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Title: A Mobile Diary Method for Studying Children's and Adolescents' Emotions : A Pilot Study

Year: 2015

Version:

Please cite the original version:

Malinen, K., Rönkä, A., Tolvanen, A., Sevón, E., & Jokinen, K. (2015). A Mobile Diary Method for Studying Children's and Adolescents' Emotions : A Pilot Study. *Social Inquiry into Well-Being*, 1(2), 51-60. <https://doi.org/10.13165/SIIW-15-1-2-05>

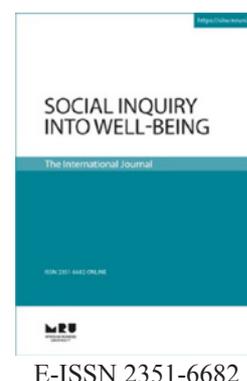
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<http://siw.mruni.eu>
2015, Vol. 1, No. 2

DOI:10.13165/SIIW-15-1-2-05

Social Inquiry into Well-Being



A Mobile Diary Method for Studying Children's and Adolescents' Emotions: a Pilot Study

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Abstract

Researching children's and adolescents' emotions from their own perspectives possesses special requirements for the data collection tools used. In this study, children's and early adolescents' emotions were investigated using a mobile diary method. The article describes and evaluates this data collection method and presents empirical results on fluctuation in the emotions of children and adolescents ($n = 60$, aged 7–14 years). The data, in the form of short text messages, were collected over one week. Every evening, children received seven questions on their emotions. Multilevel modeling was used to analyze the data. The results illustrate the potential of the mobile diary method with children and early adolescents. The data showed a two-factor structure, indicating that the mobile diary method was able to reveal the underlying dimensions of positive and negative emotions. The study also showed that daily variation in emotions along with systematic differences between participants in their emotional experiences (related to, e.g., the form of the family) can be captured using the method.

Keywords: Children, Data Collection Tools, Early Adolescents, Emotions, Mobile Diary Method, Multi-level Modeling.

Emotions can be viewed as barometers of subjective wellbeing: negative emotions are a sign of a discrepancy between what is valued and expected and what really happens, whereas positive emotions indicate that the individual's goals and needs are fulfilled (Lazarus, 2006). Researching children's and adolescents' emotions from their own perspectives possesses special requirements for the data collection tools used. This article introduces and evaluates a new method, the mobile diary, for the study of children's and early adolescents' daily emotions and uses the method to build a picture of their emotional life during one week.

Examination of Children's and Adolescents' Daily Emotions

Until recently, the psychological and sociological research on emotions has focused on adults' experiences, and thus much of what we know about emotions has been based on data gathered from adults (see, e.g., Mehl & Conner, 2012). Even when the interest has been expressly on children's emotions, the reporters of these emotions have often been adults. Nowadays, researchers are becoming more conscious of the importance of children's and adolescents' perspectives in research on

emotions, and the common practice of studying children and adolescents using adults as main informants has been subjected to criticism (see e.g., Hektner, 2012). According to Brannen and O'Brien (1996), the neglect of children as informants is related to researchers' assumptions that children lack the competence and abilities needed to understand research procedures and the phenomena of interest and to provide reliable answers.

Clearly, a child's emotional experiences are related to her/his age and developmental stage. This study focuses on children in early adolescence who are well aware of their emotions. As children grow older, their ability to differentiate and understand different and also mixed emotions improves (Zajdel, Bloom, Fireman & Larsen, 2013). As Hektner (2012) notes, it has been shown that at about the age of seven, children start to possess the abilities (e.g., reading and writing skills) required for self-reporting. In addition Larsen, To and Fireman (2007), in their study of children aged 5 to 12, found that at about the age of 8 children are able to express and understand mixed emotions. Furthermore, there is an increase in the variability of emotional experiences when a child enters adolescence. For example, adolescents report strong emotions more often than their parents (Larson & Richards, 1994). Adolescence seems to be a time for frequent ups and downs in terms of emotions. Early adolescence is also a time for emotional fluctuation in another sense. During early adolescence, individuals experience a shift towards a less positive average level of emotions (Frost, Hoyt, Chung, & Adams, 2015; Larson, Moneta, Richards, & Wilson, 2002). Furthermore, there is great variation between children and adolescents in their average levels of emotional experiences (see Larson et al., 2002). For some, emotional life is on average more positive than for others.

