

Using Experience Sampling Methodology to Advance Entrepreneurship Theory and Research

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The authors propose the use of experience sampling methodology (ESM) as an innovative methodological approach to address critical questions in entrepreneurship research. ESM requires participants to provide reports of their thoughts, feelings, and behaviors at multiple times across situations as they happen in the natural environment. Thus, ESM allows researchers to capture dynamic person-by-situation interactions as well as between- and within-person processes, improve the ecological validity of results, and minimize retrospective biases. The authors provide a step-by-step description of how to design and implement ESM studies beginning with research design and ending with data analysis, and including issues of implementation such as time and resources needed, participant recruitment and orientation, signaling procedures, and the use of computerized devices and wireless technologies. The authors also describe a cell phone ESM protocol that enables researchers to monitor and interact with participants in real time, reduces costs, expedites data entry, and increases convenience. Finally, the authors discuss implications of ESM-based research for entrepreneurs, business incubators, and entrepreneurship educators.

Keywords: *entrepreneurship research; experience sampling methodology; process-oriented studies; wireless technologies*

S hane and Venkataraman (2000) defined the field of entrepreneurship as “the scholarly examination of how, by whom, and with what effects opportunities to create future goods and services are discovered, evaluated, and exploited” (p. 218; cf. Venkataraman, 1997). In spite of the tremendous volume of empirical research that is generated in the field of entrepreneurship, there is a clear knowledge gap regarding process-oriented research to unravel

Authors' Note: We would like to thank Chuck Murnieks, Chuck Pierce, and Leon Schjoedt for their constructive comments on the earlier drafts of this manuscript. This research was conducted in part while Marilyn A. Uy was a doctoral candidate at the University of Colorado at Boulder, and Herman Aguinis held the Mehalchin Term Professorship in Management at the University of Colorado Denver. Correspondence concerning this article should be addressed to Marilyn A. Uy, Faculty of Business, University of Victoria, P.O. Box 1700 STN CSC, Victoria, BC, Canada V8W 2T2; e-mail: muy@uvic.ca.

the “how” in entrepreneurship (Davidsson & Wiklund, 2001; Low & MacMillan, 1988; Van de Ven, 1992). Process-oriented studies are critical in moving the field forward because entrepreneurship is a process that unfolds over time (Gartner, 1985; Shane & Venkataraman, 2000).

One reason for the dearth of process-oriented research in entrepreneurship is clearly methodological in nature. Notwithstanding the contributions of existing studies, typically used methodological tools are not able to uncover dynamic processes because they investigate variables and relationships in a static manner. For example, one-time surveys do not fully address questions about processes unfolding over time such as “How do entrepreneurs identify, evaluate, and implement business opportunities?”, “How do entrepreneurs cope with difficulties in the venture creation process?”, and “How do the entrepreneurs’ skills affect the process of acquiring venture resources?” A concrete example of a process-oriented construct that is not adequately addressed by existing entrepreneurship research is affect (i.e., feelings and moods). Baron (2008) suggested that affect influences whether and how entrepreneurs recognize opportunities and acquire resources for their ventures. This is because affect influences information individuals attend to, how they process information, and their motivations. Studying affect requires a methodological approach that can assess an entrepreneur’s affect at many points in time rather than assume that affect remains constant.

Another gap in the entrepreneurship literature is the lack of empirical studies that examine within-individual relationships. The existing literature has advanced our understanding of between-person relationships where comparisons are made among entrepreneurs (cf. Busenitz et al., 2003; Davidsson & Wiklund, 2001). For example, a fairly typical between-group comparison involves contrasting groups of successful and less successful entrepreneurs to gain an understanding of factors that differentiate members of one group versus the other (e.g., Aguinis, Ansari, Jayasingam, & Aafaqi, 2008).

There are at least two reasons why the examination of within-individual processes is crucial in entrepreneurship. First, no two individuals share exactly the same information at the same time and information about resources, technology, and changes in the environment is dispersed according to the idiosyncratic life circumstances of each individual (Venkataraman, 1997). Hence, the decision to exploit an opportunity is made based on the entrepreneur’s payoffs relative to that entrepreneur’s alternatives, not on the basis of payoffs to other entrepreneurs. Second, the metric to evaluate entrepreneurial activity should not be relative to other entrepreneurs’ performance as in, for example, the field of strategic management, but rather comparing performance assessments of that entrepreneur over time (Shane, 2003; Venkataraman, 1997). Within-person variability is meaningful and substantial in the field of entrepreneurship where various processes and other dynamic constructs of interest such as effort and performance exhibit changing patterns over time within the individual entrepreneur.

We propose the use of experience sampling methodology (ESM) as a methodological approach that allows for a longitudinal examination of the nature and causal directionality among the constructs investigated (cf. Stone-Romero & Rosopa, 2008). ESM, also known as ecological momentary assessment, is an innovative methodological approach that allows research participants to provide reports of their thoughts, feelings, and behaviors at multiple times across a range of situations as they occur in the participants’ natural environment (Larson & Csikszentmihalyi, 1983; Stone & Shiffman, 1994). In this article, we argue that entrepreneurship researchers will benefit from using ESM to conduct process-oriented research and analyze both between- and within-person variability.

The next section provides background information on ESM. We explain how scholars can capitalize on ESM's strengths to advance entrepreneurship theory, particularly given its ability to capture dynamic person-by-situation interactions over time, its ecological validity, its potential to capture both between- and within-person processes, and its ability to reduce memory (i.e., retrospective) biases. Then, we recommend detailed, step-by-step actions involved in implementing ESM studies including participant recruitment and orientation and the use of various devices to conduct ESM research. Furthermore, we introduce an improved ESM protocol, which uses wireless technology capabilities available in cell phones. This novel cell phone-based ESM allows researchers to interact with and monitor participants in real time, expedites data entry, reduces costs, and increases convenience. In short, in this article, we make the case for the need for ESM and the benefits associated with its use. In addition, we provide a thorough description of how researchers can conduct an ESM study and suggest ways to make the ESM approach practically feasible, particularly given its payoff in terms of its ability to address questions of practical significance in the entrepreneurship field (cf. Aguinis et al., in press).

