

# Design of an Instrument for the Evaluation of Communication Technologies with Children

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## ABSTRACT

In designing communication technology for children, it is important to understand the affective benefits and costs introduced by a particular medium. We present an Affective Benefits and Costs of Communication Technologies Questionnaire appropriate for use with native English-speaking children aged 8-10. We discuss the iterative design and testing of the survey instrument and provide the current survey items.

## Categories and Subject Descriptors

H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

## General Terms

Human Factors

## Keywords

Children, communication technologies, survey design

## INTRODUCTION

Children are regular users of new media and especially applications supporting informal social communication [11]. Accordingly, a large number of research studies are concerned with developing communication applications and systems that are designed primarily to provide affective benefits to the children, e.g., to help children stay connected with grandparents [23], to help them connect to peers [25]. Even in cases where the affective benefit is a secondary consideration, it is clear that much of the experience of using a communication system pertains to the emotional connection with the other party.

A child-centered design of such applications and media requires, among others, appropriate methods for their evaluation. To date related research does not support sufficiently the evaluation of the affective component of

communication systems. Field studies rely on qualitative methods that produce a phenomenological account of the emerging experiences during use. While valuable, corresponding evaluation criteria are non-uniform and elastic. Anecdotes of successful uses and less successful ones do not help to describe accurately and in a generalizable manner the research results reported. We argue, that related research and development efforts would largely benefit from sound and sensitive psychometric measurement of affective benefits and costs experienced by children.

Related methods have been developed for evaluating such media with adult users and some are discussed in the following section covering related work. Such instruments have been used for the evaluation of applications connecting children to adults, but measurements only concern how adults experience the communication [10]. This lack of representation of children in the evaluation is detrimental to developments in this area and is caused by the difficulty of developing survey instruments suitable for children [13]. In the following sections, we describe the process of generating scales and items for the Affective Benefits and Costs of Communication Technologies – Child Version (ABCCT-child). We discuss our iterative testing and modification of the survey instrument through two separate pilots. Finally, we provide the current version of the questionnaire items.

## RELATED WORK

There has been a series of studies on the role of mediated communication in strong tie [22] and parent-child [4] relationships. Other studies examine the specific strategies for technologically mediated communication employed by families. Some of these focus on specific technologies such as phone [2,20] or videoconferencing [1], while others look at the needs of specific types of families such as particularly busy [12], divorced families [24], or geographically-separated families [20,21].

Another source of information on how people appropriate communication systems comes from deployments of novel research prototypes. A number of systems for location and activity awareness between participants allowed for reflections on privacy and obligation [9,14,16,23]. Several

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**Table 1. Original scales and supporting literature for the first draft of the ABCCT-child**

Scale	Supporting Literature
Emotional Expressiveness	[2,8,11,13,15,25,27]
Engagement & Playfulness	[1,2,5,6,7,18,19,26,27]
Presence-in-Absence	[1,12,17,19,20,25,27]
Personal Effort	[11,13,15,19,21,23]
Social Support	[5,9,13,15,17,21,27]
Initiating and Composing	[1,15,17,27]
Feeling Obligated	[11,19,20,23,24,27]
Unmet Expectations	[4,20,23,24,25]
Threat to Privacy	[4,17,19,23,24,27]

other deployments examined more direct venues for communication through exchanging explicit messages and notes [8,17,18]. These were often appropriated by families not just for informational use, but also to increase their sense of connectedness and provide opportunities to be playful. Lastly, a host of systems was designed specifically to allow participants to engage in playful interaction to increase the sense of connectedness [5,6,15]. While there are many other systems addressing personal social connectedness, we focus on those whose findings were relevant to the design of our instrument.