What does it require from a data collection method to be able to capture emotions from children's and adolescents' own perspectives? First, we state that a method has to be able to capture basic structures of emotions. At the heart of any research on the emotional life of children and adolescents – and adults – is an understanding of what emotions are. Schimmack, Oishi, Diener, and Suh (2000) offer a framework for understanding the complex nature of affective experiences. They argue that researchers differ in what type of affective experience they are interested in (e.g., emotion, mood or affect) and what aspects of those experiences they focus on (e.g., intensity, duration, frequency). In their literature review, Beedie, Terry and Lany (2005) concluded that for academics the clearest differences between emotion and mood are related to duration and intentionality. Emotions are often regarded as more instant and object-related than moods, which are more prolonged and general in nature (Beedie et al., 2005; Schimmack et al., 2000).

Schimmack et al. (2000) further argue that researchers hold different views on what constitutes the basic qualitative distinction between affective experiences, one of the most prevalent being the distinction between positive and negative or pleasure and displeasure. Although in colloquial language, and in earlier research, happiness and sadness are often presented as polar opposites, in current research positive and negative affect are often seen as two different di-

mensions, each with its own neural basis (Larsen, McGraw, & Cacioppo, 2001). Findings showing that in some circumstances adults (Larsen et al., 2001; Lucas & Diener, 2008) as well as children (Larsen et al., 2007) can feel mixed emotions, that is, happy and sad at the same time, further support the two-dimensional nature of emotional experiences. Using the above-described framework, the method for measuring daily emotions needs to be able to differentiate between positive and negative emotions.

What seems to be common to all the research on emotions is the notion that emotions fluctuate (Augustine & Larsen, 2012). One might even say that "a primary component of an emotion or mood is change itself" (Augustine & Larsen, 2012, 499). This change, or variability, is manifested both within and between individuals. Whereas some days or moments are experienced as more positive than others, some individuals also experience more intense emotions than others (see, e.g., Herres, Ewing, & Kobak, 2015; Silk et al., 2011). Variability in emotions is partly connected to the daily and weekly rhythms of everyday life. This all means that research methods designed to measure emotions are also required to be able to detect variation in emotional experiences.

Earlier Use of Diary Methods with Children and Adolescents

Diary method is well suited to the assessment of emotions, as it provides contemporaneous and detailed information about settings, events and reactions (Henker, Whalen, Jamner, & Delfino, 2002). The diary method (see also ecological momentary assessment, EMA) enables study of the "real-world" in "real-time" and the taking into consideration of "within-person" fluctuation in the phenomena of interest (Mehl & Conner, 2012; Silk et al., 2011). Data are collected through repeated measurements over a limited time period, for example a week, the aim being to gain insight into daily and weekly fluctuation in actions, experiences and emotions. Reports are made in close proximity to actual events in the participants' natural environments. Thus the use of diaries reduces the likelihood of errors associated with retrospection and enables the acquisition of ecologically valid information.

Recently, technology has become increasingly utilized in diary studies (Intille, 2012). Electronic diaries have many advantages over traditional paper and pencil (see Rönkä, Malinen, Kinnunen, Tolvanen, & Lämsä, 2010). One of the main strengths of electronic diaries from the researcher's point of view is that the responding time can be reliably recorded. Also, the number of missing answers can be reduced by sending reminders. From the point of view of the respondents, electronic diaries can be easy and handy to use. This is especially true when the participants are using their own mobile phones. Consequently, the use of mobile phones in data collection can motivate people for participation. It has also been said that research methods employing new technology may be experienced as especially interesting by adolescents and children (Rönkä et al., 2010; Matthews, Doherty, Sharry, & Fitzpatrick, 2008).

During the recent years the use of diary methods with

children and adolescents has increased remarkably. As with emotion research in general, in earlier diary studies on children's emotions and daily life, adults, such as parents or day-care personnel, have often been used as informants. Lämsä, Rönkä, Poikonen and Malinen (2012), Plowman and Stevenson (2012) and Valiente, Fabes, Eisenberg and Spinrad (2004) have all used diaries to study the everyday life of children. In all these studies data related to children were, however, collected from parents and other close adults. Thus, children's participation in diary data collection was only partial.

