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Research report

Comparison of text messaging and paper-and-pencil for ecological momentary assessment of food craving and intake

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ABSTRACT

Electronic devices such as mobile phones are quickly becoming a popular way to gather participant reports of everyday thoughts, feelings, and behaviors, including food cravings and intake. Electronic devices offer a number of advantages over alternative methods such as paper-and-pencil (PNP) assessment including automated prompts, on-the-fly data transmission, and participant familiarity with and ownership of the devices. However, only a handful of studies have systematically compared compliance between electronic and PNP methods of ecological momentary assessment (EMA), and none have examined eating specifically. Existing comparisons generally find greater compliance for electronic devices than PNP, but there is variability in the results across studies that may be accounted for by differences across research domains. Here, we compared the two EMA methods in an unexamined domain – eating – in terms of response rate and response latency, and their sensitivity to individual difference variables such as body mass index (BMI). Forty-four participants were randomly assigned to report on their food craving, food intake, and hunger four times each day for 2 weeks using either a PNP diary (N = 19) or text messaging (TXT; N = 25). Response rates were higher for TXT than PNP (96% vs. 70%) and latencies were faster (29 min vs. 79 min), and response rate and latency were less influenced by BMI in the TXT condition than in the PNP condition. These results support the feasibility of using text messaging for EMA in the eating domain, and more broadly highlight the ways that research domain-specific considerations (e.g., the importance of response latency in measuring short-lived food craving) interact with assessment modality during EMA.

Introduction

Ecological momentary assessment (EMA) is a relatively new but growing approach for measuring everyday experiences (e.g., behaviors, thoughts, mood/emotion) in vivo and with high temporal specificity (Shiffman, Stone, & Hufford, 2008; Trull & Ebner-Priemer, 2013). EMA entails repeated measurements within and across days (e.g., four times each day for 14 days) that, depending on the research goals, can occur randomly, on a fixed schedule, or be triggered by specific events. In any case, one of the main advantages of EMA is its ability to minimize retrospective bias by eliciting reports from participants more closely in time to the event of interest than would otherwise be possible with post hoc measurements based on recollection. A second advantage is that reports are obtained in vivo and are thus more ecologically valid than those gathered in a laboratory. For these reasons, EMA has been used to provide unique information about psychological, behavioral, and clinical outcomes ranging from mood (Ebner-Priemer & Trull, 2009) and relationship quality (Laurenceau & Bolger, 2005) to cigarette smoking (Shiffman, 1993) and food intake (Thomas, Doshi, Crosby, & Lowe, 2009).

The present study focuses on compliance rates of EMA in the domain of food intake and craving. Researchers in the food domain have embraced EMA because of its ability to measure food intake and food-related affect (e.g., craving) as it occurs naturally during everyday life. Food craving is also short lived (Werthmann et al., 2011), making response latency an important consideration in this area. Preliminary evidence suggests that EMA via electronic devices, and particularly text messaging, is feasible for assessing appetite and food intake (Schembre & Yuen, 2011), and even among children (Shapiro et al., 2008). Building on this, a number of pilot studies have begun to test the efficacy of weight loss and other dietary interventions based on text messaging, generally with encouraging results (Cole-Lewis & Kershaw, 2010; Gerber, Stolley, Thompson, Sharp, & Fitzgibbon, 2009; Napolitano, Hayes, Bennett, Ives, & Foster, 2012; Patrick et al., 2009). Electronic EMA-based interventions (or "ecological momentary interventions"; Heron & Smyth, 2010) are particularly relevant in the realm of dietary intervention because of the effect of mere self-monitoring on intake (Burke et al., 2009). Nonetheless, the majority of studies to date using EMA to monitor

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or intervene upon intake use the paper-and-pencil (PNP) method (see Burke, Wang, & Sevick, 2011 for review), and to our knowledge electronic and PNP EMA have not been directly compared in this area. Thus, the overarching purpose of the present research is to directly compare response rates and latencies between these two types of EMA in the eating domain. We believe that quantifying the differences in response rate and latency between PNP and electronic methods is an important first step in the comparison between the two.

Early EMA studies used paper-and-pencil (PNP) diaries as the medium, sometimes aided by electronic reminders (e.g., Larson & Csikszentmihalyi, 1983). As portable device technology developed, researchers deployed electronic devices that minimized subject burden and increased data fidelity including Palm Pilots (Feldman Barrett & Barrett, 2001) and, more recently, short-message service text messaging (TXT; Berkman, Dickenson, Falk, & Lieberman, 2011). The key advantages of electronic devices over PNP for EMA are: (a) time stamping to thwart possible forward- or backfilling of entries, (b) built-in prompting or signaling (e.g., auditory or tactile) at preset times, (c) input gating to ensure that responses conform to criteria (e.g., a 1–5 Likert scale), (d) the potential for instantaneous wireless data transfer to reduce data loss in the event that the diary device is lost, stolen, or broken, and (e) generally greater convenience and accessibility for participants. In the case of text messaging, most participants are already familiar with the interface and own the device, which increases compliance because they are more likely to have it with them at all times and less likely to lose or forget the device. These considerable advantages have led researchers increasingly to use electronic devices not only for EMA-based observational studies but also for EMA-based interventions (Heron & Smyth, 2010).

