction is essential to satisfying human needs at several levels, in particular needs for belonging, love, and esteem, although even at the

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more basic levels of physiological and safety needs, communication and co-ordination is essential to mental and physical wellbeing, and ultimately, survival.

Reflecting this sentiment, William Schutz (Schutz, 1966 in Washington (2001)) describes two basic human needs in his interpersonal needs theory:

- Inclusion: the need for the company of others to feel accepted.
- Affection: the need to form emotionally close relationships.

In other words, we need the company of others in order to feel worthwhile and understood, and to express feelings such as friendship and love. The forming, maintaining and enhancing of relationships with other people is one of the most powerful drives for people to engage in communication. Traditionally, these needs have been addressed in the most natural way: face-to-face. Due to changing lifestyles and the emergence of new technologies, nowadays many of our daily interactions have become technologically mediated. Convenient as it may be when distance or time limit the opportunities for real meetings, there are severe doubts whether mediated communication can afford the same affective characteristics as face-to-face communication.

Most existing communication media have been developed to support the exchange of information rather than emotion. Often people engage in communication not merely to exchange information, but to pursue social and emotional goals such as being reassured about the well-being of others or to let other people know you are thinking about them. In this case, the informational content of a message is of secondary importance to the emotional, relational content that is being transmitted. Kuwabara et al. (2002) refer to this distinction as contents-oriented communication versus connectedness-oriented communication. Liechti and Ichikawa (1999) introduced the concept of affective awareness, defined as "a general sense of being close to one's family and friends". We would like to introduce a related concept, *connectedness*, which we define as "a positive emotional appraisal which is characterized by a feeling of staying in touch within ongoing social relationships" (IJsselsteijn et al., 2003).

A class of systems, which tries to take into account this need for connectedness, are awareness systems. Awareness systems help people to effortlessly maintain awareness of each other's whereabouts and and activities, thus facilitating lightweight, emotional, informal forms of communication. In line with Weiser and Brown (1995)'s notion of calm computing, such systems can be always-on, yet very gentle in terms of attentional demands. Pioneering examples of awareness systems include Media Spaces (Bly et al., 1993) and Portholes (Dourish and Bly, 1992), which were originally developed to serve the need to stay aware of each others presence and availability within the workplace.

Traditional assessments of communication media have often focused on social presence measurement. Social presence can be defined as the feeling of "being together" that people may experience when communicating through a medium (Short et al., 1976). Although highly relevant, such measurements do not address less direct, longer-lasting feelings resulting from communication. For example, do people think about each other more after sending or receiving an e-mail? Do they feel more involved in each other's lives if they use instant messaging on a regular basis? Do they feel connected with each other while talking through the telephone, and how long does this feeling linger on after the conversation has been ended? In order to answer these and related questions, new methods are needed. We need to identify and operationalize affective characteristics of communication, such as connectedness, which are essential for evaluating new media.

This paper describes the research surrounding the development of a new measurement instrument that is sensitive to measuring affective benefits and costs of communication. In the next section we first discuss a requirements gathering study in which we investigated real-life communication between family members, to identify their various communication needs and patterns, as well as their use of various existing communication media to support those needs. Subsequently, we describe the development of a new questionnaire measure assessing affective costs and benefits of communication. Finally, we will relate the results of a field study evaluating an awareness system aimed at supporting intimate social networks, such as families. During this study the newly developed questionnaire was first applied.

2 The ASTRA Requirements Study

The European ASTRA project (Awareness Services and Systems - towards Theory and Realisation - see: `http://www.presence-research.org/Astra/`) was specifically aimed to investigate awareness systems and services for social purposes (e.g., to help geographically separated but closely related people to stay in touch). In the context of the ASTRA project, a requirements study was conducted to explore communication needs in the home. Three family clusters, consisting in total of 13 people, took part in the complete study; 4 additional participants took part in the interviews only. By family clusters we mean individuals related with family ties, who live in more than one household. Examples of family ties in our study were parent-child, grandparent-grandchild and sister-sister. Different age groups were represented in the sample and participants had varying levels of affinity with technology.