Children become more visible as informants in diary studies as they start to approach adolescence (Hektner, 2012). Many researchers have also seen potential in utilizing technical tools when examining daily emotional experiences of young people (e.g., Larson et al., 2002; Whalen et al., 2006). Recent experiences on the use of mobile diaries in collecting diary data from children and adolescents are encouraging. Rönkä et al. (2010) utilized a mobile diary when studying a group of adolescents aged 11–17, and found that mobile phones were familiar and agreeable devices for adolescents, and highly suitable for the study of emotions. In Matthews et al.'s (2008) study adolescents reported experiencing a stronger sense of privacy when recording their moods using mobile phones than when using the traditional paper-and-pencil method. Mobile phones have also been utilized in collecting structured diary interview data from children and adolescents. In the study by Silk et al. (2011), the researchers gave the children, aged from 7 to 17, mobile phones on which they received calls from an interviewer for a total of five 4-day blocks. The interviewers asked several structured questions, including evaluation of current emotions with a 5-point response scale. Khor, Melvin, Reid and Gray (2014) also used a mobile phone application to examine 12- to 18-year old adolescents' daily life although their focus was on daily stresses and coping rather than emotions (see also Khor, Gray, Reid, & Melvin, 2014). Khor, Melvin et al. viewed the mobile phone assisted EMA procedure used in their study as a valuable research tool when examining adolescents with High-Functioning Autism Spectrum Disorders who often have difficulties in understanding and expressing emotions (see also Dunton, Kawabata, Intille, Wolch, & Pentz, 2012 as another example of the use of mobile diaries in examining diverse aspects of children's daily lives). Although the use of mobile phones in research with children and adolescents seems to be on the rise, it becomes clear from this literature review that in studying children's and early adolescents' emotions by means of short text messages (SMSs) we are entering a novel domain of measurement, and thus thorough scrutiny of the method used is called for.

Aims of the Study

The main aim of this study is to evaluate the use of mobile diaries as a method for assessing children's and early adolescents' emotions from their own perspectives. This aim can be divided further into three more specific research objectives. The first of these is to investigate whether the theoretical distinction between positive and negative emo-

tions is supported by the data gathered by the mobile diary. Second, it is examined whether the mobile diary can capture the variability of emotions within and between children. On the basis of the research literature (Larsen et al., 2001, 2007; Larson et al., 2002; Larson & Richards, 1994) and earlier positive experiences about the use of electronic diaries, we expect to be able to find the two-factor structure of emotions and also to capture fluctuation of emotions both within and between children. Third, it is analyzed whether the mobile diary method can detect nonrandom variation in children's emotions. Here we focus on nonrandom variation related to the day of the week and (in line with the research interests of the larger research project in which this study is connected to, focusing on children's emotional life in multiple family relations) to family types. We expect to find more positive and less negative emotions during the weekend compared to weekdays. This hypothesis is related to the weekly school-free time rhythm of children and to the previous findings of similar day-of-the-week effects which have been detected among adults in several studies (for review see, Reis, Sheldon, Gable, Roscoe, & Ryan, 2000). In respect to different family types, it is hypothesized that if there are differences between children, they are in favor of those living in intact families. That is, these children and adolescents are expected to experience positive emotions more often and negative emotions less often than participants in other types of family. This hypothesis is based on earlier findings on the association between family types and children's general well-being (e.g., Amato, 2010, 2001).

Method

The data of this study were collected as a part of a larger research project, *Children's emotional security in multiple family relations*. The research interest in this project lies in children's and adolescents' experiences and emotions in relation to their family life, including the "dark sides" of family life, such as violence and substance abuse. Altogether 60 children and adolescents filled in the mobile diary utilized in this study. The largest proportion of the participants ($n = 51$, 85 %) were fifth and sixth graders recruited from two schools in Northern Finland. The rest ($n = 9$, 15%) were recruited via NGOs working with families, such as the Finnish Federation of Single Parent Organizations and Save the Children to reach children and adolescents with diverse, and possibly challenging, family situations. The organizations selected potential participants from their clients and used ethically based criteria, for example, the current family situation was required to be relatively stable.