ESM

ESM is a methodological approach that allows researchers to gather detailed accounts of people's daily experiences over time and capture the ebb and flow of these experiences as they occur in situ (i.e., in the natural environment; Hormuth, 1986). The three types of ESM protocols are (a) interval contingent, (b) event contingent, and (c) signal contingent (Reis & Gable, 2000; Wheeler & Reis, 1991). In the *interval-contingent* protocol, participants provide ESM responses at predetermined intervals (e.g., every hour) or at the same time daily. An example of this type of protocol is the study by Ilies and Judge (2002) in which participants reported their mood and job satisfaction four times daily at fixed intervals for 19 working days. In the *event-contingent* protocol, participants respond only when the event of interest takes place. For example, Cote and Moskowitz (1998) studied affect and interpersonal behavior by requiring participants to monitor their social interactions and report on features of their interactions for 20 consecutive days, that is, participants completed ESM surveys immediately after the occurrence of significant interpersonal interactions (those lasting for at least 5 min). In the *signal-contingent* protocol, participants are prompted to respond by a signaling device at randomly selected time points in the day. As an illustration, Williams and Alliger (1994) examined mood spillover among working parents by requiring participants to complete the experience sampling forms when prompted by the sound of the alarm watches eight times daily (randomly scheduled) for 7 days.

Researchers can select from the three protocols to conduct ESM studies in entrepreneurship. Event-contingent ESM may be applicable for less frequently occurring phenomena such as opportunity discovery and evaluation. For example, researchers can ask entrepreneurs to report on independent variables such as their interactions (e.g., frequency and quality of interactions) and see how features of these encounters predict the types of business opportunities they recognize. Either interval-contingent or signal-contingent ESM may be used to examine the entrepreneurs' day-to-day venture efforts and how these efforts build up and influence their level of venture commitment and satisfaction. However, most

ESM studies are signal contingent (Hektner, Schmidt, & Csikszentmihalyi, 2007) because this protocol allows for random sampling of a broad variety of events and avoids the systematic bias of fixed-time assessments and the expectancy effects associated with prior knowledge of the sampling period (Alliger & Williams, 1993).

Scollon, Kim-Prieto, and Diener (2003) identified four major strengths of ESM. First, ESM provides insights into how multiple dynamic changes influence response outcomes; second, it enhances the ecological validity of the results; third, it allows researchers to examine both within- and between-person processes; and, finally, it reduces memory (i.e., retrospective) biases. Next, we describe each of these general strengths of ESM and link them to specific questions, research streams, and theories in entrepreneurship research.

ESM Captures Dynamic Person-by-Situation Interactions Over Time

Interaction effects are at the heart of many scientific disciplines (Aguinis, 2004; Aguinis, Beaty, Boik, & Pierce, 2005). A methodological strength of ESM is its ability to capture the dynamic interplay of within-individual and situational variables over time (Scollon et al., 2003). Shane (2003) argued that “entrepreneurship can be explained by considering the nexus of enterprising individuals and valuable opportunities . . . and by using that nexus to understand the processes of discovery and exploitation of opportunities; the acquisition of resources; entrepreneurial strategy; and the organizing process” (p. 9). Given ESM’s ability to capture the dynamic person-by-situation interaction, entrepreneurship researchers can use it to address questions on the individual-opportunity nexus. ESM studies can address questions including aspects of the physical environment (e.g., venue, time), social context (e.g., number and descriptions of interactions), thoughts, feelings, actions, and motivational self-appraisals (Csikszentmihalyi & LeFevre, 1989; Fisher, 2000; Hektner et al., 2007). Key moments of interest such as the “aha” or “eureka” experiences in opportunity discovery can be matched with contextual variables such as the entrepreneur’s location, time of day, and the people they were interacting with at that particular moment. Researchers can investigate whether these situational features interact with individual-level variables (e.g., thoughts, feelings, actions) in influencing the types of opportunities that entrepreneurs discover.

Entrepreneurial motivation is another domain that incorporates person and situation factors and potential interactions between them. Previous studies have asked entrepreneurs to recall their goals to find out what predicts entrepreneurial behavior (e.g., Kuratko, Horsnby, & Naffziger, 1997). Such one-time assessment assumes that person-situation factors that motivate entrepreneurs at the onset remain constant and influence all steps in the entrepreneurial process equally. This assumption may be questionable because the entrepreneurial process is dynamic and motivating factors in the nascent stage could be different from other venture stages (Shane, Locke, & Collins, 2003; Stanworth & Curran, 1973). With ESM, these concerns can be significantly reduced, if not circumvented, because it allows researchers to track motivational influences at different stages of the entrepreneurial process and how outcome variables such as changes in their venture goals (dependent variables) are predicted by individual and situational factors, such as their level of optimism and entrepreneurial self-efficacy (independent variables).

ESM Enhances Ecological Validity

Ecological validity is the extent to which findings can be generalized to the naturally occurring situations in which the phenomenon that is investigated takes place (Brunswick, 1949). Existing studies on how entrepreneurs make decisions and evaluate opportunities are often scenario based where participants evaluate cases or vignettes on the basis of the information available for each hypothetical situation (e.g., Busenitz & Barney, 1997; Choi & Shepherd, 2004; Keh, Foo, & Lim, 2002). Although scenarios provide respondents with standardized stimuli, the stakes are not real and assumptions are often simplified; participants might underestimate the risks involved, and the decisions made might not reflect how entrepreneurs actually make such decisions. In a related vein, some studies that probe on investors' decision-making processes use verbal protocol analysis, which requires participants to "think out loud" as they carry out a particular task as prompted by a hypothetical stimulus (e.g., Hall & Hofer, 1993; Mason & Stark, 2004). The verbalizations of participants are audio recorded, transcribed, and content analyzed through a coding scheme generated for particular research questions (Saravathy, Simon, & Lave, 1998). Notwithstanding the benefit of a much richer understanding of the process of interest, which verbal protocols offer, the effect of artificiality of the situation persists much like in scenario-based studies.

Researchers can use ESM to circumvent the limitations of scenario-based studies and examine entrepreneurs at the moment they discover or evaluate opportunities together with factors that affected this discovery and evaluation. Furthermore, ESM can also capture dynamic factors in cognition, which influence how entrepreneurs make decisions and how they act (Baron, 2008; cf. Mitchell et al., 2002). These include the entrepreneurs' temporal focus (i.e., extent to which they think about the past, present, or future), their perceived goal progress, the degree to which they focus on maximizing gains or on avoiding losses, what they attend to at a particular moment (e.g., whether they are thinking about customers' needs, technological requirements, and new markets), and their emotional states at that moment (Uy, 2009). All these cognitive factors can be examined as independent variables that could potentially affect the outcome of opportunity evaluation (whether the entrepreneur evaluates the business idea favorably or otherwise and the likelihood that the entrepreneur implements the idea).