Participants were interviewed about their attitude towards communication with family members living in another household, their experiences with existing communication means and finally their wishes for future systems. The family clusters kept a diary for one week, in which they described the time, location, device, reason, and feelings associated with each contact.

The results of the study confirm that communication with family members is highly valued. In particular, contacts for social and emotional reasons are appreciated. Participants reported that they can feel very connected with each other as a result of mediated communication. They describe this feeling as thinking about each other, feeling involved, and being emotionally touched. This feeling does not automatically disappear after the contact is ended, but may linger on for minutes, hours or even days afterwards.

Participants acknowledge and enjoy it if they perceive that another person has made an effort to contact them. The more personal this effort is, the more it is valued. For example, the effort taken to start up a PC, log in and type an e-mail is not valued as much as choosing a postcard to fit the personal taste of the receiver, and personalising it further by a handwritten message.

Apart from these positive experiences, there also appear to be costs associated with communication. Communication for social and emotional purposes can give rise to powerful expectations. Participants describe how they can feel disappointed, frustrated or even angry when these are not fulfilled. Because of this, strong feelings of obligation may arise. People are afraid to hurt or offend the other by not responding to a contact or failing to initiate one at the expected time or frequency. Timing seems to be crucial; participants indicated that they would like to share events of their everyday life with their relatives, right at the moment when they happen. On the other hand, this timing should be negotiated with the receivers so as not to disrupt them in the course of their daily life. A final cost of communication is the time and energy that it can take.

3 Development of the ABC-Questionnaire

An extensive literature review revealed that at present, there appears to exist no suitable measurement tool to address the affective characteristics of communication means. This prompted us to develop such a tool ourselves. A main difficulty was a lack of sufficient relevant literature to supply theoretical foundation. To generate alternative starting points, we conducted a brainstorm session with five people working in the area of awareness and communication research. Input to this brainstorm was existing literature, the ASTRA requirements study discussed earlier, and the results of an e-mail questionnaire about connectedness (Van Lanen, 2003). Each participant generated a number of aspects that he or she thought the questionnaire should address. These aspects were subsequently grouped in an affinity diagram to identify main concepts. The resulting ten main concepts were: Privacy, Obligations, Expectations, Effort, Thinking about Each Other, Situational Awareness, Connectedness, Sharing Experiences, Recognition, and Group Attraction. We identified two main dimensions: the first four concepts can be seen as Costs of communication, whereas the latter six relate to Benefits. Therefore, we named the questionnaire the *Affective Benefits and Costs in Communication Questionnaire* (ABC-Q).

For each concept except Group Attraction, a scale consisting of 6 questions was generated based on the brainstorm results. For group attraction, we found an existing questionnaire (Evans and Jarvis, 1986), from which we took the six items that were most appropriate to our situation,

and incorporated them in our questionnaire. All items have a seven-point scale, which runs from 'strongly agree' to 'strongly disagree'.

The first version of the ABC-Q was reviewed by two experts on questionnaire design. They were asked to check whether items were understandable and measured the intended concept. On their advice, two items were removed from the questionnaire because they were unsuitable, and the wording of five items was slightly changed to make them clearer. A pilot test was conducted to gather data for the item selection. 20 participants (students and employees of Eindhoven University of Technology) completed the questionnaire, which now contained 58 items. The goal was to reduce the number of items to 40, i.e. four per scale. Criteria to remove items were:

- The item did not contribute sufficiently to the scale (low/negative item-total correlation)
- Cronbach's alpha would improve when the item was removed.
- An item did not discriminate (low variance and/or extreme mean)

Reliability of the Effort scale turned out to be very low. A closer look at the inter-item correlations suggested that this scale was multidimensional. A short interview with several respondents confirmed that effort is a complex concept; it can be positive in one situation and negative in another. This observation is confirmed by the results of the requirements study, in which participants reported different types of effort. Because there was no time in the current project to adapt the effort scale, it was removed from the questionnaire and addressed instead using interviews.