The mobile diary data were gathered from 36 girls and 24 boys aged 7–14 years. The fifth and sixth-graders from the school sample were aged 11–12. In the organization sample, three children were aged 7–10 and three adolescents 13–14, while the rest were aged 11–12. Of these participants, 39 (65 %) were living in an intact family, whereas the biological parents of 17 (28 %) participants were not living together during the time of the study (information missing for four participants). However, the participants recruited via schools and

via NGOs differed clearly in this respect: in the school sample, the proportion of adolescents living in an intact family was 80%, whereas in the NGO sample none of the adolescents were living with both of their biological parents. A question on family type was presented in the permission paper for legal guardians. On the basis of the interview data (not utilized in this study) among the children and adolescents who had experienced parental divorce or separation, time since the divorce or separation ranged from some months to more than 10 years.

Mobile Diary Procedure

Internet-based software was utilized in collecting the mobile diary data. The diary questions were sent by the program as SMSs to children's and adolescents' mobile phones once every evening over a one-week period. Each question was sent as a separate message; a successful SMS answer from a participant was followed by the next SMS question. The responses were saved to the database in real time. If a participant did not send an SMS answer within an hour of receiving the question SMS, one reminder SMS was sent to a participant's mobile phone by the program. In addition, a request to answer again was sent to a participant if she or he sent an impossible answer to a numerical question (that is, anything other than a number from 0 to 6). After the ten question SMSs had been successfully answered by a participant, a SMS compliment was sent to the participant. All the participants used their own mobile phones, and answering and sending SMSs did not cause any costs for them. Because SMSs were used, all the available mobile phone models were suitable for answering, that is, smart phones were not required. Mobile diary data were collected in three waves. All the waves took place during the school year and there were no public holidays during the data collection weeks.

The mobile diary which comprised ten questions. Seven structured questions were used for evaluating emotions (e.g., *“How large a proportion of your waking hours have you been happy or cheerful? Please answer by selecting a number from 0 [not at all] to 6 [the whole day]”*). The emotion words used were *happy/cheerful, satisfied/contented, relaxed/calm, strained/tired, irritated/angry, worried/anxious and sad/blue*. The other three open-ended questions related to daily interaction and good and challenging moments during the day (not utilized in this study).

The Development of the Mobile Diary Method for Children and Early Adolescents

The mobile diary method has been used by us in several earlier research projects, mainly with adults (see Malinen & Rönkä, 2008; Rönkä et al., 2010, Sevón, Malinen, & Rönkä, 2014). In the present project, we paid special attention to the following aspects in developing the mobile diary method to capture the everyday lives and emotions of children and adolescents from their own perspectives. First, we focused on the usability of the mobile method. In order to limit the burden of participation, and so lower the amount of missing data and

increase the reliability of the answers, we decided to collect data only once a day over one week and limit the number of diary items to ten. This meant that the questions used needed to be carefully chosen. Special attention was paid to the wording of the diary questions, especially the emotion words used. Two words were used to describe each emotion. We aimed at choosing words that are actually used by the target participants, as suggested by Green and Salovey (1999). In addition, we also formulated the diary questions to focus on the proportion of time during a day that a child felt particular emotions instead of the intensity of that emotion (see also Schimmack et al., 2000), as it was thought this would be easier for children to evaluate and so give a more reliable picture of their daily emotional worlds.

Another issue we paid attention to in the development of the diary method was confidentiality and ethics (see also Notko, Jokinen, Malinen, Harju-Veijola, Kuronen, & Pirska-nen, 2013). The participants were recruited on a voluntary basis, and although both the children and their guardians were asked to give their informed consent, the children were asked for their consent first. All participants were informed that they were allowed to discontinue their participation in the study at any point. Special additional attention was given to informing and explaining the idea of the mobile diary to the children. The aims and procedures of the study were explained in school classes and in organizations attended by children. This demanded time and sensitivity as it was considered crucial that a proper informed consent to conduct research with them was obtained from the children (see also Powell & Smith, 2009). Further, although for every child we also required permission to participate from the guardian, we emphasized to the children that neither their parents nor anyone else, except for the researchers, would have access to their mobile diary answers. We also encouraged the children and adolescents to empty their mobile phone sent messages folder daily to ensure their privacy were they to lose their mobile phone. Moreover, as the diary method required special involvement from the participants, it was sought to ensure their wellbeing during the study by giving them the contact number of a researcher and monitoring their answers online daily.