ESM Allows for an Examination of Between- and Within-Person Variability

ESM allows researchers to examine within-person variations (Beal & Weiss, 2003; Scollon et al., 2003). Beal and Weiss (2003) underscored that within-person variability provides a more in-depth understanding of the processes linking the predictor and criterion variables as within-person research can rule out spurious third variable explanations and coincident trends. Spurious variables are relatively stable variables that can be measured at one point in time, such as personality factors, but they can also be a slice of a coincident trend, such as satisfaction at one point in time (Beal & Weiss, 2003).

More importantly, within-person processes provide insights beyond that of a between-person approach. Relationships analyzed using within- and between-individual approaches can vary dramatically in both magnitude and direction (Tennen & Affleck, 1996) because interindividual (between-person) and intraindividual (within-person) relationships are

independent. For example, although momentary exercise increases momentary heart rate (within-individual), frequent exercises decrease chronic heart rate (across-individual). In a study that required participants to engage in an analytic game, Vancouver, Thompson, Tishner, and Putka (2002) found that across individuals, self-efficacy was positively related to performance, but within individuals, self-efficacy was negatively related to performance over time as high self-efficacy can lead to errors because of overconfidence. Although beyond the findings of Vancouver et al. (2002), there may be nonlinear effects of self-efficacy on performance such that initial increases of self-efficacy improve performance, but beyond a certain level, self-efficacy hurts performance. Such curvilinear effects can be modeled using ESM data.

Practically all empirical studies in entrepreneurship have examined between-person variability instead of within-individual variability (e.g., Baron & Markman, 2003; Zhao, Seibert, & Hills, 2005). Notwithstanding the contributions of studies that have focused on between-person variability, an intraindividual approach is worth pursuing because of the substantive insights we can obtain beyond those of interindividual studies. For example, we expect fear of failure (predictor variable) and the level of entrepreneurial activity (outcome variable) to be negatively related from a between-person analysis. With the high mortality rate among new ventures, those who are more fearful or have greater fear of failure might be less likely to engage in entrepreneurial activities compared to the less fearful ones. However, fear might not reduce efforts if a within-individual approach is used as an entrepreneur can increase venture efforts for fear of losing the venture. Researchers can also use ESM to examine the entrepreneur's emotional stability (a personality trait) and how this predicts their day-to-day stress levels and psychological well-being. Between-person analysis cannot control for all personality traits that account for the levels of the entrepreneur's well-being. ESM accommodates within-individual analysis, and differences in other personality and attitudinal variables can be ruled out as explanatory factors as they are constant within each individual.

ESM Mitigates Memory (i.e., Retrospective) Biases

Data collected using traditional one-time surveys and/or interviews are based on people's summaries of their experiences and behaviors, which are prone to recall errors (Kraiger & Aguinis, 2001; Stone, Shiffman, & DeVries, 1999). Traditional surveys that ask participants to reflect on their past behaviors or report on the nature and frequency of events generate data whose precision is compromised, as remembering these experiences is a fairly challenging memory recall task (Robinson & Clore, 2002). It has been argued that memory works best in situations when retrieval happens in the same context (time and place) as when the experience is being encoded in the memory (Anderson, 1990; Rugg & Wilding, 2000). ESM minimizes the memory biases found in traditional surveys because ESM allows researchers to assess short-lived processes, states, and events as they happen in real time (Beal & Weiss, 2003).

Entrepreneurs function in environments that are usually unpredictable and ambiguous (e.g., Lichtenstein, Dooley, & Lumpkin, 2006), which make it difficult for them to recall and describe details of what researchers aim to understand from them. For example, Shane (2000) conducted in-depth interviews and demonstrated that individuals discover opportunities in areas related to their prior knowledge. However, because participants' responses in

interviews are based on retrospection, they could have rationalized the discovery process and fail to include critical information about their experiences at that time the opportunity was discovered. In yet another study, Baron and Ensley (2006) asked entrepreneurs to describe the ideas on which their new ventures were based and why these ideas were worth pursuing. Despite the study's contributions, because memory is subject to considerable distortions and changes over time, asking participants to recall events that happened in the past are indirect evidence at best (Schacter, Norman, & Koutstaal, 1998).

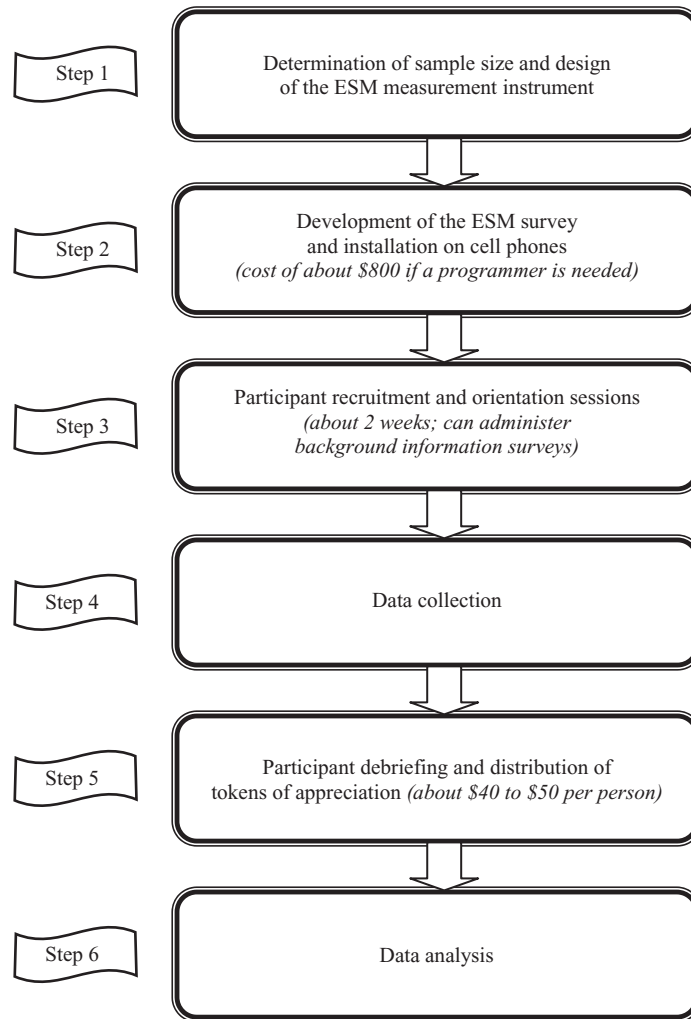
Researchers that probe processes using one-time questionnaires must be wary that entrepreneurs may not distinguish among the actual event that occurred, from their personal wishes, and from social expectancies that could influence their reports. Asking entrepreneurs to summarize their experiences and behaviors might not accurately reflect the actual course of events of the entrepreneurial process. ESM can account for factors relevant to this process before they are altered by self-reflection (Hektner et al., 2007), and ESM achieves this by assessing experiences as they unfold in situ (Beal & Weiss, 2003).