Media psychologists have proposed several instruments for the assessment of the experience of mediated interpersonal communication through self-report. For example, Harms & Biocca [7] proposed and validated a questionnaire appropriate for synchronous communication. Such approaches though implicitly assume that the main purpose of communication systems is to substitute or emulate physical co-presence. For a growing number of applications this is not the aim and affective benefits are sought that are delivered through the sustained awareness of each other or

**Table 2. Post-extended pilot scales and Cronbach's alpha statistics.**

Scale	Cronbach's Alpha
<b>Benefits</b>	<b>0.88</b>
Emotional Expressiveness	0.65
Engagement & Playfulness	0.74
Presence-in-Absence	0.71
Opportunity for Social Support	0.86
<b>Costs</b>	<b>0.80</b>
Feeling Obligated	0.64
Unmet Expectations	0.78
Threat to Privacy	0.72

playful interactions that the medium supports.

The ABC Questionnaire [10] supported the psychometric evaluation of affective costs and benefits of technologies to adult users. This questionnaire (in its final version) includes 10 subscales, each containing 6 items. The ABC questionnaire has gone through several iterations allowing for its partial validation and some high reliability to be achieved. Efforts to better relate affective benefits to theory measured have led to the development of a *social connectedness* questionnaire [3]. This instrument requires respondents to evaluate the status of their relationship to a particular person or to the whole of the social network, assuming that introduction of a novel communication medium will lead to measurable differences to social connectedness. In our investigation we have found both judgments hard for children to make outside the context of a specific medium.

With this in mind we set out to adapt the ABC questionnaire for use by children. Several essential aspects of ABC made it inappropriate for children: its scales do not reflect the most relevant constructs for communication with children, it contains a high number of reciprocity scales which are difficult for children, the wording of the questions is at too high a reading level, and it is considerably too long to deploy in a single session with a child. Lastly, it requires respondents to evaluate usage of all available media currently. This makes the judgment very abstract and difficult for children and it reduces the sensitivity of the instrument when evaluating the introduction of a single novel technology in the set of media that children use already. This can be a severe restriction: while a novel technology may be useful and may come with distinct affective costs and benefits, these may be difficult to measure when users already employ 2-3 existing media.

### GENERATING SCALES AND QUESTIONS

Four types of sources were used to generate the original ABCCT-child scales and questions: the adult ABCQ [10], the theoretical background provided in related literature (Table 1), re-coding of the interview data on parent-child communication in separated families [24], and brainstorming by two experts in designing for social connectedness. The original drafting yielded 12 scales with *at least* 5 questions per scale (total 90 items).

To shorten the survey, we decided to narrow the scope of the survey to only include *affective* benefits and costs. As a result, the "Coordination" scale was dropped from benefits and the "Efforts of Scheduling" scale was dropped from costs. Additionally, we removed any reciprocity scales and questions (e.g., "My partner worries about me violating their privacy"), because development literature shows that it is too challenging for children to conceptualize another person's world view [19]. Review and discussion of the resulting measure by 2 experts lead to eliminating 23 questions and rewriting a significant portion of the remaining questions. This resulted in the first draft of the

survey with 9 scales and 60 items. Table 1 lists these original scales and related literature that supports the inclusion of each scale.

**PILOTING SCALES AND QUESTIONS**

We conducted two sets of pilot deployments of the survey to refine the items, shorten the instrument, and gather reliability data.

**Think-Out-Loud Pilot**

Three nine- and ten-year old boys were asked to complete the survey one-on-one with the researcher while reasoning out loud. By observing when the children became restless while taking the survey, we noted that it needed to be cut in size by half. The next draft of the survey restructured two of the scales and eliminated 9 questions that the children found unclear. The resulting measure was piloted with another 4 ten-year old children using a think-aloud protocol. From this pilot, the next draft had one scale eliminated, most questions refined and redundant ones eliminated, resulting in an 8-scale, 32 item questionnaire (4 questions per scale). The “Cost of Initiating and Composing” scale was dropped as one with most confusing questions; also because it refers to ease of use which can be evaluated in other ways.