Before implementing the study, we conducted tested the mobile diary with nine children. These children were not included in the sample used in this study. After the diary week these children were interviewed about their experiences. In particular, we interviewed them about the scale used to evaluate emotions asking, for example, what they meant when they chose a certain number as their answer. The results of this diary week and the interviews were encouraging and supported the view that children of this age were able to understand the instructions used and to use numbers to evaluate their emotions and also they were willing to participate in the mobile diary.

Likewise, throughout the research project, our experiences regarding the suitability and user-friendliness of the mobile diary method for children of this age were encouraging. During the diary week, we offered technical phone support, but none of the participating adolescents used this

possibility. There were no drop-outs and the number of missing answers was also reasonable for an intensive diary study. Thirty-one (52 %) participants had no missing values in the emotion variables during the diary week. The mean percentage of missing values in the emotion variables was 9.22 ($SD = 12.82$; range 0–46.94). The data consisted of 387 observations the possible maximum being 420 observations (60 participants \times 7 diary days).

Statistical Analyses

The diary data were analyzed using structural equation modeling (SEM) and multilevel modeling in Mplus (version 7; L. K. Muthén & Muthén, 1998-2007). The estimation method used was MLR, which produces maximum likelihood parameter estimates with standard errors and a chi-square test statistic that are robust to nonnormality of observations (L. K. Muthén & Muthén, 1998-2007). To examine variance decomposition, the total variance of each emotion item was divided into four components. Between-level variance measures the variation in the averages of individuals' values over the measurement points and within-level variance measures the daily variation around these averages. Intra-class correlations (between-level variance divided by total variance) indicate the extent to which participants show individual differences in emotional experiences (Heck & Thomas, 2009). On both levels, factor variance relates to the variance that is accounted for by the latent factor while item variance indicates the variance that is left unaccounted for by the latent variable and is unique to each item, that is, the residual variance.

Differences between the two family types in the levels of emotional experiences were tested by adding the variable of family type as a predictor of the emotion variables into the model. To test day-of-the-week fluctuation in the emotion variables a nonlinear growth curve component with fixed and random effects in multilevel modeling was estimated (Tolvanen, 2007). This approach enables testing of the statis-

tical significance of the components of day-of-the-week fluctuation at the mean level, and the significance of the variation between individuals in the strength of this fluctuation.

Results

Can the Mobile Diary Capture the Two-Dimensional Structure of Children's Emotions?

Descriptive statistics on the emotion items are presented in Table 1. For all the emotion items, the participants' used the whole range from 0 to 6 in answering. The mean ratings of these items indicated that the children and adolescents clearly experienced more positive (happy, satisfied and relaxed) than negative (strained, irritated, worried and sad) emotions. On both the within and between levels, all the positive emotion items, and all the negative emotion items, correlated positively with each other. The correlations between the positive and the negative emotion items were mainly negative on both levels. To evaluate the factor structure of emotions, two models were created, a one-factor model in which all seven emotion items loaded on the same factor, and a two-factor model, in which three positive items loaded on one factor and four negative items on another factor. Whereas the one-factor model ($\chi^2[28] = 72.13, p < .000, CFI = .86, TLI = .80, RMSEA = .06, \text{within SRMR} = .04, \text{between SRMR} = .25$) showed inadequate fit to the data, for the two-factor model ($\chi^2[26] = 32.86, p = .166, CFI = .98, TLI = .97, RMSEA = .03, \text{within SRMR} = .04, \text{between SRMR} = .10$) good fit to the data was found. Further analyses showed that the loadings of items could be set equal for the within and between levels of the two-factor model ($\chi^2[31] = 45.02, p = .050, CFI = .96, TLI = .94, RMSEA = .03, \text{within SRMR} = .06, \text{between SRMR} = .11; \chi^2_{\text{dif}}(5) = 10.30, p = .067$). In this model, all the items loaded significantly on the given latent factor. As Table 2 shows the confidence intervals of the standardized loadings were considerable small. In sum, the analyses made supported the two-factor structure of emotions.