Designing and Implementing ESM in Entrepreneurship Research

The previous section explained many benefits that can be accrued by using ESM to advance entrepreneurship theory and research. However, we candidly acknowledge that ESM studies can entail a considerable amount of time, energy, and resources from both researchers and participants compared to more traditional methods (e.g., one-time survey administered online). On the part of researchers, the high cost to implement these studies could be seen as a major difficulty. On the side of participants, they have to deal with the burden of response compliance imposed by this methodology, which can also be a practical hurdle. As is the case with any proposal including innovative and high-involvement research design approaches (Grant & Wall, in press), implementation is a key issue. We are fully aware that researchers are not likely to use ESM, or any other innovative methodological approach, in the absence of detailed practical guidelines. Accordingly, in this section, we discuss some of the major issues in designing and implementing ESM in entrepreneurship research using cell phone technology. These include sample size and the ESM survey, device and signaling schedules, and participant recruitment and orientation issues. Finally, we describe the resulting data structure and provide recommendations regarding data analysis strategies. Figure 1 includes a flow chart summarizing the steps involved in implementing an ESM study.

Our purpose is to stimulate scholars to generate their own research questions that can be examined using this methodology. We use the research question "How does the entrepreneur's affect influence effort?" as a concrete example to explain the logistics of implementing an ESM study from designing the ESM survey to data analysis. Elaborating on the theoretical foundations for this illustrative question is beyond the scope or purpose of our methodological implementation description. It suffices to note that entrepreneurs who experience negative affect should exert more effort (Carver, 2003) because negative affect signals that things are not going well at the moment and something needs to be done to correct the situation. Studying affect requires a methodological approach that can assess an entrepreneur's state at many points in time rather than assume that affect remains constant.

Figure 1
Steps in Conducting a Cell Phone Based Experience Sampling Methodology Study



ESM allows the researcher to capture the impact of affect (independent variable) on the entrepreneur's effort (dependent variable).

Sample Size and the ESM Survey

Because of the amount of effort involved in the data collection process, most ESM studies have samples of participants that are considered modest in size by social science research standards (Aguinis & Harden, 2009). Nonetheless, because participants are required to respond at multiple times during the study, the total sample size (i.e., the total

number of data points) is usually sufficient in statistical analyses that model within-individual relationships. The sampling involved in ESM studies pertains to sampling data from cases; in other words, gathering multiple reports on the experience of the same set of participants over the course of the study. For example, the number of participants in the study by Ilies and Judge (2002) was only 27, but they obtained a total of 1,907 ESM ratings of mood and job satisfaction. Researchers can conduct a multilevel power analysis (Snijders & Bosker, 1999; see Scherbaum & Ferreter, 2009, for a detailed introduction) to determine the number of participants and the frequency of responses required per participant, while bearing in mind the level of response burden placed on the participants.

In designing the ESM survey, it is important to take into account the research question being addressed and the variables being examined. ESM surveys can capture internal and external dimensions of the phenomenon of interest. For example, in studying the affect and venture effort relationships over time, the ESM survey should have items that ask entrepreneurs to evaluate their affect at that particular moment and the extent to which they are engaged in venture-related tasks. In addition, if researchers are interested to know how external factors might impact the affect–effort relationship, the ESM surveys can also ask participants to provide information on elements of their current situation such as where they are at that moment and whether they are alone or with other people.

Given the nature of ESM studies, researchers have to strike a balance between obtaining enough information and not overburdening participants. Typically, ESM surveys that can be completed in 2 min or less are considered reasonable (Hektner et al., 2007). In the example of affect and venture effort, the main items in the ESM survey are affect and effort assessments. The shortened Positive and Negative Affect Scale (PANAS; Watson, Clark, & Tellegen, 1988) can be used to measure affect. Shortened versions are routinely used in ESM studies to ease participant burden (e.g., Song, Foo, & Uy, 2008; Zohar, Tzischinski, & Epstein, 2003). Moreover, although not without controversy (e.g., Wanous & Hudy, 2001; Warren & Landis, 2007), the use of single-item scales is common in experience sampling studies (e.g., Ong, Bergeman, Bisconti, & Wallace, 2006; Williams & Alliger, 1994) because of the effort required of participants to respond to each survey item at multiple times. In examining venture efforts, researchers can ask participants to report how much effort they put into venture tasks that are required immediately and how much effort they put into venture tasks beyond what is immediately required. Both affect and venture efforts are captured using Likert-type measures (based on a 5-point scale), which do not impose much difficulty for participants to comply and provide sufficient range to minimize detrimental effects of scale coarseness (Aguinis, Pierce, & Culpepper, in press). Figure 2 shows sample screen shots as they appear on participants' cell phones.

Scheduling and Signaling Devices

The frequency and interval of the signals and the study duration depend on the research goals. There are no clear-cut rules for setting intervals, and scholars should consider theory-related and practical issues including the effect of time on the variables measured, participant burden, and the type of statistical analyses to be used (Hektner et al., 2007). Signaling schedules are typically randomized within the day (Larson & Richards, 1994). Researchers generate the ESM schedule by determining the participants' waking hours and reasonable

Figure 2
Experience Sampling Methodology via Cell Phones: Sample Screenshots



time periods to prompt them to respond without being too disruptive. For example, in examining the affective influences on venture efforts, an ESM schedule between 10 a.m. to 10 p.m. can be adopted because we want to survey entrepreneurs during their typical work hours. An ESM schedule that includes extremely late hours would be too intrusive even though entrepreneurs might work erratic hours.