**Expanded Pilot for Reliability Measures**

An expanded pilot to generate reliability statistics was conducted in Preston, England with 45 eight- to ten-year-

old children participating in testing the survey. Children were excused from class for 20 minutes in groups of 6 at a time. The survey was read aloud by the researcher to each focus group as they filled it out. The children were observed as they completed the survey and confusing questions were noted. After completing the survey, each group of six was led by the researcher to discuss which questions seemed to be most problematic. From this process, 7 questions were noted as requiring significant revisions—3 of the 7 confusing questions were rephrased, while 4 were removed completely. Factorial analysis was done on the survey results leading to one item being moved to a different scale and to the merging of two closely-related scales. Reliability measures were calculated for the resulting survey (the three rephrased questions were not included). Six questions were eliminated in an effort to shorten the survey, because removing them increased or did not affect the Cronbach’s  $\alpha$  of the scale. The resulting draft consisted of a 7-scale, 22 item questionnaire. The Cronbach’s  $\alpha$  of the resulting scales and dimensions are available in Table 2.

The relatively low scores on four of the scales reflect the small number of items on each scale and the presence of poorly worded questions. However, each dimension achieved an acceptable Cronbach’s  $\alpha$ . The items on the current version of the questionnaire are provided in Table 3.

**Table 3. Current scales and items in the Affective Costs and Benefits of Communication Technologies Questionnaire.**

<b>Affective Benefits and Costs of Communication Technologies – Child Version</b>	
<b>Directions:</b> Substitute the particular medium name (e.g., videoconferencing) for the phrase “the medium” in each question. Ask the participant to answer each question about a specific communication partner X. With younger children, read the questions out loud to the child.	
<p><b>Emotional Expressiveness</b></p> <ul style="list-style-type: none"> <li>I could let X know how I was feeling over the medium.</li> <li>I could tell over the medium how much X cares about me.</li> <li>I could tell over the medium how X was feeling that day.</li> </ul>	<p><b>Feeling Obligated</b></p> <ul style="list-style-type: none"> <li>I had to answer when X tried to contact me using the medium even if I didn’t want to.</li> <li>I had to talk to X using the medium even if I didn’t want to.</li> <li>I felt guilty if I didn’t answer a contact X made using the medium.</li> </ul>
<p><b>Opportunity for Social Support</b></p> <ul style="list-style-type: none"> <li>X was there for me over the medium when I needed them.</li> <li>Using the medium with X when I was having a bad day helped me feel better.</li> <li>I felt less worried about something after using the medium with X.</li> <li>X made me feel special in our contact using the medium.</li> </ul>	<p><b>Unmet Expectations</b></p> <ul style="list-style-type: none"> <li>I felt sad because X wasn’t around when I tried to contact X over the medium.</li> <li>I felt sad because X took too long to respond when I tried to contact X using the medium.</li> <li>I felt sad because X didn’t pay enough attention to me when we used the medium.</li> </ul>
<p><b>Engagement &amp; Playfulness</b></p> <ul style="list-style-type: none"> <li>It was boring to use the medium with X.</li> <li>I had fun with X while using the medium.</li> <li>I was excited about using the medium with X.</li> </ul>	<p><b>Threats to Privacy</b></p> <ul style="list-style-type: none"> <li>I worried that X might learn something over the medium that I want to keep secret.</li> <li>I worried that others would overhear or see something that X and I shared using the medium.</li> <li>I worried about my privacy while X and I were using the medium together.</li> </ul>
<p><b>Presence-In-Absence</b></p> <ul style="list-style-type: none"> <li>I felt more connected to X after out contact using the medium.</li> <li>I felt closer to X after using the medium together.</li> <li>After we were done, I still kept thinking back to something X shared using the medium.</li> </ul>	<p>Each statement should be ranked on the scale: { never, rarely, sometimes, usually, always }.</p>

## CONCLUSION

We have argued for the need to develop psychometric instruments suitable for children to evaluate affective aspects of communication through novel technologies. Existing instruments targeting adults are inapplicable because of the assumptions they make about how children use such technologies and the cognitive abilities required to respond to the survey items. We have summarized the development of the ABCCT-child (affective benefits and costs of communication technologies-child version) and the steps taken for its evaluation. Future work should seek further evidence for the validity of this instrument, e.g., through experimental studies, and through triangulating with data obtained by other methods.

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