Table 1

Descriptive statistics for emotion variables (within-level correlations below the diagonal, between-level correlations above the diagonal, $n = 60$ children)

Emotion item	M	1.	2.	3.	4.	5.	6.	7.
1. Happy/cheerful	4.72		.87	.44	-.29	-.19	.02	-.17
2. Satisfied/contented	4.44	.32		.68	-.21	-.11	-.07	-.13
3. Relaxed/calm	3.42	.16	.27		.16	.12	.22	.13
4. Strained/tired	1.76	.17	-.34	-.17		.90	.89	.74
5. Irritated/angry	0.94	-.18	-.28	-.29	.13		.85	.91
6. Worried/anxious	1.25	-.06	.09	-.09	.13	.12		.74
7. Sad/blue	0.86	-.29	-.37	-.26	.38	.30	.19	

Note: Scale: 0 = not at all, 6 = the whole day.

Table 2.

Standardized factor loadings, standard errors and 95% confidence intervals

Emotion	Standardized factor loading (S.E.)		Lower 95% confidence interval		Upper 95% confidence interval	
	Within	Between	Within	Between	Within	Between
Positive emotions						
Happy/cheerful	.50 (.08)	.78 (.09)	.36	.61	.65	.96
Satisfied/contented	.62 (.08)	1.0 ^a	.45	1.0 ^a	.78	1.0 ^a
Relaxed/calm	.45 (.07)	.61 (.12)	.31	.39	.58	.84
Negative emotions						
Strained/tired	.48 (.06)	.90 (.06)	.37	.78	.59	>1.0
Irritated/angry	.52 (.05)	.97 (.06)	.43	.86	.61	>1.0
Worried/anxious	.34 (.06)	.81 (.13)	.23	.56	.45	>1.0
Sad/blue	.54 (.07)	.93 (.05)	.40	.84	.68	>1.0

Note: ^a Fixed to one because the standardized loading is slightly greater than one if estimated freely.

Can the Mobile Diary Capture the Within and Between Level Variance in Children's Emotions?

In the model with two latent factors, the positive factor showed statistically significant variance on both the within level, $var(S.E.) = 0.25 (0.09)$, $p = .006$, and between level, $var(S.E.) = 0.31 (0.11)$, $p = .005$. The variance for the negative factor was significant on the within level, $var(S.E.) = 0.16 (0.05)$, $p = .001$, but nonsignificant on the between level, $var(S.E.) = 0.34 (0.21)$, $p = .113$. The intra-class correlations showed that 55 percent of variation in the positive factor, $ICC (S.E.) = .55 (.11)$, $p < .001$, and 68 percent of variation in the negative factor, $ICC (S.E.) = .68 (.11)$, $p < .001$, was due to variation between children (i.e., inter-individual differences). The rest of the total variance was related to daily fluctuation within children. The correlation of the two factors was

remarkably high on the within level ($r[S.E.] = -.95[.08]$, $p < .001$), but nonsignificant on the between level ($r[S.E.] = -.13[.13]$, $p = .318$).

Similarly, when examining seven emotion items we found sizable, statistically significant total variation in each of the items (see Table 3). Intra-class correlations varied from .27 to .42. Decomposition of the within- and between-level variances into item and factor variances showed that on the between level the proportions of the total variance accounted for by the factor varied from 14 to 36 percent and were statistically significant for all the studied emotion items except for worried. The proportions of the rest of the variances on the between level, that is item-related, residual variances, differed clearly between the seven emotions. Whereas for satisfied item the proportion of this variance component rounded to zero, for relaxed item, almost one-third of the total var-

Table 3.

Decomposition of the variance components for seven emotions (n = 60 children)

Emotion item	Total variance var (S.E.)	Within-level variance		Between-level variance		ICC
		Factor % of total var (S.E.)	Residual % of total var (S.E.)	Factor % of total var (S.E.)	Residual % of total var (S.E.)	
Positive emotions						
Happy/cheerful	1.51 (0.20)***	16.9 (5.2)**	50.0 (7.0)***	20.4 (5.8)***	12.8 (5.3)*	.332
Satisfied/contented	2.20 (0.22)***	25.9 (8.0)**	42.7 (6.5)***	31.4 (5.7)***	0.0 (0.0)***	.314
Relaxed/calm	2.92 (0.30)***	10.5 (3.6)**	48.1 (5.8)***	14.1 (5.3)**	27.3 (5.8)***	.414
Negative emotions						
Strained/tired	2.93 (0.37)***	14.5 (4.0)***	47.9 (6.7)***	30.1 (8.6)***	7.4 (3.8)*	.375
Irritated/angry	1.52 (0.27)***	16.8 (3.9)***	46.1 (6.9)***	34.9 (10.5)**	2.2 (3.9)	.371
Worried/anxious	1.94 (0.33)***	8.4 (2.3)***	64.9 (8.6)***	17.4 (9.2)	9.2 (4.8)	.266
Sad/blue	1.93 (0.36)***	17.2 (5.2)**	41.2 (8.8)***	35.6 (9.7)***	6.0 (3.7)	.416

Note: Scale: 0 = not at all, 6 = the whole day.