The earliest ESM studies were conducted using paper and pencil in which participants carry the questionnaire booklet and complete the required questions at random intervals as prompted by a portable electronic device such as beepers and programmable wrist watches (e.g., Csikszentmihalyi & Larson, 1987; Fisher, 2000, 2002; Marco & Suls, 1993—as a side note, the third author, HA, of this article was one of the participants in the Marco & Suls, 1993 study, so we understand the burden placed on participants in a very vivid and personal way). Such procedures have a number of limitations including the inability to assess compliance accurately, difficulty in data management (i.e., encoding data by hand introduces human error), and failure to rule out sampling bias because there is no fool-proof way to check the time gap between the random prompts and when the participant actually responded (Feldman Barrett & Barrett, 2001). With technological advances, researchers have opted for computerized ESMs such as the use of personal digital assistants (PDAs) and handheld computers or palmtops (e.g., Miner, Glomb, & Hulin, 2005) as well as web-based ESM procedures, which require participants to go online and encode their

responses on the researchers' Web site (e.g., Judge & Ilies, 2004). These types of computerized ESMs have a number of advantages including precisely controlled signal timing, objective compliance tracking, and reduced human error in data management (Feldman Barrett & Barrett, 2001; Shiffman, 2000). Computerized ESMs also allow researchers to obtain ancillary information such as the time gaps between the prompt and response which could provide additional insights on the phenomenon of interest.

Computerized ESM might be better than paper-and-pencil ESM because many entrepreneurs, especially those in business incubators, are familiar with portable electronic gadgets and the Internet. However, existing computerized ESM employing PDAs and web-based procedures have some limitations. Not all entrepreneurs have PDAs and researchers have to purchase these expensive devices and lend them to the entrepreneurs. The entrepreneurs could also find it inconvenient to carry an extra device, and this gadget might be left at home. Web-based procedures where entrepreneurs log on to the researchers' Web site to provide their responses could pose some difficulties as entrepreneurs might not have access to the Internet at all times. Although compliance can be objectively assessed for PDAs and web-based procedures, researchers cannot perform real-time tracking of responses. Moreover, in both types of computerized ESM, researchers cannot interact with the entrepreneurs immediately and resolve issues at the moment when they occur, and this could negatively affect response rates.

ESM and Cell Phones

To overcome some of the limitations associated with the devices described earlier, we developed a cell phone based ESM. Cell phones have wireless application protocol (WAP) features allowing researchers to embed survey items (usually as an application programmed in Java) on the cell phones (Song et al., 2008; Vos & de Klein, 2002). The use of cell phones in entrepreneurship ESM studies has all the advantages of computerized ESM mentioned earlier and addresses the challenges attached to the use of PDAs and web-based procedures. For one, practically every entrepreneur owns a cell phone and they rely on their cell phones as part of their day-to-day functioning. Thus, in terms of familiarity and ease of use, cell phones clearly prevail over PDAs.

With cell phones, participant responses are immediately transmitted, which allow researchers to track participant compliance in real-time. Moreover, this technology allows for real-time interactive contact with entrepreneurs. For example, researchers can personally call the participants to get feedback and resolve compliance issues. If the entrepreneur accidentally deletes the survey application, the participant can inform the researcher immediately, and the latter can transmit a new application at once (using WAP), which could help boost response rates. Such interactive features may not be available in PDA and web-based procedures. In addition, the wireless networking feature in cell phones simplifies the researchers' task because responses can be directly transmitted into a researcher's computer, unlike in PDAs where entrepreneurs have to bring the gadgets to the researcher's office for data transfers (i.e., uploading or "hot syncing" the data; Feldman Barrett & Barrett, 2001). Table 1 summarizes the advantages of using cell phones in ESM in relationship to existing computerized ESMs (PDAs and web-based platforms).

Table 1
Comparison Among Computerized ESM Devices: PDA, Web-Based Assessment, and Cell Phones

| | PDAs | Web-Based | Cell Phones |
|-------------------------------|--|---|--|
| Accessibility and convenience | Limited: not all entrepreneurs own PDAs | Limited: entrepreneurs do not have access to the Internet all the time | Superior: practically considered a necessity by entrepreneurs; part of their daily functioning |
| Cost | Fair: if researchers have to purchase them and lend to the entrepreneur, each gadget costs about US\$100 | Superior: most entrepreneurs have computers and Internet subscriptions | Superior: most entrepreneurs own cell phones |
| Objective compliance tracking | Limited: allows for recording of precise time when participants responded, but usually cannot accommodate "real-time tracking" of responses and "immediate" interaction with participants | Limited: allows for recording of precise time when participants responded, but usually cannot accommodate <i>real-time tracking</i> of responses and <i>immediate</i> interaction with participants | Superior: accommodate <i>real-time tracking</i> of responses and <i>immediate</i> interaction with participants. Participants can call or send SMS to the researchers and the researchers can immediately address the concerns of the participants; can boost response rates |
| Data management | Good: allows direct transfer of data from the device to the master computer without the need for human encoding. But gadgets have to be brought to the researchers' office for "hot syncing" or data synchronization | Superior: allows direct transfer of data from the device to the master computer in real time without human encoding | Superior: allows direct transfer of data from the device to the master computer in real time without human encoding |

Note: PDAs refer to nonphone PDAs. Smartphones or PDAs with phone features are classified under cell phones rather than PDAs. ESM = experience sampling methodology; PDA = personal digital assistants; SMS = short message service.

In ESM with cell phones, researchers can prompt entrepreneurs to complete the survey by sending a text reminder (these reminders are prescheduled by the researchers; Song et al., 2008), and entrepreneurs respond by opening the survey application in their cell phones, completing the survey, and sending the completed survey to a telephone number, which receives all the responses (“system number”). Their answers are received by the researcher’s computer as a text message or short message service (SMS). Technical details of using cell phones in ESM are outlined in Appendix. A challenge of using cell phones involves phone compatibility because each phone model has a unique application programming interface (API), and there can be instances when the survey application cannot be launched on the entrepreneur’s phone (Chu, Song, Wong, Kurakake, & Katagiri, 2004). Fortunately, this problem can be resolved by adjusting the API to fit a particular phone model, and based on our experience, this is a relatively simple programming task, which can be handled by a knowledgeable computer programmer. There are other issues such as the cell phone network traffic, which can cause delays and even loss of information in the course of sending and receiving SMSs, but these are not within the control of the researchers. Nonetheless, telecommunication companies have to adhere to strict service quality standards, and therefore, the downside of congested network traffics are experienced rather infrequently.