After removing the Effort Scale internal consistency, as measured by Cronbach's alpha, of the ABC-Q as a whole was .86, which indicates that the questionnaire is very reliable. Values for Cronbach's alpha for the scales of the ABC-Q can be found in Table 1.

Table 1: Internal Consistency of the ABC-Q

ABC-Q	*.86*
Costs	*.64*
- *Obligations*	*.41*
- *Expectations*	*.73*
- *Privacy*	*.76*
Benefits	*.88*
- *Thinking about Each Other*	*.70*
- *Situational Awareness*	*.84*
- *Connectedness*	*.58*
- *Sharing Experiences*	*.81*
- *Recognition*	*.72*
- *Group Attraction*	*.84*

4 The ASTRA Field Test

The ABC-Q was first applied in a field test conducted in the context of the ASTRA project. In this project, a prototypical awareness system was developed to help distributed family members to stay in touch with each other by sharing moments of their daily life in the form of pictures, drawings and short text messages (Markopoulos et al., 2004). The field test aimed to evaluate how people experience the usage of this system in their daily life. This study offered an excellent opportunity to investigate whether the newly developed ABC-Q would yield sensible and stable results.

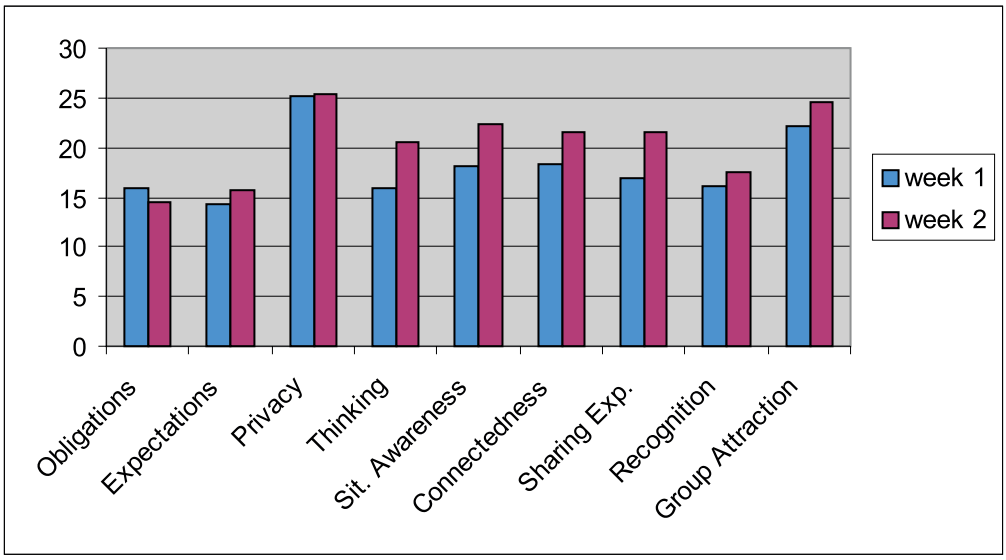

Figure 1: Mean scores on the ABC-Q in the first and the second week of the field test.

4.1 Participants

Two families, both distributed over two separate households, took part in the field test. In total, thirteen people participated, consisting of seven adults, four teenagers, and two children. The children were too young to complete the questionnaires, therefore questionnaire data were gathered from eleven participants.

4.2 Method

A within-subjects design was used, consisting of two phases that lasted a week each. In the first week, communication between two related households using existing communication means was studied. In the second week, the ASTRA system was introduced in both households. In both the first and the second week, group interviews were conducted. Participants also kept a diary and filled out two questionnaires: the IPO-SPQ measuring social presence (de Greef and IJsselsteijn, 2001), and the ABC-Q.