* $p < .05$; ** $p < .01$; *** $p < .001$.

iance was accounted for by this component. On the within level, the factors accounted from 8 to 26 percent of the total variance. For each emotion item the largest proportion of the total variance, 41 percent to 65 percent, was related to within-level item variance.

In sum, these results showed that the mobile diary method was able to capture both between and within variance in examined emotions.

Can the Mobile Diary Capture Day-of-the-week Fluctuation and Differences between Family Types?

Nonlinear growth estimates showed that children's reports of irritation were lower on Wednesday, est. (S.E.) = -0.19 (0.08), $p = .010$, and on Friday, est. (S.E.) = -0.25 (0.10), $p = .008$, and higher on Sunday, est. (S.E.) = 0.39 (0.20), $p = .047$, compared to the average level of this emotion. Statistically significant day-of-the-week fluctuation was not found in the other emotion variables or when using latent variables. In addition, no statistically significant individual variation in the strength of day-of-the-week fluctuation was found ($p = .717-.909$).

There were differences in the children's reports of their emotions according to family type. Children in intact families reported negative emotions less often than children who were not living with both of their biological parents, which was visible both in the latent variable, est. (S.E.) = -0.64 (0.28), $p = .021$, and in the separate items of strained, est. (S.E.) = -1.22 (0.38), $p = .001$, irritated, est. (S.E.) = -0.73 (0.30), $p = .015$, worried, est. (S.E.) = -0.83 (0.31), $p = .008$, and sad, est. (S.E.) = -0.73 (0.33), $p = .026$. The children in intact families reported also feeling satisfied more often than the other children, est. (S.E.) = 0.61 (0.25), $p = .014$. For the latent positive emotion variable the difference approached significance, est. (S.E.) = 0.33 (0.18), $p = .070$, as it also did for the happy item, est. (S.E.) = 0.47 (0.25), $p = .056$, whereas for relaxed we found no statistically significant difference between the family types.

We also re-ran the analyses, focusing on family type by excluding participants who had been recruited via NGOs working with families ($n = 9$). This was done because the proportions of family types were different between these children and the children recruited via schools. It was assumed that the children in the NGO subsample were living or had lived in a challenging family situation (e.g., parental substance abuse), which could also affect their daily emotion evaluations. The results of these analyses showed similar differences to those implemented with the whole sample, although a few results showing statistically significant differences between the family types in the earlier analyses failed to reach significance in the analyses utilizing a smaller sample (more detailed results available from the authors).

Discussion

This study introduced and analyzed mobile diary method in studying children's and early adolescents' emotions. The use of mobile phones in research with children and early ad-

olescents would appear to be a legitimate choice. The equipment is familiar to them and, thus, easily adaptable for use in research. According to the report of the Finnish Communications Regulatory Authority, almost all Finnish adolescents over the age of 11 and over half of those under that age have their own mobile phones (Aaltonen, 2009). On the basis of this study, further use of mobile diary methods among children and early adolescents can be recommended. The results showed that daily variation in positive and negative emotions and systematic differences between children in their emotional experiences can be revealed using the method.

In this study, the data collected with a mobile diary method showed a clear two-factor structure indicating that the mobile diary method was able to reveal the underlying dimensions of positive and negative emotions. Using the mobile diary method a picture of children's emotional life during one week could be built. The mobile diary data also showed that on a daily basis, the children's positive and negative emotions fluctuated in high synchrony, as shown by the notably high within-level correlation. Thus, on days when children experienced high amounts of positive emotions, compared to their average level, they also experienced low amounts of negative emotions, and vice versa. It thus seems that when a child reacts emotionally, this change is visible in both her/his positive and negative emotions. In contrast, no variation was perceived between children in their negative emotions on the level of their weekly averages, that is, on the between level. Consequently, the latent factors of positive and negative emotion did not correlate on the between level. In this study, a child's weekly tendency to experience positive emotions did not indicate anything about her or his tendency to experience negative emotions.