Participant Recruitment and Orientation

Recruiting entrepreneurs to participate in ESM studies can be a challenging task because of the considerable effort required of participants. An ideal situation to conduct ESM studies is one in which researchers have access to a captive audience. To examine the affective influences in venture efforts among start-up entrepreneurs, researchers can recruit participants in business incubators. Because these entrepreneurs are housed in one location, it is easier for researchers to interact with them and in the process earn their trust, confidence, and subsequently increase response rates (Uy, 2009). In our experience, many of the incubators are high-tech business incubators that accommodate high-tech start-up entrepreneurs who are familiar with electronic gadgets (e.g., cell phones). Although it is not always possible to get a group of entrepreneurs housed in one location, the key issue is to recruit entrepreneurs who are motivated to participate in the study. One such example is to recruit entrepreneurs affiliated with entrepreneurship centers of universities and academic institutions, as well as participants of business plan competitions. These individuals value entrepreneurship in an academic environment and might be more willing to be research participants. This approach of recruiting entrepreneurs has its drawbacks as the results may not be generalized to the population of entrepreneurs. Nonetheless, these entrepreneurs provide a good starting point to understand process and within-individual issues in entrepreneurship. Moreover, our illustration is designed so that a single researcher with limited time and monetary resources can conduct the research. A research team with greater resources may be able to conduct ESM on a random sample of entrepreneurs.

Prospective participants might be apprehensive of the inconvenience that ESM procedures inflict and the seemingly intrusive nature of the protocols (Hektner et al., 2007). Researchers can overcome these potential difficulties through the orientation. Researchers should clarify the research goals, orient participants about the mechanics and duration of the study, and teach them how to complete the ESM surveys. In addition, researchers should

handle the orientation professionally but with a tinge of personal touch to make the entrepreneurs feel that their participation constitutes an integral part of the research endeavor. It is also critical for researchers to be personally available for logistical and technical assistance in the course of the study, and to provide verbal encouragement and support consistently throughout the study (e.g., Alliger & Williams, 1993; Larson & Csikszentmihalyi, 1983). Doing so will motivate participants to remain engaged until the end of the study, boost response rates, and ensure data quality. Past ESM studies provide evidence that recruiting busy people such as working parents with children (e.g., Williams & Alliger, 1994) and hospital residents (e.g., Zohar et al., 2003) is possible as long as researchers are diligent in establishing good relationships with their respective participants.

Using the cell phone-based ESM to study the affect and venture effort relationship would require the researcher to assist participants in installing the ESM survey in their respective phones (please refer to Appendix for the installation procedures). The researcher must explain every item in the ESM survey to prevent any confusion or misinterpretation. Participants are instructed to download and install the ESM survey in their phones and not to delete it until the end of the study. Moreover, the researcher can also administer background information surveys in the orientation by asking participants to provide demographic and venture-related information, which can be incorporated in the data analysis. For example, in the entrepreneurial affect–effort study, dispositional factors and venture information can be measured during the orientation before the start of the ESM study. It is also important to conduct a debriefing at the end of the study and ask participants about the overall experience of completing the ESM study—whether they had compliance difficulty or whether they found the whole procedure to be too disruptive. Pilot tests and well-conducted orientation sessions can minimize unpleasant participant feedback in the debriefing.

Although the steps listed above may seem logistically overwhelming at first glance, the resources needed in conducting ESM studies are actually reasonable. The researcher will need to dedicate about 2 weeks for recruitment and orientation, and the next 2 weeks will involve implementing the study and closely monitoring the participants' compliance. It is important for the researcher to be constantly available to assist participants and address their issues for the whole 4 weeks to ensure smooth implementation and compliance with the research protocol. In terms of budget, the main costs include the development of the ESM survey and the tokens of appreciation for the participants. We obtained a quote of US\$800 from a company to program the ESM survey in a form that can be installed in the participants' cell phones. Given the 50–60 participants typical in ESM studies, and an average of US\$40–50 per participant as a token of appreciation, the total cost including survey development is about US\$3,000–4,000.

Data Structure and Analysis

The process of data collection using cell phone ESM is extremely efficient because researchers can automatically transfer the ESM data to the statistical package without the need for manual encoding. In addition, because all reminders and responses include date and time stamps, researchers can determine which responses are valid. For example, consistent with other ESM studies (e.g., Judge & Ilies, 2004), a 2-hr window can be a

Table 2
Hypothetical Example of Stacked ESM Data and Examples of
Statistical Commands

| Participant ID # | Date | Reminder Sent | Response Received | Affect1 | Affect2 | Effort | Social Interactions | Prior Experience |
|------------------|----------------|---------------|-------------------|---------|---------|--------|---------------------|------------------|
| 1 | August 1, 2009 | 10:00 a.m. | 10:20 a.m. | 2 | 3 | 4 | 2 | 2 |
| 1 | August 1, 2009 | 7:45 p.m. | 7:55 p.m. | 3 | 2 | 3 | 1 | 2 |
| 1 | August 2, 2009 | 11:15 a.m. | 11:30 a.m. | 3 | 2 | 3 | 3 | 2 |
| 1 | August 2, 2009 | 6:20 p.m. | 6:46 p.m. | 2 | 5 | 3 | 0 | 2 |
| 2 | August 1, 2009 | 10:50 a.m. | 11:03 a.m. | 4 | 3 | 2 | 2 | 1 |
| 2 | August 1, 2009 | 8:03 p.m. | 8:24 p.m. | 5 | 5 | 4 | 1 | 1 |
| 2 | August 2, 2009 | 10:03 a.m. | 10:40 a.m. | 5 | 4 | 5 | 1 | 1 |
| 2 | August 2, 2009 | 4:55 p.m. | 5:13 p.m. | 4 | 3 | 3 | 0 | 1 |
| 3 | August 1, 2009 | 11:07 a.m. | 11:38 a.m. | 3 | 3 | 3 | 3 | 0 |
| 3 | August 1, 2009 | 5:28 p.m. | 6:01 p.m. | 2 | 1 | 4 | 2 | 0 |

Note: To analyze the influence of affect on effort, the following `xtmixed` command can be used in Stata 9: `xtmixed effort affect || participantID`. To analyze the moderating effect of prior experience on affect and effort, the following command can be used: `xtmixed effort affect experience affectXexperience || participantID`. For detailed information on fixed and random options and other mixed model commands available in Stata 9, please see Rabe-Hesketh and Skrondal (2005). ID = identification.

reasonable time frame such that responses received beyond 2 hr after the signal or text prompt has been sent are considered invalid.

For our example on affect predicting venture effort, we can have two sets of data. The first set is the response-level data (or Level 1 data), which include affect and venture efforts assessed via cell phone based ESM. The second set consists of person-level data (or Level 2 data) such as gender, ethnicity/race, age, industry of business venture, and other dispositional factors obtained from the background information survey administered in the orientation. The two sets can be merged by means of a unique identifier, which in most cases is the participant's identification (ID) number. The ESM data structure is stacked such that multiple observations for each participant are stacked on top of one another. Therefore, each ESM response occupies one data row, and the number of data rows for each participant equals to the number of ESM responses for that participant. Table 2 illustrates how the stacked data structure might look like.