4.3 Results

In this paper, only results which are relevant for the evaluation of the ABC-Q will be discussed. For a more extensive description of results, please see the ASTRA Project Assessment deliverable (available from: `http://www.presence-research.org/Astra/`).

The mean scores for all scales of the ABC-Q are shown in Figure 1 (N.B. For all scales, the minimum score is 4 and the maximum score is 28). The Wilcoxon test was used to test for significant differences between scores. The results show that the first three scales, relating to Costs, do not differ significantly between the first and the second week. The Benefits scales, however, show some marked differences. Participants thought about each other more often in the second week, when they were using ASTRA ($Z = -2.67$, $p = .008$). Also, their awareness of the situation of their family members was much higher ($Z = -2.31$, $p = .021$). Participants indicated they felt more connected to each other in the second week ($Z = -2.02$, $p = .043$). They also felt they were sharing more experiences with each other ($Z = -2.38$, $p = .011$). The level of group attraction was higher in the second week ($Z = -2.23$, $p = .026$). The recognition, finally, was slightly higher in the second week but this difference was not significant.

In summary, the results from the ABC-Q imply that the ASTRA system did not increase

the costs associated with communication, but did deliver substantial affective benefits to the participants. An interview which was conducted with each of the 4 participating households after they used the ASTRA system confirmed these results. Participants reported that they felt more in touch with each other in the second week. They thought about each other more often, were more aware of what their family members were doing, and could share more of their own experiences. Many remarks were made that support this. Some illustrative quotes:

> *"There was more involvement, more curiosity. I was thinking about them much more than usual."*

> *"You become more conscious of what your family members are doing, and you also become curious."*

> *"It is so good to see what they are doing. I always want to stay in touch, but I normally don't have the time. Now it is easier."*

> *"It was fantastic to keep them up-to-date."*

5 Conclusions

The results from this study imply that the ABC-Q is a promising measure. The initial pilot testing during the development phase has shown that it is a reliable measure. In the field test, the ABC-Q proved to be sensitive to changes in condition (in our case, the introduction of the ASTRA system). Although validity has not yet been formally established, the correspondence between the ABC-Q scores and the interviews is striking and encouraging. Therefore, we believe that the ABC-Q will be a useful addition to the currently limited spectrum of relevant measurement tools in the field of communication.

6 Future work

We are currently in the process of redesigning and evaluating a new version of the ABC-Q. This version is different from the initial ABC-Q in three ways.

First of all, the concept of Effort has been brought back into the questionnaire. Originally, this was a scale in the Costs dimension, but in the pilot test it turned out to be multidimensional and therefore unreliable. As explained previously, we think the reason for this is that there are different types of effort. The first is associated with time, energy or financial costs, for example buying a stamp and walking to the post office to mail a letter. We call this "process effort". The second type of effort is meaningful to the communication, for example choosing a postcard with a nice picture on it and writing a personal message on it. We call this "personal effort". Process effort, even though time or money is invested by the sender, is not proportionally appreciated by the receiver. It can therefore be considered a Cost. Personal effort, on the other hand, is enjoyed by the sender, who has the feeling of sharing something special, and very much appreciated by the receiver. It can therefore be seen as a Benefit. Accordingly, we have added two seperate effort scales to the ABC-Q: one for process effort, which is part of the Costs dimension, and one for personal effort, which is part of the Benefits dimension.

A second change is related to the Sharing Experiences scale and the Situation Awareness scale. Questions in these two scales are quite similar, and high correlations between the two scales were found in both the pilot test and the ASTRA field test. We therefore decided to combine them into one scale.

Finally, the ABC-Q was extended with questions addressing reciprocity. In the new version, each scale addresses not only the participant's own feelings, but also the participant's perception of the feelings of his or her communication partner. For instance, the item "I feel involved in the other person's life" is now matched by the item "(I think that) the other person feels involved in my life".

We will conduct a study in the near future to evaluate the new ABC-Q. We aim to compare different media such as e-mail, traditional phone, mobile phone and SMS.

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