According to the empirical findings of this study, in addition to reflecting the underlying dimensions of positive and negative emotions, the children's scores for the seven emotion items measure each phenomenon separately, as the large proportions of item-specific variance indicate. It can be assumed that the items used uniquely measure emotional experiences that are not covered by more general positive and negative descriptions. For example, evaluations of the amount of tiredness reflect both the negative emotional experience of a child as well as aspects of tiredness that are not related to the general negative emotion (for example, feelings of physical exhaustion). It is also reasonable to assume that some proportion of this residual variance is due to measurement error. The considerable high proportions of item-specific variance should be taken into account and the structure of the used measure should be examined in detail when using similar data collection procedure in future studies. In sum, the results showed that for children and early adolescents, feeling happy, satisfied and relaxed as well as strained, irritated, worried and sad are distinct emotions which at the same time have something in common.

One advantage of the diary method is its ability to reveal intra-individual variation. In this study, 27–42% of the variance of emotions was shown to be due to the variance between individuals and as much as two-thirds of the variance was related to daily individual variation. This suggests

that although over the course of a week children have their own, personal way of experiencing emotions, the variation in emotions is rather a day-to-day phenomenon characterized by situational variation than the disposition of a child. These results encourage the use of diary methods for studying emotions in children and adolescents.

In this study the mobile diary method was also shown to be able to detect nonrandom variation in children's and adolescents' emotions. The mobile diary results showed that the children in intact families reported more positive and fewer negative emotions than those whose biological parents were not living together. Although the main focus of this study is on methodological questions we want to note here that these findings allude to the importance of the family environment for children's and adolescents' emotional experiences (see also, Shaffer, Suveg, Thomassin, & Bradbury, 2012). We can assume that in this study most, if not all, of the children and adolescents not living with both of their biological parents had personally experienced a parental divorce or separation during their life. Extensive research has shown that parental divorce and factors related to it are to some degree a risk for children's well-being and that these negative effects of divorce remain visible for several years (for a review, see Amato, 2010, 2001). The results of this mobile diary study suggest that these effects may also be present when studying children's and adolescents' own daily emotional experiences even several years after the parental divorce. These findings, however, should be treated with caution because of the limited sample size of this study. More research with larger samples is needed to confirm these results. It should also be noted that with respect to the effects of parental divorce, a great deal of variability is present among children. As observed by Amato (1993), it is "the total configuration of resources and stressors, rather than the presence or absence of a particular factor" (p. 35) that is essential for the well-being of children of divorced parents.

In addition, the mobile diary data analyses comparing children's and adolescents' emotions in different days of the week were able to detect some differences. Children and

adolescents were least irritated on Wednesdays and Fridays and most irritated on Sundays. For the children of this age, the fluctuation in emotions is probably related to the weekly rhythm of school and free time, although this reasoning does not explain Wednesdays' lower irritation levels. On Fridays, the approaching weekend may buffer feelings of irritation, whereas on Sundays children may be bothered by the impending school week.

More research with diverse samples and larger sample sizes is needed to demonstrate the reliability and validity of the mobile diary method. It should also be remembered that – in order to limit the burden of participation – the time-frame of the diaries in this study was one week. Although on the basis of our results this duration seemed to be appropriate for capturing intra-individual variation in emotional experiences, for other viewpoints one week can be considered a rather short period for examining affective experiences (see also Bolger, Davis, & Rafaeli, 2003). For example, the tendency of children to report certain kinds of emotions, measured by between-level variance, can reflect not only trait-like dispositions, but also environmental aspects, the fluctuation in which has a longer time-frame than can be detected by daily measurements within one week. For example, a child who is grieving over the recent death of a pet may continually report sadness in her or his one-week research diary. Sadness in reports like these reflects an external situation rather than the personality of the child.

This study showed promising support for the use of a longitudinal design of this intensity when studying children's and adolescents' emotions from their own perspectives. The design seems to be suitable for capturing the average levels of their diverse emotions reliably, studying daily variation in the positive and negative emotions, and identifying the more permanent, such as family-related, factors affecting the average levels of their positive and negative emotions. Last but not least, the children and adolescents themselves found the mobile diary method convenient and engaging, and thus participation in the study worthwhile.

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