Given the hierarchical structure of the ESM data with multiple responses nested within individuals, multilevel modeling is an appropriate statistical methodology to analyze the data (Bliese, Chan, & Ployhart, 2007; Klein & Kozlowski, 2000). Multilevel modeling

takes into account the correlated structure of the data as multiple reports are obtained from the same person over the course of the ESM study (Walls & Schafer, 2006). It is also equipped to handle nested data with unequal number of observations across individuals as well as irregular intervals between observations (Nezlek, 2001). A number of statistical programs (e.g., HLM, Mplus, SAS, SPSS, Stata) have multilevel modeling features that can be used to analyze ESM data. A situational factor that might influence the affect–effort relationship among entrepreneurs is prior experience. Prior experience might weaken the relationship between affect and effort because the entrepreneur can draw from past experiences to determine the amount of required effort and dilute the informational content of affect (Forgas, 1995). In Table 2, we include some examples of commands in Stata 9 that can be used in conducting the analyses. Rabe-Hesketh and Skrondal (2005) provide detailed information regarding these commands and other multilevel modeling procedures in Stata.

Moreover, because ESM accommodates temporal order, researchers can incorporate lagged effects to test the directionality of the relationships. Using the example on affect and venture effort, researchers can test whether affect predicts subsequent venture effort. Researchers can also test whether venture effort influences the entrepreneur's affect the following day. Although ESM data can be used to test temporal effects, researchers must exercise caution in inferring causality (Beal & Weiss, 2003) because temporal sequencing is a necessary but not sufficient condition, and causality can only be inferred if one can rule out other possible alternative explanations.

The steps involved in implementing ESM as summarized in Figure 1 refer to our specific example. These steps can be applied more broadly to other questions in entrepreneurship research. For example, for the question of how the entrepreneurs' social interaction frequency predicts venture sales, similar steps as shown in Figure 1 can be used, except that this can be an event-contingent ESM in which entrepreneurs complete the ESM survey immediately after a significant social interaction occurs (e.g., meeting with investors, suppliers). Just like our illustrative example, direct and reverse relationships can be tested to ascertain the directionality of the relationships of these dynamic variables, and different lagged outcomes can be modeled in the analysis to examine the stability of the effects.

Discussion

A large body of literature in entrepreneurship research emphasizes the importance of the entrepreneur “in whose mind all of the possibilities come together, who believes that innovation is possible, and who has the motivation to persist until the job is done” (Shaver & Scott, 1991, p. 39). The entrepreneurship field needs more rigorous empirical studies that assess how entrepreneurs discover, evaluate, and implement business ideas (Shane & Venkataraman, 2000). However, important phenomena in entrepreneurship research cannot be adequately examined if we continue to use traditional methodologies, particularly cross-sectional designs including one-time data collection via surveys and/or interviews. Moreover, important advances in data analytic approaches (Dean, Shook, & Payne, 2007) cannot overcome design and measurement limitations inherent in many data sets. In fact, Aguinis, Pierce, Bosco, and Muslin (2009) reported that more than half of the authors of the 25 most frequently cited articles published in *Academy of Management Review* from 1987 to

2007 indicated that innovations in research design, rather than data analysis, are needed to make important theory-based advancements in the organizational sciences.

ESM can address research questions that probe into how entrepreneurs think and feel, and what motivates them as they are experienced in situ. In exploring how entrepreneurs think, for example, researchers want to know why, when, and how entrepreneurs decide favorably on the opportunities they discover because not all discovered opportunities are implemented. To examine this phenomenon, it would be necessary to account for possible predictors of opportunity discovery such as the content of the entrepreneur's thought, (i.e., their object of focus, which might include information on the technology, the customer), their temporal focus, how new information is incorporated with prior knowledge, and how changes in these cognitive factors over time affect venture-relevant decisions. Moreover, because affect plays a significant role in how information is selected and interpreted (Isen & Labroo, 2003; Mellers, 2000; Wegener & Petty, 1994), entrepreneurial affect may be critical in venture decisions (Baron, 2008). Affective influences are salient to entrepreneurs as they have to cope with stress brought about by the ambiguity and complexity of the entrepreneurial environment (Aldrich & Martinez, 2001). ESM can track affective experiences of entrepreneurs as they unfold, and changes in entrepreneurial affect and their impact on venture efforts can be modeled using ESM data. Lastly, factors relevant to entrepreneurial motivation such as passion and drive are not static. These motivational factors vary at each stage of the venture process and continue to change as the entrepreneur transitions from the nascent stage to the start-up and on to the growth phase (Shane et al., 2003). Using ESM, scholars can examine issues such as entrepreneurial passion (Cardon, Wincent, Singh, & Drnovsek, in press; Cardon, Zietsma, Saporito, Matherne, & Davis, 2005) in situ to improve our understanding of these processes and consequently advance entrepreneurship theory.

ESM can be adopted to explore other important questions in entrepreneurship research. For example, the work-family interface is highly salient for entrepreneurs because achieving a balance between work and family is one of the factors that motivate individuals to start their own businesses (Boden, 1999; DeMartino & Barbato, 2003). ESM can be used to test theoretical frameworks in entrepreneurship that incorporate work and family considerations (e.g., Jennings & McDougald, 2007). ESM studies can be designed to assess independent variables such as how changes in the entrepreneurs' work-family experiences and attitudes (such as work and family satisfaction) influence outcomes such as coping strategies and psychological well-being. These dynamic data can be further analyzed alongside data collected from one-time initial surveys on their work and family orientation, family background (e.g., number of children, socioeconomic status), and secondary data on the financial performance of the venture. ESM can also be used to examine how entrepreneurs cope with business failures. Researchers can use ESM to track what happens after the entrepreneur's business venture folds up, how various emotional reactions predict the way they cope with business failure, how they bounce back and learn from this experience—whether they start a new venture immediately or take a hiatus from activities related to new venture creation.