Despite the enthusiasm for electronic EMA, only a few studies have directly compared it with older, more extensively validated PNP methods. An initial study comparing the two methods (Stone, Shiffman, Schwartz, Broderick, & Hufford, 2002) found that participants in the PNP group reported completing 90% of the assessments within 15 min of the targeted time, but a covert light-sensitive computer chip revealed that only 11% of the responses were actually in compliance. By comparison, the actual completion rate for electronic EMA in that study was 94%. Subsequent studies that took steps to equate the two methods in other ways (e.g., by providing audible alerts and giving feedback on compliance) found more comparable response rates between PNP and electronic methods as well as comparable patterns in the data in terms of central tendency and covariance (Green, Rafaeli, Bolger, Shrout, & Reis, 2006). One study in the paper by Green et al. (2006) elicited a 94% completion rate from participants in the PNP condition (compared with 92% in the electronic version), and the authors concluded that compliance likely varies as a function of study design and participant motivation more than it does by data collection format. Nonetheless, the reliability of self-reports of PNP completion has remained a controversial topic (Broderick & Stone, 2006), and scientists have emphasized the need for more research on this issue with particular attention to variability in completion rates across research domains (Tennen, Affleck, Coyne, Larsen, & DeLongis, 2006).

The goal of the present study is to directly compare PNP and TXT formats for EMA of food intake and craving. Specifically, we compared response rates (i.e., compliance), response latency, and user experience across 14 consecutive days of EMA with four assessments per day between two groups of individuals who had been randomly assigned to either a PNP or electronic format. The TXT EMA was delivered using text messaging, and the PNP EMA was delivered using a pocket-sized diary. To facilitate a "fair" comparison (Tennen et al., 2006), we used electronic time-stamp verification for the PNP method and took steps to equate the experimental procedures for the two conditions aside from differences inherent in the assessment format. As an exploratory aim, we also gathered several individual difference measures to test if compliance was systematically related to trait-level variables and, if so, whether that differed between the EMA formats (e.g., Courvoisier, Eid, & Lischetzke, 2012). We reasoned that several broad personality traits (impulsivity, self-control, and the big five traits agreeableness, conscientiousness, extraversion, neuroticism, and openness) and a food intake-specific measure (body mass index; BMI) might relate to compliance in either or both groups.

Method

Participants

A total of 44 participants (30 female, age M = 21.25, SD = 2.32, range = 18–30) completed the study after being recruited through flyers placed around the University of Oregon campus. Participants were randomly assigned to either the PNP (N = 19) or the TXT (N = 25) EMA formats (see Table 1 for demographics by group). Participants were paid $10 for the baseline session, $5 for the endpoint session, $5 per week of EMA, and an additional $5 per week that they responded to 90% or more of the prompts. Thus, participants would receive at least $25 if they participated in the entire experiment, and as much as $35 if they completed more than 90% of the prompts in both weeks. All gave informed consents in accordance with the University of Oregon Institutional Review Board.

Procedure overview

The study consisted of 2 weeks of daily EMA of food intake and craving bookended by one baseline and one endpoint laboratory session. All participants were emailed nightly during the EMA phase with a reminder (that was identical between conditions) to complete all assessments the following day in a timely manner.

Baseline session

At the baseline session, participants completed questionnaires assessing individual differences in self-control, impulsivity, and personality: the 13-item Brief Self-Control Scale (BSCS; Tangney, Baumeister, & Boone, 2004; M = 4.05, SD = .91, α = .83; 1 = "completely disagree," 4 = "neutral," 7 = "completely agree"), the Barratt Impulsivity Scale (BIS-10; Patton, Stanford, & Barratt, 1995; M = 2.48, SD = .23, α = .62; 1 = "rarely/never," 2 = "occasionally," 3 = "often," 4 = "almost always/always"), and the Big Five Inventory (BFI; John,

Table 1
Demographics for each group and for the total sample.

	Paper and pencil	Text messaging	Total
Number of subjects	19	25	44
# Female/Male	13 F/6 M	17 F/8 M	30 F/14 M
% Female/% Male	68.4 F/31.6 M	68 F/32 M	68.2 F/31.8 M
Age (SD)	20.26 (1.098)	22.00 (2.722)	21.25 (2.324)
Response rate (SD)	69.91% (29.5)	95.87% (3.78)	84.66% (23.27)
Response latency (SD)	78.93 m (40.56)	29.02 m (16.09)	50.58 m (38.19)