Importantly, ESM can be used together with other methods (Scollon et al., 2003), such as one-time and multiple-wave surveys. For example, researchers can examine how stress

(a dynamic predictor) together with the entrepreneurs' characteristics (stable predictors as they do not change during the ESM study) influences an entrepreneurs' well-being (a dynamic outcome variable). Characteristics collected using traditional surveys include the entrepreneurs' motives for starting a business, and the extent to which they believe they can achieve certain milestones in their start-up ventures, such as attracting customers, hiring new employees, and enticing prospective investors (cf. Panel Study of Entrepreneurial Dynamics or PSED survey, Reynolds, 2000). In this particular example, entrepreneurs who believe they can meet their milestones may cope with stress more effectively and report better well-being. Information on the person and situation variables can be gathered not just from the entrepreneur but also from other people such as members of the entrepreneurial team, venture capitalists, customers, suppliers, and family members. ESM can also be used to augment similar repeated measures studies such as paper-and-pencil diary studies (cf. Bolger, Davis, & Rafaeli, 2003 for a review of the use of diary studies), repeated interviews (e.g., Delmar & Wiklund, 2008), as well as experiments and verbal protocols (e.g., Brundin, Patzelt, & Shepherd, 2008).

ESM has potential to contribute to the advancement of entrepreneurship theory and can also offer insights into entrepreneurship practice. For example, the rich quality of ESM data can inform us regarding which dynamic elements attributed to the individual and opportunity matter in the opportunity recognition process. Being aware of this process is important not just for aspiring entrepreneurs but also for incumbents. For example, if ESM studies reveal that positive affect facilitates opportunity discovery, entrepreneurs can engage in activities to experience more positive affect. Knowledge gained from ESM studies can also benefit entrepreneurship educators, directors, and executive teams of entrepreneurship centers, as well as business incubator heads to design interventions and activities that promote sound entrepreneurship practice. For instance, we can use ESM to track entrepreneurs in business incubators to understand the processes that entrepreneurs go through and their needs and concerns while in the incubation program. Entrepreneurship educators can incorporate findings about how entrepreneurs deal with various issues, such as stress, over time, in their entrepreneurship classes.

We acknowledge several implementation issues that make ESM a challenging methodology to use, such as the high level of commitment it requires of the participants and the amount of resources needed by the researchers. Because ESM is a time and resource intensive methodology, we suggest practical steps on how these issues can be addressed. Although acknowledging that ESM is not without drawbacks, we encourage entrepreneurship scholars to expand on their methodological toolkit by considering ESM and to take advantage of cell phones and wireless network technologies.

In closing, our goals are to demonstrate that ESM can be used to advance entrepreneurship theory and research by capitalizing on its methodological strengths, and to recommend ways to overcome the challenges of implementing ESM in entrepreneurship research. As noted by Brundin, "The use of real-time process studies represents one way to capture entrepreneurial activities as they happen and be able to uncover the more intangible, yet very important, issues in the daily life of the entrepreneur" (2007, p. 279). Indeed, ESM represents such real-time process studies that allow researchers to gather data that capture processes and dynamic person-by-situation interactions over time in a unique and valuable way.

Appendix

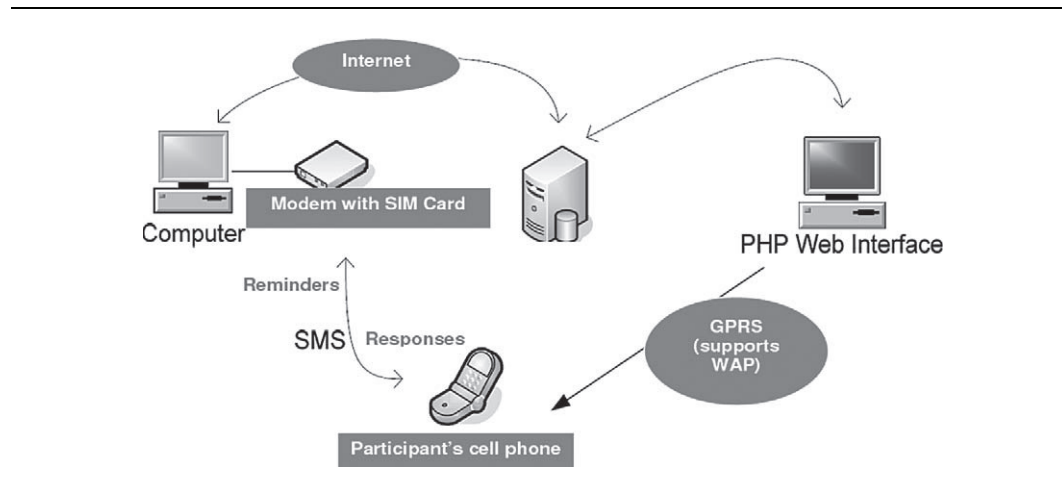
Technical Details on Conducting Cell Phone ESM Studies in Entrepreneurship

Researchers who are interested in implementing ESM using cell phones may need to hire a knowledgeable computer programmer who can program the survey in Java language and upload it to a Web site that will serve as the host site for the study. Researchers also need to secure a cell phone subscriber identity module (SIM) card (i.e., the memory chip used to activate the cell phone), which will serve as the “system number” for the study. The system number will be the main contact number of the researchers which participants can access anytime during the course of the study. The SIM card will be placed in a modem that will be connected to the researchers’ computer where the main software is installed. The programmer should be able to develop a program that would send and receive text messages or short message service (SMS), and this program will be linked to the system number that will be used to interact with the participants and collate all their responses in a master database. The program should allow researchers to preset the schedules of when participants receive the SMS alerts for the duration of the study.

To install the survey application into the cell phones, participants must first activate the General Packet Radio Service (GPRS) feature of their cell phones. Most cell phone models have a GPRS feature albeit not automatically activated. Activation is free of charge and is usually done through the mobile service providers. Once the cell phone is GPRS-ready, the researchers can send the survey application by sending a wireless application protocol (WAP) push to the participants’ cell phones. A WAP push is an encoded message that includes a link to the address where the survey is hosted. When the participants receive the WAP push, they can access the link and download the survey application into their cell phones. Alternatively, if the participant’s cell phones have the integrated Bluetooth feature, researchers will have a much easier way of embedding the survey application into the participants’ cell phones. To do this, participants must first switch on the Bluetooth feature of their cell phones, and then the researcher activates the Bluetooth of the master computer and identifies the cell phones of the participants as the target destination of the survey application.

Once the participants have successfully downloaded and saved the survey application into their respective cell phones, the ESM survey can begin. Participants are prompted to complete the cell phone survey by the SMS reminder sent through the master computer. They open the application and complete the survey using their cell phones. At the end of the survey, a question will appear on the screen asking if responses are ready to be sent to the system number. Participants must click yes and their responses will be sent to the researcher’s computer in a form of an SMS. The following diagram (Figure A1) displays the architecture of the ESM via cell phone study process:

Figure A1
ESM via Cell Phone WAP Survey Architecture



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